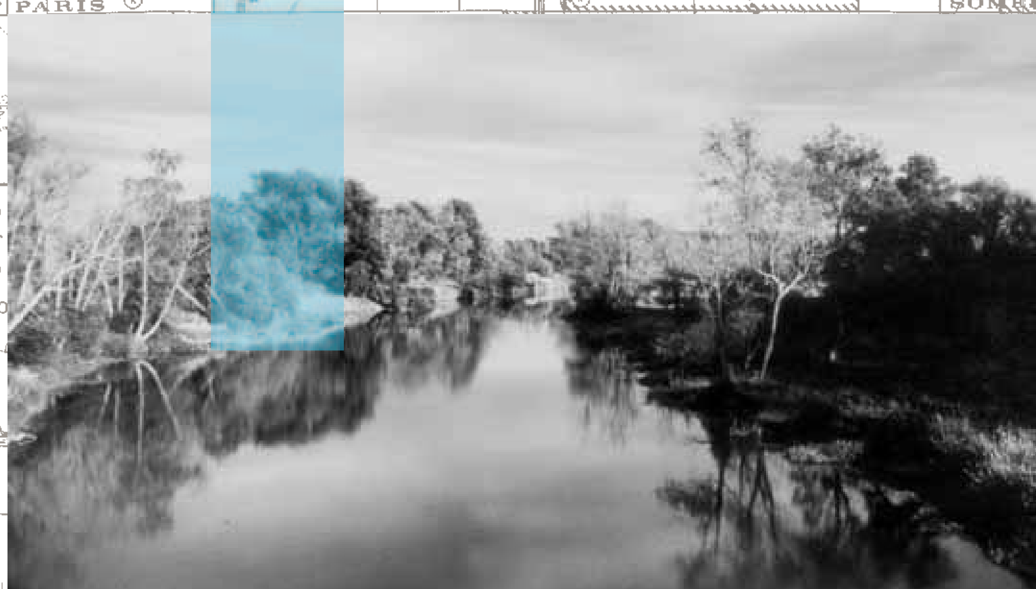
PLANNING REPORT NO. 44

A COMPREHENSIVE PLAN FOR THE DES PLAINES RIVER WATERSHED



Part Two

Chapters 11-17

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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PLANNING REPORT NUMBER 44

A COMPREHENSIVE PLAN FOR THE DES PLAINES RIVER WATERSHED

Part Two of Three Parts
Chapters 11–17

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Chapter XI

RECOMMENDED LAND USE PLAN AND PARK AND OPEN SPACE PLAN FOR THE WATERSHED

INTRODUCTION

The demographic and economic base and the existing land use pattern of the Des Plaines River watershed were described in Chapter III of this report. Forecasts of probable future population and economic activity levels, together with attendant demands for various land uses within the watershed, were set forth in Chapter IV. Under the alternative future selected for use in the watershed planning effort, the resident population of the watershed would increase from the 1990 level of about 19,700 persons to a year 2010 level of about 33,500 persons, an increase of about 71 percent, over the 20-year period. The number of households within the watershed would increase from the 1990 level of about 6,600 to a year 2010 level of about 11,500, an increase of about 74 percent. Similarly, employment within the watershed would increase from the 1990 level of about 8,200 jobs to a year 2010 level of about 36,700 jobs, an increase of about 348 percent. This growth in population, households, and employment would require the conversion of an additional 8.7 square miles of land within the watershed from rural to urban uses, increasing the amount of land devoted to urban use from about 12.5 square miles in 1990 to about 21.2 square miles in 2010, an increase of about 70 percent. The demand for urban land will have to be satisfied primarily through the conversion of a portion of the remaining agricultural and other open lands of the watershed to urban uses. This conversion, if unplanned or poorly planned and if not properly related to the natural resource base, may be expected to further intensify the existing developmental and environmental problems in portions of the watershed and to expand the scope of such problems within the watershed.

It is thus important that new urban development within the watershed be properly related to soil capabilities, to the wetlands and woodlands of the watershed, to the floodlands of the streams and watercourses of the watershed, and to established utility systems. If the intensification of developmental and environmental problems is to be avoided and the problems of flooding and water pollution already existing within the Des Plaines River watershed are to be abated, new urban development within the watershed must assume a pattern which is more carefully adjusted to the ability of the underlying and sustaining natural resource base to support such development. A land use plan must, therefore, constitute a major element of any comprehensive plan for the development of the Des Plaines River watershed. This land use plan element should represent the basic approach to resolution of the growing developmental and environmental problems of the watershed. The land use plan element and any structural water control facility, floodland management, and water quality management plan elements should be mutually supportive in that land use development will determine to a considerable extent the loading on the floodlands and the water control and water quality management facilities, while those features of the watershed will, in turn, influence land use development, particularly in the riverine areas.

REGIONAL LAND USE PLAN

Because the socioeconomic factors that determine growth in a large urbanizing region, such as Southeastern Wisconsin, operate on an areawide basis, transcending both political and natural watershed boundaries, a land use plan for a watershed within such a region must be set within the framework of an areawide, or regional, land use plan. The watershed land use plan recommended herein is accordingly set within the context of, and reflects the concepts contained in, the adopted regional land use plan for the design year 2010. The regional land use plan seeks to encourage the centralization of urban development to the greatest degree practicable; to encourage new urban development to occur in locations and at densities consistent with the economical provision of public centralized sanitary-sewer, water-supply, and mass transit facilities and services; and to encourage new urban development only in areas which are covered by soils well suited to urban use and which are not subject to such special hazards as flooding.

Importantly, the plan seeks to protect and preserve in essentially natural, open uses the primary environmental corridors of the Region. These environmental corridors, while constituting only about 17 percent of the total area of the Region, encompass almost all the best remaining woodlands, wetlands, wildlife habitat areas, surface waters, and associated undeveloped floodlands and shorelands; areas covered by organic soils; areas of rough topography and significant geological formations; sites having scenic, scientific, and cultural value; areas of groundwater recharge and discharge; and the best remaining potential park and related open space sites. Protection and preservation of the primary environmental corridors is considered essential to the protection and wise use of the natural resource base; to the preservation of the cultural heritage and natural beauty of the Region; and to the enrichment of the physical, intellectual, and spiritual development of the resident population. Such protection and preservation is also necessary to avoid the intensification of existing developmental and environmental problems, such as flooding and water pollution, and to avoid the creation of new problems of this type. The topography, soils, and flood hazards in these corridors, moreover, make them poorly suited to intensive urban development of any kind, but well suited to recreational and conservancy uses.

While the adopted regional land use plan forms the basis for the watershed land use plan as herein presented, it should be noted that in the preparation of the watershed land use plan, the regional land use plan was refined and detailed to reflect more precisely the flood hazards existing in the riverine areas of the watershed as determined under the watershed planning program; to reflect recent local development decisions regarding major trunk sewer locations; and, to the extent practicable, to reflect the proposals contained in existing community and neighborhood development plans and plan implementation ordinances.[1] The regional land use development objectives which the regional land use plan is designed to meet are set forth in SEWRPC Planning Report No. 40 and were judged to remain valid and attainable within the context of the more detailed watershed development plan. These objectives, principles, and standards were refined and detailed under the watershed planning effort, as described in Chapter X of this report.

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[1]*The following local land use and related plans were also utilized in the preparation of the watershed land use plan: Camiros, Ltd.,* Town of Paris Land Use Plan*, 1993; Lane Kendig, Inc.,* Town of Bristol Land Use Plan*, 1992; Meehan & Company, Inc.,* Comprehensive amendment of the Town of Salem land Use Plan*, 1994; SEWRPC Community Assistance Planning Reports No. 200,* A Land Use and Transportation System Development Plan for the IH 94 South Freeway Corridor, Kenosha, Milwaukee, and Racine Counties*, and No. 212,* A Comprehensive Plan for the Kenosha Urban Planning District*, 1995; and the zoning ordinances and zoning district maps adopted by the municipalities within the watershed.*

REGIONAL PARK AND OPEN SPACE PLAN

The first park and open space plan for the area within the Des Plaines River watershed was set forth in the first regional park and open space plan, adopted by the Regional Planning Commission on December 1, 1977.[2] That plan identified existing and probable future park and open space needs within the Region and recommended a park system consisting of large resource-oriented parks and smaller nonresource-oriented urban parks, together with attendant recreational facilities. The regional park and open space plan also recommended the development of a network of hiking and bicycling trails within natural resource corridors of regional significance. The regional park and open space plan further recommended that primary environmental corridors and prime agricultural lands be preserved in order to sustain the natural resource base and the environmental quality of the Region.

The regional park and open space plan was subsequently refined through the preparation and adoption of park and open space plans by each of the counties in the Region. The Kenosha County plan is documented in SEWRPC Community Assistance Planning Report No. 131, *A Park and Open Space Plan for Kenosha County*, November 1987, adopted by the Kenosha County Board of Supervisors on October 18, 1988, and by the Regional Planning Commission on December 5, 1988. The Racine County plan is documented in SEWRPC Community Assistance Planning Report No. 134, *A Park and Open Space Plan for Racine County*, September 1988, adopted by the Racine County Board of Supervisors on February 14, 1989, and by the Regional Planning Commission on March 6, 1989. Both plans have a design year of 2000.

The park plans for both Kenosha and Racine Counties set forth recommendations for the acquisition of such resource-oriented recreational facilities as major parks, recreation corridors and associated trail facilities, and lake-access facilities. The County plans also set forth recommendations intended to protect and preserve prime farmlands and important natural resources within primary environmental corridors.

The park and open space plan for that portion of Kenosha County lying east of IH 94/USH 41, which encompasses a portion of the Des Plaines River watershed, was updated in 1995 as part of the comprehensive plan for the Kenosha Urban Planning District.[3] The park and open space plan for the Des Plaines River watershed described in this chapter reflects current recommendations for park and open space sites and facilities from the Kenosha and Racine County park plans, from the comprehensive plan for the Kenosha Urban Planning District, and from locally adopted park and open space plans.[4] It also incorporates pertinent recommendations for additional trail facilities, including a trail within the Des Plaines River corridor, made by the regional bicycle system plan[5] adopted by the Regional Planning Commission on January 25, 1995.

WATERSHED LAND USE PLAN

As already noted, the regional land use and park and open space plans for the design year 2010 form the basis for the recommended land use plan for the Des Plaines River watershed. The watershed land use plan would meet the social, physical, and economic needs of the future resident population of the watershed by allocating sufficient land to each of the various major land use categories to satisfy the known and anticipated demand for each use,

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[2]*See SEWRPC Planning Report No. 27,* A Regional Park and Open Space Plan for Southeastern Wisconsin: 2000*, November 1977.*

[3]*See SEWRPC Community Assistance Planning Report No. 212,* A Comprehensive Plan for the Kenosha Urban Planning District*, December 1995.*

[4]*The following locally adopted park and open space plans or plan components were used in the preparation of the watershed park and open space plan: Meehan & Company, Inc.,* Comprehensive Amendment of the Town of Salem Land Use Plan*, 1994; and SEWRPC Community Assistance Planning Report No. 199,* A Park and Open Space Plan for the Town of Mt. Pleasant, Racine County, Wisconsin*, November 1991.*

[5]*See SEWRPC Planning Report No. 43,* A Regional Bicycle and Pedestrian Facilities System Plan for Southeastern Wisconsin: 2010*, December 1994.*

meeting, to the extent practicable, both the demands of the urban land market and the design standards developed for the updated regional land use plan. Under the regional land use plan, the allocation of future land uses within each county of the Region is based on the demand for land which may be expected to be created by the forecast resident population and employment growth within each county through the plan design year 2010. The land use plan seeks to protect and enhance the natural resource base of the Region and the watershed and allocates new urban development only to those areas of the Region and watershed that are covered by soils well suited to such development; that are not subject to such special hazards as flooding; and that can be readily provided with gravity-drainage sanitary sewer, public water supply, and urban public transit services.

The land use plan emphasizes continued reliance on the urban land market to determine the location, intensity, and character of future development within the Region and the watershed for residential, commercial, and industrial land uses. It does, however, propose to regulate in the public interest the effect of this market on development in order to provide for a more orderly and economical land use pattern and in order to avoid the intensification of developmental and environmental problems within the Region and the watershed. This land use plan for the watershed is presented graphically on Map 60. A quantitative summary of the plan is presented in Table 99.

In designing the land use plan, it was found that the locally adopted urban service areas would be able to accommodate population, household, and employment levels greater than envisioned for the watershed by the year 2010. Larger blocks of land within the planned urban service areas which are not expected to be needed for urban uses until after the year 2010, under so termed “buildout” conditions, are identified as urban reserves on Map 60 and Table 99. It is recommended that the development of those reserves be discouraged until after the year 2010. As indicated in Chapter IV, however, these urban reserves were considered to be fully developed for urban use in the determination of the flood flows and stages and in the delineation of flood-hazard areas.

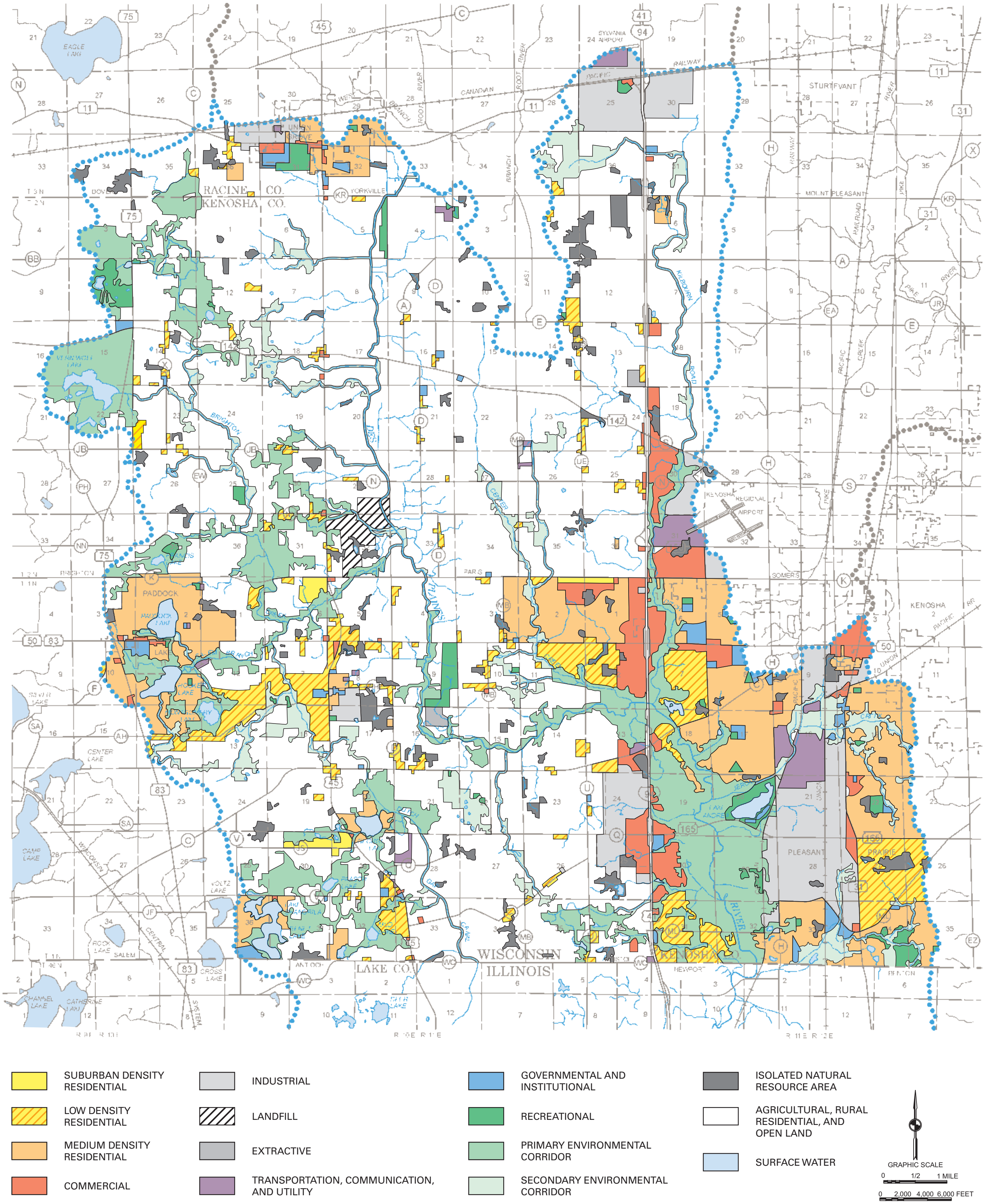
In order to meet the needs of the expected resident population, household, and employment levels, the amount of land devoted to urban use within the watershed, as indicated in Table 99, is projected to increase from the 1990 total of about 12.5 square miles, or about 9 percent, of the total area of the watershed, to about 21.2 square miles, or about 16 percent, of the total area of the watershed, by year 2010. It is important to note that about 26.4 square miles, or about 20 percent, of the total area of the watershed, are comprised of primary and secondary environmental corridors and isolated natural resource areas proposed to be preserved permanently in essentially natural, open uses through the exercise of land use controls and public acquisition. The demand for urban land will have to be satisfied primarily through the conversion of a portion of the remaining agricultural and other open lands of the watershed from rural to urban uses. Such rural land uses may thus be expected to decline collectively from about 93.5 square miles in 1990 to about 84.6 square miles in the year 2010, a decrease of about 10 percent, between 1990 and 2010.

Residential Land Use
As indicated in Table 99, about 7.9 square miles, or about 6 percent, of the total area of the watershed, are presently devoted to residential use. About 3.8 square miles are proposed to be added to the existing stock of residential land in the watershed between the years 1990 and 2010, an increase of about 50 percent. As shown on Map 60, this new residential development is proposed to occur primarily at medium and low densities, with lot sizes ranging from approximately 6,200 to 19,000 square feet per dwelling unit in medium-density areas and 19,000 square feet to 1.5 acres per dwelling unit in low-density areas.

As indicated on Map 60 and in Table 99, the buildout alternative envisions continued residential development within the planned urban service areas after the year 2010. This would occur through the infilling of the designated residential reserve areas within the watershed. Under the buildout alternative, an additional 6.5 square miles of land would be developed for residential use after the year 2010.

Map 60

RECOMMENDED LAND USE PLAN FOR THE DES PLAINES RIVER WATERSHED



The land use plan for the watershed would meet the social, physical, and economic needs of the future watershed population by allocating sufficient land to each of the various major land use categories to satisfy the known and anticipated demand for each use. About 12.5 square miles, or 9.4 percent of the watershed, were devoted to urban land uses in 1990. The recommended land use base would accommodate the anticipated demand for urban land uses through the conversion of about 20.5 square miles of land to urban use.

Source: SEWRPC.

Table 99

DISTRIBUTION OF EXISTING AND PROPOSED LAND USE IN THE DES PLAINES RIVER WATERSHED: EXISTING 1990, PLANNED 2010, AND BUILDOUT

Land Use Category[a]	1990		2010				Buildout Alternative[b]			
			Planned Increment 1990-2010				Planned Increment 2010-Buildout			
	Acres	Percent	Acres	Percent	Total (acres)	Percent	Acres	Percent	Total (acres)	Percent
Residential	5,046	5.9	2,454	48.6	7,500	8.8	4,152	55.4	11,652	13.7
Commercial	388	0.4	1,088	280.4	1,476	1.7	1,015	68.8	2,491	2.9
Industrial	347	0.4	1,345	387.6	1,692	2.0	2,339	138.2	4,031	4.7
Freeway	573	0.7	- -	- -	573	0.7	- -	- -	573	0.7
Transportation, Communication, and Utilities	534	0.6	205	38.4	739	0.9	- -	- -	739	0.9
Governmental and Institutional	303	0.4	215	71.0	518	0.6	- -	- -	518	0.6
Recreation	840	1.0	246	29.3	1,086	1.3	32	2.9	1,118	1.3
Subtotal	8,031	9.4	5,553	69.1	13,584	16.0	7,538	55.5	1,122	24.8
Agricultural, Rural Residential, and Open Lands	59,843	70.3	-5,696	-9.5	54,147	63.6	-7,538	-13.9	46,609	54.8
Primary Environmental Corridor	10,763	12.7	132	1.2	10,895	12.8	- -	- -	10,895	12.8
Secondary Environmental Corridor	4,078	4.8	5	0.1	4,083	4.8	- -	- -	4,083	4.8
Isolated Natural Resource Area	1,935	2.3	- -	- -	1,935	2.3	- -	- -	1,935	2.3
Extractive and Landfill	433	0.5	6	1.4	439	0.5	- -	- -	439	0.5
Subtotal	77,052	90.6	-5,553	-7.2	71,499	84.0	-7,538	-10.5	63,961	75.2
Total	85,083	100.0	- -	- -	85,083	100.0	- -	- -	85,083	100.0

[a]*Street and parking areas are included in the associated land use categories.*

[b]*Assumes full development of all planned urban service areas in the watershed.*

Source: SEWRPC.

Commercial Land Use

As indicated in Table 99, the recommended land use plan envisions that the area devoted to commercial land uses within the watershed would increase from about 0.6 square mile in 1990 to about 2.3 square miles by the year 2010, an increase of about 1.7 square miles, or 280 percent, during the planning period. In addition to neighborhood, community, and highway-oriented commercial areas, one regional commercial center is proposed to be located in the watershed. Under the recommended land use plan, this center would be located in the area around the IH 94/USH 41/STH 50 interchange.

As indicated on Map 60 and in Table 99, the buildout alternative envisions continued commercial development in the watershed after the year 2010. As shown on Map 60, this would occur primarily in areas along the IH 94/USH 41 corridor. Under the buildout alternative, an additional 1.6 square miles of land would be developed for commercial use after the year 2010.

Industrial Land Use

As indicated in Table 99, the recommended land use plan envisions that the area devoted to industrial land uses within the watershed would increase from about 0.5 square mile in 1990 to about 2.6 square miles by the year 2010, an increase of about 2.1 square miles, or 420 percent, during the planning period. Most of that anticipated increase would occur within the LakeView Corporate Park in the Village of Pleasant Prairie.

As indicated on Map 60 and in Table 99, the buildout alternative envisions continued industrial development in the watershed after the year 2010. As shown on Map 60, this would occur in areas adjacent to the LakeView Corporate Park, on lands west of the IH 94/USH 41/STH 165 interchange, on lands west of, and adjacent to, the Village of Union Grove, on lands north of the Kenosha Airport, and on lands around the IH 94/USH 41/STH 11 interchange. Under the buildout alternative, an additional 3.7 square miles of land would be developed for industrial uses after the year 2010.

Governmental and Institutional Land Use

As indicated in Table 99, the recommended land use plan envisions that the area devoted to governmental and institutional land uses within the watershed would increase from about 0.5 square mile in 1990 to about 0.8 square mile by the year 2010, an increase of about 0.3 square mile, or 60 percent, during the planning period. Most of that anticipated increase would take place, as development occurs, in the form of new neighborhood governmental and institutional centers.

No additional land for governmental or institutional uses is identified under the buildout alternative because of the insignificant amount of additional land, if any, that is expected to be required for such uses beyond the year 2010. Any expansion of such facilities as schools which may be necessary as growth continues in this watershed can be accommodated in areas adjacent to existing or planned facilities.

Other Urban Lands

As indicated in Table 99, the recommended land use plan envisions increases in other urban land uses by the year 2010. Under the plan, transportation, communication, and utility lands, consisting primarily of airport and utility uses, would increase by about 0.3 square mile and lands in recreational use would increase by about 0.4 square mile. A more detailed description of recommended park and open space preservation and development actions is presented in a subsequent section of this chapter.

Rural Land Uses

The recommended increases in urban land uses in the watershed would result in a corresponding decrease in agricultural and other open lands. As indicated in Table 99, the existing stock of such land within the watershed would decrease from about 93.5 square miles in 1990 to about 84.6 square miles in 2010. Thus, by the year 2010, about 84 percent of the total area of the watershed would remain in rural land uses.

As indicated on Map 60 and in Table 99, the continued urban development envisioned in the buildout alternative would result in an additional 11.8 square miles of agricultural and open lands being converted to urban uses after the year 2010.

As noted earlier in this chapter, about 26.4 square miles, or about 20 percent, of the total area of the watershed, are comprised of environmental corridors and isolated natural resource areas proposed to be preserved under both the recommended land use plan and buildout alternative for the watershed. A more detailed description of these areas, as well as preservation recommendations, is presented in the following section of this chapter.

OPEN SPACE PRESERVATION ELEMENT

The preservation in essentially natural, open uses of the primary environmental corridors, secondary environmental corridors, and isolated natural resource areas of the Des Plaines River watershed is essential to the maintenance of the overall quality of the environment within the watershed. The corridors, particularly, form the basic framework of the recommended land use plan for the watershed.

Primary Environmental Corridors

Primary environmental corridors, more fully described in Chapter III of this report, are linear areas in the landscape that contain concentrations of high-value elements of the natural resource base. These primary environmental corridors contain almost all the best remaining woodlands, wetlands, wildlife habitat, lakes and streams, and associated shoreland and floodland areas in the Southeastern Wisconsin Region. The protection of the primary environmental corridors from intrusion by urban development, thereby preserving such lands in natural, open uses for resource protection, for the preservation of their scenic value, and for outdoor recreational use, is one of the important objectives of this watershed plan.

As shown on Map 60, the primary environmental corridors of the watershed are located in association with the major perennial streams, lakes, and wetland areas of the watershed, including along the lower reaches of the Des Plaines River, along the lower reaches of Kilbourn Ditch, and along Brighton Creek and the Salem Branch of Brighton Creek. In 1990, about 16.8 square miles, or about 13 percent, of the total watershed area, were encompassed by the primary environmental corridors.

Under the plan, development within primary environmental corridors would be limited to that needed to accommodate required transportation and utility facilities; outdoor recreation facilities consistent with the recommendations made in the outdoor recreation element of the watershed plan; and, in upland areas, rural-density residential use. In addition, the plan recommends that approximately 0.2 square mile of floodlands adjacent to the Des Plaines River in the southwestern portion of the Village of Pleasant Prairie, which are currently in agricultural or other open uses, be restored to a wetland condition, thereby becoming part of the environmental corridor network. The total size of the primary environmental corridors within the watershed would therefore increase from about 16.8 square miles to about 17.0 square miles under the recommended plan.

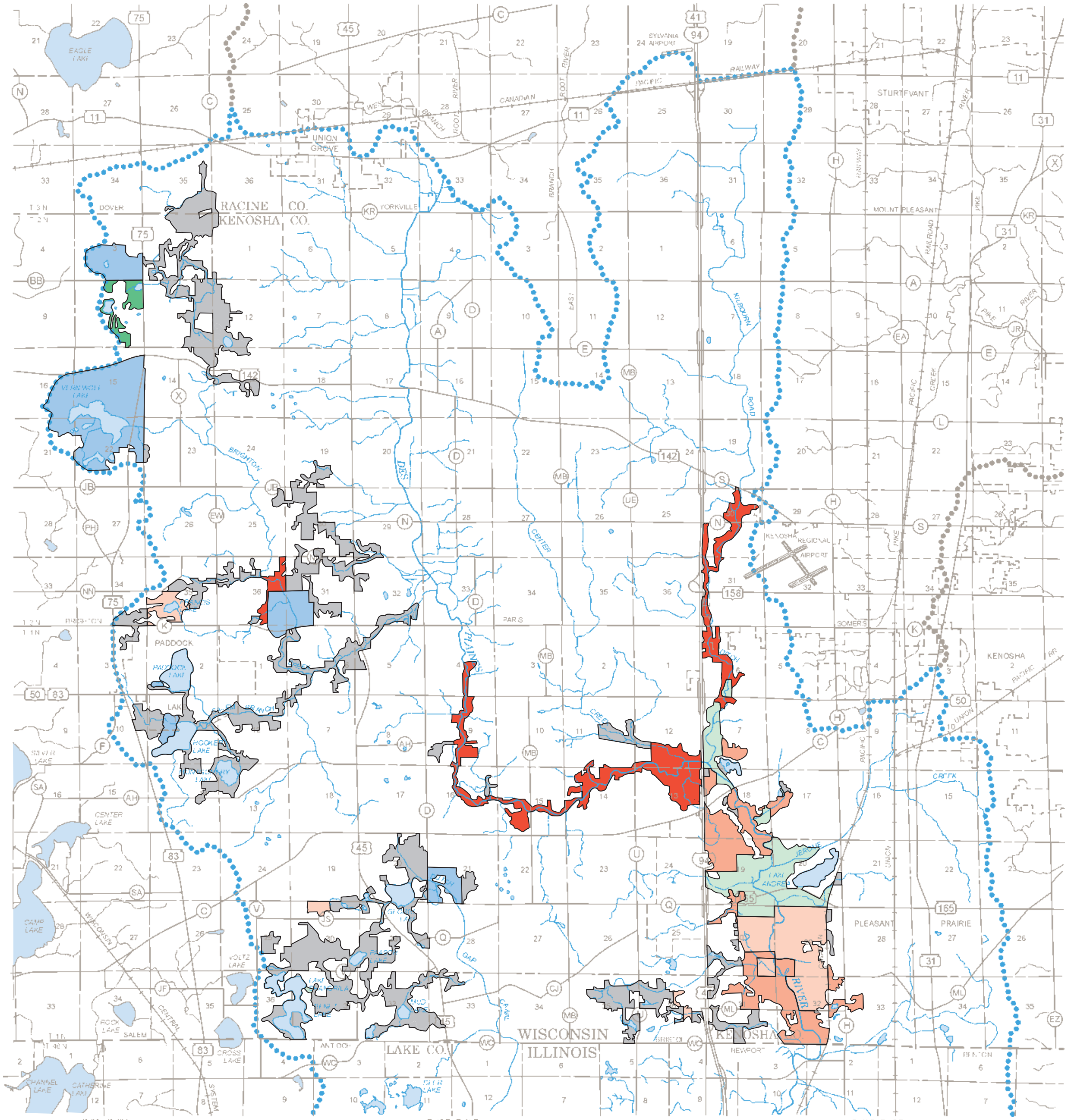
Within urbanizing areas, the permanent preservation of the primary environmental corridors in essentially natural, open space uses is most certain when the corridor lands are acquired in the public interest for resource preservation and compatible outdoor recreation uses. The plan recommends that about 5.1 square miles of the primary environmental corridor lands located east of IH 94/USH 41 be preserved through continued public or public-interest ownership or be publicly acquired, as shown on Map 61. This recommendation is consistent with the recommendations made by the *Comprehensive Plan for the Kenosha Urban Planning District*. Similarly, 3.3 square miles of primary environmental corridor lands outside the Kenosha Urban Planning District, constituting about 19 percent of primary corridors within the watershed, are recommended to be preserved through continual public or public interest ownership or be publicly acquired under the recommended outdoor recreation plan element. Thus, a total of 8.4 square miles, or about 49 percent, of the primary environmental corridors of the watershed, are recommended to be protected through public or public-interest ownership. An additional 1.5 square miles, or about 9 percent, of primary environmental corridor lands are privately owned but are currently in, and are anticipated to remain in, compatible outdoor recreation use. The remaining 7.1 square miles, or 42 percent, of primary environmental corridors are located in areas that are not anticipated to be developed for urban uses by the year 2010 or needed for future trail development and should be protected through public conservancy zoning.

A summary of the existing and proposed public and public-interest ownership of the primary environmental corridors and associated acquisition costs is presented in Table 100. Approximately 4.4 square miles, or about 26 percent, of the primary corridor within the watershed, were in public or public-interest ownership in 2000. Under the plan, an additional 4.0 square miles, or an additional 23 percent, of the primary environmental corridors of the watershed would be acquired by public agencies at an estimated cost of about $4.6 million. A total of about 8.4 square miles, or about 49 percent, of the primary corridors of the watershed would therefore be in public or public-interest ownership by the year 2010.

As further indicated on Table 100, about 7.1 square miles, or about 42 percent, of the primary environmental corridors within the watershed, are proposed to remain in private ownership and protected through conservancy zoning. An additional 1.5 square miles, or about 9 percent, of primary corridors are proposed to remain in compatible nonpublic outdoor recreation use. These areas should, however, also be placed in appropriate conservancy or public park and open space zoning districts to prevent their possible future conversion to urban use.

Map 61

PRIMARY ENVIRONMENTAL CORRIDOR PRESERVATION RESPONSIBILITIES UNDER THE OPEN SPACE PRESERVATION ELEMENT OF THE DES PLAINES RIVER WATERSHED PLAN



EXISTING PUBLIC INTEREST OWNERSHIP

- COUNTY
- CITY, VILLAGE, OR TOWN
- OTHER

PROPOSED ADDITIONAL PUBLIC INTEREST OWNERSHIP

- COUNTY
- CITY, VILLAGE, OR TOWN

- EXISTING COMPATIBLE OUTDOOR RECREATION USE (PRIVATE OWNERSHIP)
- PROPOSED PUBLIC LAND USE REGULATION (PRIVATE OWNERSHIP)
- SURFACE WATER

GRAPHIC SCALE
0 1/2 1 MILE
0 2,000 4,000 6,000 FEET

Source: SEWRPC.

Table 100

PRESERVATION OF PRIMARY ENVIRONMENTAL CORRIDOR LANDS UNDER THE PARK AND OPEN SPACE PLAN ELEMENT FOR THE DES PLAINES RIVER WATERSHED

Owner	Lands Proposed for Preservation										
	Existing Public Interest Ownership		Existing Compatible Nonpublic Outdoor Recreation Use		Public Land Use Regulation		Proposed Additional Public Ownership			Total	
	Area (acres)	Percent	Area (acres)	Percent	Area (acres)	Percent	Area (acres)	Percent	Acquisition Cost[a,b]	Area (acres)	Percent
Kenosha County	133	1.2	0	0.0	0	0.0	1,349	12.4	$2,322,100	1,482	13.6
Racine County	0	0.0	0	0.0	0	0.0	66	0.6	67,300	66	0.6
City of Kenosha	18	0.2	0	0.0	0	0.0	0	0.0	0	18	0.2
Village of Paddock Lake	4	- -[c]	0	0.0	0	0.0	0	0.0	0	4	- -[c]
Village of Pleasant Prairie	536	5.0	0	0.0	0	0.0	1,135	10.4	2,170,800	1,671	15.4
Town of Bristol	3	- -[c]	0	0.0	0	0.0	0	0.0	0	3	- -[c]
Other Public or Public Interest	2,126[d]	19.6	0	0.0	0	0.0	4	- -[c]	5,100	2,130	19.6
Private	0	0.0	972	8.9	4,535[e]	41.7	0	0.0	0	5,507	50.6
Total	2,820	26.0	972	8.9	4,535	41.7	2,554	23.4	$4,565,300	10,881	100.0

NOTE: Cost estimates are expressed in 2000 dollars.

[a] *Unit costs used to estimate acquisition costs were $1,000 per acre of wetlands, $5,000 per acre of woodlands, and $2,500 per acre of other open lands.*

[b] *In carrying out the recommended outdoor recreation plan element, the concerned local units of government should be aware of possible State and Federal aid. These financial aids are described in more detail in Chapter XVI "Plan Implementation."*

[c] *Less than 0.1 percent.*

[d] *Includes lands owned by the Wisconsin Department of Natural Resources, the University of Wisconsin, and The Nature Conservancy.*

[e] *Includes 4,500 acres in Kenosha County and 35 acres in Racine County.*

Source: SEWRPC.

Secondary Environmental Corridors and Isolated Natural Resource Areas

Secondary environmental corridors and isolated natural areas are shown on Map 60. Secondary environmental corridors in the watershed are located chiefly along the upper reaches of the Des Plaines River, along the upper reaches of Kilbourn Ditch, along portions of Brighton Creek, and along several intermittent streams. Secondary environmental corridors contain a variety of resource elements and are often remnants of primary environmental corridors, portions of which have been developed for intensive agricultural or urban uses. Secondary environmental corridors facilitate surface water drainage and may provide good locations for drainageways and local park and open space facilities. About 6.4 square miles, or about 5 percent, of the total area of the watershed, were encompassed within secondary environmental corridors in 1990. This area is expected to remain virtually unchanged during the plan design period and should be protected by appropriate local zoning and official mapping.

Isolated natural resource areas within the watershed include a geographically widely distributed variety of isolated wetlands and woodlands. Isolated natural resource areas may provide the only available wildlife habitat in an area, provide good locations for local parks and open space areas, and lend aesthetic character and natural diversity to an area. About 3.0 square miles, comprising about 2 percent of the watershed, were encompassed within isolated natural resource areas in 1990. This area is also expected to remain virtually unchanged during the plan period, and should be protected by appropriate local zoning and official mapping.

Accordingly, it is recommended that secondary environmental corridors in developing areas be considered for preservation in natural, open use or incorporated in local plans as drainageways, stormwater detention or retention areas, or as local parks or recreation trails. It is also recommended that isolated natural resource areas be preserved in natural open uses insofar as practicable, being incorporated in local plans as parks and open space reservations or stormwater detention or retention areas as appropriate. About 365 acres, or about 9 percent, of secondary environmental corridor lands within the watershed, are recommended for public acquisition to accommodate recreation trail facilities under the outdoor recreation plan element presented in the following section.[6] In addition, about 28 acres of isolated natural resource area are recommended for public acquisition as part of the new community park in the Village of Pleasant Prairie, which is also described under the urban outdoor recreation plan element. Other public acquisition of secondary environmental corridors and isolated natural resource areas should be identified on the basis of detailed neighborhood unit development plans.

OUTDOOR RECREATION PLAN ELEMENT

The outdoor recreation plan element of this plan is composed of both a resource-oriented component, containing recommendations for the provision of major parks, recreation corridors, and associated park and trail facilities, and an urban-oriented component, containing recommendations for the provision of community and neighborhood parks, park facilities, and local trails. Outdoor recreation sites and trails recommended by this plan are shown on Map 62. Acquisition and development costs for providing such recreation sites and facilities, summarized on Table 101, are estimated at about $11.2 million.

In carrying out the recommended outdoor recreation plan element, the concerned local units of government should be aware of possible State and Federal aid. Potential sources of funding for the land acquisition of park and open space sites and for the development of a recreational trail system include Federal and State grants-in-aid for the development of both bicycle trails and multiple-use recreational trails. These financial aids are described in more detail in Chapter XVI, "Plan Implementation."

Recommended Resource-Oriented Outdoor Sites and Facilities

Major Parks: Major parks are defined as large, public, general-use outdoor recreation sites, containing natural resource amenities and providing opportunities for such activities as camping, golfing, picnicking, and swimming. Such sites typically are 250 acres or larger and attract users from relatively long distances, including residents of both urban and rural areas. In 2002, there were three major parks within the Des Plaines River watershed, all located within Kenosha County: Brighton Dale Park, in the Town of Brighton; Bristol Woods Park, in the Town of Bristol; and Prairie Springs Park, in the Village of Pleasant Prairie.

Brighton Dale Park is a 515-acre park owned and operated by Kenosha County. Of that total area, 324 acres are located within the watershed. Existing facilities at the park include a regulation 45-hole golf course, picnic areas, playfields, ice-skating and fishing ponds, and trail facilities. The plan recommends the continued maintenance of this facility.

Bristol Woods Park is a 206-acre park owned and operated by Kenosha County. The park is located entirely within the watershed. Existing facilities at the site include picnic areas and hiking and skiing trails. The plan also recommends the continued maintenance of this facility.

Prairie Springs Park is a 441-acre park owned by the Village of Pleasant Prairie. The park is also located entirely within the watershed. The park includes a former gravel pit which has been used to create an approximately 100-

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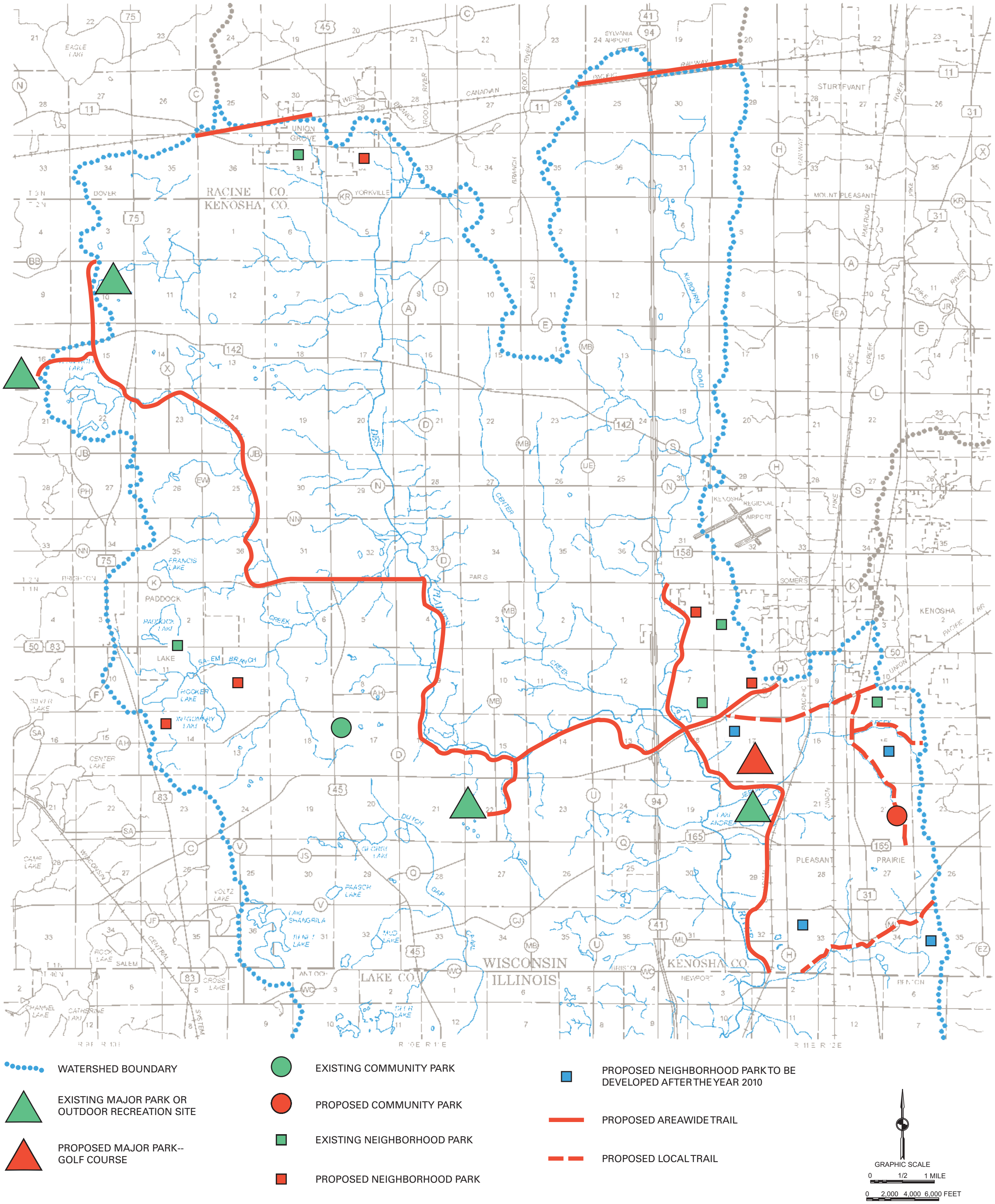
[6]*Kenosha County currently owns a 332-acre parcel of secondary environmental corridor located on the east side of the Des Plaines River south of CTH K; however, it is not anticipated that this parcel will be needed for the development of the Des Plaines River Trail. It should be noted, however, that detailed engineering studies must be conducted prior to trail construction, and that the trial locations shown in the plan are, therefore, subject to change.*

Map 62

RECOMMENDED PARKS AND RECREATION TRAIL SYSTEM UNDER THE OUTDOOR RECREATION ELEMENT OF THE DES PLAINES RIVER WATERSHED PLAN



Source: SEWRPC.

Table 101

SUMMARY OF COSTS FOR IMPLEMENTATION OF THE AREAWIDE OUTDOOR RECREATION PLAN ELEMENT OF THE DES PLAINES RIVER WATERSHED PLAN

Facility	Estimated Acquisition Cost[a, b]	Estimated Development Cost[a, b]	Total Cost[a, b]
Major Parks	$ 0	$ 200,000	$ 200,000
Golf Course	800,000	5,000,000	5,800,000
Areawide Trails	607,000	3,000,000	3,607,000
Total	$1,407,000	$8,200,000	$9,607,000

NOTE: Cost estimates are expressed in 2000 dollars.

[a]*In carrying out the recommended outdoor recreation plan element, the concerned local units of government should be aware of possible State and Federal aid. These financial aids are described in more detail in Chapter XVI, "Plan Implementation."*

[b]*Costs do not include those associated with community and neighborhood parks and local trails.*

Source: SEWRPC.

acre lake. Other existing resource-oriented facilities at the site include a swimming beach, concrete boat ramp for nonmotorized boating, picnic areas, about 2.5 miles of paved trails, and other nature trails. Ice skating and sledding are also proposed resource-oriented uses for the park. The park also provides a number of nonresource-oriented facilities, including a recreation center and playfields. Four additional playfields are proposed to be developed at the park. The development cost for the park is estimated at about $200,000.

The watershed also encompasses a portion of Bong State Recreation Area, a major special-purpose outdoor recreation site. The recreation area has a total area of 4,515 acres, with about 1,150 acres of that total located within the watershed. Facilities are available for a number of activities, including camping, swimming, and hunting. The site also provides trails for a number of uses, including hiking, skiing, horseback riding, and snowmobiling.

Proposed New Public Golf Course

The park and open space plan for Kenosha County recommends that a regulation 18-hole golf course be provided in the southwestern portion of the Village of Pleasant Prairie. The need for a public golf course in this area was identified initially in the year 2000 regional park and open space plan. It is, accordingly, recommended that Kenosha County act to acquire property for, and construct, a golf course in this area. An area immediately north of the new Prairie Springs Park has been identified in the *Comprehensive Plan for the Kenosha Urban Planning District* as a general site for the golf course; that recommendation is incorporated into this park and open space plan.

It is recommended that a minimum of 160 acres be acquired by a public/private partnership, or Kenosha County, for development of the golf course. The cost for land acquisition and golf course development is estimated at $800,000 and $5,000,000, respectively.

Areawide Recreation Trail System
The areawide recreation trail system proposed herein refines and details the system proposed in the park plans for Kenosha and Racine Counties and extends that system to include several bicycle and pedestrian ways recommended under the year 2010 regional bicycle and pedestrian facilities system plan and the *Comprehensive Plan for the Kenosha Urban Planning District*.

As defined by the Commission, a recreation corridor is a publicly owned corridor at least 15 miles in length located through areas of scenic or cultural interest. Such areas are generally located along a stream, river, or ridge line and are intended to provide aesthetic and natural resource continuity. Such corridors serve as ideal locations for recreational trails.

As shown on Map 62, a recreation corridor is recommended to be located in Kenosha County along the main stem of the Des Plaines River from the Illinois-Wisconsin State line northward to Brighton Creek. The corridor is then recommended to follow Brighton Creek westward into the Bong State Recreation Area. A recreation corridor is also recommended to run northward along Kilbourn Ditch from the Des Plaines River to Kenosha CTH K. Trails for hiking and bicycling are recommended to be developed within these recreation corridors. It is recommended that the trail proposed within that portion of the Des Plaines River corridor lying within Kenosha County be located to connect with the Des Plaines River trail proposed to be developed within Lake County, Illinois, in accordance with plans prepared by the Northeastern Illinois Planning Commission.[7] The trail has been constructed by the Lake County Forest Preserve District as far north as Russell Road, about one mile south of the State line.

It is also recommended that trail segments be provided in Kenosha County within the rights-of-way of STH 165, to connect the proposed Des Plaines River trail to the existing Kenosha County South trail, located east of the watershed, and along CTH C, to connect the proposed Des Plaines River trail to the proposed Pike River trail, which would be located northeast of the watershed.

This plan also includes a proposed trail within the right-of-way of the Canadian Pacific Railway, former Chicago, Milwaukee, St. Paul & Pacific Railroad, line from the City of Racine to the City of Burlington, should the right-of-way become available for trail use. Development of a trail within the railroad right-of-way, which is recommended in the Racine County park and open space plan, would provide an opportunity to link the Root River and Lake Michigan trails in the eastern portion of the County to the Fox River trail in the western portion of the County.

The recommended areawide recreation trail system consists of about 36.5 linear miles of trails, including about 27.9 miles of off-street trails and about 8.6 miles of trails within highway rights-of-way. There are no existing trails within the watershed. Within Kenosha County, the recommended areawide recreation trail system includes about 32.2 linear miles of trails, including about 23.6 miles of off-street trails and about 8.6 miles of trails within highway rights-of-way. The areawide trail system also includes about 4.3 miles of trails within Racine County, all of which are proposed to be located off-street. As indicated in Table 102, the estimated cost for providing the recommended trails is $4.3 million, including $630,000 for land acquisition and $3.7 million for trail development.

Recommended Urban Outdoor Recreation Sites and Facilities
In addition to meeting resource-oriented outdoor recreation needs, a park plan should seek to provide sites and facilities for nonresource-oriented activities, such as baseball, tennis, and playground activities. In comparison to the resource-oriented outdoor recreation site and facilities, sites and facilities for nonresource-oriented activities rely less heavily on natural resource amenities, generally meet a greater need in urban than rural areas, and have a relatively small service radius. For these reasons, nonresource-oriented outdoor recreation sites and facilities, as a

[7] *Northeastern Illinois Planning Commission and Openlands Projects,* Northeastern Illinois Planning Commission Greenways Plan*, Chicago, Illinois, September 17, 1992.*

Table 102

ACQUISITION AND DEVELOPMENT COSTS FOR AREAWIDE RECREATION TRAILS IN THE DES PLAINES RIVER WATERSHED[a]

Trail Name	On- or Off-Street	Length (miles)[b]	Estimated Acquisition Cost	Estimated Development Cost[c]	Total Cost[d]	Recommended Jurisdiction[e]
Des Plaines River Trail	On-street portion	3.3[f]	$ 0[g]	$ 330,000	$ 330,000	Kenosha County
	Off-street portion	18.0	558,000[h]	1,800,000	2,358,000	Kenosha County and Village of Pleasant Prairie[i]
Bristol Woods Park Connector	Off-street	1.0	22,000	100,000	122,000	Kenosha County
Brighton Dale Park Connector	Off-street	2.0	0[j]	200,000	200,000	Wisconsin Department of Natural Resources and Kenosha County[k]
CTH H/CTH C Connecting Route[l]	On-street	2.7	0[g]	270,000	270,000	Kenosha County
Kilbourn Ditch North Trail	Off-street	1.1	0[m]	110,000	110,000	Kenosha County
Kilbourn Ditch South Trail	Off-street	1.5	0[m]	150,000	150,000	Village of Pleasant Prairie
STH 165 Connecting Route[n]	On-street	2.6	0[g]	260,000	260,000	Wisconsin Department of Transportation
Milwaukee Road Trail	Off-street	4.3	50,000	430,000	480,000	Racine County
Total	- -	36.5	$630,000	$3,650,000	$4,280,000	- -

NOTE: Cost estimates are expressed in 2000 dollars.

[a]*All trails are to be located in Kenosha County except the proposed Milwaukee Road Trail, which would be located in Racine County.*

[b]*Trail lengths are given in route-miles. Where trails are proposed to be located on-street, the number of lane-miles will be approximately twice the number of route-miles, as bicycle lanes or bicycle routes would be located along both sides of a street.*

[c]*The unit improvement costs used for estimating trail development costs were $100,000 per mile for the construction of four-foot-wide shoulders or four-foot-wide bicycle lanes along both sides of an arterial street or highway and $100,000 per mile for the construction of a 10-foot-wide asphalt path.*

[d]*In carrying out the recommended outdoor recreation plan element, the concerned local units of government should be aware of possible State and Federal aid. These financial aids are described in more detail in Chapter XVI, "Plan Implementation."*

[e]*Level of government recommended to assume responsibility for construction and maintenance of trail segment. The responsible agency may enter into operating or maintenance agreements with other units of government to perform maintenance activities.*

[f]*Includes 2.7 miles along CTH K and 0.6 miles on CTH C west of the Des Plaines River.*

[g]*On-street trails will be constructed within the highway right-of-way; therefore, there are no acquisition costs associated with trail construction.*

[h]*Acquisition costs for that portion of the Des Plaines River Trail located within primary environmental corridor lands are included on Table 100. Acquisition costs for lands outside a primary environmental corridor are included on this table.*

[i]*Kenosha County would be responsible for developing off-street portions of the trail lying west of IH 94/USH 41, and the Village of Pleasant Prairie would be responsible for developing those off-street portions of the trail lying east of IH 94/USH 41.*

[j]*Proposed trail to be located on lands in existing public ownership.*

[k]*It is recommended that the Wisconsin Department of Natural Resources be responsible for developing that portion of the trail within the Bong State Recreation Area and that Kenosha County be responsible for that portion of the trail within Brighton Dale Park.*

[l]*Trail would connect Des Plaines River and Pike River trails.*

[m]*Trail would be located within primary environmental corridor; acquisition costs are included in Table 100.*

[n]*Trail would connect Des Plaines River and Kenosha County South trails.*

Source: SEWRPC.

practical matter, should be provided only in areas having significant population concentrations. Responsibility for the provision of such sites and facilities generally rests with city, village, and town governments.

A graphic summary of the plan recommendations for urban public recreation sites and facilities, including community parks, neighborhood parks, and local recreation trails, is presented on Map 62. More specific information for local park and trail development within the Kenosha Urban Planning District, that portion of the watershed located in Kenosha County east of IH 94/USH 41, can be found in Chapter XI and Appendix B of

SEWRPC Community Assistance Planning Report No. 212, *A Comprehensive Plan for the Kenosha Urban Planning District*. Recommendations for local parks in that portion of the watershed outside the District were based upon recommendations contained in the Regional Park and Open Space Plan prepared by the Regional Planning Commission, in the Land Use Plan for the Town of Salem prepared by Meehan & Company, Inc., and in the Park and Open Space Plan for the Town of Mt. Pleasant prepared by the Planning Commission.

Community Parks

Regional Planning Commission standards suggest that community parks should range in size from 25 to 99 acres, have a service radius of two miles, and generally provide such community-oriented recreational facilities as baseball diamonds, softball diamonds, and swimming pools. There is one existing community park within the watershed, Richard Hanson Memorial Park in the Town of Bristol. In accordance with recommendations contained in the comprehensive plan for the Kenosha Urban Planning District, one community park would be developed within the watershed in the south-central portion of the Village of Pleasant Prairie, as shown on Map 62. This park would have a total area of about 65 acres, including about 28 acres of isolated natural resource area.

Neighborhood Parks

Regional Planning Commission standards suggest that neighborhood parks should be less than 25 acres in size, have a service radius of 0.5 to 1.0 mile, and be located within walking distance of urban residential areas. Such parks should provide facilities for children's outdoor recreation activities, such as playground and playfield activities, ice-skating, and basketball and other court games. Existing and proposed neighborhood parks in the watershed are shown on Map 62.

There are currently five neighborhood parks located within the watershed, five in Kenosha County and one in Racine County. The existing neighborhood parks in the Kenosha County portion of the watershed include Gangler Park and White Caps Park, in the City of Kenosha; Old Settlers Park, in the Village of Paddock Lake; and the Pleasant Prairie Ballpark, in the Village of Pleasant Prairie. The existing neighborhood park in the Racine County portion of the watershed is Old Settlers Park, in the Town of Yorkville. Together, these six neighborhood parks have an area of 54 acres.

A total of five new neighborhood parks are recommended within the watershed. Together, these five parks would have an area of about 50 acres.

There are two new neighborhood parks recommended by the year 2010 for that portion of the watershed located within the Kenosha Urban Planning District. The new parks are proposed to be located in the far western portion of the City of Kenosha and in the northwestern portion of the Village of Pleasant Prairie. Each park is proposed to be about 10 acres in size. Recommendations for facility development at each park are set forth in the report documenting the District plan.

Three new neighborhood parks are proposed within that portion of the watershed outside the Kenosha Urban Planning District; one within Racine County, adjacent to the Village of Union Grove, and two within Kenosha County, in the Town of Salem. It is recommended that each new neighborhood park be about 10 acres in size and be developed with playfields, a playground, a softball diamond, basketball goals, and picnicking facilities.

Additional development is also proposed at two existing neighborhood parks in the City of Kenosha, Gangler Park and White Caps Park. Additional recommended facilities are set forth in the report documenting the Kenosha Urban Planning District plan.

The plan for the Kenosha Urban Planning District further proposes the acquisition and development of four additional new neighborhood parks within the Village of Pleasant Prairie to serve urban development expected to occur after the year 2010. The proposed general location of each park is shown on Map 62. The precise size and location for these park sites has not been determined; however, Regional Planning Commission standards recommend that neighborhood parks range in size from five to 25 acres.

Local Recreation Trail System

In addition to park sites and facilities, the park and outdoor recreation plan recommends a network of local trails that connects to and supplements the areawide trail system described earlier in this chapter. The local trail network, shown on Map 62, is intended to provide access to neighborhood and community parks, as well as to the areawide trail system. The recommended recreation trail system within the watershed includes about 9.0 linear miles of trails, including about 5.4 miles to be located off-street and about 3.6 miles to be located within highway rights-of-way. There are no existing local trails within the watershed.

SUMMARY

This chapter has presented a recommended land use plan and park and open space plan for the watershed. The salient recommendations of these plan elements may be summarized as follows:

1. Under the recommended land use plan, the amount of land devoted to urban use within the watershed would increase from the 1990 total about 12.5 square miles, or about 9 percent, of the total area of the watershed, to about 21.2 square miles, or about 16 percent, of the total area of the watershed, by the plan design year 2010. About 3.9 square miles, or about 44 percent, of the 8.7-square-mile increase in urban lands anticipated in the watershed, would be devoted to the residential land uses; while 1.7 square miles, or about 20 percent, of the anticipated increase in urban land, would be devoted to commercial land uses, and 2.1 square miles, or about 24 percent, would be devoted to industrial land uses. The remaining 1.0 square mile, or about 13 percent, of the 8.7 square mile increase in urban land uses anticipated, would be devoted to transportation, communication, utility, governmental, institutional, and recreational land uses. Thus, in the plan design year, residential land uses would comprise 11.7 square miles, or about 9 percent, of the total area of the watershed; commercial land uses, 2.3 square miles, or about 2 percent; industrial land uses, 2.6 square miles, or about 2 percent; transportation, communication, and utility uses, 1.2 square miles, or about 1 percent; governmental and institutional uses, 0.8 square miles, or about 1 percent; and park and outdoor recreational uses, 1.7 square miles, or about 1 percent.

   Under the buildout alternative, an additional 11.8 square miles are envisioned to be developed, largely for residential, commercial and industrial land uses, after the year 2010.

2. The increase in urban land uses in the watershed by the plan design year 2010 would result in a corresponding decrease in rural land uses. Under the recommended land use plan for the watershed, the existing stock of rural land would decrease from 120.4 square miles, or 91 percent, of the total area of the watershed, in 1990, to about 111.6 square miles, or 84 percent, of the total area of the watershed, in the plan design year 2010. Virtually all the decrease in rural land uses anticipated in the watershed would be through the conversion of agricultural and other open lands to urban uses.

   Under the buildout alternative, an additional 10.0 square miles of agricultural and open lands are envisioned to be converted to urban uses after the year 2010.

   Under both the recommended land use plan and buildout alternative, the approximately 26.4 square miles, or 20 percent, of the total area of the watershed, which consist of environmental corridors and isolated natural resource areas are proposed to be permanently preserved.

3. In 1990, about 16.8 square miles, or about 13 percent, of the watershed, were encompassed within the primary environmental corridors. The recommended watershed plan recommends that approximately 0.2 square mile of floodlands adjacent to the Des Plaines River in the southwestern portion of the Village of Pleasant Prairie, which are currently in agricultural or other open uses, be restored to a wetland condition and integrated into the primary environmental corridor network of the watershed. The primary environmental corridor area within the watershed would therefore increase from about

16.8 square miles to about 17.0 square miles under the recommended plan. The plan further recommends that an additional 4.0 square miles, or 23 percent, of primary corridors within the watershed be acquired by public agencies, at an estimated cost of about $4.6 million. A total of about 8.4 square miles, or about 49 percent, of the total primary corridor area within the watershed would therefore be in public or public-interest ownership by the year 2010. The remaining 8.6 square miles, or 51 percent, of the primary environmental corridors of the watershed are recommended to remain in compatible nonpublic recreation use, or be protected through conservancy zoning.

4. In 1990 about 6.4 square miles, comprising about 5 percent of the watershed, were encompassed within secondary environmental corridors. This area is expected to remain virtually unchanged during the plan period. An additional about 3.0 square miles, comprising about 2 percent of the watershed, were encompassed within isolated natural resource areas. This area is also expected to remain virtually unchanged during the plan period. The plan recommends that secondary environmental corridors be considered for preservation in natural, open use or incorporated as drainageways, stormwater detention or retention areas, or as local parks or recreation trails, in developing areas. The plan also recommends that isolated natural resource areas be preserved in natural, open uses, as much as is practicable, being incorporated for use as parks and open space reservations or stormwater detention or retention areas, as appropriate. The plan recommends public acquisition of certain identified segments of secondary environmental corridor, a total of 365 acres in area, for the development of the recreation trail system and acquisition of one isolated natural area, about 28 acres in area, as part of the recommended new community park in the Village of Pleasant Prairie. Other public acquisition of secondary environmental corridors and isolated natural resource areas should be identified on the basis of detailed neighborhood unit development plans.

5. There are three major parks within the watershed, all within Kenosha County: Brighton Dale Park, in the Town of Brighton; Bristol Woods Park, in the Town of Bristol; and Prairie Springs Park, in the Village of Pleasant Prairie. These parks together comprised an area of 1,162 acres, 971 acres of which are located within the watershed. The plan recommends the continued maintenance of Brighton Dale Park and Bristol Woods Park and the continued development of Prairie Springs Park. The cost for additional development at Prairie Spring Park is estimated at about $200,000. The plan further recommends the acquisition of 160 acres of land for development of a regulation 18-hole golf course by a public/private partnership, or Kenosha County, in the southwestern portion of the Village of Pleasant Prairie. The cost for land acquisition and golf course development is estimated at $800,000 and $5,000,000, respectively.

6. The plan also recommends the development of an areawide recreation trail system consisting of about 36.5 linear miles of trails, including about 27.9 miles of off-street trails and about 8.6 miles of trails within street and highway rights-of-way, to provide opportunities for trail-based recreation in major stream corridors, including along the Des Plaines River, and to provide connections to major parks and to major trails outside the watershed. The estimated cost for developing the areawide trail system within the watershed is about $4.3 million.

7. Richard Hanson Memorial Park in the Town of Bristol is the only community park within the watershed. The plan recommends the development of one new 65-acre community park in the Village of Pleasant Prairie.

8. In 1990 there were six neighborhood parks within the watershed, five in Kenosha County and one in Racine County, including two such parks in the City of Kenosha, one in the Village of Paddock Lake, one in the Village of Pleasant Prairie, one in the Town of Bristol, and one in the Town of Yorkville. Together these six parks encompass an area within the watershed of 54 acres. This plan recommends the acquisition and development of five new neighborhood parks within the watershed, with one new park proposed to be located in the far western portion of the City of Kenosha; one in the northwestern portion of the Village of Pleasant Prairie; one within the Town of Yorkville, adjacent to the Village of

Union Grove; and two in the Town of Salem. Together these five parks would encompass an area of about 50 acres. Additional facility development is also proposed at two existing neighborhood parks in the City of Kenosha.

9. This plan also recommends a network of local trails that connects to and supplements the areawide trail system described above. The local trail network is intended to provide access to neighborhood and community parks, as well as access to the areawide trail system. The recommended recreation trail system includes about 9.0 linear miles of trails, including about 5.4 miles to be located off-street and about 3.6 miles to be located within highway rights-of-way.

The watershed land use plan would meet the social, physical, and economic needs of the future resident population of the watershed by allocating sufficient land to each of the various major land use categories to satisfy the known and anticipated demand for each use. The plan seeks to protect and enhance the natural resource base of the watershed by allocating new urban development only to those areas that are covered by soils well suited to such development, that are not subject to special hazards, such as flooding; and that can be readily provided with gravity drainage sanitary sewer, public water supply, and urban mass transit services. Adoption and implementation of this plan element would promote the wise use of the natural resource base; preserve the cultural heritage and natural beauty of the watershed; help enrich the physical, intellectual, and spiritual development of the resident population, and avoid the intensification of such existing developmental and environmental problems as flooding and water pollution or the creation of new problems of this type. The plan will also permit the design of surface water quality management and drainage and flood control facilities to proceed on a sound basis within the watershed.

Chapter XII

ALTERNATIVE AND RECOMMENDED FLOODLAND AND STORMWATER MANAGEMENT MEASURES

INTRODUCTION

The inventory and analysis phases of the Des Plaines River watershed planning program identified certain water resource and related problems, including flooding and water pollution. As stated in Chapter I, the primary purpose of the Des Plaines River watershed planning program is to assist in the abatement of these problems by developing a workable plan which can be used to guide development within the watershed into a safer, more healthful, more attractive, and more economic pattern. This pattern should be properly related to the underlying and sustaining natural resource base so as to avoid the intensification of existing and the creation of new developmental and environmental problems in the watershed.

The purpose of this chapter is to present alternative floodland and stormwater management measures from which a recommended floodland and stormwater management plan for the watershed can be synthesized. The alternatives described herein should be considered as adjuncts to the basic land use development proposals advanced in Chapter XI, and were designed to facilitate the attainment of regional and watershed development objectives. The alternative floodland and stormwater management measures are thus subordinate to the basinwide land use plan element, and the incremental benefits and costs of these alternatives can be separated from those of the basinwide land use plan element.

The evaluation of a particular alternative relative to other alternatives intended to resolve an identified problem is a sequential process during which the alternative is subjected to several levels of review and evaluation, including technical, economic, financial, legal, and administrative feasibility and political acceptability. The technical, economic, and environmental aspects of each alternative are presented in this chapter.

This chapter includes the following sections:

- Description of floodland management measures available for resolution or prevention of flood problems,
- Presentation of the hydrologic, hydraulic, and economic consequences of planned land use changes,
- Description of specific alternative floodland and stormwater management measures for the various stream reaches of the watershed,

- Evaluation of need for bridge and culvert alteration or replacement for transportation purposes throughout the watershed,
- Description of the nonstructural floodland management measures recommended for application throughout the watershed, and
- Description of accessory floodland and stormwater management measures.

AVAILABLE FLOODLAND MANAGEMENT MEASURES

Floodland management may be defined as the planning and implementation of a combination of measures intended to reconcile the floodwater conveyance and storage function of floodlands with the space needs and other socioeconomic needs of the resident population of a watershed. Floodland management is intended to eliminate loss of life, lessen danger to human health and safety, minimize monetary damage to private and public property, reduce the cost of utilities and services, and minimize disruption in community affairs, while recognizing environmental considerations and protecting significant natural resource features wherever possible. A broader goal is the enhancement of the overall quality of life of the watershed residents by the protection of those environmental values—recreational, aesthetic, ecological, and cultural—normally associated with, and concentrated in, riverine areas.

The preparation of a floodland management plan for a watershed involves the development of alternative plan elements, a comparative evaluation of those elements, and the synthesis of the most effective elements into an integrated plan. The floodland management plan for the Des Plaines River watershed is specifically intended to achieve the land use development, sanitary sewerage system development, and water control facility development objectives and their supporting standards as set forth in Chapter X.

The techniques of floodland management may be broadly divided into two categories—nonstructural measures and structural measures. Nonstructural measures include reservation of floodlands for conservation, recreation, and other open space uses; floodland use regulations; land use and related stormwater management measures designed to limit rainfall runoff outside the floodlands; structure floodproofing and/or elevation; structure removal; channel maintenance; flood insurance; lending institution policies; realtor policies; community utility policies; and emergency programs. Structural measures include floodwater storage facilities, such as reservoirs and impoundments; floodwater diversion facilities, such as dikes and channels; floodwater containment facilities, such as earthen dikes and concrete floodwalls; floodwater conveyance facilities, such as channel modifications; and bridge and culvert modifications or replacements. Table 103 lists the structural and nonstructural floodland management measures which may apply, individually or in combinations, to the stream network of the Des Plaines River watershed, and summarizes the function of each. Structural measures tend to be more effective in achieving the objectives of floodland management in riverine areas that have already been urbanized, while nonstructural measures, being preventative, are generally more effective in riverine areas that have not yet been converted to flood damage-prone development even though they have the potential for such development.

Since passage of the National Flood Insurance Reform Act of 1994, Federal policy has placed increased emphasis on the application of nonstructural approaches to floodland management. One key nonstructural measure that is well-suited to the Des Plaines River watershed, which has significant floodlands in areas that are not urbanized, is the preservation of floodlands in open space uses. Maintaining floodlands in open space uses enables the preservation of their floodwater storage characteristics. That helps to moderate the impacts of watershed development on downstream flood flows and stages and avoids potential increases in flows and stages due to indiscriminate filling of the flood fringe. Consistent with the objective of floodland preservation, the floodland zoning ordinances for Kenosha and Racine Counties and the Village of Pleasant Prairie require the maintenance of floodwater storage within the 100-year recurrence interval floodplain.

In the initial assessment of floodland management needs and in developing alternative plans to resolve existing and anticipated future flooding problems, the full range of nonstructural and structural approaches was

Table 103

ALTERNATIVE FLOODLAND MANAGEMENT MEASURES CONSIDERED IN THE DES PLAINES RIVER WATERSHED PLANNING PROGRAM

Alternative		Function	Comment
Major Category	Name		
Structural	Storage	To detain floodwaters upstream of floodprone reaches for subsequent gradual release	May be accomplished by on-channel reservoirs or by off-channel or underground storage
	Diversion	To divert waters from a point upstream of the floodprone reaches and discharge to an acceptable receiving watercourse outside of the watershed, or to divert floodwaters around a floodprone area on a completely new alignment	- -
	Dikes and floodwalls	To prevent the occurrence of overland flow from the channel to floodland structures and facilities	- -
	Channel modification and enclosure	To convey flood flows through a river reach at significantly lower stages	May be accomplished by straightening, lowering, widening, lining, and otherwise modifying a channel or by enclosing a major stream; includes construction of a new length of channel for the purpose of bypassing a reach of a natural stream
	Bridge and culvert alteration or replacement	To reduce the backwater effect of bridges and culverts	May be accomplished by increasing the waterway opening or otherwise substantially altering the crossing or by replacing it
Nonstructural	Floodland regulations	To control the manner in which new urban development is carried out so as to assure that activities in the floodway and flood fringe do not aggravate upstream and downstream flood problems, or, to control selected practices by which existing urban or rural lands are managed	May be accomplished through zoning, land subdivision control, sanitary and building ordinances
	Reservation of floodlands for recreational and related open space use	To minimize damage by using floodlands for compatible recreational and related open space uses and also to retain floodwater storage and conveyance	May be accomplished through private development, such as a golf course, or by public acquisition of the land or by use of an easement
	Control land use and related stormwater management measures outside the floodlands	To control the manner in which urban development occurs outside of the floodlands so as to minimize the hydrologic impact on downstream floodlands	- -
	Structure floodproofing and/or elevation	To minimize damage to structures by applying a combination of protective measures and procedures on a structure-by-structure basis	- -
	Structure removal	To eliminate damage to existing structures by removing them from floodprone areas	- -
	Flood insurance	To minimize monetary loss or reduce monetary impact on structure owner	Premiums may be subsidized or actuarially determined
	Lending institution policies	To discourage acquisition or construction of floodprone structures by means of mortgage granting procedures	- -

Table 103 (continued)

Alternative		Function	Comment
Major Category	Name		
Nonstructural (continued)	Community utility policies	To discourage construction in floodprone areas by controlling the extension of utilities and services	- -
	Emergency programs	To minimize the danger, damage, and disruption from impending flood events	Such a program may include installation of remote stage sensors and alarms, emergency warning system installation and operation, road closures, and evacuation of residents
	Community education programs	To inform and educate citizens regarding personal and private actions by property owners and residents which 1) may adversely affect flood flows and stages or 2) could favorably affect or prevent changes in flood flows and stages in the watershed	May have relationship to aesthetic, recreational, urban utility, or water quality aspects of water resources management in the watershed
	Channel maintenance	To maintain integrity of flood stage profiles; to permit unobstructed flow from storm sewers, drainage ditches, and drainage tiles; and to remove potentially troublesome buoyant material	Will not significantly reduce stages of major floods, except as those stages might be influenced by accumulation of buoyant material on the upstream side of bridge waterway openings

Source: SEWRPC.

considered. However, given the existing floodland zoning practices in the watershed; the large areas of uplands that are, and are expected to remain, in open space uses; and the relatively dispersed nature of structures that could be subject to flooding, it was found that nonstructural measures are especially well-suited to the solution of many of the existing and/or future structure flooding problems in the watershed.

Nonstructural Measures

Each of the nonstructural floodland management measures set forth in Table 103 is discussed briefly below. The function of each measure is described and the key factors or basic requirements needed to determine if the given alternative applies to a riverine area or portion of the watershed are discussed. In addition, some of the more significant positive and negative features of the various measures are identified.

Floodland Regulations

Floodland regulations take the form of or are incorporated into zoning, land subdivision, and building ordinances adopted by counties, cities, villages, and towns under the police powers granted them by State legislatures. Such regulations are ordinarily intended to mitigate flood damage by controlling the manner in which new urban development is carried out in the floodlands so as to assure that it is not floodprone and, equally important, that it does not aggravate upstream and downstream flood problems. As discussed in Chapter IX of this report, floodlands in Wisconsin are governed primarily by the rules and regulations adopted by the Wisconsin Department of Natural Resources (WDNR) pursuant to Section 87.30 of the Wisconsin Statutes. All counties, cities, and villages are expected to adopt reasonable and effective floodland regulations that meet the State rules. Floodland regulations control the manner in which new development occurs in riverine areas and they can be written to avoid the loss of floodwater storage and conveyance capacity.

Reservation of Floodlands for Conservation, Recreation, and Other Open Space Uses
Comprehensive land use planning recognizes that there is a need for active and passive recreational and open space lands. Floodlands may provide an ideal location for such lands and supporting facilities, because the floodlands and the environmental corridors of which they are a part provide sufficient space, assure the presence of water and other key recreation elements, and improve the accessibility of the recreation areas to the urban population.

Recreational and related open space uses of floodlands may be accomplished by several mechanisms, including public or private acquisition of the land or acquisition of an easement followed by development for such recreational uses as cross-country hiking and skiing trails. The principal advantage of this floodland management alternative is its definitiveness and legal incontestability, whereas the key disadvantage is the public cost. Public acquisition of floodland areas for recreational and related open space uses can sometimes be accomplished at no major direct cost to the municipalities by encouraging developers of large tracts to dedicate the land in the environmental corridor portions of those tracts to a local governmental unit or agency for public maintenance and use. The land developer may be receptive to the idea of dedicating the floodlands and adjacent environmental corridors since floodlands are not well suited for residential development, not only because of flooding, but also because of limiting soils and difficulties in supplying and maintaining utilities; since land subdivision regulations often require developers to provide a minimum amount of recreational and open space land; and since existing floodland regulations may limit the extent of floodland development.

In addition to preventing additional floodprone development, minimizing the aggravation of upstream and downstream flood problems, and providing prime and readily accessible outdoor recreational land, the reservation of floodlands for recreational and open space uses also may be expected to have a significant and favorable impact on the value of residential property in proximity to the riverine-area parkways. Furthermore, this impact is directly related to the size of the open land as well as to the value of the natural resource amenities which it contains.

Control of Land Use Outside the Floodlands
It is important to regulate the manner in which urban development occurs outside the floodlands, as well as within the floodlands, so as to minimize the hydrologic impact on floodland areas receiving direct runoff from tributary watershed areas. Although planning for land use outside floodland areas has not traditionally been considered a floodland management alternative, studies of the hydrologic-hydraulic interdependence between the land surface and the streams of the watershed system suggest that land use planning and related stormwater management measures can, indeed, be an effective floodland management measure. It is vital that land use planning consider the hydrologic-hydraulic consequences of the location of future urban development, the amount of impervious surface in that development, and the manner in which stormwater runoff from that development is controlled. The application of innovative source control stormwater management measures could be an important component of the watershed plan in the urbanizing areas of the watershed. Such measures are incorporated in conservation developments that utilize "low impact development" methods or "source control" measures that are intended to maintain the natural hydrology of the watershed as development proceeds. These measures include:

- Conserving existing natural areas.
- Minimizing development impacts:
  - Clustering buildings,
  - Limiting roadway widths and other impervious surfaces,
  - Limiting lot disturbance, and
  - Preserving recharge areas.
- Maintaining natural runoff rates:
  - Using open drainage,

— Maintaining natural flow paths, and

— Incorporating integrated stormwater management practices, such as bio-retention (rain gardens), infiltration systems, and related landscaping measures.

Such measures could be applied in new developing areas and could be considered for retrofitting in existing developed areas, where practical in order to minimize increases in runoff due to development and to reduce nonpoint source pollutant loadings.

Structure Floodproofing and/or Elevation
Residential, commercial, and industrial structures located within or adjacent to floodlands are particularly vulnerable to flood damage because of the variety of ways in which floodwaters can enter such structures. It is possible and generally practicable for individual owners to make certain structural adjustments to their private properties and to employ certain measures or procedures, all of which are intended to reduce flood damages significantly. This approach is referred to as floodproofing, and may be more specifically defined as a combination of physical measures applied to existing structures in combination with selected emergency procedures, all of which are intended to eliminate or significantly reduce damage to the structure and its contents.

Floodproofing measures and techniques intended for application to existing structures generally can be divided into one of three categories:[1] 1) techniques for preventing entry of floodwaters, or dry floodproofing; 2) techniques for ensuring continuation of, or at least protection of, utilities and other services during flood events and for protecting structure contents in the event that the water does—by design or otherwise—enter the building; and 3) the techniques of raising—that is, elevating—the structure such that the first floor—or other most damage-prone floor—is above the design flood stage, supplemented with measures to protect the basement and other portions of the structure below the design flood stage from damage.

The particular combination of floodproofing measures applied to a given structure must be tailored to the function of the structure, the nature of its construction, and the vertical and horizontal position of the structure within the floodplain. Extensive floodproofing should be applied only under the guidance of a registered professional engineer who has carefully inspected the building and contents, has analyzed its structural integrity, and has evaluated the flood threat. It is important to emphasize that, even if a successful floodproofing program is instituted in a floodprone area, overland flooding and the inconvenience it causes will continue to occur.

Prevention of Floodwater Entry
A variety of floodproofing measures and techniques can be used to prevent the entry of floodwaters. Sanitary sewer backup through basement floor drains may be prevented by the installation of backwater valves or the use of vertical standpipes screwed into a fitting in the floor drain, provided that the building sewer can withstand the

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[1]*For more detailed descriptions of floodproofing measures and estimate of costs, see:*

- U.S. Army Corps of Engineers, National Floodproofing Committee: *Flood Proofing Tests,* August 1988*; Raising and Moving the Slab-On-Grade House with Slab Attached,* 1990*; Floodproofing Techniques, Programs, and References,* February 1991*; Flood Proofing – How to Evaluate Your Options,* July 1993*; and Local Flood Proofing Programs,* June 1994.

- U.S. Army Corps of Engineers: Flood Proofing Systems & Techniques, December 1984 and Flood Proofing Regulations, EP 1165-2-314, December 15, 1995.

- Federal Emergency Management Agency: Design Manual for Retrofitting Flood-prone Residential Structures, FEMA 114, September 1986; Elevated Residential Structures, FEMA 54, March 1984; and Floodproofing Non-Residential Structures; FEMA 102, May 1986.

attendant pressure that will be exerted. Sump pumps, preferably provided with standby gasoline-powered electrical generators, can remove water that enters the basement of a structure through foundation drains or other openings, provided that the discharge point is above, and not affected by, flood stage. Waterproof seals can be installed at structural joints, such as the contact between basement walls. Overland flood damage may be prevented by the construction of earthen berms or concrete or masonry walls around the perimeter of the structure or cluster of structures. Flood shields have been designed for quick installation over doorways, windows, and other structural openings.

It is important to reemphasize the critical need for a complete analysis of the ability of a given structure to withstand the external hydrostatic forces that would be applied to the walls and basement floor of a structure prior to implementing floodproofing procedures intended to prevent water from entering the basement of the structure. Generally speaking, the concrete block basements widely used in residential construction in Southeastern Wisconsin are not capable of withstanding the hydrostatic forces associated with complete saturation of the soil surrounding buildings.

Maintenance of Utilities and Services and Protection of Contents
Another category of floodproofing measures applicable to structures consists of techniques designed to ensure the maintenance of utilities and other services needed for the building to function immediately after, and possibly during, a flood event, and to protect structural contents. This second set of floodproofing measures should be considered for structures having concrete block basements.

Mechanical equipment, such as heating and air conditioning units, or manufacturing equipment may be placed on upper floors, elevated above floor level, surrounded by low walls to prevent the intrusion of floodwaters, temporarily covered with impermeable sheet material, or altered so as to be mobile for removal from floodprone areas prior to the occurrence of a flood event. Electrical circuits serving floodprone sections of a structure should be altered so that they can be easily shut off, and consideration should be given to moving the electrical service box to the first floor of the structure above anticipated flood levels and to using waterproof electrical fixtures in floodprone areas of the structure. Some mechanical and electrical equipment may be protected by removing critical water-vulnerable components—for example, the blower motor on a forced air heating unit—prior to entry of the floodwaters.

If there is a high probability that water will enter portions of the structure and damage the contents, such as furnishings in a house or stock stored in a commercial building, an emergency evacuation program should be prepared for such contents. Flood-vulnerable contents could be temporarily moved out of the buildings, be moved to higher floors, or be temporarily elevated on supports or shelves.

A possible alternative to preventing floodwater from entering a basement is intentionally flooding the basement with clean water prior to the inflow of floodwater, thereby maintaining the structural integrity of the basement while minimizing the entry of sanitary sewage, sediment, and other objectionable materials normally associated with basement flooding and, as described above, incorporating measures to maintain utilities and services and protect structure contents. This is called wet floodproofing.

Some of the above floodproofing measures are contingent upon receiving adequate forewarning—at least several hours—of the occurrence of a flood event. It is important to recognize that such a warning, even if it were provided at the outset of a flood, would not be very effective in small, heavily urbanized basins that are characterized by a rapid response of peak flood flows to a major rainfall event.

Elevating the Structure
The third category of floodproofing measures is raising the structure—that is, elevating it—on its present site such that the first floor or other most damage-prone floor is above the design flood stage. Structure raising is supplemented with basic floodproofing measures like those described above to protect the basement and other portions of the structure that remain below the design flood stage.

Basic floodproofing measures like those discussed above are generally considered feasible for most nonresidential structures—such as businesses, commercial buildings, and schools—even if the design flood stage is above the first floor elevation. However, such measures generally are not technically feasible or practical for single-family residences when the design flood stage is above the elevation of the first floor. This is the condition for which structure elevation is often the most appropriate floodproofing measure.

The total capital cost of elevating a structure is dependent on the extent to which the structure is elevated, but includes fixed costs that are independent of the height to which the structure is raised. Examples of fixed costs include the costs of placing beams or other supports beneath the structure, disconnecting utilities, and replacing shrubs, whereas examples of the variable costs include the cost of vertical extensions to the basement walls, and of the fill required to raise the yard grade.

Principal Advantages and Disadvantages of Floodproofing

The principal advantage of floodproofing is that it provides a means whereby individual homeowners or property owners unilaterally can take definitive action to protect their floodprone structures against flood damage. A significant negative aspect of floodproofing is the possibility that it will be applied without adequate professional engineering guidance, possibly leading to major damage to the structure and posing a threat to users of the structure.

Another negative attribute of floodproofing individual structures is the possibility that the technique will not be applied in a coordinated way throughout the entire floodprone portion of a community, thereby leaving a significant demand for flood relief—a demand that will focus on community officials and will be intensified during and immediately after each flood event. In such a situation, and in spite of the fact that numerous individual property owners have implemented floodproofing and have incurred the necessary costs, community officials still will be faced with the problem of reducing the flood threat to those structures that have not been floodproofed.

Finally, it should be noted that buildings which have been floodproofed are not exempt from Federal requirements regarding the purchase of flood insurance. Buyers of homes which have been floodproofed, but still lie within floodprone areas, are required to purchase flood insurance when obtaining a loan from a federally insured lending institution.

Structure Removal

As noted above, it is generally technically and economically feasible to apply basic floodproofing measures to well-constructed brick and masonry structures used for commercial or industrial purposes and to floodproof private residences, sometimes by elevating them. There are, however, situations in which structure floodproofing is not technically practicable or economically sound, such as when the structures are dilapidated and do not meet building code standards or when the cost of elevating them would be prohibitively high because of a large difference between the first floor elevation and the design flood stage.

Therefore, floodproofing measures considered in the design of alternative flood damage abatement plans are sometimes supplemented with proposals to remove those structures, usually private residences, having first floor elevations below the 100-year recurrence interval flood stage—the stage used to design floodproofing and removal alternatives. The cost of removing a residential structure from a floodprone area is computed as the sum of the structure and site acquisition cost, structure demolition or moving cost, site restoration costs, and occupant relocation costs.[2]

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[2]*Wisconsin relocation law is codified under Sections 32.185 through 32.27 of the* Wisconsin Statues. *The Wisconsin Department of Commerce rules regarding relocation rights are set forth in Chapter COMM 202 of the* Wisconsin Administrative Code.

A positive aspect of structure removal, in addition to flood damage reduction, is that it enhances the opportunity to develop the aesthetic and recreation potential of riverine lands. Structure removal can assist in restoring river floodlands to an open, near natural state, thereby enhancing the aesthetic value of the riverine area and, in effect, recreating environmental corridors. Such restored environmental corridor lands could be used for outdoor recreation and related open space purposes.

A negative aspect of structure removal is the opposition which is likely to be encountered from some property owners even if they are offered an equitable price for the flood damage-prone property. Although some of the value placed on a home may be intangible, and therefore cannot be expressed in monetary terms, it is nevertheless real and must be considered when structure removal alternatives are proposed.

Another potentially negative aspect of structure removal is a loss in the tax base to a community as a result of removing taxable property. It should be noted, however, that while there may be such a loss, the net cost to the community may be considerably smaller than the lost taxes because of the likely compensating effect of several factors, including: the reduced cost of municipal services such as schools, water supply, and sewerage; the reduced cost of flood-related emergency service; and the likelihood that some of the evacuated residents will construct new residences within the civil division on previously undeveloped land, thereby restoring some of the lost tax base.

Flood Insurance

The overriding objective of the national Flood Insurance Program is to encourage the purchase of flood insurance by individual landowners to reduce the need for periodic Federal disaster assistance. From the perspective of the owner of the floodprone residential, commercial, or industrial structure, Federal flood insurance provides a means of distributing monetary flood losses in a relatively uniform manner in the form of an annual flood insurance premium, and also actually reduces the monetary flood losses in those situations where the insurance premiums are Federally subsidized.

As of the date of publication of this report, all of the communities in the Des Plaines River watershed except the Village of Paddock Lake were participating in the Federal Flood Insurance Program. Such participation can provide relief in the event that a serious flood occurs prior to implementation of committed or planned flood control measures. It is important to note that one of the requirements that must be met by a community before citizens can participate in the Federal Flood Insurance Program is that the community must enact land use controls which meet Federal standards for floodland protection and development. Therefore, a very close tie exists between two of the nonstructural floodland management measures—the Flood Insurance Program and floodland regulations.

Lending Institution Policies

The Federal Flood Disaster Protection Act of 1973 requires the purchase of flood insurance for a structure within a flood hazard area when the purchaser seeks a mortgage through a Federally supervised lending institution. The private lending institutions obtain flood hazard determinations from companies authorized to make such determinations by the Federal Emergency Management Agency (FEMA).

Community Utility Policies

Local communities may adopt policies relating to the extension of certain public utility services that discourage construction in floodprone areas. Such policies should relate to the extension of streets and utilities such as sanitary sewers and water mains. The location and size or capacity of utility facilities tend to influence the location of urban development. For example, a sewer alignment that parallels and lies near or within a floodplain or terminates at the edge of a floodplain may, in the absence of other land use controls, result in the construction of floodprone residential, commercial, and industrial development. The sanitary sewerage system development objectives and standards which have been incorporated into the overall development objectives and standards for the Des Plaines River watershed specify that floodlands should not be served by sanitary sewers, and that analyses related to the sizing of sanitary sewer system components should not assume the ultimate urbanization of those floodlands. Similar objectives and standards can be established for water supply, transportation, and other facilities and services by the appropriate local units of government and other agencies in the Des Plaines River watershed. In addition to contributing to sound floodland management, community utility policies that are restrictive in serving floodprone areas may have a significant economic benefit in that the unit cost of utilities and services constructed in floodprone areas is normally higher than the unit cost of such facilities and services constructed in nonfloodprone areas. Sanitary sewer construction in floodprone areas also entails higher treatment costs since increased clearwater infiltration and inflow problems will probably develop in floodlands.

Emergency Programs

The function of an emergency program is to minimize the damage and disruption associated with flooding through a coordinated preplanned series of actions to be taken when a flood is impending or occurring. Such a program may include a variety of devices and measures, such as the installation of remote upstream stage sensors and alarms, patrolling of riverine areas to note when bankfull conditions are imminent, monitoring of National Weather Service flash flood watch and warning bulletins, broadcasting of emergency messages to community residents over radio and television, use of police patrol cars or other vehicles equipped with public address systems, use of a siren warning system employing a special pattern to indicate that flooding is occurring, preplanning road closures and evacuation of residents, and the mobilization of portable pumping equipment to relieve the surcharge of sanitary sewers.

Community Education Programs

It is important that the public be fully aware of how the actions of property owners can affect flood flows and stages. Private actions, such as the dumping of debris in a stream channel by property owners and residents, may adversely affect flood flows and stages upstream. Also, localized channelization or the removal of obstructions to flow may increase the flood flows and stages downstream. Proper actions by property owners and residents, however—taken within the framework of a water resources management plan for the watershed—may serve to reduce an existing flooding problem or prevent a future problem, thereby reducing the degree of action necessary by local units of government and minimizing the public financial burden.

Channel Maintenance

Channel maintenance consists of the periodic removal of silt, sand, and gravel deposits, heavy vegetation, and the wide variety of debris found in streams. Examples of obstructions and debris commonly found in stream channels are: brush, beaver dams, tree limbs, scrap lumber, oil drums, wooden crates, cardboard boxes, rubble from demolition activities, tires, bicycles, shopping carts, and appliances.

Channel maintenance may be expected to have several positive effects on flooding and stormwater inundation problems. Periodic cleaning and maintenance of the stream channels is needed to maintain the channel bottom profile at an elevation below the invert of existing or planned storm sewer and stormwater channel outfalls in urban areas and drainage tile and drainage ditch outfalls in rural areas. Failure to clean and maintain the channels may result in partial or full blockage of the outfalls by debris, vegetation, silt, and other deposits, in turn causing nuisance or serious flooding or stormwater inundation of urban areas and of cropland. Cleaning and maintenance of the watershed channel system are important to reduce the probability that buoyant objects and debris will be carried downstream with the rising floodwaters and accumulate on the upstream side of bridge and culvert waterway openings, thereby partially blocking them and further increasing flood stages in areas of inundation. It should be noted that the implementation of nonpoint source pollution controls is an important component of a plan to reduce the amount of sediment and debris in the streams and, therefore, can reduce the costs of channel maintenance. Also, since the removal of sediment from a stream channel may be considered to be dredging by the WDNR, a permit for such dredging activities may be required.

Structural Measures

Each of the structural floodland management measures set forth in Table 103 is discussed briefly below. Emphasis is placed on the function of each measure; on the key factors, or basic requirements, used to determine if the given alternative applies to a particular riverine area or portion of the watershed; and on some of the more significant positive and negative features of each measure.

Storage
From the perspective of floodland management, the function of stormwater or floodwater storage facilities is either to detain floodwaters upstream of floodprone areas for subsequent gradual release—as is the case with a detention basin—or to retain floodwaters for evaporation or groundwater recharge—as is the case with a retention basin—thereby decreasing downstream discharges and flood stages and associated flood damages. A key factor in the application of this alternative is the existence of sites having sufficient floodwater storage volume upstream of all, or a significant portion of, the floodprone riverine areas, and which thereby can control the runoff from a significant portion of the total watershed area tributary to the floodprone areas. In addition, the site must be available in the sense that it does not contain significant urban development.

Stormwater detention basins may be either decentralized basins serving individual developments or centralized basins serving multiple developments. The need for centralized basins is generally determined through a watershed planning process or a detailed stormwater management planning process. Centralized basins offer economy of scale in construction, centralization of maintenance, and more certainty of their level of control of runoff on a watershedwide basis. Centralized detention facilities would generally be constructed by a community and the costs of construction would be recovered over time from individual developments in the area tributary to the basin. That approach requires that the community spend money for land acquisition and basin construction prior to new development occurring in the tributary area. It is preferable that the necessary level of control to be provided be either centralized or decentralized basins be determined based on analysis under an overall stormwater and floodland management plan. It may be easier for communities to implement a decentralized detention requirement than to provide centralized detention because such an approach places the responsibility for the provision of sufficient land for the facility and construction of the facility on the individual developer.

The construction of centralized or decentralized detention basins could reduce the costs of local urban stormwater facilities and provide some water quality benefits, by limiting the amount of urban nonpoint source pollution entering the stream system if the detention basins were designed with features to achieve nonpoint source pollution control.

Diversion
The function of a diversion is to intercept potentially damaging floodwaters at a point upstream of the floodprone reaches and to route those floodwaters along a completely new alignment in order to bypass the floodprone reach. Diverted flood flows are sometimes discharged to receiving watercourses outside the subwatershed and, despite the legal problems that may be involved, outside the watershed in which flood mitigation is desired. A key factor in assessing the application of this alternative is the availability of a suitable diversion route or alignment and an adequate receiving watercourse or other point of discharge.

Dikes and Floodwalls
Earthen dikes and concrete or sheet steel floodwalls are technically feasible means of providing flood control in certain floodprone riverine areas. The principal function of dikes and floodwalls is to contain the floodwaters; that is, to prevent the occurrence of overland flow laterally from the channel to adjacent floodland areas containing flood damage-prone structures and facilities. A key physical factor in the potential application of this structural alternative is the availability of sufficient space between the stream channel and the land uses that are to be protected to permit the construction of the dikes or floodwalls, the latter having the advantage of requiring a narrower strip of land than the former.

In order to be effective in reducing flooding, dikes and floodwalls must normally be supplemented by the installation of backwater gates on those storm sewer outfalls and other drainage outlets penetrating the dikes and floodwalls that have street inlets or other entry points in the area to be protected. During major floods high river levels may in some areas reverse the operation of the stormwater drainage system, thus negating its function, and resulting in the movement of floodwaters from the river into developed riverine areas. Backwater gates prevent such flow reversal by functioning as valves that normally pass the stormwater to the river, but close when the hydraulic head on the river side of the hinged gate exceeds the head on the opposite side of the gate.

While backwater gates, operating as described above, will prevent the movement of floodwaters from the river, they may, depending on topographic conditions, create local flooding problems attributable to the accumulation of stormwater runoff which does not have access to the river because of the closed storm sewer outfall. Areas susceptible to this problem may be protected through the provision of temporary or permanent pumping facilities to convey the impounded stormwater over the dikes and floodwalls to the river during major flood events.

A favorable feature of dikes and floodwalls is that they are a means of protecting development from flood inundation by local action. It must be recognized, however, that there are serious negative aspects of dikes and floodwalls, including the potential for increasing upstream flood stages as a result of the hydraulic constriction imposed on the stream, and the possibility that a series of successive dike-floodwall projects along a stream may substantially reduce the natural floodwater storage capability of the river reach and thereby increase downstream discharges and associated stages. Other significant negative characteristics of dikes and floodwalls include the potentially high capital costs; the potentially high aesthetic cost, or penalty, normally associated with the placement of these high, long structures in the riverine areas, particularly if the areas protected are devoted primarily to residential land use; and the false sense of security against flood dangers that may be engendered by the presence of the dikes or floodwalls.

Channel Enclosure and Modification

Channel enclosure refers to the installation of large underground conduits along or near the alignment of major stream reaches intended to convey floodwaters through an area so as to reduce overland flooding and sanitary sewer backup. Channel modifications—more commonly called channelization—may include one or more of the following major changes to the natural stream channel, all designed to increase the capacity of the stream system channel: 1) straightening, deepening, and widening; 2) placement of a concrete invert and partial sidewalls; and 3) reconstruction of selected bridges and culverts as needed.

The function of channel modifications or enclosure is to yield a lower, hydraulically more efficient waterway through which a given flood discharge can be conveyed at a lower flood stage relative to that which would exist under natural or pre-channelization conditions. Key factors in the application of this alternative to a floodprone reach are the acquisition of a strip of land of sufficient width to accommodate the modified channel, and careful consideration of the length of the upstream and downstream natural channel that must be modified to effect an acceptable transition from the natural channel and floodplain to the channelized or enclosed reach.

A key advantage of channelization or enclosure is that it—like dikes and floodwalls—provides a means whereby action can be taken locally to provide relief to a floodprone area. Significant negative features include negative environmental impacts, including aesthetic impacts, maintenance, and the possibility of aggravating downstream discharges and stages resulting from the loss of floodwater storage capacity in a long channelized or enclosed reach.

A possible alternative to direct modification of the stream channel is modification of one, or both overbanks, to potentially increase both floodwater conveyance and storage. This approach, which is sometimes referred to as floodplain lowering, may avoid some of the potential negative environmental and downstream flooding impacts of channel modification.

Bridge and Culvert Alteration or Replacement

Existing or new highway and railway bridges and culverts, or modifications to existing bridges and culverts, may, by virtue of the conveyance provided, significantly affect upstream and downstream flood stages and aggravate existing, or create new, flood hazards. Furthermore, increased regulatory flood stages attendant to bridge and culvert construction or reconstruction must be reflected in enlarged floodland regulatory zones, thereby creating difficult administrative, legal, and political problems for community officials. Flood events, on the other hand, can interfere with the proper functioning of the transportation system by inundating highways or railway bridges or their approaches, thereby rendering the facilities impassable during major floods.

The purpose of bridge and culvert removal, alteration, or replacement is to avoid or minimize the adverse effects of bridges and culverts on flood flow characteristics and the adverse effects of flood flows on the functioning of the related transportation facilities. These adverse effects are eliminated by increasing the size of the waterway opening, or by replacing it. The usefulness of this structural alternative in a watershed is contingent upon identifying those bridges and culverts that produce major backwater effects as a result of inadequate hydraulic capacity, and identifying those structures that are impassable during major flood events. Determination of bridge and culvert backwater effects is a routine component of this watershed planning effort.

HYDROLOGIC-HYDRAULIC CONSEQUENCES OF PLANNED LAND USE

The purpose of developing and calibrating a mathematical water resource simulation model under the Des Plaines River watershed planning program, as described in Chapter VIII of this report, was to provide a tool for quantitatively analyzing the hydrologic, hydraulic, and water quality characteristics and performance of the watershed under existing and future land use conditions. The future or planned land use conditions as defined in Chapters IV and XI incorporate buildout of the planned sewer service areas within the watershed. The results of applying the hydrologic and hydraulic submodels to the entire watershed for critical watershed land use and channel/floodplain conditions are described below.

Procedure

The hydrologic and hydraulic simulation submodels were applied to the entire watershed for two combinations of land use and channel/ floodplain conditions in order to quantify the probable impact of future urban development on flood flows and stages in the Des Plaines River watershed. These two conditions were:

1. 1990 land use and existing channel and floodplain conditions—under which about 9 percent of the total area of the watershed was in urban land uses and about 91 percent in rural land uses; and
2. Planned land use and existing channel and floodplain conditions—under which about 25 percent of the total area of the watershed would be in urban land uses and about 75 percent in rural land uses. This planned land use pattern was that described in Chapter XI.[3] The planned land use, existing channel condition flood profiles and the 100-year floodplain limits delineated using those profiles are set forth in Appendix H.

The hydrologic and hydraulic submodels were applied to each of the combinations of land use and channel/floodplain conditions in accordance with the procedures described in Chapter VIII. Utilizing the submodels, flood flows and stages were computed for numerous selected locations on the stream system of the watershed, including the Des Plaines River, Jerome Creek, the Kilbourn Road Ditch, Center Creek, Brighton Creek, the Salem Branch of Brighton Creek, the Dutch Gap Canal, and the remaining tributaries studied. Discharge-frequency relationships at selected locations were chosen as the best means of comparing and

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[3]*The land use plan, and the associated hydrologic and hydraulic analyses for planned land use conditions, were updated as necessary to reflect large-scale "committed" development proposals that were put forth during preparation of the watershed study. In particular, the following proposed developments were specifically accounted for:*

- *In the City of Kenosha and the Town of Bristol along Center Creek and several of its tributaries, north of STH 50 and west of IH 94 in U.S. Public Land Survey (USPLS) Sections 1, 2, and 3, Township 1 North, Range 21 East, and*
- *In the Village of Pleasant Prairie along several tributaries to the Des Plaines River west of IH 94 in USPLS Sections 24 and 25, Township 1 North, Range 21 East.*

contrasting the hydrologic-hydraulic response of the watershed to the combinations of land use and channel/floodplain conditions, inasmuch as discharge-frequency relationships are concise representations of the watershed or subwatershed flood flow characteristics.

The hydraulic response of the watershed to planned land use conditions was determined by comparing the 100-year recurrence interval flood stages to the 1990 baseline condition. The impact of the planned land use condition was also quantified by comparing the average annual monetary flood risks for selected floodprone reaches under 1990 and planned conditions. These comparisons are presented in subsequent sections of this chapter.

Land Use Considerations

The planned land use plan for the Des Plaines River watershed, as described in Chapters IV and XI, was the basis for floodland management planning under the watershed study. For the purposes of the study, the discharges and stages developed under planned land use and existing channel/floodplain conditions were used as the base condition for comparison of alternative floodland management measures. Insofar as such measures would serve to reduce flood problems in the watershed to levels below those presented by the base condition, they were considered further for inclusion in a final watershed plan.

Hydrologic-Hydraulic Response of the Watershed to Planned Land Use Pattern

The 1.01-, two-, 10-, 50-, and 100-year recurrence interval discharge-frequency data for the combinations of land use and channel/floodplain conditions are presented for the Des Plaines River and its major tributaries in Table 104. The locations of the flood flow comparisons in Table 104 and on Figures 60 through 68 are shown on Map 63. The discharge-frequency relationships, shown graphically in Figures 61 through 68, quantitatively demonstrate the hydrologic-hydraulic impacts of existing and planned land use patterns. The following discussion draws on the results of the watershedwide simulation modeling to identify the locations at which significant changes in flood discharges and stages may be expected to occur, and to indicate the magnitude and significance of those impacts.

Discharge-Frequency Relationships

Figures 61 through 68 are typical of the discharge-frequency relationships that exist, and may be expected to exist, within the watershed under the land use development conditions investigated. The discharge-frequency curves at each location tend to converge as the severity of flood event increases. If the discharge-frequency curves for any two land use and channel/floodplain conditions at a given location on the stream system were indeed parallel, then a constant ratio of flood flows would exist between the two conditions. A convergence of the discharge-frequency curves for increasing recurrence intervals indicates that the ratio of flood flows for the two conditions decreases for the more infrequent flood events. Therefore, the relative impact of land use conditions on flood flows and stages tends to be somewhat less for the severe flood events—as indicated by a decrease in the ratios of the flood flows shown in Table 105. This is to be expected, because 1) the rainfall and rainfall-snowmelt associated with the more severe flood events saturate the pervious portions of the watershed, causing those areas to behave in a manner similar to impervious areas and 2) during larger events, when flow occurs outside the low-flow channels of the streams, floodwater storage in the overbanks detains runoff and attenuates peak flood flows.[4]

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[4]*This is because:*

- *A greater proportion of the total storm rainfall over pervious surfaces with similar vegetation characteristics is intercepted or infiltrated during a small storm than during a large storm, assuming comparable available water storage volume in the soil column at the start of each storm. Because small storm total rainfall amounts are smaller relative to the available vegetative interception and soil moisture storage capacities than are large storm amounts, much of the small storm rainfall is used to satisfy those interceptions and storage capacities, and proportionally less runs off. The rainfall that occurs during the early part of very large storms tends to saturate the ground, filling the available water storage capacity in the soil column and limiting infiltration later in the storm when heavy rains may occur. The saturated ground may function in a hydrologically similar manner to an*

(footnote continued)

Such attenuation of peak flows tends to reduce the differences between the two development conditions, especially in cases where the increase in runoff volume due to additional urban development is small relative to the floodwater storage volume available in the floodplain. In general, the impact on peak flood flows of urban development in the headwaters of a stream decreases with distance downstream from the development.

Hydrologic-Hydraulic Impact of Planned Land Use Conditions

Based upon the comparison of 1.01- through 100-year flood flows at the locations listed in Table 104, in the absence of mitigating measures, the largest flow increases between 1990 and planned land use conditions would be expected for the 1.01-year flood event, which is likely to occur annually. The smallest flow increases between 1990 and planned land use conditions would be expected for the 100-year flood. Along the lower 16 miles of the Des Plaines River in Wisconsin, the 1.01-year flood would be expected to increase by up to 30 percent, with the average increase being about 18 percent. In that same reach, the peak 100-year flood flow would only be expected to increase by up to 4 percent, with the average increase being about 2 percent. Along the upper 5.5 miles of the Des Plaines River in Wisconsin, the 1.01-year flood would be expected to increase by up to 180 percent, with the average increase being about 105 percent. In that same reach, the peak 100-year flood flow would be expected to increase by no more than 1 percent, and along most of the reach, would not be expected to increase at all.

Increases in the 1.01-year flood peaks may be significant because these more-frequent floods are considered to be the "channel forming" events that affect the low-flow channel size and configuration. In general, relatively large increases in the magnitude of the 1.01-year flood peak would be expected along stream reaches that would experience significant urban development in their tributary area. In addition to the Des Plaines River, those streams include Jerome Creek, Kilbourn Road Ditch, the downstream reach of Center Creek, the Salem Branch of Brighton Creek, the Union Grove Industrial Tributary, the Mud Lake Outlet, and some of the smaller tributary streams. Relatively small increases, or no change, in the 1.01-year flood peak would be expected along the upper reach of Center Creek, Brighton Creek, and the Dutch Gap Canal.

Increases in 100-year flood flows are important because they affect the potential limits of flooding during large events and also the limits as adopted for local floodplain zoning and Federal flood insurance purposes. Generally insignificant increases in the magnitude of the 100-year flood peak would be expected along the entire main stem of the Des Plaines River, the lower 2.4 miles of Jerome Creek, the middle reach of Kilbourn Road Ditch from River Mile 2.8 to 10.0, Center Creek upstream of River Mile 1.3, the entire length of Brighton Creek, the Salem Branch of Brighton Creek, the entire length of Dutch Gap Canal, and the entire length of the Mud Lake outlet.

Significant increases in the magnitude of the 100-year flood peak would be expected along the upper reach of Jerome Creek from River Mile 2.4 to 4.6, the lower and upper reaches of Kilbourn Road Ditch from River Mile 0.0 to 2.8 and from River Mile 10.0 to 12.6, and the lower 1.3-mile-long reach of Center Creek.

One of the standards set forth in Appendix C-4, "Water Control Facility Development Objectives, Principles, and Standards for the Des Plaines River Watershed," calls for peak flow rates at the Wisconsin-Illinois state line during the two- through 100-year floods occurring under planned land use and recommended stormwater and

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impervious surface during the later stages of large storms and the relative amount of runoff following the conversion of pervious surfaces to impervious surfaces will generally not increase as much during large storms as it would during small storms.

- *The effect of floodplain storage volumes in attenuating flood peaks is generally less significant during smaller events when flood flows are confined to stream channels, rather than conveyed and stored within broad floodplains, as is often the case during large floods.*

Table 104

HYDROLOGIC EFFECT OF CHANGING LAND USE IN THE DES PLAINES RIVER WATERSHED

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Lower Des Plaines River	0.00	Wisconsin-Illinois state line	1.01	147	173	18
			2	746	806	8
			10	1,540	1,600	4
			50	2,270	2,310	2
			100	2,580	2,600	1
	1.323	0.6 mile upstream of 122nd Street (CTH ML)	1.01	143	173	21
			2	759	821	8
			10	1,600	1,660	4
			50	2,360	2,410	2
			100	2,680	2,730	2
	2.267	0.7 mile downstream of STH 165	1.01	141	173	23
			2	762	826	8
			10	1,630	1,690	4
			50	2,430	2,490	2
			100	2,770	2,820	2
	3.213	0.3 mile upstream of STH 165	1.01	130	158	22
			2	700	750	7
			10	1,530	1,590	4
			50	2,340	2,420	3
			100	2,690	2,790	4
	4.659	1.0 mile downstream of Wilmot Road (CTH C)	1.01	124	159	28
			2	674	747	11
			10	1,510	1,600	6
			50	2,370	2,460	4
			100	2,750	2,840	3
	6.297	210 feet downstream of 120th Avenue (East Frontage Road)	1.01	119	127	7
			2	539	555	3
			10	1,110	1,120	1
			50	1,640	1,650	1
			100	1,870	1,880	1
	7.261	0.9 mile upstream of 120th Avenue (West Frontage Road)	1.01	116	127	9
			2	519	534	3
			10	1,080	1,090	1
			50	1,630	1,650	1
			100	1,880	1,890	1
	8.491	1.3 miles downstream of 160th Avenue (CTH MB)	1.01	116	127	9
			2	519	529	2
			10	1,080	1,090	1
			50	1,630	1,640	1
			100	1,880	1,890	1

Table 104 (continued)

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Lower Des Plaines River (continued)	9.627	0.2 mile downstream of 160th Avenue (CTH MB)	1.01	110	124	13
			2	491	504	3
			10	1,040	1,050	1
			50	1,590	1,610	1
			100	1,840	1,870	2
	11.334	1.5 miles upstream of 160th Avenue (CTH MB)	1.01	106	121	14
			2	480	493	3
			10	1,030	1,040	1
			50	1,600	1,630	2
			100	1,860	1,900	2
	12.600	0.4 mile downstream of 75th Street (STH 50)	1.01	102	120	18
			10	1,010	1,020	1
			50	1,590	1,610	1
			100	1,850	1,890	2
	13.569	0.5 mile upstream of 75th Street (STH 50)	1.01	101	119	18
			2	464	479	3
			10	1,020	1,030	1
			50	1,610	1,640	2
			100	1,880	1,930	3
	14.140	50 feet upstream of 60th Street (CTH K)	1.01	101	119	18
			2	464	479	3
			10	1,020	1,030	1
			50	1,610	1,640	2
			100	1,880	1,930	3
Upper Des Plaines River	14.810	0.7 mile upstream of 60th Street (CTH K)	1.01	45	57	27
			2	183	192	5
			10	413	420	2
			50	687	702	2
			100	825	847	3
	16.140	370 feet upstream of CTH N	1.01	35	46	31
			2	150	161	7
			10	366	376	3
			50	646	663	3
			100	794	818	3
	17.571	0.7 mile downstream of Burlington Road (STH 142)	1.01	38	59	55
			2	202	237	17
			10	576	609	6
			50	1,130	1,150	2
			100	1,450	1,460	1

Table 104 (continued)

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Upper Des Plaines River (continued)	18.916	0.6 mile upstream of Burlington Road (STH 142)	1.01	34	59	74
	18.110	0.2 mile downstream of Burlington Road (STH 142)	1.01	36	58	61
			2	192	229	19
			10	551	586	6
			50	1,090	1,100	1
			100	1,400	1,400	0
			2	188	233	24
			10	545	585	7
			50	1,080	1,080	0
			100	1,390	1,390	0
	19.350	1.1 miles upstream of Burlington Road (STH 142)	1.01	32	58	81
			2	174	223	28
			10	506	552	9
			50	1,010	1,010	0
			100	1,300	1,300	0
	20.163	Private drive	1.01	27	76	181
			2	141	228	62
			10	395	470	19
			50	768	768	0
			100	977	977	0
	20.594	0.6 mile downstream of County Line Road	1.01	9	21	133
			2	51	73	43
			10	145	158	9
			50	278	278	0
			100	351	351	0
	21.196	County Line Road	1.01	4	9	125
			2	29	41	41
			10	100	112	12
			50	219	219	0
			100	291	291	0
	21.791	0.6 mile upstream of County Line Road	1.01	1	1	0
			2	15	15	0
			10	62	62	0
			50	155	155	0
			100	216	216	0
Jerome Creek	0.402	0.4 mile upstream confluence with the Des Plaines River	1.01	26	48	85
			2	78	104	33
			10	137	158	15
			50	191	202	6
			100	215	220	2

Table 104 (continued)

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Jerome Creek (continued)	0.813	0.3 mile downstream of 88th Avenue (CTH H)	1.01	29	53	83
			2	71	87	23
			10	106	110	4
			50	131	131	0
			100	141	141	0
	1.716	0.6 mile upstream of 88th Avenue (CTH H)	1.01	20	29	45
			2	40	47	18
			10	55	58	5
			50	66	66	0
			100	70	70	0
	2.350	Chicago North Western Railroad	1.01	22	37	68
			2	43	52	21
			10	59	62	5
			50	71	71	0
			100	75	75	0
	2.550	0.1 mile downstream of Green Bay Road (STH 31)	1.01	41	52	27
			2	72	96	33
			10	108	149	38
			50	143	202	41
			100	159	226	42
	3.863	Private drive 0.6 mile downstream of 93rd Street	1.01	1	3	200
			2	5	12	140
			10	16	27	69
			50	31	49	58
			100	39	60	54
Kilbourn Road Ditch	0.139	734 feet upstream confluence with the Des Plaines River	1.01	59	189	220
			2	301	499	66
			10	721	938	30
			50	1,210	1,420	17
			100	1,450	1,660	14
	1.022	0.3 mile downstream of 75th Street (STH 50)	1.01	57	193	239
			2	299	510	71
			10	720	953	32
			50	1,210	1,440	19
			100	1,450	1,670	15
	1.315	75th Street (STH 50)	1.01	55	169	207
			2	286	466	63
			10	690	883	28
			50	1,160	1,340	16
			100	1,400	1,550	11

Table 104 (continued)

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Kilbourn Road Ditch (continued)	3.910	0.5 mile upstream of 52nd Street (STH 158)	1.01	44	94	114
			2	215	294	37
			10	554	626	13
			50	1,000	1,030	3
			100	1,250	1,250	0
	4.920	38th Street (CTH N)	1.01	43	90	109
			2	223	297	33
			10	592	656	11
			50	1,100	1,110	1
			100	1,370	1,370	0
	6.196	0.7 mile upstream of Burlington Road (STH 142)	1.01	36	88	144
			2	171	237	39
			10	432	471	9
			50	779	779	0
			100	964	964	0
	7.491	0.5 mile downstream of 12th Street (CTH E)	1.01	33	85	158
			2	146	217	49
			10	366	420	15
			50	661	661	0
			100	819	819	0
	8.009	12th Street (CTH E)	1.01	32	83	159
			2	137	211	54
			10	344	406	18
			50	622	634	2
			100	772	772	0
	10.090	0.7 mile downstream of County Line Road (CTH KR)	1.01	20	74	270
			2	76	172	126
			10	187	311	66
			50	339	465	37
			100	422	541	28
	11.717	0.2 mile downstream of Braun Road	1.01	14	73	421
			2	50	181	262
			10	119	346	191
			50	211	541	156
			100	262	639	144
	12.355	Private drive 0.4 mile upstream of Braun Road	1.01	16	69	331
			2	50	162	224
			10	112	289	158
			50	192	428	123
			100	236	495	110

Table 104 (continued)

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Center Creek	0.202	1,070 feet upstream confluence with the Des Plaines River	1.01	19	46	142
			2	155	210	35
			10	418	478	14
			50	723	781	8
			100	869	928	7
	1.338	0.3 mile downstream of 144th Avenue	1.01	15	15	0
			2	114	115	1
			10	333	339	2
			50	630	643	2
			100	788	805	2
	2.360	Private drive 0.1 mile upstream of 75th Street (STH 50)	1.01	12	12	0
			2	100	101	1
			10	323	330	2
			50	655	669	2
			100	839	858	2
	3.642	0.1 mile downstream of 60th Street (CTH K)	1.01	7	7	0
			2	72	73	1
			10	262	267	2
			50	574	586	2
			100	758	773	2
Brighton Creek	0.306	1,620 feet upstream confluence with the Des Plaines River	1.01	61	70	15
			2	296	309	4
			10	660	676	2
			50	1,040	1,070	3
			100	1,220	1,250	2
	1.350	0.5 mile downstream of Bristol Road (USH 45)	1.01	57	65	14
			2	310	328	6
			10	716	736	3
			50	1,150	1,170	2
			100	1,340	1,370	2
	3.165	0.5 mile downstream of 60th Street (CTH K)	1.01	33	41	24
			2	203	213	5
			10	483	496	3
			50	779	808	4
			100	914	956	5
	4.649	60th Street (CTH K)	1.01	29	29	0
			2	169	170	1
			10	425	429	1
			50	725	735	1
			100	873	885	1

Table 104 (continued)

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Brighton Creek (continued)	5.100	0.5 mile upstream of 60th Street (CTH K)	1.01	24	24	0
			2	148	149	1
			10	388	392	1
			50	683	690	1
			100	831	840	1
	6.031	0.2 mile downstream of 45th Street (CTH NN)	1.01	20	20	0
			2	148	149	1
			10	437	442	1
			50	836	847	1
			100	1,050	1,060	1
	7.631	0.2 mile downstream of 31st Street (CTH JB)	1.01	17	17	0
			2	128	129	1
			10	381	386	1
			50	726	739	2
			100	909	927	2
Salem Branch of Brighton Creek	0.077	406 feet upstream confluence with the Des Plaines River	1.01	24	34	42
			2	118	133	13
			10	277	286	3
			50	456	456	0
			100	543	543	0
	0.600	158 feet downstream of 216th Avenue	1.01	17	23	35
			2	62	68	10
			10	124	128	3
			50	189	189	0
			100	219	219	0
	2.153	53 feet downstream of private bridge	1.01	17	30	76
			2	51	66	29
			10	97	111	14
			50	147	155	5
			100	171	176	3
	2.214	0.2 mile downstream of Hooker Lake outlet	1.01	4	6	50
			2	14	16	14
			10	29	31	7
			50	46	49	7
			100	55	58	5
	2.370	Hooker Lake outlet	1.01	4	5	25
			2	13	15	15
			10	28	30	7
			50	44	46	5
			100	52	54	4

Table 104 (continued)

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Union Grove Industrial Tributary	0.008	40 feet upstream confluence with the Des Plaines River	1.01	17	57	235
			2	88	163	85
			10	256	339	32
			50	509	557	9
			100	611	671	10
	1.524	0.3 mile upstream of Schroeder Road (Hwy KR)	1.01	17	73	329
			2	66	186	182
			10	172	359	109
			50	334	562	68
			100	428	665	55
Dutch Gap Canal	0.000	Wisconsin-Illinois state line/ 128th Street (CTH WG)	1.01	49	53	8
			2	197	205	4
			10	421	431	2
			50	665	673	1
			100	782	787	1
	0.455	0.5 mile upstream of 128th Street (CTH WG)	1.01	29	31	7
			2	108	110	2
			10	210	212	1
			50	309	309	0
			100	353	353	0
	0.854	0.2 mile downstream of 121st Street (CTH CJ)	1.01	26	29	12
			2	84	87	4
			10	161	162	1
			50	238	238	0
			100	274	274	0
	1.588	0.5 mile downstream of 110th Street (CTH V)	1.01	13	13	0
			2	45	45	0
			10	91	91	0
			50	138	138	0
			100	160	160	0
	3.452	0.6 mile downstream of 93rd Street (CTH C)	1.01	7	7	0
			2	21	21	0
			10	39	40	3
			50	56	57	2
			100	64	64	0
Mud Lake Outlet	0.000	Confluence with Dutch Gap Canal	1.01	18	22	22
			2	54	57	6
			10	90	90	0
			50	117	117	0
			100	128	128	0

Table 104 (continued)

Location			Recurrence Interval (years)	Existing (1990) Condition Discharge (cfs)	Planned Land Use	
Stream	River Mile	Description			Discharge (cfs)	Change Relative to Existing Conditions (percent)
Mud Lake Outlet (continued)	0.840	0.2 mile upstream of USH 45	1.01	19	29	53
			2	52	55	6
			10	77	77	0
			50	92	92	0
			100	98	98	0

Source: SEWRPC.

floodland management conditions to be held to the corresponding rates under 1990 land use and existing stormwater and floodland management conditions, to the extent practical. As set forth in Table 104, under planned land use and existing stormwater and floodland management conditions, in the absence of measures to mitigate increases in flows, the two-year flood flow of the Des Plaines River at the state line would be expected to increase by about 8 percent, but the 100-year flood flow would only be expected to increase by about 1 percent. The two-year flood flow of the Dutch Gap Canal at the state line would be expected to increase by about 4 percent, but the 100-year flood flow would only be expected to increase by about 1 percent.

SELECTION OF FLOODPRONE REACHES

In order to develop the floodland management element of the comprehensive plan for the Des Plaines River watershed, the existing and probable future floodprone reaches within the watershed were identified, and alternative floodland management measures developed and evaluated for those reaches which have or may be expected to have severe flood problems. A two-step approach was used to determine the stream reaches for which alternative floodland management measures were to be developed. The first step involved the hydrologic-hydraulic simulation of flood flows and stages under 1990 land use and existing channel and floodplain conditions to identify approximate existing floodprone reaches and areas. The results of this step were checked against the findings of the historic flood damage survey conducted under the watershed study. The second step involved the hydrologic-hydraulic simulation of flood flows and stages under planned land use and existing channel and floodplain conditions. The results of this two-step approach and of the subsequent design and evaluation of alternative flood damage-abatement measures on a watershedwide basis are described in the following sections of this chapter.

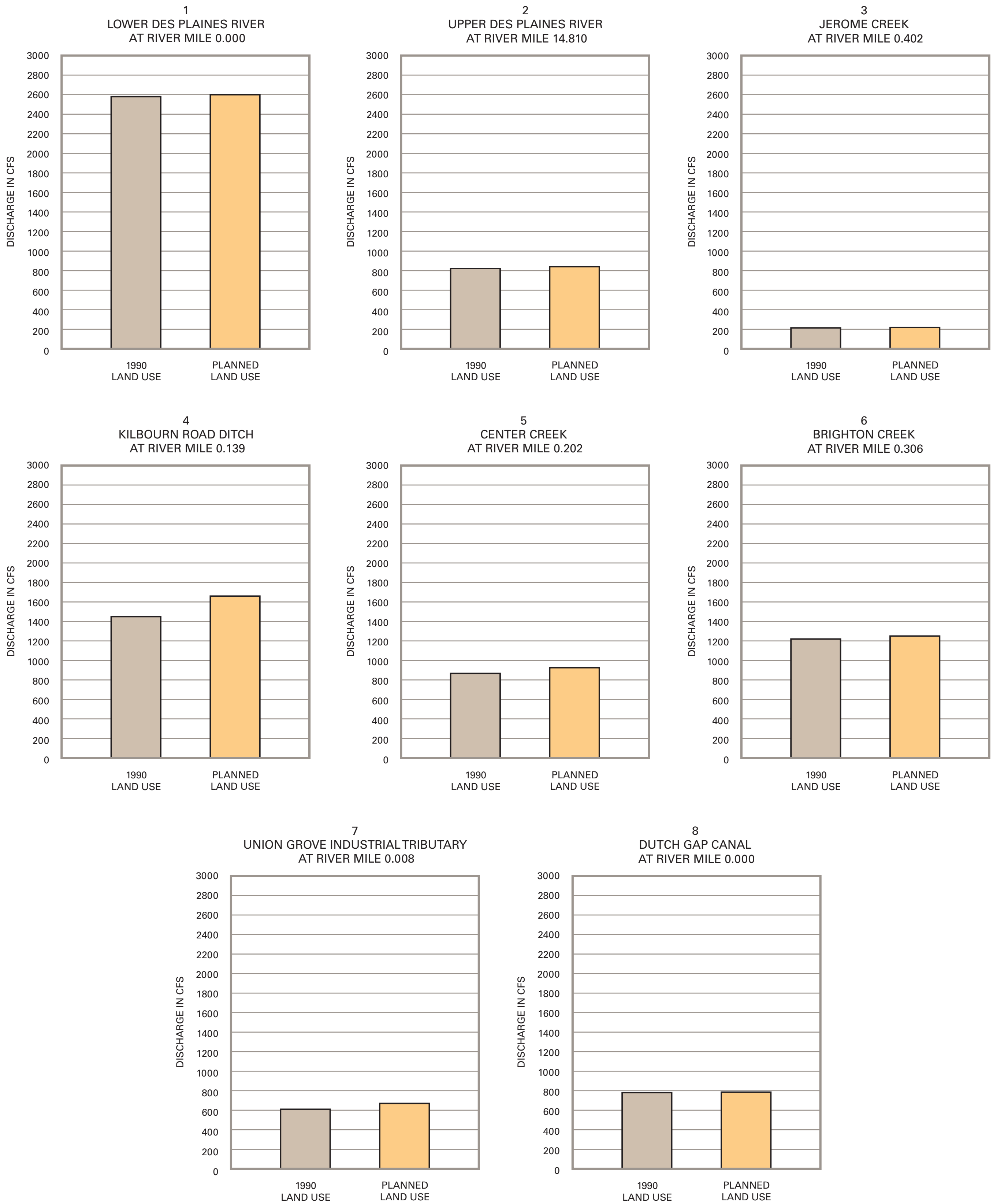
ALTERNATIVE FLOODLAND MANAGEMENT PLANS FOR THE DES PLAINES RIVER WATERSHED

The Flood Problem

The hydrologic-hydraulic simulation of the Des Plaines River watershed under 1990 land use and existing channel conditions and under planned land use and existing channel conditions indicates that there is the potential for modest flood damage to both crops and structures in the watershed. The potential for crop damage is spread throughout much of the watershed, while the majority of the structure damage potential is concentrated in the

Figure 60

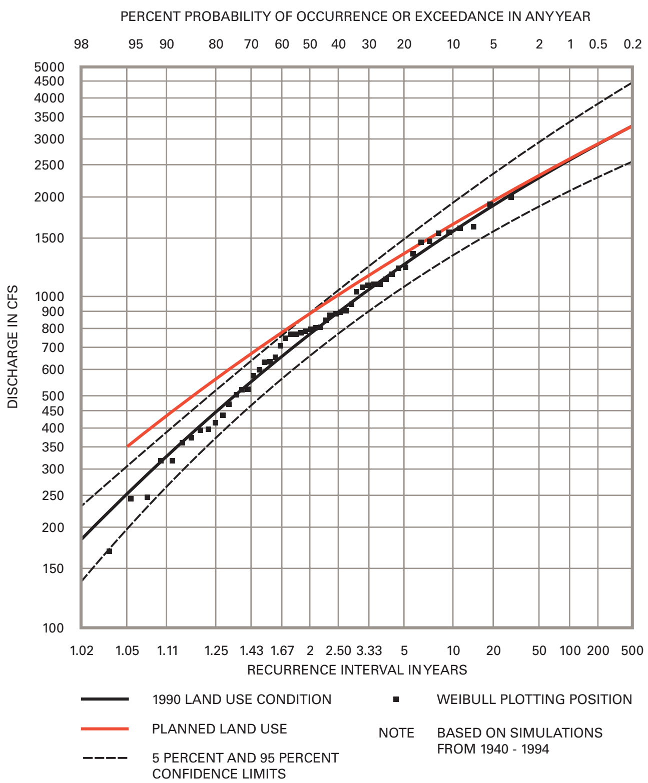
EFFECTS OF CHANGING LAND USE ON 100-YEAR FLOWS IN THE DES PLAINES RIVER WATERSHED: EXISTING CHANNEL CONDITIONS



Source: SEWRPC.

Figure 61

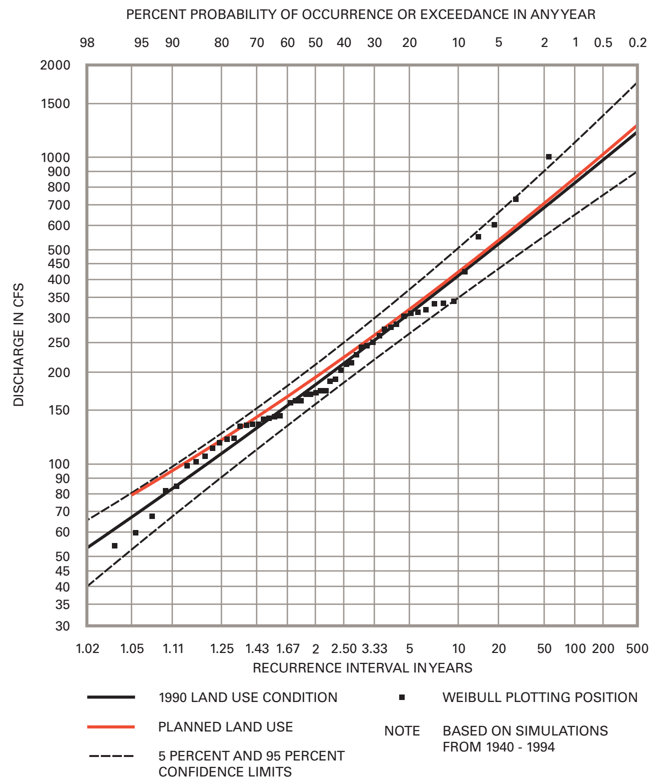
SIMULATED DISCHARGE-FREQUENCY RELATIONSHIPS FOR LOWER DES PLAINES RIVER AT RUSSELL ROAD UNDER 1990 AND PLANNED LAND USE CONDITIONS



Source: SEWRPC.

Figure 62

SIMULATED DISCHARGE-FREQUENCY RELATIONSHIPS FOR UPPER DES PLAINES RIVER ABOVE BRIGHTON CREEK UNDER 1990 AND PLANNED LAND USE CONDITIONS



Source: SEWRPC.

southern one-half of the watershed. As set forth in Table 105, it is estimated that during a 100-year flood under 1990 land use and existing channel conditions, 95 structures could be damaged. During a 100-year flood under planned land use and existing channel conditions, 101 structures could be damaged. Concentrated areas of potential structural damages are located along several tributaries to the Des Plaines River as indicated in Table 105. Along the main stem of the Des Plaines River, potentially damaged structures are not concentrated, but are located at scattered sites.

The average annual monetary damages attributable to flood damages to crops and structures may be expected to approximate \$58,000 and \$91,000, respectively, under 1990 land use and existing channel conditions; and \$70,000 and \$126,000, respectively, under planned land use and existing channel conditions.[5]

Organization of Floodland Management Alternatives Analysis

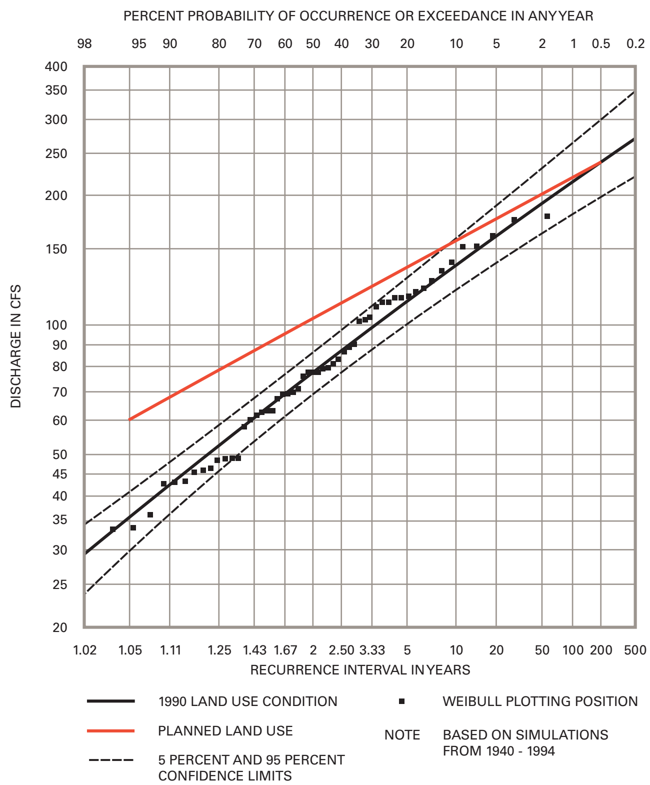
The following six watershedwide floodland management alternative plans were developed:

- No action;
- Structure floodproofing, elevation, and removal;

[5] *Flood damage estimates are determined based on 1999 fair market values of buildings.*

Figure 63

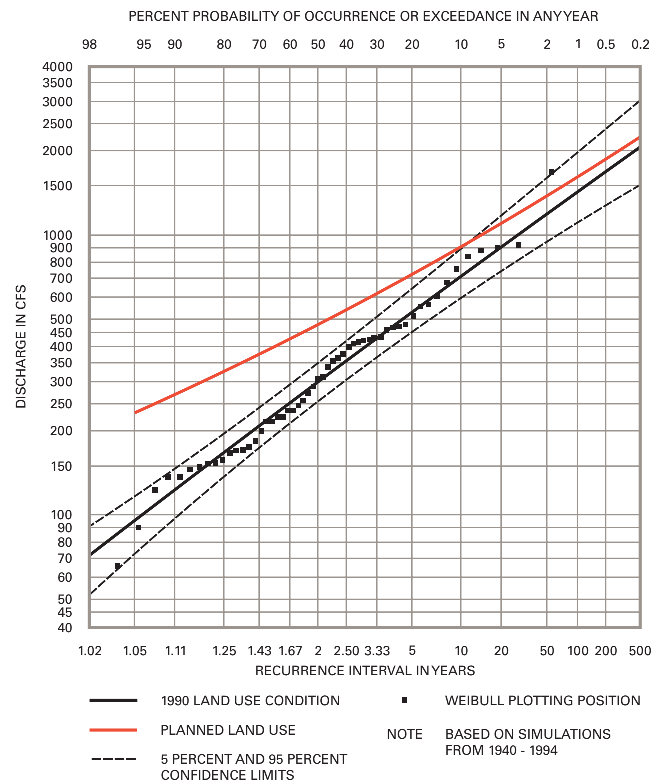
SIMULATED DISCHARGE-FREQUENCY RELATIONSHIPS FOR JEROME CREEK AT MOUTH UNDER 1990 AND PLANNED LAND USE CONDITIONS



Source: SEWRPC.

Figure 64

SIMULATED DISCHARGE-FREQUENCY RELATIONSHIPS FOR KILBOURN ROAD DITCH AT MOUTH UNDER 1990 AND PLANNED LAND USE CONDITIONS



Source: SEWRPC.

- Detention storage with structure floodproofing, elevation, and removal;
- Prairie restoration with structure floodproofing, elevation, and removal;
- Wetland restoration with structure floodproofing, elevation, and removal; and
- Stream rehabilitation with structure floodproofing, elevation, and removal.

In addition, case-specific alternative plans were developed for Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake.

The alternatives were evaluated in the following sequence:

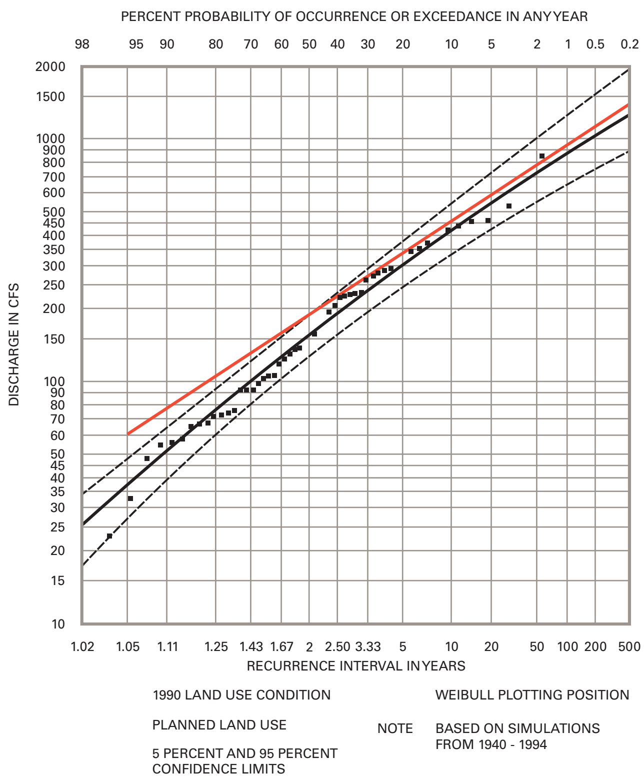
- Six watershedwide alternatives,
- Case-specific alternatives for Unnamed Tributary No. 6 to Brighton Creek in the Village of Paddock Lake, and
- Case-specific alternatives for Unnamed Tributary No. 1 to Hooker Lake in the Town of Salem.

The recommended floodland management plan for the Des Plaines River watershed was developed by:

- Selecting a recommended watershedwide alternative;

Figure 65

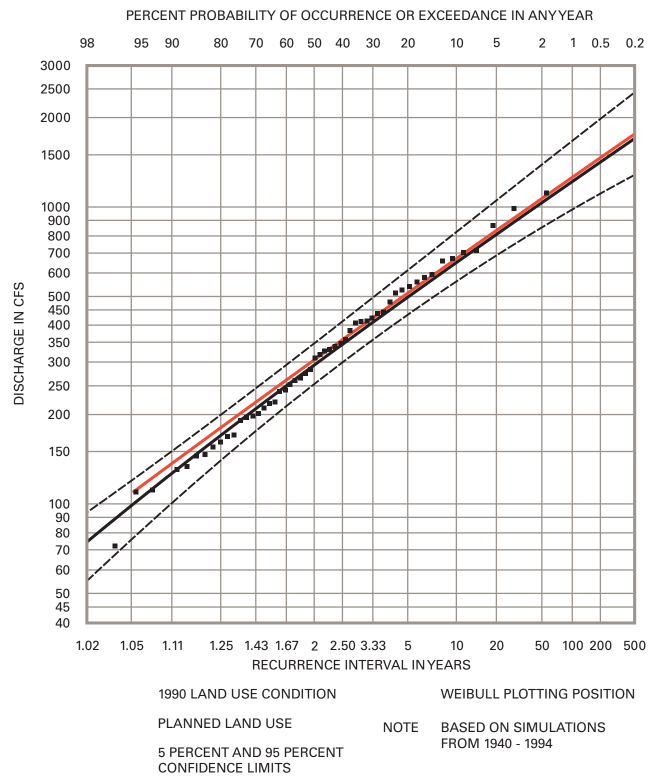
SIMULATED DISCHARGE-FREQUENCY RELATIONSHIPS FOR CENTER CREEK AT MOUTH UNDER 1990 AND PLANNED LAND USE CONDITIONS



Source: SEWRPC.

Figure 66

SIMULATED DISCHARGE-FREQUENCY RELATIONSHIPS FOR BRIGHTON CREEK AT MOUTH UNDER 1990 AND PLANNED LAND USE CONDITIONS



Source: SEWRPC.

- Augmenting that alternative to include key features from other alternatives considered;
- Selecting recommended case-specific alternatives for the two unnamed tributaries; and
- Developing the final recommended alternative by combining the augmented watershedwide alternative with the recommended case-specific alternatives for the two tributaries, recommended bridge and culvert alterations or replacements, and auxiliary nonstructural recommendations.

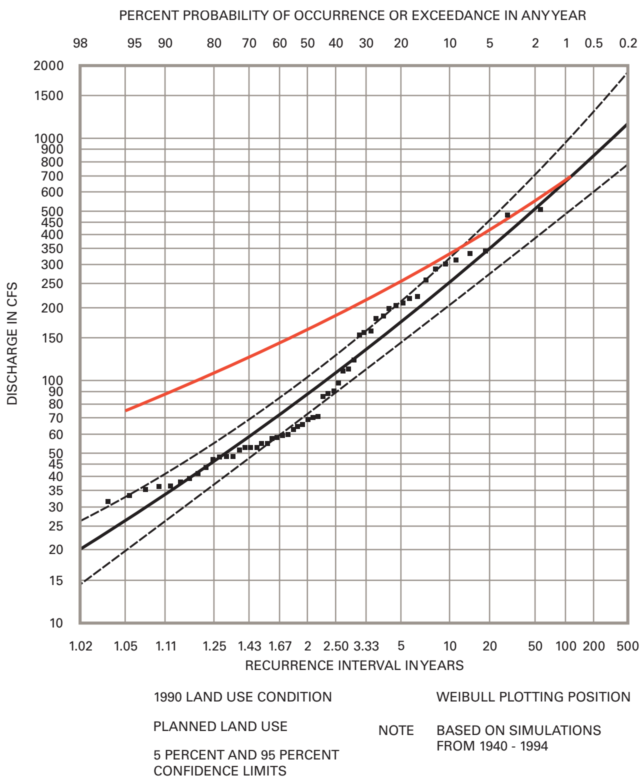
The alternative plans are described in detail in the following sections of this report. In addition to the measures that comprise each plan, each plan assumes that the floodplain boundaries identified under this watershed study will be adopted for zoning purposes and that the floodwater storage capacity of those floodplains will be maintained, consistent with current local ordinances throughout much of the watershed.

No Action Alternative

One alternative course of action for addressing the flood problems of the Des Plaines River watershed is to do nothing—that is, to recognize the inevitability of flooding in the watershed, but to decide not to mount a collective, coordinated program to abate the flood damages. Under this alternative, 101 structures may be expected to experience flood damages under a 100-year recurrence interval flood under planned land use conditions. The average annual structural flood damages in the watershed may be expected to approximate $126,000 and the average annual agricultural flooding damages would be about $70,000, yielding total flood

Figure 67

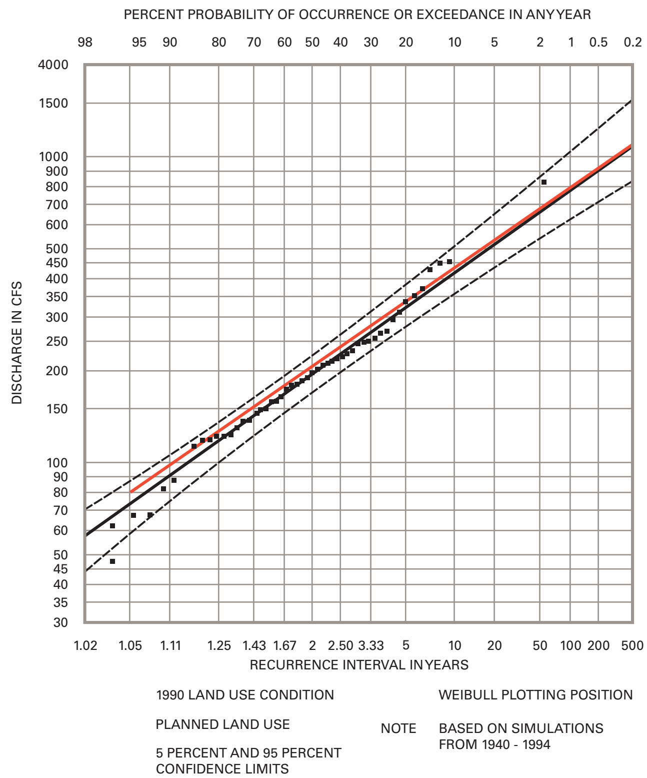
SIMULATED DISCHARGE-FREQUENCY RELATIONSHIPS FOR UNION GROVE INDUSTRIAL TRIBUTARY AT MOUTH UNDER 1990 AND PLANNED LAND USE CONDITIONS



Source: SEWRPC.

Figure 68

SIMULATED DISCHARGE-FREQUENCY RELATIONSHIPS FOR DUTCH CAP CANAL AT MOUTH UNDER 1990 AND PLANNED LAND USE CONDITIONS



Source: SEWRPC.

damages of $196,000. There are no monetary benefits associated with this “do nothing” alternative. Table 106 lists the features of this alternative.

Structure Floodproofing, Elevation, and Removal Alternative

A structure floodproofing, elevation, and removal alternative flood control plan was prepared and evaluated to determine if such a structure-by-structure approach would be a technically feasible and economically sound solution to the urban flood damage problems within the Des Plaines River watershed.[6] For analytical purposes, the 100-year recurrence interval flood stage under planned land use and existing channel conditions was used to estimate the number of existing floodprone structures to be floodproofed, elevated, or removed and the approximate costs involved.[7]

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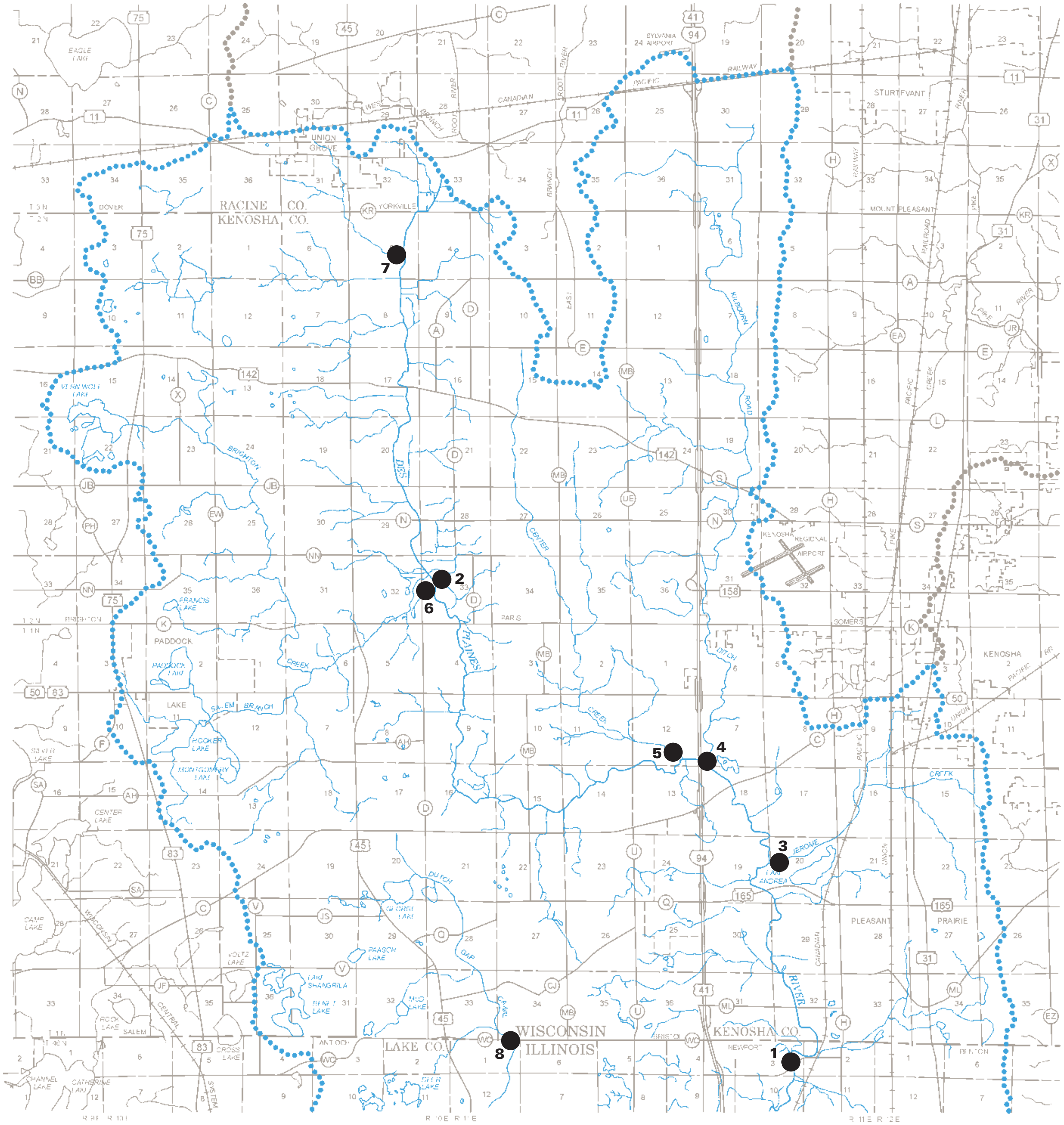
[6]*Because of the infrequent and relatively minor nature of much of the anticipated structure flooding in the watershed, in most cases structure removal is not warranted and, in many cases, minimal floodproofing measures may be adequate to resolve flood problems. In some instances, infrequent, minor flooding of agricultural structures may be tolerable and floodproofing may not be judged necessary by the individual property owner.*

[7]*The costs of all alternative plans are determined for 1999 conditions with an* Engineering News-Record *Construction Cost Index of 7022.*

Map 63

LOCATIONS SELECTED FOR ANALYSES OF THE EFFECTS OF CHANGING LAND USE ON 100-YEAR FLOOD FLOWS IN THE DES PLAINES RIVER WATERSHED: EXISTING CHANNEL CONDITIONS



4 LOCATION SELECTED FOR COMPARISON OF FLOOD FLOWS UNDER LAND USE CONDITIONS (NUMBER ON MAP CORRESPONDS TO THOSE ON FIGURE 60)

GRAPHIC SCALE
0 1/2 1 MILE
0 2,000 4,000 6,000 FEET

Analysis conducted under the watershed study indicated that relative to existing land use, channel, and floodplain conditions, 100-year recurrence interval flood flows in the watershed under planned land use and existing channel and floodplain conditions may be expected to increase by up to 4 percent along the main stem of the Des Plaines River. Along the tributary streams for which this map indicates comparison locations, increases in 100-year flood flows could range up to 144 percent in headwaters areas, although, as indicated in Table 104, the increases are generally considerably less than that.

Source: SEWRPC.

Table 105

NUMBER OF STRUCTURES FLOODED DURING THE 100-YEAR RECURRENCE INTERVAL FLOOD: EXISTING CHANNEL CONDITIONS

Stream or Lake	1990 Land Use Conditions	Planned Land Use Conditions
Des Plaines River	26	26
Unnamed Tributary No. 2 to the Des Plaines River	- -	1
Jerome Creek	8	10
Kilbourn Road Ditch	15	17
Unnamed Tributary No. 1 to the Kilbourn Road Ditch	1	1
Dutch Gap Canal	10	10
Hooker Lake	5	5
Unnamed Tributary No. 1 to Hooker Lake	2	2
Unnamed Tributary No. 6 to Brighton Creek	25	25
Salem Branch of Brighton Creek	1	1
Unnamed Tributary No. 1 to Salem Branch of Brighton Creek	1	1
Unnamed Tributary No. 3 to Salem Branch of Brighton Creek	1	1
Unnamed Tributary No. 1 to Center Creek	- -	1
Total	95	101

Source: SEWRPC.

In the case of residential structures, floodproofing was assumed to be feasible if the design flood stage was below the first floor elevation. Structure elevation was considered feasible for residential structures with basements if the estimated cost of elevating the structure was less than the estimated structure removal cost. Structures to be elevated were assumed to have the first floor raised to an elevation of at least two feet above the 100-year recurrence interval flood stage to provide adequate freeboard. For aesthetic reasons, structure elevation was limited to a maximum of four feet. Structures that would have to be elevated more than four feet were considered for removal.

Floodproofing was assumed to be feasible for all nonresidential structures provided the flood stage was not more than seven feet above the first floor elevation. However, in practice, it was found that flooding was generally limited to less than three feet above the first floor elevation. The floodproofing costs were assumed to be a function of the depth of water over the first floor.

For existing channel conditions, a comparison of 1.01- through 100-year flood flows along the studied streams in the watershed under 1990 and planned land use conditions is set forth in Table 104. Because this alternative plan includes no features to mitigate potential flood flow increases due to planned urban development, planned condition flood flows would increase with respect to 1990 condition flows as shown in Table 104 and as described above in the section titled "Hydrologic-Hydraulic Impact of Planned Land Use Conditions."

The computed two-year flood flows of the Des Plaines River at the state line indicate an increase of about 8 percent, but the 100-year flood flows only indicate an increase of about 1 percent. The computed two-year flood flows of the Dutch Gap Canal at the state line indicate an increase of about 4 percent, but the 100-year flood flows only indicate an increase of about 1 percent. Relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the hydrologic model. Thus, the standard in Appendix C-4 that calls for the peak two- through 100-year flood flows at the Wisconsin-Illinois state line to be maintained at 1990 levels, where practical, would essentially be met for the 100-year floods on the Des Plaines River and Dutch Gap Canal and for the two-year flood on the Dutch Gap Canal. A slight increase in the peak two-year flood flow on the Des Plaines River at the state line might be expected.

Table 106

PRINCIPAL FEATURES, COSTS, AND BENEFITS OF THE FLOODLAND MANAGEMENT ALTERNATIVES FOR THE DES PLAINES RIVER WATERSHED

Alternative			Economic Analysis[a]											
				Capital Cost[b]									Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technical Feasibility	Item	(thousands)	Annual Amortized Capital Cost (thousands)	Annual Operation and Maintenance Cost (thousands)	Total[c] Annual Cost (thousands)	Annual[c] Benefits (thousands)	Excess of Annual Benefits Over Costs (thousands)	Benefit-Cost Ratio	Benefit Cost Ratio Greater than 1.0	Positive	Negative
1	No Action		Yes	- -	- -	- -	- -	- -[d]	- -[d]	- -[d]	- -	No	- -	Continue to incur average annual flood damages of $196,000
2	Structure Floodproofing, Elevation, and Removal	a. Floodproof 79 residential, commercial, and agricultural structures b. Elevate five residential structures c. Remove 17 residential and agricultural structures	Yes	Floodproofing Elevating Removal Subtotal	$ 1,210 330 935 $ 2,475	$ 157	- -	$ 157	$126[e]	$-31	0.80	No	Immediate partial flood relief at discretion of property owners Most of the costs would be borne by beneficiaries	Complete, voluntary implementation unlikely and, therefore, left with a significant residual flood problem. Overland flooding and some attendant problems remain. Some floodproofing is likely to be applied without adequate professional advice and, as a result, structure damage may occur. Residual agricultural damages. Partial resolution of flood problem Provides no control of streamflows
3	Detention with Structure Floodproofing, Elevation, and Removal Scenario 1—Peak Flow Control for the 100-Year Storm Based on NRCS Method Flows	a. Provide detention storage facilities for planned new development b. Floodproof 74 residential, commercial, and agricultural structures c. Elevate five residential structures d. Remove 17 residential and agricultural structures	Yes	Detention facilities Land cost Floodproofing Elevation Removal Subtotal	$37,000 2,700 1,135 330 935 $42,100	$2,673	$ 613	$3,286	$126[e]	$-3,160	0.04	No	Potential to retain public open space. Improvement of instream water quality if basins would be expanded to include permanent ponds	Difficult to apply to small-scale development proposals. Structure floodproofing, elevation, and removal needed to resolve structure flooding problem. Complete, voluntary implementation unlikely and, therefore, left with a significant residual flood problem. Overland flooding and some attendant problems remain. Some floodproofing is likely to be applied without adequate professsional advice and, as a result, structure damage may occur. Residual agricultural damages. Partial resolution of flood problem Provides little or no control of frequently occurring, “channel forming” flows; therefore, does not significantly contribute to maintenance of stable stream channels

Table 106 (continued)

Alternative			Economic Analysis[a]											
				Capital Cost[b]									Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technical Feasibility	Item	(thousands)	Annual Amortized Capital Cost (thousands)	Annual Operation and Maintenance Cost (thousands)	Total[c] Annual Cost (thousands)	Annual[c] Benefits (thousands)	Excess of Annual Benefits Over Costs (thousands)	Benefit-Cost Ratio	Benefit Cost Ratio Greater than 1.0	Positive	Negative
3	Scenario 2—Peak Flow Control for the Two- and 100-Year Storms Based on NRCS Method Flows	a. Provide detention storage facilities for planned new development b. Floodproof 76 residential, commercial, and agricultural structures c. Elevate five residential structures d. Remove 17 residential and agricultural structures	Yes	Detention facilities Land cost Floodproofing Elevation Removal Subtotal	$23,770[f] 2,030 1,165 330 935 $28,230	$1,793	$ 299	$2,092	$126[e]	$-1,966	0.06	No	Potential to retain public open space. Improvement of instream water quality if basins would be expanded to include permanent ponds	Difficult to apply to small-scale development proposals. Structure floodproofing, elevation, and removal needed to resolve structure flooding problem. Complete, voluntary implementation unlikely and, therefore, left with a significant residual flood problem. Overland flooding and some attendant problems remain. Some floodproofing is likely to be applied without adequate professional advice and, as a result, structure damage may occur. Residual agricultural damages. Partial resolution of flood problem Provides little or no control of frequently occurring, "channel forming" flows; therefore, does not significantly contribute to maintenance of stable stream channels
3	Scenario 3—Peak Flow Control for the Two- and 100-Year Storms Based on HSPF Continuous Simulation Method Flows	a. Provide detention storage facilities for planned new development b. Floodproof 70 residential, commercial, and agricultural structures c. Elevate five residential structures d. Remove 17 residential and agricultural structures	Yes	Detention facilities Land cost Floodproofing Elevation Removal Subtotal	$24,100[f] 3,000 1,040 330 935 $29,405	$1,867	$ 239	$2,106	$126[e]	$-1,980	0.06	No	Potential to retain public open space. Improvement of instream water quality if basins would be expanded to include permanent ponds. Provides a relatively high level of control of frequently occurring, "channel forming" flows; thereby, helping to maintain stability and morphology of stream channels	Difficult to apply to small-scale development proposals. Structure floodproofing, elevation, and removal needed to resolve structure flooding problem. Complete, voluntary implementation unlikely and, therefore, left with a signify-cant residual flood problem. Overland flooding and some attendant problems remain. Some floodproofing is likely to be applied without adequate professional advice and, as a result, structure damage may occur. Residual agricultural damages. Partial resolution of flood problem
4	Prairie Restoration with Structure Floodproofing, Elevation, and Removal	a. Floodproof 79 residential, commercial, and agricultural structures b. Elevate five residential structures c. Remove 17 residential and agricultural structures d. Restore prairie conditions on 3.0 square miles of agricultural land	Yes	Floodproofing Elevating Removal Prairie Restoration Subtotal	$ 1,210 330 935 7,390 $ 9,865	$ 626	$10 to $670[g] Subtotal	$ 626 10 to 670 211[h] $ 847 to $1,507	$126[e]	$ -721 to $-1,381	0.08 to 0.15	No	Immediate partial flood relief at discretion of property owners Most of the costs would be borne by beneficiaries Potential to create public open space Some reduction in runoff volumes Terrestrial habitat improvement	Complete, voluntary implementation unlikely and, therefore, left with a significant residual flood problem. Overland flooding and some attendant problems remain. Some floodproofing is likely to be applied without adequate professional advice and, as a result, structure damage may occur. Residual agricultural damages. Partial resolution of flood problem Provides no significant control of frequently occurring, "channel forming" flows; therefore, does not significantly contribute to maintenance of stable stream channels
5	Wetland Restoration with Structure Floodproofing, Elevation, and Removal	a. Floodproof 79 residential, commercial, and agricultural structures b. Elevate five residential structures c. Remove 17 residential and agricultural structures d. Restore wetland conditions on 14.8 square miles of agricultural land	Yes	Floodproofing Elevation Removal Wetland Restoration Subtotal	$ 1,210 330 935 31,260 $33,735	$2,142	$47 to $3,315[g] Subtotal	$2,142 47 to 3,315 1,042[h] $3,231 to $6,499	$126[e] 35[i] Subtotal = $161	$-3,070 to $-6,373	0.02 to 0.05	No	Immediate partial flood relief at discretion of property owners Most of the costs would be borne by beneficiaries Potential to create public open space Improvement of instream water quality Some reduction in runoff volumes Aquatic and terrestrial habitat improvement	Structure floodproofing, elevation, and removal needed to resolve structure flooding problem. Complete, voluntary implementation unlikely and, therefore, left with a significant residual flood problem. Overland flooding and some attendant problems remain. Some floodproofing is likely to be applied without adequate professional advice and, as a result, structure damage may occur. Residual agricultural damages. Partial resolution of flood problem

Table 106 (continued)

Alternative			Economic Analysis[a]											
				Capital Cost[b]									Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technical Feasibility	Item	(thousands)	Annual Amortized Capital Cost (thousands)	Annual Operation and Maintenance Cost (thousands)	Total[c] Annual Cost (thousands)	Annual[c] Benefits (thousands)	Excess of Annual Benefits Over Costs (thousands)	Benefit-Cost Ratio	Benefit Cost Ratio Greater than 1.0	Positive	Negative
6	Stream Rehabilitation with Structure Floodproofing, Elevation, and Removal Scenario 1 – Natural Restoration	a. Floodproof 79 residential, commercial, and agricultural structures b. Elevate five residential structures c. Remove 17 residential and agricultural structures d. Restore 6.3 miles of the Upper Des Plaines River	Yes	Floodproofing Elevation Removal Stream guage Field surveys Culvert lowering Subtotal	$1,210 330 935 15 25 50 $2,565	$163	$20	$183	$126[e]	-57	0.69	No	Immediate partial flood relief at discretion of property owners Most of the costs would be borne by beneficiaries Aquatic habitat improvement Long-term improvement of instream water quality due to removal of sediment	Structure floodproofing, elevation, and removal needed to resolve structure flooding problem. Complete, voluntary implementation unlikely and, therefore, left with a significant residual flood problem. Overland flooding and some attendant problems remain. Some floodproofing is likely to be applied without adequate professional advice and, as a result, structure damage may occur. Residual agricultural damages. Partial resolution of flood problem Provides no control of streamflows
6	Stream Rehabilitation with Structure Floodproofing, Elevation, and Removal Scenario 2 – Mechanical Sediment Removal and Associated Stream Rehabilitation Measures	a. Floodproof 79 residential, commercial, and agricultural structures b. Elevate five residential structures c. Remove 17 residential and agricultural structures d. Restore 6.3 miles of the Upper Des Plaines River	Yes	Floodproofing Elevation Removal Sediment removal Culvert lowering Stream restoration Subtotal	$1,210 330 935 300 50 6,000 to 12,700 $8,825 to $15,525	$560 to $986	$20	$580 to $1,006	$126[e]	$-454 to $-880	0.13 to 0.22	No	Immediate partial flood relief at discretion of property owners Most of the costs would be borne by beneficiaries Aquatic habitat improvement Long-term improvement of instream water quality due to removal of sediment	Structure floodproofing, elevation, and removal needed to resolve structure flooding problem. Complete, voluntary implementation unlikely and, therefore, left with a significant residual flood problem. Overland flooding and some attendant problems remain. Some floodproofing is likely to be applied without adequate professional advice and, as a result, structure damage may occur. Residual agricultural damages. Partial resolution of flood problem Provides no control of streamflows

[a] *Economic analyses are based on an annual interest rate of 6 percent and a 50-year amortization period and project life.*

[b] *Based upon 1999* Engineering News-Record *Construction Cost Index of 7022. Includes engineering, administration, and contingencies.*

[c] *Annual benefits and costs used in the benefit-cost analysis include only the direct benefits derived from the abatement of monetary flood damages, and the direct costs attendant to implementation of the floodland management measures, including capital and operation and maintenance costs. Environmental and recreational benefits and costs were not addressed in the benefit-cost analysis since these represent intangible benefits and costs and, therefore, cannot be readily quantified.*

[d] *There are no direct capital costs or benefits associated with the "No Action" alternative..*

[e] *Reduction in structure flooding damages.*

[f] *Incremental cost between control of two-year and 100-year events.*

[g] *Range for minimal maintenance (mowing only) to active management.*

[h] *Annual land rental cost for prairie restoration areas.*

[i] *Annual land rental cost for wetland restoration areas.*

[j] *Reduction in agricultural flooding damages.*

Source: SEWRPC.

As shown on Map 64, of the 101 structures which are expected to incur flood damage, 79 would have to be floodproofed, five would have to be elevated, and 17 would have to be removed under this alternative. Future flood damage to the existing structures in the watershed would be virtually eliminated by these measures. The potential for damage to crops in the watershed would remain, however. Table 106 sets forth the number and type of structures to be floodproofed, elevated, or removed and summarizes the estimated costs and benefits.

Assuming that these structure floodproofing measures would be fully implemented, and utilizing an annual interest rate of 6 percent and a project life and amortization period of 50 years, the average annual cost of this alternative is estimated at \$157,000. This cost consists of the amortization of the \$2,475,000 capital cost—\$1,210,000 for floodproofing, \$330,000 for structure elevation, and \$935,000 for structure removal. The average annual flood damage abatement benefit to structures was estimated at \$126,000 per year, yielding a benefit-cost ratio of 0.80. Therefore, the structure floodproofing, elevation, and removal alternative plan as described herein, while technically feasible, was found to have a benefit-cost ratio less than one.

Detention Storage with Structure Floodproofing, Elevation, and Removal Alternative
An alternative floodland management plan consisting of detention storage along with structure floodproofing, elevation, and removal was considered. This alternative is shown on Map 65, with the physical characteristics and estimated costs and benefits being set forth in Table 106. This alternative assumes that detention storage would be provided for runoff from all significant areas of planned development. The detention storage was simulated in the hydrologic model such that it could be provided as centralized detention facilities each serving several individual developments or as decentralized detention facilities each serving a single development.[8] For each scenario considered, the procedure that was applied to represent detention storage in the continuous simulation hydrologic model is set forth in Appendix I.

Detention Scenarios
Three detention restoration scenarios were analyzed. Scenarios 1 and 2 represent the likely effects of designing detention facilities for new development based on applying the most commonly used engineering methods to satisfy current community detention standards and the proposed NR 151 runoff quantity control standard. Scenario 3 represents the likely effects of designing detention facilities based on applying alternative, more sophisticated engineering methods developed under this watershed study to satisfy current community and proposed NR 151 runoff quantity control standards. Scenarios 1 through 3 provide a watershedwide test of the effectiveness of the community and NR 151 standards for regulating peak rates of runoff. Later in this chapter in the sections describing the results of the analyses of the three scenarios, the efficacy of current local and proposed State (NR 151) levels of runoff quantity control are evaluated. In order to effectively meet the goal of avoiding increases in peak rates of runoff, the recommended plan calls for a level of control that differs from those that are currently applied in the watershed.[9]

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[8]*The relative merits of centralized and decentralized detention are described above in the section on "Available Floodland Management Measures."*

[9]*The hydrologic methodology for the Scenarios 2 and 3 is the same except for the magnitude of the peak 100-year inflow and the target two- and 10-year outflows. Scenario 2 determines detention requirements associated with peak 100-year inflow and two- and 10-year target outflow discharges computed based on Natural Resources Conservation Service (NRCS) methods commonly used in development site design. Scenario 3 determines detention requirements using inflows computed based on peak inflows and target outflows that were determined using flood frequency relationships based on application of the continuous simulation hydrologic model developed under the watershed study. Scenario 2 was developed to evaluate whether the application of current, standard hydrologic design procedures would result in the design of detention facilities that would achieve an adequate level of control of flows throughout the watershed. Since it was found that the detention facilities designed using procedures set forth under the Scenario 2 approach did not achieve an adequate level of control, Scenario 3 was developed which based detention requirements on the continuous simulation target flows, which are considered to better represent actual flow conditions in the watershed than the NRCS Scenario 2 flows. Because it was found that detention facilities designed under the Scenario 3 methodology also did not achieve an adequate level of (footnote continued)*

The following scenarios were analyzed:

- Scenario 1—Peak Flow Control for the 100-Year Storm Based on NRCS Method Flows: Consistent with current practice in several of the communities in the watershed, it was assumed that the detention facilities would reduce the peak rate of discharge from the tributary area during a 100-year event under planned land use conditions to the peak rate of discharge from the site during a 10-year event under 1990 land use conditions. The 10- and 100-year peak flows were determined using Natural Resources Conservation Service (NRCS) design storm methodology within the calibrated HSPF model.
- Scenario 2—Peak Flow Control for the Two- and 100-Year Storms Based on NRCS Method Flows: The 100-year post-development to 10-year pre-development level of control from the preceding scenario was applied along with control of the post-development two-year storm peak flow to the two-year pre-development peak flow. That level of control of the two-year storm is consistent with the proposed Chapter NR 151, "Runoff Management," of the Wisconsin Administrative Code. The two-, 10-, and 100-year peak flows were determined using NRCS design storm methodology within the calibrated HSPF model.
- Scenario 3—Peak Flow Control for the Two- and 100-Year Storms Based on HSPF Continuous Simulation Method Flows: The 100-year post-development to 10-year pre-development and two-year post-development to two-year pre-development peak flow levels of control from the preceding scenario were applied. However, the two-, 10-, and 100-year peak flows were determined using continuous simulation methodology, within the calibrated HSPF model.

Flood Flow Comparisons
Comparisons of 1.01- through 100-year flood flows along the studied streams in the watershed under planned land use and existing channel conditions with and without the three detention storage scenarios implemented is set forth in Tables I-1 and through I-6 of Appendix I.

Peak Flow Control for the 100-Year Storm—Scenario 1
Table I-1 shows that in general the impact of this detention storage scenario on reducing flood flows relative to planned land use conditions without detention storage is greatest along small streams, in headwaters areas, and along the Upper Des Plaines River. However, along some larger tributaries to the Des Plaines River, where future urban development is to be located near the downstream reaches, significant localized flow reductions may be attained through this detention scenario. Such reductions occur along the Salem Branch of Brighton Creek, Kilbourn Road Ditch, and Jerome Creek.

As noted above, a standard set forth under the second principle in Appendix C-4 calls for the peak two- through 100-year flood flows at the Wisconsin-Illinois state line to be maintained at 1990 levels, where practical. Table I-2 sets forth a comparison of alternative plan flows with 1990 land use flows. On the Des Plaines River main stem at the state line, comparison of the computed 100-year flood flow under planned land use conditions with detention of runoff from new development to the 100-year flow under 1990 land use, drainage, and channel conditions indicates an increase of about 2 percent. Comparison of the two-year flood flows indicates an increase of about 9 percent relative to 1990 conditions. On the Dutch Gap Canal at the state line, comparison of the computed 100-year flood flow under planned land use conditions with this detention scenario to the 100-year flow under 1990 land use, drainage, and channel conditions indicates an increase of about 1 percent. Comparison of the two-year flood flows indicates an increase of about 4 percent relative to 1990 conditions. Relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the

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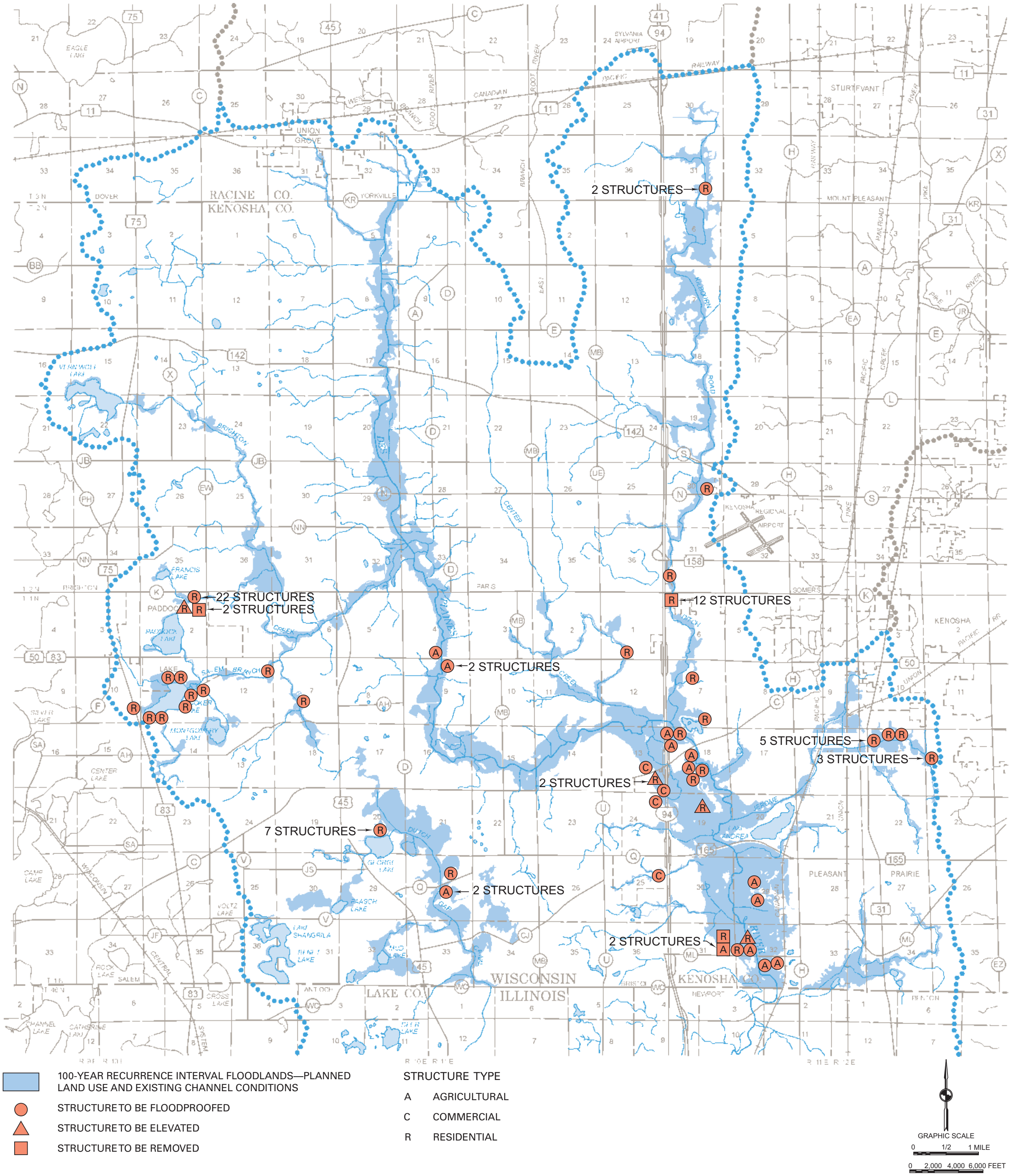
control, the recommended release rates for runoff from new development were developed to meet the flow control objectives of the watershed study. Additional explanation of the detention storage methodology is provided in Appendix I, "Analysis of Watershedwide Detention Storage for New Development."

Map 64

STRUCTURE FLOODPROOFING, ELEVATION, AND REMOVAL ALTERNATIVE FOR THE DES PLAINES RIVER WATERSHED

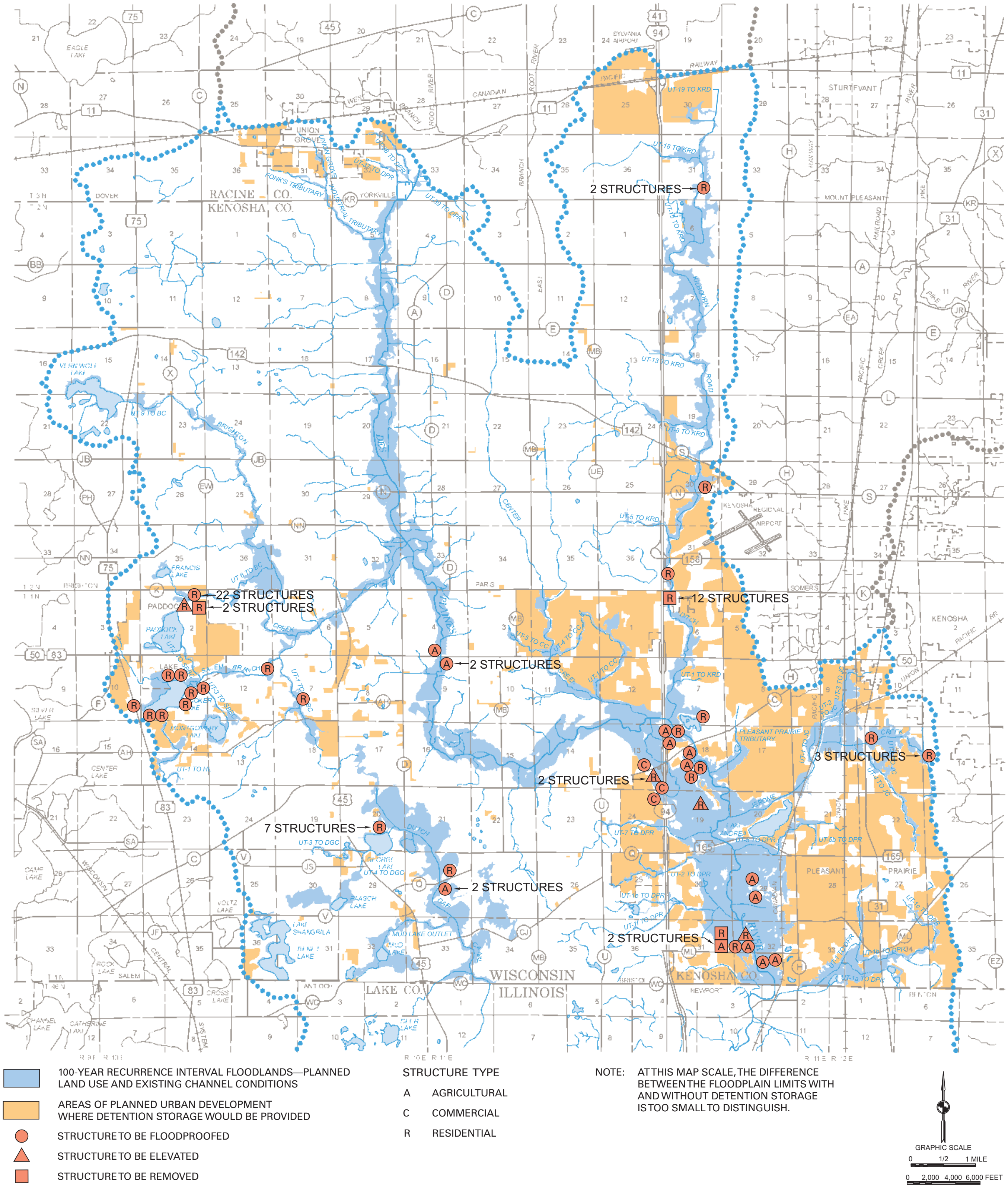


A structure floodproofing, elevation, and removal alternative floodland management plan was prepared and evaluated to determine if such a measure would provide a technically feasible and economically sound solution to the flood damage problem in the Des Plaines River watershed. Under this alternative 79 structures would have to be floodproofed, five structures would have to be elevated, and 17 structures would have to be removed. Residual crop damages amounting to $70,000 on an average annual basis would remain in the watershed. This alternative was found to be technically feasible and to have a benefit cost ratio of 0.80.

Source: SEWRPC.

Map 65

DETENTION STORAGE WITH STRUCTURE FLOODPROOFING, ELEVATION, AND REMOVAL ALTERNATIVE FOR THE DES PLAINES RIVER WATERSHED



A detention storage with structure floodproofing, elevation, and removal alternative floodland management plan was prepared and evaluated to determine if such a measure would provide a technically feasible and economically sound solution to the flood damage problem in the Des Plaines River watershed. Under this alternative, detention storage facilities would be provided as land is converted from rural to urban uses. This alternative corresponds to Scenario 3. Nine buildings would be eliminated from the 100-year floodplain due to the provision of detention. Structure floodproofing, elevation, or removal would be required to eliminate flood damage to the 92 buildings remaining in the floodplain. While technically feasible, this alternative was found to have a benefit-cost ratio of significantly less than one.

Source: SEWRPC.

hydrologic model. Thus, under this approach, the goal of maintaining the peak 100-year flood flow at the 1990 level at the state line would essentially be met for the 100-year floods on the Des Plaines River and Dutch Gap Canal and for the two-year flood on the Dutch Gap Canal. A slight increase in the peak two-year flood flow on the Des Plaines River at the state line might be expected.

During a 100-year event occurring under planned land use and existing channel conditions, detention of runoff from new development under this scenario would only be expected to reduce the number of buildings flooded by five, from 101 to 96.

Peak Flow Control for the Two- and 100-Year Storms—Scenario 2

Table I-3 shows that, as is the case under Scenario 1, in general the impact of this detention storage scenario on reducing flood flows relative to planned land use conditions without the assumed level of detention storage is greatest along small streams, in headwaters areas, and along the Upper Des Plaines River. However, along some larger tributaries to the Des Plaines River, where future urban development is to be located near the downstream reaches, significant localized flow reductions may be attained through this detention scenario. Such reductions occur along the Salem Branch of Brighton Creek, Kilbourn Road Ditch, and Jerome Creek.

Table I-4 sets forth a comparison of alternative plan flows with 1990 land use flows. On the Des Plaines River main stem at the state line, comparison of the computed 100-year flood flow under planned land use conditions with detention of runoff from new development to the 100-year flow under 1990 land use, drainage, and channel conditions indicates an increase of about 2 percent. Comparison of the two-year flood flows indicates an increase of about 8 percent relative to 1990 conditions. On the Dutch Gap Canal at the state line, comparison of the computed 100-year flood flow under planned land use conditions with this detention scenario to the 100-year flow under 1990 land use, drainage, and channel conditions indicates an increase of about 1 percent. Comparison of the two-year flood flows indicates an increase of about 4 percent relative to 1990 conditions. As noted above, relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the hydrologic model. Thus, under this approach, the goal of maintaining the peak 100-year flood flow at the 1990 level at the state line would essentially be met for the 100-year floods on the Des Plaines River and Dutch Gap Canal and for the two-year flood on the Dutch Gap Canal. A slight increase in the peak two-year flood flow on the Des Plaines River at the state line might be expected.

During a 100-year event occurring under planned land use and existing channel conditions, detention of runoff from new development under this scenario would only be expected to reduce the number of buildings flooded by three, from 101 to 98.

Peak Flow Control for the Two- and 100-Year Storms—Scenario 3

Table I-5 shows that in general the impact of this detention storage scenario on reducing flood flows relative to planned land use conditions without the assumed level of detention storage is greatest along small streams, in headwaters areas, and along the Upper Des Plaines River. However, along some larger tributaries to the Des Plaines River, where future urban development is to be located near the downstream reaches, significant localized flow reductions may be attained through this detention scenario. Such reductions occur along the Salem Branch of Brighton Creek, Kilbourn Road Ditch, and Jerome Creek.

Table I-6 sets forth a comparison of alternative plan flows with 1990 land use flows. On the Des Plaines River main stem at the state line, comparison of the computed 100-year flood flow under planned land use conditions with detention of runoff from new development to the 100-year flow under 1990 land use, drainage, and channel conditions indicates an increase of about 2 percent. Comparison of the two-year flood flows indicates an increase of about 9 percent relative to 1990 conditions. On the Dutch Gap Canal at the state line, comparison of the computed 100-year flood flow under planned land use conditions with this detention scenario to the 100-year flow under 1990 land use, drainage, and channel conditions indicates an increase of about 1 percent. Comparison of the two-year flood flows indicates an increase of about 4 percent relative to 1990 conditions. As noted above, relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the hydrologic model. Thus, under this approach, the goal of maintaining the peak 100-year floodflow at the 1990 level at the state line would essentially be met for the 100-year floods on the Des Plaines River and Dutch Gap Canal and for the two-year flood on the Dutch Gap Canal. A slight increase in the peak two-year flood flow on the Des Plaines River at the state line might be expected.

During a 100-year event occurring under planned land use and existing channel conditions, detention of runoff from new development under this scenario would only be expected to reduce the number of buildings flooded by nine, from 101 to 92.

Economic Analyses

Scenario 1— Peak Flow Control for the 100-Year Storm Based on NRCS Method Flows

Utilizing an interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this scenario was estimated at $3,286,000. This cost consists of the amortization of the $42,100,000 capital cost—$1,135,000 for floodproofing, $330,000 for structure elevation, and $935,000 for structure removal, $37,000,000 for construction of the detention basins, and $2,700,000 for land acquisition for the detention basins,[10] plus $613,000 in annual operation and maintenance costs for the detention basins.[11] It should be noted that some of these costs would be incurred, in any case, as part of the current development policies and regulations. The average annual flood abatement benefit to structures was estimated at $126,000, yielding a benefit cost ratio of 0.04. Therefore, the Scenario 1 detention storage with structure floodproofing, elevation, and removal alternative plan as described herein, while technically feasible, was found to have a benefit-cost ratio less than one.

Scenario 2—Peak Flow Control for the Two- and 100-Year Storms Based on NRCS Method Flows

The total capital cost of this scenario is $42,130,000, which is $30,000 greater than the cost of Scenario 1. Because control of the two-year event is mandated under the proposed Chapter NR 151 of the Wisconsin Administrative Code, it is appropriate to deduct that cost from the overall cost of this scenario. With the cost to provide control of the two-year storm deducted, and utilizing an interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative was estimated at $2,092,000. This cost consists of the amortization of the $28,230,000 capital cost—$1,165,000 for floodproofing, $330,000 for structure elevation, and $935,000 for structure removal, $23,770,000 for construction of the detention basins, and $2,030,000 for land acquisition for the detention basins,[12] plus $299,000 in annual operation and maintenance costs for the detention basins.[13] The average annual flood abatement benefit to structures was estimated at $126,000, yielding a benefit cost ratio of 0.06. Therefore, the Scenario 2 detention storage with structure floodproofing, elevation, and removal alternative plan as described herein, while technically feasible, was found to have a benefit-cost ratio less than one.

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[10]*This estimated cost is based on the acquisition of up to about 270 acres of land. These land costs were included since the area occupied by these basins could, in the absence of a detention storage plan, be used for other* purposes.

[11]*The estimated cost of this alternative did not include a credit for reductions in the size and cost of local stormwater conveyance facilities, since such reductions are uncertain in the absence of detailed system plans.*

[12]*This estimated cost is based on the acquisition of up to about 200 acres of land. That area represents the additional land acquisition amount needed for 100-year control, beyond that needed for two-year control. These land costs were included since the area occupied by these basins could, in the absence of a detention storage plan, be used for other purposes.*

[13]*The estimated cost of this alternative did not include a credit for reductions in the size and cost of local stormwater conveyance facilities, since such reductions are uncertain in the absence of detailed system plans.*

Scenario 3—Peak Flow Control for the Two- and 100-Year Storms
Based on HSPF Continuous Simulation Method Flows

The total capital cost of this scenario is $43,405,000, which is $1,305,000 greater than the cost of Scenario 1 and $1,275,000 greater than the cost of Scenario 2. As for Scenario 2, it is appropriate to deduct the cost of control of the two-year event from the overall cost of this scenario. With the cost to provide control of the two-year storm deducted and utilizing an interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative was estimated at $2,106,000. This cost consists of the amortization of the $29,405,000 capital cost—$1,040,000 for floodproofing, $330,000 for structure elevation, and $935,000 for structure removal, $24,100,000 for construction of the detention basins, and $3,000,000 for land acquisition for the detention basins,[14] plus $239,000 in annual operation and maintenance costs for the detention.[15] The average annual flood abatement benefit to structures was estimated at $126,000, yielding a benefit cost ratio of 0.06. Therefore, the Scenario 3 detention storage with structure floodproofing, elevation, and removal alternative plan as described herein, while technically feasible, was found to have a benefit-cost ratio less than one.

Prairie Restoration with Structure Floodproofing, Elevation, and Removal Alternative

An alternative floodland management plan consisting of restoration of prairies in portions of the watershed along with structure floodproofing, elevation, and removal was considered. This alternative is shown on Map 66, with the physical characteristics and estimated costs and benefits being set forth in Table 106. The alternative was developed to evaluate the changes in watershed hydrology that could occur through restoration of prairies and to quantify the possible effects of restoration on rates and volumes of runoff. The procedure that was developed by the Commission staff to identify areas that are candidates for prairie restoration is described in Appendix J.

Restoration Scenarios

Two prairie restoration scenarios were analyzed:

- Restoration of all potential prairie areas in the watershed.
- Restoration of 10 percent of the potential prairie areas.

Under the scenario with all potential prairie areas restored, 29.9 square miles, or 22 percent of the watershed area would be covered by prairies. That maximum restoration condition would result in a situation similar to the pre-settlement condition when it is estimated that prairies covered 25 to 29 percent of the watershed area in Wisconsin. Achievement of the maximum restoration condition is considered to be impractical, considering landowner willingness to convert land and the available Federal and State funding for the Conservation Reserve and Conservation Reserve Enhancement Programs. However, analysis of that condition provides a "maximum effect" scenario under which to evaluate the hydrologic effectiveness of prairie restoration alternatives.

Under the scenario with 10 percent of the potential prairie areas restored, 3.0 square miles, or 2.2 percent of the watershed area would be covered by restored prairies.[16] Achievement of that restoration condition is considered to

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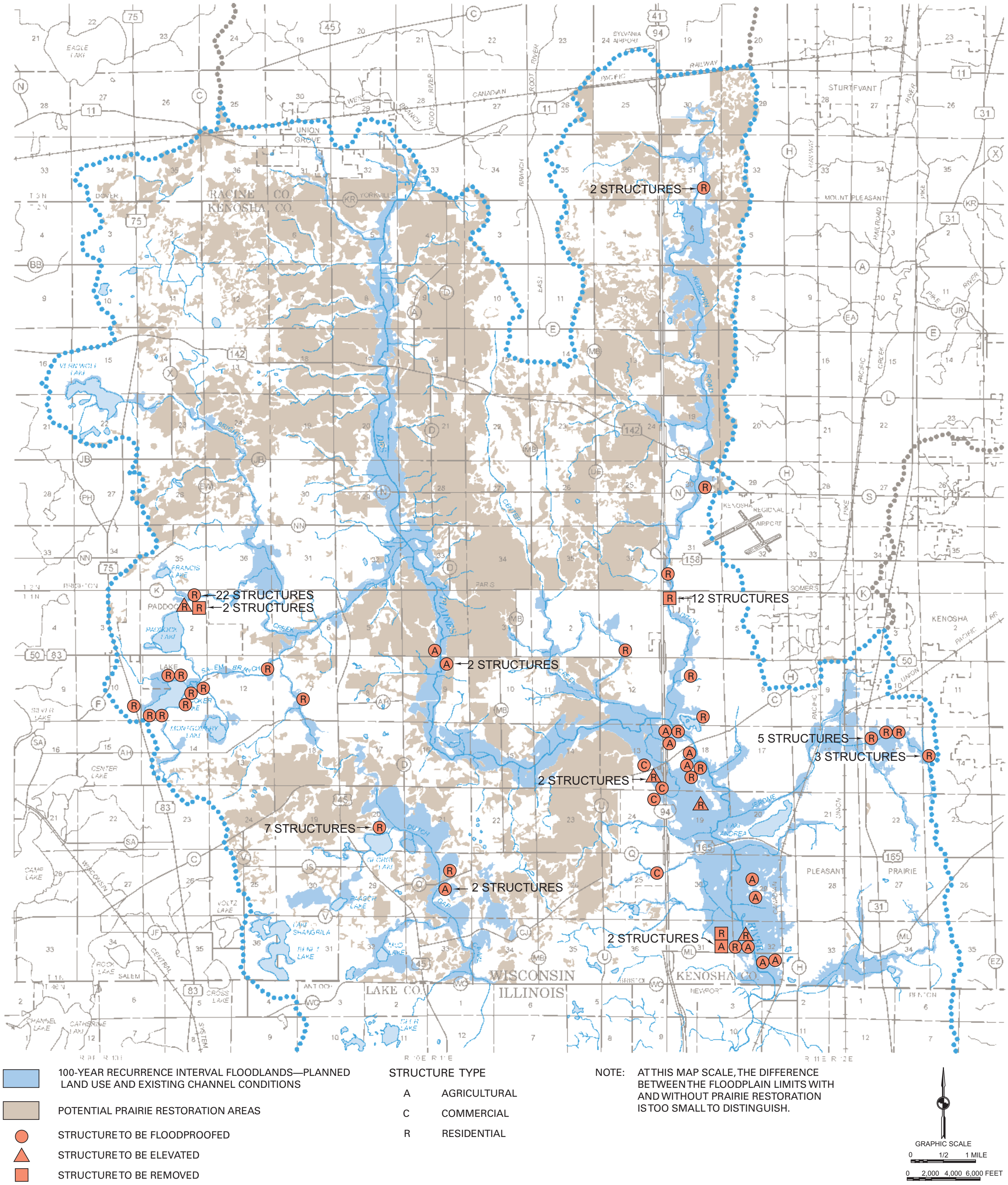
[14] *This estimated cost is based on the acquisition of up to about 290 acres of land. That area represents the additional land acquisition amount needed for 100-year control, beyond that needed for two-year control. These land costs were included since the area occupied by these basins could, in the absence of a detention storage plan, be used for other purposes.*

[15] *The estimated cost of this alternative did not include a credit for reductions in the size and cost of local stormwater conveyance facilities, since such reductions are uncertain in the absence of detailed system plans.*

[16] *There are areas of existing prairies/grasslands in the watershed; however the land area covered by prairies, or grasslands, is variable over time, depending on changing agricultural and development activities in the watershed. If existing prairie/grassland areas are taken into account, the total amount of land covered by prairies would be greater than the restored area. Chapter XV, "Recommended Comprehensive Plan," includes quantification of grasslands on lands in existing or proposed public interest ownership. Those grasslands would be expected to be preserved over time.*

Map 66

PRAIRIE RESTORATION WITH STRUCTURE FLOODPROOFING, ELEVATION, AND REMOVAL ALTERNATIVE FOR THE DES PLAINES RIVER WATERSHED



A prairie restoration with structure floodproofing, elevation, and removal alternative floodland management plan was prepared and evaluated to determine if such a measure would provide a technically feasible and economically sound solution to the flood damage problem in the Des Plaines River watershed. Under this alternative, prairie vegetation would be established on 10 percent (3.0 square miles) of the lands designated as potential restoration areas. No buildings would be eliminated from the 100-year floodplain due to the provision of 10 percent prairie restoration. Structure floodproofing, elevation, or removal would be required to eliminate flood damage to the 101 buildings in the floodplain. While technically feasible, this alternative was found to have a benefit-cost ratio of significantly less than one.

Source: SEWRPC.

be possible, considering landowner willingness to convert land and the available Federal and State funding. Thus, the prairie restoration alternative was developed for the 10 percent restoration condition.

Under this alternative plan, it was assumed that agricultural land would be converted to native prairie conditions on 10 percent of the lands identified as candidates for prairie restoration on Map 66. The restoration areas were assumed to be evenly distributed throughout the candidate areas. The potential hydrologic effects of such restoration were represented in the U.S. Environmental Protection Agency (USEPA) HSPF continuous simulation hydrologic model through modification of key input parameters as described in Appendix J. One of the key hydrologic impacts of prairie restoration is anticipated to be increases in the infiltration capacity of the soils relative to undrained cropland. Such increases in capacity are largely attributable to the deep root systems of native prairie vegetation.

Prairie restoration may include the establishment of linear riparian buffer strips with prairie vegetation, or the conversion of other agricultural lands to prairie conditions. Such restoration would be consistent with attainment of the nonpoint source pollution control standards as proposed under Chapter NR 151 of the Wisconsin Administrative Code and as recommended in Chapter XIII of this report, “Recommended Water Quality Management Measures.”

Flood Flow Comparisons

Comparisons of 1.01- through 100-year flood flows along the studied streams in the watershed under planned land use and existing channel conditions with and without maximum prairie restoration and with and without 10 percent restoration are set forth in Tables J-4 through J-7 in Appendix J.

Maximum Prairie Restoration

Table J-5 shows that the impact of maximum prairie restoration relative to planned land use conditions without maximum restoration would be significant throughout the watershed along those streams that would be expected to have large proportions of land in agricultural uses under planned land use conditions. Along those streams, conversion of lands to prairie vegetation would result in a general reduction in 1.01 through 100-year flood flows compared to planned land use conditions without prairie restoration. The reductions in flows fall in the general range of from 0 to 20 percent. Along the main stem of the Des Plaines River, Brighton Creek, Center Creek, and Kilbourn Road Ditch the relative reduction in flows would be greater for the large flood events than for the small floods.

As noted above, a standard set forth in Appendix C-4 calls for the peak two- through 100-year flood flows at the Wisconsin-Illinois state line to be maintained at 1990 levels, where practical. Table J-4 sets forth a comparison of alternative plan flows with 1990 land use flows. On the Des Plaines River main stem at the state line, comparison of the computed 100-year flood flow under planned land use conditions with maximum prairie restoration to the 100-year flow under 1990 land use, drainage, and channel conditions indicates a decrease of about 5 percent. Comparison of the two-year flood flows indicates an increase of about 1 percent relative to 1990 conditions. On the Dutch Gap Canal at the state line, comparison of the computed 100-year flood flow under planned land use conditions with this detention scenario to the 100-year flow under 1990 land use, drainage, and channel conditions indicates a decrease of about 3 percent. Comparison of the two-year flood flows indicates a decrease of about 1 percent relative to 1990 conditions. As noted above, relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the hydrologic model. Thus, under this approach, the goal of maintaining the peak 100-year flood flow at the 1990 level at the state line would essentially be met for the two- and 100-year floods on the both the Des Plaines River and Dutch Gap Canal.

10 Percent Prairie Restoration

Table J-7 shows that the impact of 10 percent prairie restoration relative to planned land use conditions without 10 percent restoration would be evident throughout the watershed along those streams that would be expected to have large proportions of land in agricultural uses under planned land use conditions. Along those streams, conversion of lands to prairie vegetation would result in a general reduction in 1.01 through 100-year flood flows compared to planned land use conditions without prairie restoration. However, the reduction would be much less than under the maximum restoration scenario, falling in the general range of from 0 to 4 percent. In general, the reduction in flows would be similar for the large and small flood events.

Table J-6 sets forth a comparison of alternative plan flows with 1990 land use flows. On the Des Plaines River main stem at the state line, comparison of the computed 100-year flood flow under planned land use conditions with 10 percent prairie restoration to the 100-year flow under 1990 land use, drainage, and channel conditions indicates an increase of about 1 percent. Comparison of the two-year flood flows indicates an increase of about 7 percent relative to 1990 conditions. On the Dutch Gap Canal at the state line, comparison of the computed 100-year flood flow under planned land use conditions with 10 percent prairie restoration to the 100-year flow under 1990 land use, drainage, and channel conditions indicates no change. Comparison of the two-year flood flows indicates an increase of about 4 percent relative to 1990 conditions. As noted above, relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the hydrologic model. Thus, under this approach, the goal of maintaining the peak 100-year flood flow at the 1990 level at the state line would essentially be met for the 100-year floods on the Des Plaines River and Dutch Gap Canal and for the two-year flood on the Dutch Gap Canal. A slight increase in the peak two-year flood flow on the Des Plaines River at the state line might be expected.

During a 100-year event occurring under planned land use and existing channel conditions, 10 percent prairie restoration would not be expected to reduce the number of buildings flooded relative to the number under planned land use and existing channel conditions. Thus, there would still be a need to floodproof, elevate, and remove 101 structures as under the structure floodproofing, elevation, and removal alternative.

Economic Analysis

The economic viability of enrollment of land in the U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP) depends on the relatively complex interconnection of several factors, including commodity prices, the costs of producing crops, and CRP rental rates. The variability of commodity prices and production costs complicates the economic evaluation over the 10- to 15-year enrollment period characteristic of the CRP. Appendix K includes a set of graphs to assist landowners in determining the economic viability of enrollment of land in the CRP. Other options for reserving land for prairie restoration include purchasing development rights or conservation easements or acquiring suitable lands.

For estimating the cost of this prairie restoration alternative, it was assumed that a typical CRP rental rate of $110 per acre is a satisfactory representation of the cost of removing agricultural land from production.[17] That is an intermediate rental for the soil types in the watershed and it represents the economic break-even point for a fairly wide range of crop yields and commodity prices for corn and soybeans. Generalized unit costs for establishment and maintenance of prairie vegetation were also applied. The measures necessary to restore prairie conditions were assumed to cost $3,500 per acre.

Utilizing an interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative was estimated to possibly range from $847,000 to $1,507,000, depending on the level of maintenance and management of the restored prairie areas. This cost consists of the amortization of the $9,865,000 capital cost—$1,210,000 for floodproofing, $330,000 for structure elevation, and $935,000 for structure removal, and $7,390,000 for prairie restoration over the 3.0-square-mile restoration area, plus the estimated annual land rental cost of $211,000, and the estimated annual maintenance cost of $10,000 to $670,000.[18] The average annual flood abatement benefit to structures was estimated at $126,000, yielding a

[17]*Another option would be to purchase the land that is to be converted. That option may be more expensive than enrolling in the CRP.*

[18]*The lower maintenance cost assumes a minimal level of mowing. The higher cost assumes intensive active management, including periodic burning, weed and herbicide management, mowing, brush reduction, buffer plantings, and monitoring of vegetation and hydrology. Actual maintenance costs would be expected to fall within the range cited.*

benefit cost ratio of from 0.08 to 0.15. Therefore, the prairie restoration with structure floodproofing, elevation, and removal alternative plan as described herein, while technically feasible, was found to have a benefit-cost ratio less than one.

Wetland Restoration with Structure Floodproofing, Elevation, and Removal Alternative
An alternative floodland management plan consisting of restoration of wetlands in portions of the watershed along with structure floodproofing, elevation, and removal was considered. This alternative is shown on Map 67, with the physical characteristics and estimated costs and benefits being set forth in Table 106. The alternative was developed to evaluate the changes in watershed hydrology that could occur through restoration of wetlands and to quantify the possible effects of restoration on rates and volumes of runoff. The procedure that was developed by the Commission staff to identify areas that are candidates for wetland restoration is described in Appendix J.

Restoration Scenario
A single scenario calling for restoration of all potential wetland areas in the watershed was analyzed. Under that scenario, 14.8 square miles, or 11 percent of the watershed area would be covered by restored wetlands. When the potentially restored wetland area is combined with the existing wetland area of 10.5 square miles, approximately 19 percent of the watershed area in Wisconsin would be wetlands. That is similar to the pre-settlement condition under which it is estimated that wetlands covered 14 percent of the watershed area in Wisconsin. Achievement of the maximum restoration condition is considered to be impractical, considering landowner willingness to convert land and the available Federal funding for the Wetland Reserve Program. However, analysis of that condition provides a "maximum effect" scenario under which to evaluate the hydrologic effectiveness of wetland restoration.

Under this alternative plan, it was assumed that agricultural land would be converted to wetland conditions on all of the lands identified as candidates for wetland restoration on Map 67 The potential hydrologic effects of such restoration were represented in the USEPA HSPF continuous simulation hydrologic model through modification of key input parameters as described in Appendix J. The key hydrologic impacts of wetland restoration are anticipated to be increases in the growing season evapotranspiration relative to cropland and an increase in the upper zone groundwater/surface storage. The affects of changes in those processes, which would be expected to decrease runoff, would be offset somewhat by an anticipated reduction in the amount of available water storage capacity in the lower soil zone when drained cropland is restored to wetland and the groundwater table is allowed to return to historically higher levels.

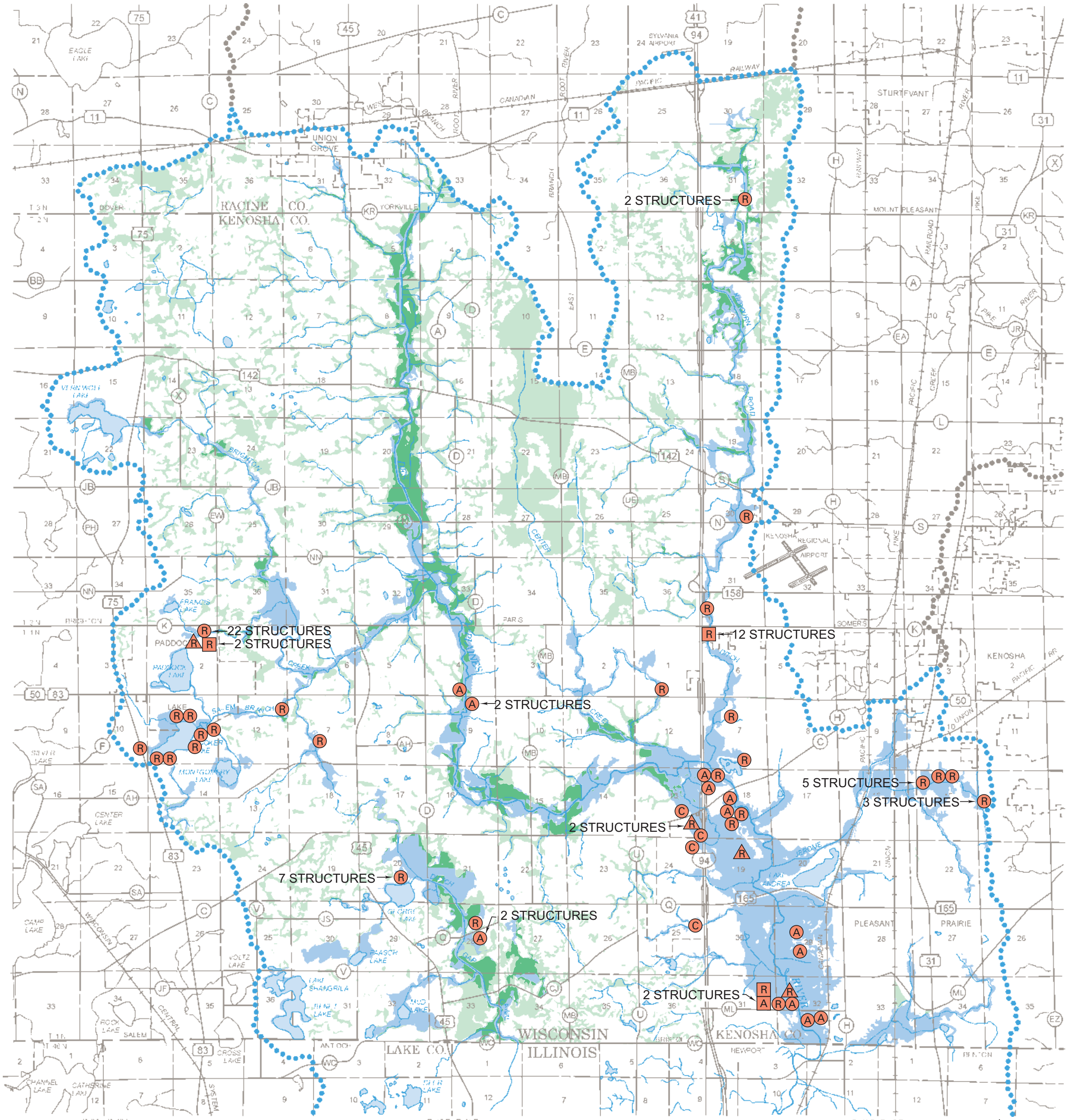
Flood Flow Comparisons
Comparisons of 1.01- through 100-year recurrence interval flood flows along the studied streams in the watershed are set forth in Tables J-2 and J-3 in Appendix J. Flood flows under 1990 and planned land use conditions are compared with and without wetland restoration.

Table J-3 shows that, in general, with maximum wetland restoration, two- through 100-year flood flows in streams throughout the watershed would be unchanged or reduced slightly, compared to planned land use conditions without wetland restoration. A description of how the hydrology of wetlands was modeled is provided in Appendix J.

As noted previously, a standard of Appendix C-4 calls for the peak two- through 100-year flood flows at the Wisconsin-Illinois state line to be maintained at 1990 levels, where practical. Table J-2 sets forth a comparison of alternative plan flows with 1990 land use flows. On the Des Plaines River main stem at the state line, comparison of the computed peak two- and 100-year flood flows under planned land use conditions with wetland restoration to the two- and 100-year flows under 1990 land use, drainage, and channel conditions indicate an increase of about 12 percent for the two-year flow and a decrease of about 2 percent for the 100-year flow. On the Dutch Gap Canal at the state line, comparison of the computed peak 100-year flood flow under planned land use conditions with this wetland restoration to the 100-year flow under 1990 land use, drainage, and channel conditions indicates no change in flow. Comparison of the two-year peak flood flows indicates an increase of about 3 percent relative to 1990 conditions. As noted above, relatively small changes in flow of up to several percent are considered to be

Map 67

WETLAND RESTORATION WITH STRUCTURE FLOODPROOFING, ELEVATION, AND REMOVAL ALTERNATIVE FOR THE DES PLAINES RIVER WATERSHED



100-YEAR RECURRENCE INTERVAL FLOODLANDS —PLANNED LAND USE AND EXISTING CHANNEL CONDITIONS

AREA WITHIN THE 100-YEAR RECURRENCE INTERVAL FLOODPLAIN WHERE WETLANDS WOULD BE RESTORED

AREA OUTSIDE THE 100-YEAR RECURRENCE INTERVAL FLOODPLAIN WHERE WETLANDS WOULD BE RESTORED

STRUCTURE TO BE FLOODPROOFED

STRUCTURE TO BE ELEVATED

STRUCTURE TO BE REMOVED

STRUCTURE TYPE

A AGRICULTURAL

C COMMERCIAL

R RESIDENTIAL

NOTE: AT THIS MAP SCALE, THE DIFFERENCE BETWEEN THE FLOODPLAIN LIMITS WITH AND WITHOUT WETLAND RESTORATION IS TOO SMALL TO DISTINGUISH.

GRAPHIC SCALE

0 1/2 1 MILE

0 2,000 4,000 6,000 FEET

A wetland restoration with structure floodproofing, elevation, and removal alternative floodland management plan was prepared and evaluated to determine if such a measure would provide a technically feasible and economically sound solution to the flood damage problem in the Des Plaines River watershed. Under this alternative, wetland conditions would be established on the lands designated as potential restoration areas (14.8 square miles). No buildings would be eliminated from the 100-year floodplain due to the provision of wetland restoration. Structure floodproofing, elevation, or removal would be required to eliminate flood damage to the 101 buildings in the floodplain. While technically feasible, this alternative was found to have a benefit-cost ratio of significantly less than one.

Source: SEWRPC.

insignificant given the degree of accuracy of the hydrologic model. Thus, under this approach, the goal of maintaining the peak 100-year flood flow at the 1990 level at the state line would essentially be met for the 100-year flood on the Des Plaines River and Dutch Gap Canal and for the two-year flood on Dutch Gap Canal. The peak two-year flood flow on the Des Plaines River would be expected to increase somewhat.

During a 100-year event occurring under planned land use and existing channel conditions, maximum wetland restoration would be expected to cause no significant change in flood flows in potential structure damage reaches. Thus, implementation of this alternative plan was assumed to require a level of floodproofing, elevation, and removal of structures similar to that for the structure floodproofing, elevation, and removal alternative. Under this alternative, the conversion of cropland to wetlands would eliminate agricultural flood damages on 1,975 of the total of 4,000 acres of farm land in the 100-year floodplain.

One approach that has been cited in the literature as an effective way of reducing flood flows and volumes is to construct restored wetlands that retain most runoff from tributary areas. Such features do not rely on the wetland characteristics to reduce flood flows and volumes, but, rather, they utilize retention storage for that purpose. While such an approach is not incompatible with wetland restoration, its effectiveness is dependent on the retention of runoff, not the establishment of wetlands. This approach requires the construction of dikes or excavation to create the storage volumes for runoff. When applied in a floodplain, the construction of dikes, and the possible establishment of ponds within those dikes may actually decrease floodwater storage volumes and consequently increase flood flows. When applied outside floodplains, this method can be effective in reducing flood flows and volumes; however, the retention storage volume should be provided to achieve significant reductions of flood flows and volumes during events with recurrence intervals up to, and including, 100 year years. The cost of establishing retention storage areas which include wetlands may be about three times the cost of establishing wetlands without the associated excavation or dike construction.

Economic Analysis

For estimating the cost of this wetland restoration alternative, it was assumed that a typical CRP rental rate of $110 per acre is a satisfactory representation of the cost of removing agricultural land from production.[19] That is an intermediate rental rate for the soil types in the watershed and it represents the economic break-even point for a fairly wide range of crop yields and commodity prices for corn and soybeans. Other options for reserving land for wetland restoration include purchasing conservation easements or acquiring suitable lands. Generalized unit costs for establishment and maintenance of wetland vegetation were applied. The measures necessary to restore wetland conditions were assumed to cost $3,000 per acre.

Utilizing an interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative was estimated to possibly range from $3,231,000 to $6,499,000, depending on the level of maintenance and management of the restored wetland areas. This cost consists of the amortization of the $33,735,000 capital cost—$1,210,000 for floodproofing, $330,000 for structure elevation, and $935,000 for structure removal, and $31,260,000 for establishment of wetland vegetation over the 14.8-square-mile restoration area, plus the estimated annual land rental cost of $1,042,000, and the estimated annual maintenance cost of $47,000 to $3,315,000.[20] The average annual flood abatement benefit to structures was estimated at $126,000, and

[19] *Another option would be to purchase the land that is to be converted. That option may be more expensive than enrolling in the CRP.*

[20] *The lower maintenance cost assumes a minimal level of mowing. The higher cost assumes intensive active management, including periodic burning, weed and herbicide management, mowing, brush reduction/shoreline plantings, and monitoring of vegetation and hydrology. Actual maintenance costs would be expected to fall within the range cited.*

the average annual flood abatement benefit to cropland was estimated at $35,000,[21] yielding a total annual benefit of $161,000 and a benefit cost ratio of from 0.02 to 0.05. Therefore, the wetland restoration with structure floodproofing, elevation, and removal alternative plan as described herein, while technically feasible, was found to have a benefit-cost ratio less than one.

If the approach of providing retention storage of runoff in candidate wetland restoration areas outside floodplains were to be implemented, the cost for the wetland retention areas is estimated to be $90,000,000. Even if some cost reduction were achieved for structure floodproofing, elevation, and removal, the cost of that alternative would be far in excess of the wetland restoration alternative described above.

Stream Rehabilitation with Structure Floodproofing, Elevation, and Removal Alternative

An alternative floodland management plan consisting of stream rehabilitation, primarily along the main stem of the Upper Des Plaines River,[22] along with structure floodproofing, elevation, and removal was considered. This alternative is shown on Map 68 with the physical characteristics and estimated costs and benefits being set forth in Table 106.

Selection of Rehabilitation Reach

A channelized, 6.3-mile-long reach of the Upper Des Plaines River was selected for rehabilitation based on consideration of the following factors:

- As shown on Map 51 in Chapter VII, significant sediment accumulation on the streambed was documented in this reach;
- The ability to rehabilitate the fishery in this reach is in part dependent on physical rehabilitation of the channel, including control of sediment delivered to the channel and removal of accumulated sediment in the channel; and
- Rehabilitation of the channel offers an opportunity to improve drainage from agricultural lands where drain tile outfalls are obstructed by sediment.

Description of Stream Rehabilitation Process

This implementation of the stream rehabilitation component of this alternative plan would be closely coordinated with, and contingent upon, efforts to control the erosion of sediment from the land surface and streambanks throughout the watershed. Chapter XIII, "Recommended Water Quality Management Measures," calls for significant measures to reduce soil erosion, the delivery of eroded soil to streams, and erosion of streambanks. Recommended measures include:

- Developing farm conservation plans which promote activities such as conservation tillage, no-till practices where applicable, crop rotations to minimize soil loss, contour farming, and rotational grazing of horses and cattle where practical;
- Establishing and maintaining riparian buffers;
- Stabilizing critical streambank erosion sites as identified in Chapter VII, "Water Quality Characteristics and Problems";
- Reducing construction site erosion; and

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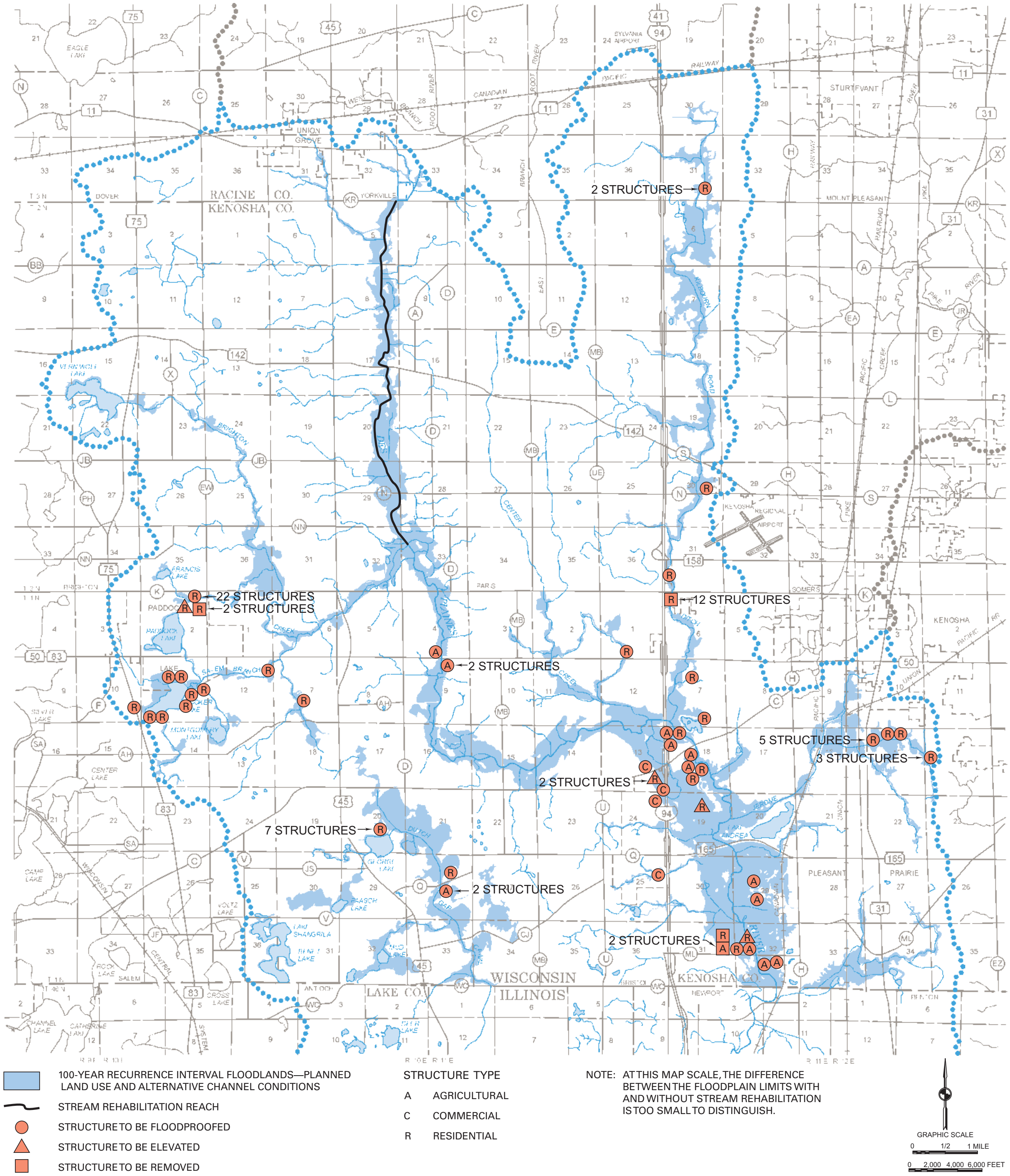
[21]*The estimated $70,000 average annual agricultural flooding damages under planned land use and existing channel and drainage conditions would be reduced by about $35,000 due to the conversion into wetlands of 1,975 acres of former agricultural land in the 100-year floodplain.*

[22]*The Upper Des Plaines River is the seven-mile-long reach upstream of the confluence with Brighton Creek.*

Map 68

STREAM REHABILITATION WITH STRUCTURE FLOODPROOFING, ELEVATION, AND REMOVAL ALTERNATIVE FOR THE DES PLAINES RIVER WATERSHED



A stream rehabilitation with structure floodproofing, elevation, and removal alternative floodland management plan was prepared and evaluated to determine if such a measure would provide a technically feasible and economically sound solution to the flood damage problem in the Des Plaines River watershed. Under this alternative a channelized 6.3-mile-long reach of the upper Des Plaines River would be rehabilitated. One hundred and one structures would have to be floodproofed, elevated, or removed. This alternative was found to be technically feasible and to have a benefit cost ratio less than one.

Source: SEWRPC.

- Developing information and education programs regarding the environmental and economic benefits of erosion control.

The erosion and sedimentation measures listed above would have to be substantially implemented prior to embarking on the direct stream rehabilitation phase of this alternative plan. No active instream rehabilitation measures would be implemented until 1) farm conservation plans are in place for 75 percent of the agricultural land area that is within the Upper Des Plaines River subwatershed and which contains highly erodible soils as shown on Map 50 in Chapter VII, and 2) streambank stabilization measures are in place along 75 percent of the stream length in the Upper Des Plaines River watershed that is identified as having high or medium streambank erosion potential on Map 52 in Chapter VII. That level of control of erosion from agricultural lands and streambanks would be supplemented by more stringent local construction erosion control requirements as required under Chapter NR 151, "Runoff Management," of the Wisconsin Administrative Code.

Upon local adoption of this comprehensive watershed plan, a baseline survey would be conducted to document the configuration of the Upper Des Plaines River channel from River Mile 14.9 just upstream of the confluence with Brighton Creek through River Mile 21.20 on the downstream side of County Line Road (CTH KR). Cross-sections of the channel would be field surveyed and sediment depths would be measured at each cross-section. The cross-sections would be surveyed annually to enable detection of any change. In addition, a continuous recording streamflow and water quality gauge would be installed near the outlet of the Upper Des Plaines River subwatershed to enable, at a minimum, monitoring of streamflow and suspended sediment concentrations. Measurements at the gauge would establish a baseline condition for suspended sediment loads and concentrations and, over time, would be used to evaluate conditions during the stream rehabilitation phase.

Observations by riparian landowners and the Commission staff have verified that beaver dams in the Upper Des Plaines River have resulted in elevated water levels along appreciable stream reaches upstream of those dams. Submergence of drain tile outfalls and elevated water levels in agricultural drainage ditches result from the backwater created by beaver dams. In addition, beaver dams promote siltation in the slow-flowing impoundments they create and they present barriers to fish migration. Thus, an important component of any effort to rehabilitate the stream and improve agricultural drainage is to establish a program to aggressively control beavers and to remove beaver dams. This alternative plan includes such a program.

When the required farm plans, streambank stabilization, and construction erosion control requirements are in place, thus significantly reducing the sediment load to the stream system, minimal measures would be constructed to establish riffles and promote formation of pools and the Upper Des Plaines River stream channel would be monitored for three years to 1) determine whether sediment was being removed through natural processes, 2) evaluate instream sediment concentrations relative to the baseline conditions, and 3) determine whether agricultural drainage was improving due to the combination of aggressive beaver and beaver dam control policies and less obstruction of drain tile outfalls by sediment. Such monitoring would include field surveys of the baseline cross-sections, continued collection of streamflow and suspended sediment data at the stream gauge, and surveys of farmers along the Upper Des Plaines River. The level of sediment removal would be evaluated relative to the proposed average bed profile shown on Figure 69, and sediment concentrations would be compared to the baseline condition. If it were found that sediment was being removed, and pools and riffles were forming in the streambed, to an adequate degree through natural processes, there might be no need to excavate sediment from the channel.[23] If an adequate degree of sediment removal and pool and riffle formation were not occurring after the three-year monitoring period, physical modification of the channel to remove sediment and establish pools

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[23] *Some degree of natural sediment removal would be expected since, with a significant portion of the existing sediment supply to the stream eliminated through controls, transport of the accumulated sediment on the streambed would be accelerated to maintain the level of sediment transport that is characteristic of the stream.*

and riffles would be considered.[24] Instream habitat structures would be provided, as recommended in Chapter XIV, "Recommended Fisheries Management Measures."

The rehabilitation reach includes 11 stream crossings. Two of those, CTH N (38th Street) and STH 142 (Burlington Road), are public highway bridges. The remaining nine crossings are private bridges or culverts. To facilitate sediment removal by natural processes and to enable fish migration, it would be necessary to lower the culvert inverts consistent with the desired streambed profile as set forth on Figure 69. The culverts would also be lowered if it were necessary to implement the physical modification option.

Flood Flow Comparisons

A comparison of 1.01- through 100-year flood flows along the main stem of the Des Plaines River under planned land use and existing channel conditions with and without stream rehabilitation measures is set forth in Table 107. The hydrologic and hydraulic effects of stream rehabilitation were evaluated based on the streambed profile set forth in Figure 69. That comparison shows that in general the impact of stream rehabilitation on flood flows with recurrence intervals ranging from two through 100 years, is greatest in the extreme upstream portion of the rehabilitation reach, upstream of River Mile 20.163. For the 1.01-year flood, the effect on flood flows is greatest in the reach of the Upper Des Plaines River from River Mile 14.81 through 20.594. In the reaches cited, the removal of sediment from the stream channel would reduce the available floodwater storage volume, thereby increasing flood flows. Despite the increase in flood flows along the Upper Des Plaines River, along the upper six miles of the seven-mile-long reach, 100-year flood stages would be expected to decrease by up to about 0.4 foot relative to planned land use conditions without stream rehabilitation. Along the 11-mile-long reach of the main stem, beginning at River Mile 15.73 just upstream from the confluence with Brighton Creek, and extending to River Mile 4.66 100-year flood stages would be expected to increase by up to about 0.04 foot relative to planned land use conditions without stream rehabilitation. Those increases would be due to possible slight changes in flood flows due to the elimination of some upstream floodwater storage. The small stage increases would not create any significant additional flood hazard. The need to offset those slight stage increases derives from the requirement to limit 100-year flood stage increases to less than 0.01 foot as called for under the Kenosha County zoning ordinance and Chapter NR 116 of the Wisconsin Administrative Code.

As noted previously, a standard of Appendix C-4 calls for the peak two- through 100-year flood flows at the Wisconsin-Illinois state line to be maintained at 1990 levels, where practical. Table 108 sets forth a comparison of alternative plan flows with 1990 land use and channel condition flows. On the Des Plaines River main stem at the state line, comparison of the computed 100-year flood flow under planned land use conditions with stream rehabilitation to the 100-year flow under 1990 land use, drainage, and channel conditions indicates an increase of about 2 percent. Comparison of the two-year flood flows indicates an increase of about 8 percent relative to 1990 conditions. Because the stream rehabilitation would be limited to the main stem of the Des Plaines River, it would have no impact on the Dutch Gap Canal. As noted above, relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the hydrologic model. Thus, under this approach, the goal of maintaining the peak 100-year flood flow at the 1990 level at the state line would essentially be met for the 100-year flood on the Des Plaines River. A slight increase in the peak two-year flood flow on the Des Plaines River at the state line might be expected.

Implementation of stream rehabilitation measures would not be expected to reduce the number of buildings flooded during a 100-year event occurring under planned land use and existing channel conditions. A slight reduction in agricultural damages might be achieved through the anticipated flood stage reductions along the Upper Des Plaines River and through the improved functioning of agricultural drain tiles.

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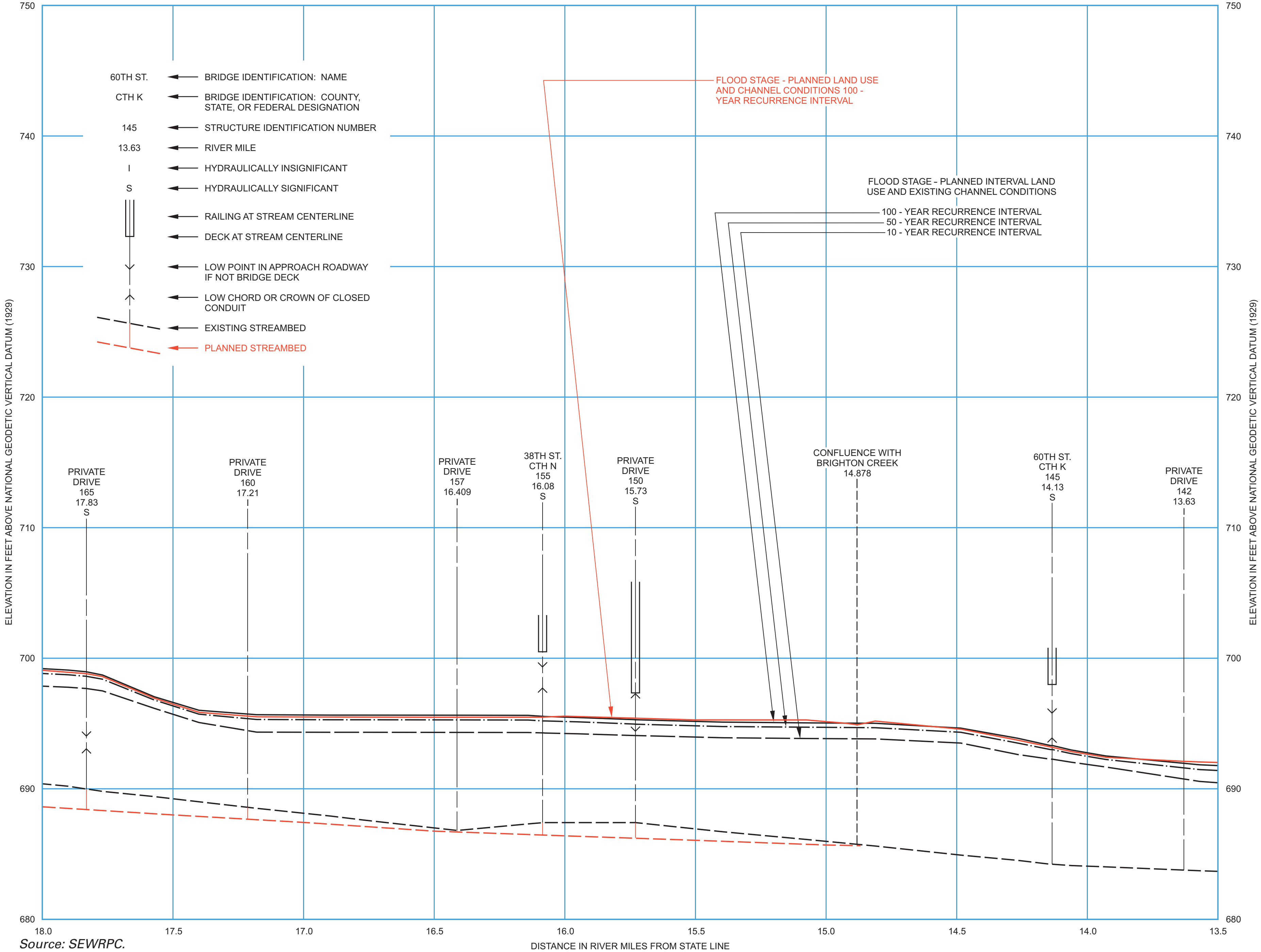
[24]*A sediment excavation program would have to be designed to meet the requirements of the Kenosha County Shoreland/Floodplain Zoning Ordinance which restricts the removal of trees and shrubbery in the shoreland jurisdictional zone.*

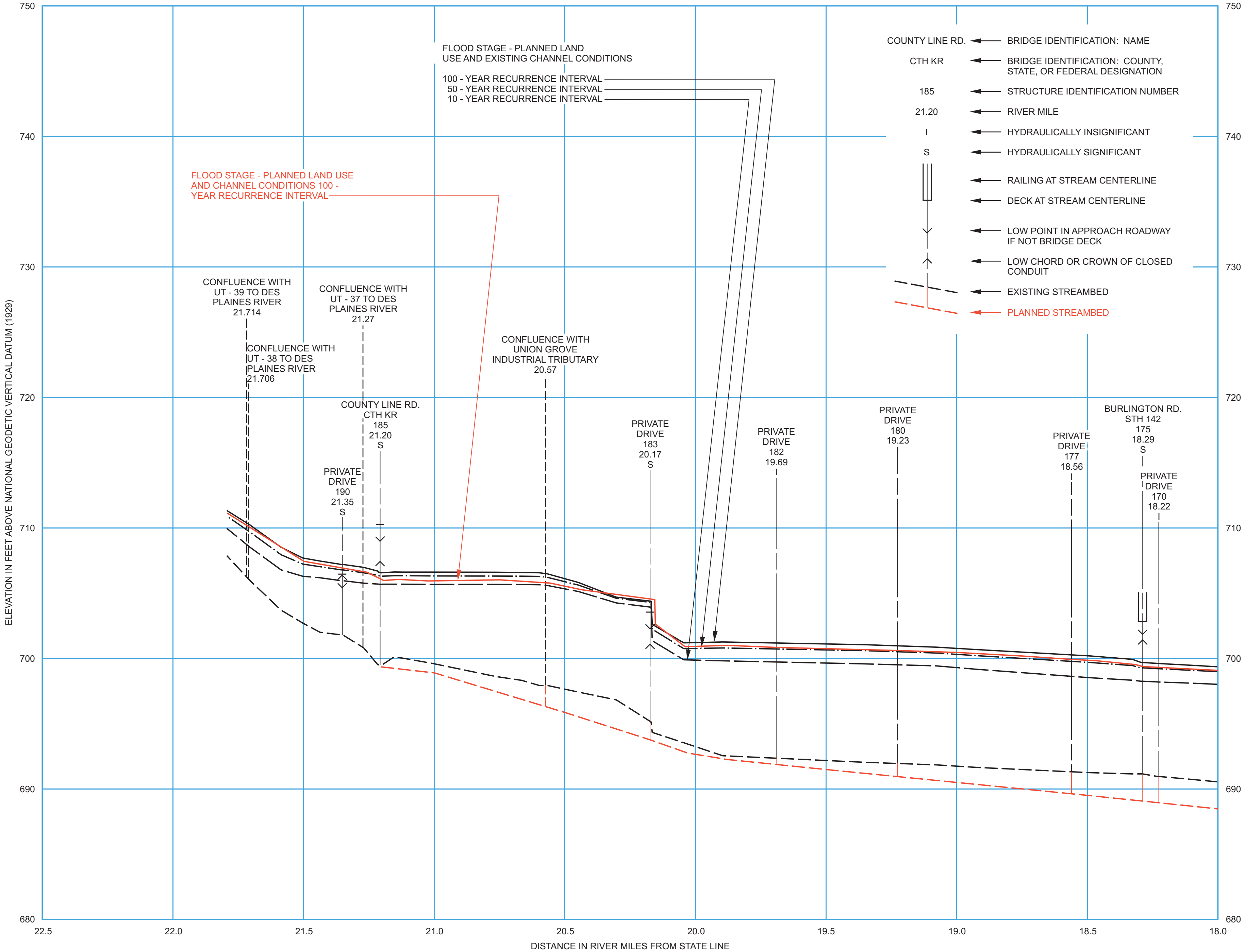
Figure 69

UPPER DES PLAINES RIVER STREAM REHABILITATION ALTERNATIVE PLAN - PROPOSED STREAMBED AND 100-YEAR FLOOD PROFILES



Source: SEWRPC.

Figure 69 (continued)



Source: SEWRPC.

Table 107

COMPARISON OF FLOOD DISCHARGES FOR THE DES PLAINES RIVER WITH AND WITHOUT IMPLEMENTATION OF THE STREAM REHABILITATION ALTERNATIVE PLANNED LAND USE CONDITIONS[a,b]

Upper Des Plaines River

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01			2			10			50			100		
			Existing Channel	Rehabilitated Channel	Percent Difference	Existing Channel	Rehabilitated Channel	Percent Difference	Existing Channel	Rehabilitated Channel	Percent Difference	Existing Channel	Rehabilitated Channel	Percent Difference	Existing Channel	Rehabilitated Channel	Percent Difference
68	14.810	0.7 mile upstream of 60th Street (CTH K)	57	62	9	192	199	4	420	430	2	702	718	2	847	867	2
62	16.140	370 feet upstream of CTH N	46	50	9	163	168	3	379	389	3	665	686	3	818	848	4
58	17.571	0.7 mile downstream of Burlington Road (STH 142)	59	71	20	237	258	9	609	631	4	1,150	1,150	0	1,460	1,450	-1
54	18.110	0.2 mile downstream of Burlington Road (STH 142)	58	68	17	229	249	9	586	607	4	1,100	1,110	1	1,390	1,380	-1
50	18.916	0.6 mile upstream of Burlington Road (STH 142)	59	66	12	233	248	6	585	606	4	1,080	1,100	2	1,360	1,370	1
44	19.350	1.1 miles upstream of Burlington Road (STH 142)	58	64	10	223	240	8	552	576	4	1,010	1,030	2	1,260	1,280	2
29	20.163	Private drive	76	82	8	228	238	4	470	491	4	758	795	5	905	951	5
16	20.594	0.6 mile downstream of County Line Road	21	23	10	73	88	21	158	202	28	261	344	32	313	418	34
8	21.196	County Line Road	9	9	0	41	43	5	112	120	7	218	238	9	279	308	10
2	21.791	0.6 mile upstream of County Line Road	1	1	0	15	15	0	62	62	0	155	155	0	216	216	0

Lower Des Plaines River

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01			2			10			50			100		
			Existing Channel	Rehabilitated Channel	Percent Difference	Existing Channel	Rehabilitated Channel	Percent Difference	Existing Channel	Rehabilitated Channel	Percent Difference	Existing Channel	Rehabilitated Channel	Percent Difference	Existing Channel	Rehabilitated Channel	Percent Difference
384	0.000	Wisconsin-Illinois state line	218	220	1	855	860	1	1,620	1,620	0	2,290	2,300	0	2,570	2,580	0
362	1.323	0.6 mile upstream of 122nd Street (CTH ML)	222	223	0	869	875	1	1,670	1,670	0	2,380	2,390	0	2,690	2,700	0
358	2.267	0.7 mile downstream of STH 165	225	227	1	872	878	1	1,690	1,700	1	2,450	2,460	0	2,780	2,790	0
304	3.213	0.3 mile upstream of STH 165	196	198	1	796	803	1	1,600	1,610	1	2,360	2,380	1	2,700	2,710	0
298	4.659	1.0 mile downstream of Wilmot Road (CTH C)	209	211	1	787	793	1	1,590	1,600	1	2,410	2,420	0	2,790	2,800	0
216	6.297	211 feet downstream of 120th Avenue (East Frontage Road)	127	130	2	553	560	1	1,120	1,130	1	1,650	1,660	1	1,880	1,900	1
172	7.261	0.9 mile upstream of 120th Avenue (West Frontage Road)	126	129	2	533	540	1	1,090	1,100	1	1,640	1,660	1	1,890	1,910	1
170	8.491	1.3 miles downstream of 160th Avenue (CTH MB)	126	130	3	528	535	1	1,090	1,100	1	1,640	1,660	1	1,890	1,910	1
166	9.627	0.2 mile downstream of 160th Avenue (CTH MB)	123	128	4	503	511	2	1,050	1,060	1	1,610	1,620	1	1,870	1,880	1
162	11.334	1.5 miles upstream of 160th Avenue (CTH MB)	121	127	5	492	501	2	1,040	1,050	1	1,620	1,640	1	1,900	1,920	1
156	12.600	0.4 mile downstream of 75th Street (STH 50)	120	126	5	478	486	2	1,020	1,030	1	1,610	1,630	1	1,890	1,920	2
154	13.569	0.5 mile upstream of 75th Street (STH 50)	119	126	6	478	487	2	1,030	1,040	1	1,640	1,660	1	1,930	1,950	1
152	14.140	53 feet upstream of 60th Street (CTH K)	118	125	6	478	487	2	1,030	1,040	1	1,640	1,660	1	1,930	1,950	1

[a] *Assume removal of accumulated sediment along the Upper Des Plaines River between Brighton Creek and the Kenosha-Racine county line.*

[b] *Due to minor adjustments to the hydrologic model during the development of alternative plans, the flows in this table may not be exactly the same as those set forth at other locations in the watershed study report.*

Source: SEWRPC.

Table 108

COMPARISON OF 1990 LAND USE EXISTING CHANNEL CONDITION FLOOD DISCHARGES AND FLOOD DISCHARGES FOR PLANNED LAND USE CONDITION WITH IMPLEMENTATION OF THE STREAM REHABILITATION ALTERNATIVE[a,b]

Upper Des Plaines River

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01 1990 Land Use	1.01 Rehabilitated Channel	1.01 Percent Difference	2 1990 Land Use	2 Rehabilitated Channel	2 Percent Difference	10 1990 Land Use	10 Rehabilitated Channel	10 Percent Difference	50 1990 Land Use	50 Rehabilitated Channel	50 Percent Difference	100 1990 Land Use	100 Rehabilitated Channel	100 Percent Difference
68	14.810	0.7 mile upstream of 60th Street (CTH K)	45	62	38	183	199	9	413	430	4	687	718	5	825	867	5
62	16.140	370 feet upstream of CTH N	35	50	43	150	168	12	366	389	6	646	686	6	794	848	7
58	17.571	0.7 mile downstream of Burlington Road (STH 142)	38	71	87	202	258	28	576	631	10	1,130	1,150	2	1,450	1,450	0
54	18.110	0.2 mile downstream of Burlington Road (STH 142)	36	68	89	192	249	30	551	607	10	1,090	1,110	2	1,400	1,380	-1
50	18.916	0.6 mile upstream of Burlington Road (STH 142)	34	66	94	188	248	32	545	606	11	1,080	1,100	2	1,390	1,370	-1
44	19.350	1.1 miles upstream of Burlington Road (STH 142)	32	64	100	174	240	38	506	576	14	1,010	1,030	2	1,300	1,280	-2
29	20.163	Private drive	27	82	204	141	238	69	395	491	24	768	795	4	977	951	-3
16	20.594	0.6 mile downstream of County Line Road	9	23	156	51	88	73	145	202	39	278	344	24	351	418	19
8	21.196	County Line Road	4	9	125	29	43	48	100	120	20	219	238	9	291	308	6
2	21.791	0.6 mile upstream of County Line Road	1	1	0	15	15	0	62	62	0	155	155	0	216	216	0

Lower Des Plaines River

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01 1990 Land Use	1.01 Rehabilitated Channel	1.01 Percent Difference	2 1990 Land Use	2 Rehabilitated Channel	2 Percent Difference	10 1990 Land Use	10 Rehabilitated Channel	10 Percent Difference	50 1990 Land Use	50 Rehabilitated Channel	50 Percent Difference	100 1990 Land Use	100 Rehabilitated Channel	100 Percent Difference
384	0.000	Wisconsin-Illinois state line	171	220	29	797	860	8	1,570	1,620	3	2,240	2,300	3	2,520	2,580	2
362	1.323	0.6 mile upstream of 122nd Street (CTH ML)	172	223	30	808	875	8	1,610	1,670	4	2,330	2,390	3	2,620	2,700	3
358	2.267	0.7 mile downstream of STH 165	169	227	34	807	878	9	1,630	1,700	4	2,380	2,460	3	2,690	2,790	4
304	3.213	0.3 mile upstream of STH 165	158	198	25	744	803	8	1,530	1,610	5	2,270	2,380	5	2,590	2,710	5
298	4.659	1.0 mile downstream of Wilmot Road (CTH C)	151	211	40	718	793	10	1,520	1,600	5	2,300	2,420	5	2,650	2,800	6
216	6.297	211 feet downstream of 120th Avenue (East Frontage Road)	118	130	10	537	560	4	1,100	1,130	3	1,630	1,660	2	1,870	1,900	2
172	7.261	0.9 mile upstream of 120th Avenue (West Frontage Road)	116	129	11	519	540	4	1,080	1,100	2	1,630	1,660	2	1,880	1,910	2
170	8.491	1.3 miles downstream of 160th Avenue (CTH MB)	116	130	12	514	535	4	1,080	1,100	2	1,630	1,660	2	1,880	1,910	2
166	9.627	0.2 mile downstream of 160th Avenue (CTH MB)	110	128	16	491	511	4	1,040	1,060	2	1,590	1,620	2	1,840	1,880	2
162	11.334	1.5 miles upstream of 160th Avenue (CTH MB)	106	127	20	480	501	4	1,030	1,050	2	1,600	1,640	3	1,860	1,920	3
156	12.600	0.4 mile downstream of 75th Street (STH 50)	102	126	24	465	486	5	1,010	1,030	2	1,590	1,630	3	1,850	1,920	4
154	13.569	0.5 mile upstream of 75th Street (STH 50)	101	126	25	464	487	5	1,020	1,040	2	1,610	1,660	3	1,880	1,950	4
152	14.140	53 feet upstream of 60th Street (CTH K)	101	125	24	464	487	5	1,020	1,040	2	1,610	1,660	3	1,880	1,950	4

[a] *Assume removal of accumulated sediment along the Upper Des Plaines River between Brighton Creek and the Kenosha-Racine county line.*

[b] *Due to minor adjustments to the hydrologic model during the development of alternative plans, the flows in this table may not be exactly the same as those set forth at other locations in the watershed study report.*

Source: SEWRPC.

Economic Analysis
The cost of this alternative depends on the degree of success in rehabilitating the stream channel through natural processes. If the natural rehabilitation process were completely successful, the total capital cost is estimated to be $2,565,000. This cost consists of $1,210,000 for floodproofing, $330,000 for structure elevation, $935,000 for structure removal, $15,000 for the installation of a continuous streamflow and water quality monitoring gauge that would measure sediment concentrations in the River, $25,000 for field surveys to establish baseline stream channel cross-sections, and $50,000 for lowering culverts at nine private crossings. The annual operation and maintenance cost for the rehabilitated stream is estimated to be $20,000. Utilizing an interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost under this scenario was estimated to be $183,000. If the natural rehabilitation process were not completely successful and mechanical sediment removal and associated stream rehabilitation measures were required, the total capital cost is estimated to range from $8,825,000 to $15,525,000. This cost consists of $1,210,000 for floodproofing, $330,000 for structure elevation, $935,000 for structure removal, $6,000,000 to $12,700,000 for stream rehabilitation measures[25], $300,000 for sediment removal, and $50,000 for lowering culverts at nine private crossings. The annual operation and maintenance cost for the rehabilitated stream is estimated to be $20,000. Utilizing an interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost under this scenario was estimated to range from $580,000 to $1,006,000, depending on the scope of the rehabilitation measures that would be required. The average annual flood abatement benefit to structures was estimated at $126,000, yielding a benefit cost ratio of 0.69 for the natural rehabilitation scenario and a benefit cost ratio ranging from 0.13 to 0.22 for the mechanical sediment removal with associated constructed rehabilitation features. Therefore, the stream rehabilitation with structure floodproofing, elevation, and removal alternative plan as described herein, while technically feasible, was found to have a benefit-cost ratio less than one.

EVALUATION OF WATERSHEDWIDE ALTERNATIVE PLANS

The following five different floodland management alternatives were examined as possible solutions to the flood problems of the Des Plaines River watershed as a whole:

- Structure floodproofing, elevation, and removal;
- Detention storage with structure floodproofing, elevation, and removal;
- Prairie restoration with structure floodproofing, elevation, and removal;
- Wetland restoration with structure floodproofing, elevation, and removal; and
- Stream rehabilitation with structure floodproofing, elevation, and removal.

Also, an alternative which involve essentially no action was also presented. The flood damages attendant to the "no action" alternative provide an important basis for analyses of the potential benefits associated with each of the other alternatives.

In addition to the five watershedwide alternative plans, detailed, case-specific sets of alternative and recommended plans were developed for two tributaries: Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake. Those alternative plans are described below. The watershedwide alternatives were evaluated relative to one another as described below. Following selection of a watershedwide recommended plan, the final recommended floodland management plan was adapted to include the case-specific recommended plans selected for Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake.

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[25]*Determination of the scope of the necessary stream rehabilitation would require a detailed facilities design. Due to uncertainties in the scope of the rehabilitation at this systems-level stage, a cost range is provided.*

The principal features of, and the costs and benefits associated with, each of the watershedwide floodland management alternatives are summarized in Table 106, together with the nontechnical and noneconomic considerations likely to influence selection of the most desirable approach. Excluding the “no action” approach, all of the above alternatives were found to be technically feasible. However, none of the alternatives were found to have benefit-cost ratios of greater than one. The five watershedwide alternative plans are evaluated below.

Comparison of Alternative Plans
The watershedwide alternative plans were compared and contrasted to determine which alternatives best promote and complement achievement of the overall plan objectives relative to floodland management; water quality, including sediment control; land use development; and outdoor recreation, and open space preservation.[26] Each of the alternative plans promotes the land use and outdoor recreation, and open space objectives to a similar degree. Thus, the main considerations for comparison and contrast are satisfaction of floodland management and water quality objectives and relative cost.

The No Action alternative was eliminated from further consideration because it has no features to mitigate increases in flood flows due to planned development plus the fact that, by definition, it does nothing to address the existing and potential water resource problems identified in the watershed.

The pure Structure Floodproofing, Elevation, and Removal alternative also has no features to mitigate increases in flood flows due to planned development, but it does provide an opportunity to substantially resolve flooding problems, while being compatible with the water quality objectives of the plan and having a relatively low cost.

Each of the Scenarios considered under the Detention Storage with Structure Floodproofing, Elevation, and Removal alternative has features to significantly mitigate increases in flood flows due to planned development, provides an opportunity to substantially resolve flooding problems, and could be expanded to promote the water quality objectives of the plan,[27] but each has a relatively high cost.

The Prairie Restoration with Structure Floodproofing, Elevation, and Removal alternative has features to mitigate increases in flood flows due to planned development, provides an opportunity to substantially resolve flooding problems, would promote the water quality objectives of the plan, and it has an intermediate cost.

The Wetland Restoration with Structure Floodproofing, Elevation, and Removal alternative has features to mitigate increases in flood flows at some locations in the watershed, provides an opportunity to substantially resolve flooding problems, and would promote the water quality objectives of the plan, but it has a relatively high cost.

The Stream Rehabilitation with Structure Floodproofing, Elevation, and Removal alternative has no features to mitigate increases in flood flows due to planned development, but it does provide an opportunity to substantially resolve flooding problems, it would promote the water quality objectives of the plan, and it could have a cost in the low to intermediate range.

Selection of Recommended Floodland Management Plan
An overall recommended floodland management plan was selected from the four watershedwide alternatives, that plan was then refined to:

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[26] *The reasons for adopting the recommended plans for Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake are set forth below in the sections of this chapter that describe those alternative plan analyses.*

[27] *Water quality benefits could be achieved through design configurations conducive to water quality improvement, including permanent ponds and wetland bottoms in detention basins and the appropriate use of native vegetation.*

- Incorporate the selected case-specific recommended plans for Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake, and
- Include important flood flow mitigation and habitat improvement features from other alternative plans.

After due consideration of the various technical and economic features and intangible aspects of the alternative floodland management measures, the Advisory Committee recommended that the Structure Floodproofing, Elevation, and Removal alternative be the basis for achieving reductions in flood damages for all of the watershed except Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake. The following additional alternative measures were added to augment the base floodproofing plan:

- The provision of detention storage to control runoff from areas of planned development during the two- and 100-year storms. The detention storage component incorporated in the final recommended plan has a higher level of control of the two-year event than any of the three scenarios set forth in the section describing the detention storage alternative. Comparison of peak two-year flood flows under 1990 and planned land use conditions along streams in developing subwatersheds throughout the watershed indicated that substantial increases in peak flow could be expected if peak two-year flows under post-development conditions were only limited to pre-development peak flows. The increases would occur because the post-development runoff volume would be greater than the pre-development volume and the near-peak post-development flows would be maintained over a longer time period than the near-peak pre-development flows. That condition would result in downstream flow combinations that would produce higher peaks following development. Also, in many cases, downstream peak flow rates would not be attenuated significantly during a two-year event because flows would largely be contained within channel banks. That situation would also tend to contribute to increases in two-year flood peaks. It was found that, under planned land use conditions, the potential increases in downstream two-year flows relative to 1990 land use conditions could generally be avoided by limiting the peak rate of runoff from areas of new development to 0.04 cfs per acre of new development. Under 100-year flood conditions, the level of control provided under detention Scenario 3 would be adequate to reduce post-development flood peaks relative to 1990 land use conditions along most of the tributary stream reaches in, and downstream from, areas of planned development. Also, peak 100-year flood flows at the Wisconsin-Illinois state line under planned land use conditions would essentially be maintained at the level they were at under 1990 land use conditions. In order to simplify the requirement for control of runoff from new development, a single 100-year release rate was also determined. The post-development outflows from recommended detention facilities under planned land use conditions were reviewed, and it was determined that application of a 100-year release rate of 0.3 cfs per acre of new development would approximate the adequate level of control simulated under detention Scenario 3.[28] An enhanced detention storage component was added because it contributes to maintenance of 1990 peak two- through 100-year flood flows throughout the watershed and at the Wisconsin-Illinois state line. The level of control of two-year storm runoff is more stringent than that required following promulgation of Chapter NR 151 of the Wisconsin Administrative Code. As noted above, the greater level of control of two-year flood flows is needed to avoid, to the degree possible, increases to peak flows throughout the stream system of the watershed.
- The restoration of 20 percent of the candidate prairie restoration areas in the watershed (six square miles). This target level of restoration falls between the 10 and 100 percent levels analyzed under the prairie restoration alternative described above. Because 1) of the wide range of benefits of prairie

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[28]*The analyses assume that the two- and 100-year storm flow limitations would be achieved through the provision of detention storage for new development. It may be possible to achieve a portion of the necessary level of control through stormwater management measures to promote infiltration; however, adequate supporting data would be needed to verify the effects of infiltration measures on peak rates of runoff.*

restoration, including habitat creation, water quality benefits, and flood flow reduction; 2) establishment of an ambitious long-term target will enable those benefits to be maximized; and 3) the degree of landowner willingness to restore prairies cannot be established until specific properties are proposed for restoration, it was decided to establish a restoration goal beyond the 10 percent level. This plan component would not be economically favorable for flood control, but it would be consistent with the water quality recommendations in Chapter XIII of this report which call for the provision of riparian buffers. Also, it would provide minor flood control benefits in Illinois through possible reduction in flood flows downstream from the Wisconsin-Illinois state line.

- Restoration of all candidate wetland areas within 100-year floodplains along the streams of the watershed (3.1 square miles). This plan component would also not be economically favorable for flood control, but its implementation would reduce agricultural flood damages by about 50 percent and it would provide benefits associated with the functional values of wetlands.[29]

Auxiliary Recommendation

The Advisory Committee also adopted the auxiliary recommendations 1) that the baseline monitoring phase of the Stream Rehabilitation alternative plan be implemented and 2) that beavers and beaver dams be controlled. The baseline monitoring phase would include establishment of a continuous recording streamflow and water quality gauge on the Des Plaines River, downstream of its confluence with Brighton Creek, and documentation of the configuration of the Upper Des Plaines River channel through annual field surveys of channel cross sections between River Miles 14.9 and 21.2.[30]

ALTERNATIVE FLOODLAND AND STORMWATER MANAGEMENT PLANS FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK IN THE VILLAGE OF PADDOCK LAKE

The Flood Problem

The hydrologic-hydraulic simulation of Unnamed Tributary No. 6 to Brighton Creek under both existing and planned land use conditions and existing channel and drainage conditions indicated that, for the reach beginning 1.7 miles upstream from the confluence with Brighton Creek and extending upstream about 0.3 mile to 237th Avenue, a significant potential exists for flood damage to homes. Average annual monetary flood damages attributable to primary and secondary structural flooding were estimated at $18,500 under existing conditions, and $31,400 under planned land use and existing channel conditions, assuming that no new floodprone structures would be constructed in the subwatershed. The increase in damages would be caused solely by increases in flood flows and stages caused by the conversion of land from rural to urban use in the tributary drainage area. As noted in Chapter XI, the only significant development of urban land in this drainage area under planned land use conditions is envisioned to occur on lands immediately adjacent to and south of 60th Street (CTH K). If additional floodprone development is permitted to occur, even higher monetary damages may be expected.

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[29]*The functional values of wetlands, include detention and retention of stormwater and floodwater; maintenance of baseflow; filtration and storage of sediments, nutrients, or toxic substances; protection against shoreline erosion; the provision of habitat for aquatic organisms and resident and transient wildlife species; and recreational, cultural, educational, scientific, and natural aesthetic values.*

[30]*Following achievement of the level of erosion and sediment control envisioned under the Stream Rehabilitation element, the annual stream cross section and suspended sediment monitoring phase of the Stream Rehabilitation element would be continued for a three-year period. Following that three-year period, the level of natural sediment removal in the Upper Des Plaines River would be evaluated. Selected mechanical sediment removal would be accomplished if there were locations where natural sediment removal has not been effective. Low-cost instream habitat restoration measures would be constructed based on reach-specific plans.*

Under existing land use, channel, and drainage conditions, flood damages of about $370; $74,270; $120,150; and $139,020 may be expected to be incurred during the two-, 10-, 50-, and 100-year recurrence interval flood events, respectively. Under planned land use and existing channel and drainage conditions, flood damages of about $2,340; $94,110; $124,430; and $147,370 may be expected to be incurred during the two-, 10-, 50-, and 100-year flood events, respectively.

No Action Alternative

One alternative course of action regarding the flood problem along Unnamed Tributary No. 6 to Brighton Creek is to do nothing, that is to recognize the inevitability of extensive flooding but to deliberately decide not to mount a collective, coordinated program to abate the flood damages. There are no monetary benefits associated with this alternative, and the average annual cost would be equivalent to the average annual flood damages under planned land use and existing channel and drainage conditions, or $31,400.

Alternative Plan No. 1: Structure Floodproofing, Elevation, and Removal

A structure floodproofing, elevation, and removal alternative floodland management plan was prepared and evaluated to determine if such a structure-by-structure approach would be a technically feasible and economically sound solution to the urban flood damage problems along Unnamed Tributary No. 6 to Brighton Creek. For analytical purposes, the 100-year recurrence interval flood stage under planned land use conditions and existing channel and drainage conditions was used to estimate the number of existing floodprone structures to be floodproofed, elevated, or removed and the approximate costs involved.

In the case of residential structures in the primary flood hazard are—defined as the 100-year recurrence interval floodplain—floodproofing was assumed to be feasible if the design flood stage was below the first floor elevation. Structure elevation was considered feasible for residential structures if the estimated cost of elevating the structure was less than the estimated structure removal cost. Structures to be elevated were assumed to have the first floor raised to an elevation two feet higher than the 100-year recurrence interval flood stage to provide adequate freeboard. For aesthetic reasons, structure elevation was limited to a maximum of four feet. Structures which would have to be elevated more than four feet were considered for removal.

Structures which are located outside, but immediately adjacent to, the 100-year recurrence interval flood hazard area, which have basement floors below the 100-year flood stage, and which have experienced secondary basement flooding based on past reports compiled by Village officials were identified as being likely to experience secondary basement flooding during the 100-year recurrence interval flood.[31] It was assumed that floodproofing would be applied to all structures where a secondary flooding hazard was identified.

As shown on Map 69, the analysis indicated that 16 structures are located in the primary flood hazard area, and nine are located in the secondary flood hazard area along Unnamed Tributary No. 6 to Brighton Creek. Of the 16 structures located in the primary flood hazard area, 13 would have to floodproofed, two would have to be removed, and one structure would have to be elevated under this alternative. All nine structures in the secondary flood hazard area would have to be floodproofed. Future flood damage to the existing private residences along this reach would be virtually eliminated by these floodproofing, elevation, and removal measures. However, residual problems associated with flooding of streets and yards would not be mitigated. Table 109 sets forth the number of structures to be floodproofed, elevated, and removed and summarizes the estimated costs and benefits.

Assuming that these structure floodproofing measures would be fully implemented, and utilizing an annual interest rate of 6 percent and a project life and amortization period of 50 years, the average annual cost is estimated at $40,100, consisting entirely of the amortization of the $632,000 capital cost—$414,000 for

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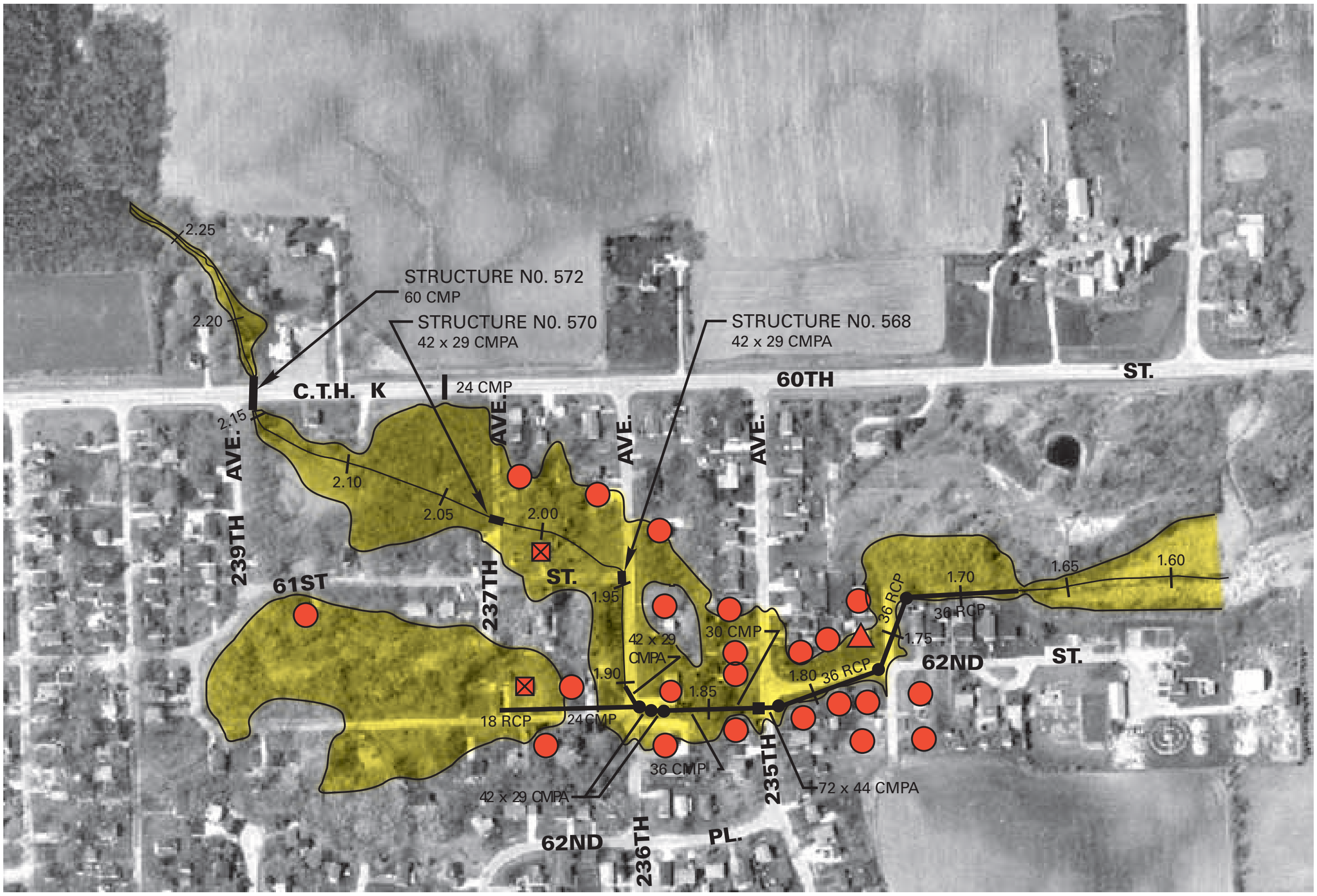
[31]*Secondary flooding reports based on observations during the floods of August 16, 1995, and May 23, 1996. The August 1996 flood had an estimated recurrence interval in excess of 100 years.*

Map 69

ALTERNATIVE PLAN NO. 1
STRUCTURE FLOODPROOFING, ELEVATION AND REMOVAL
FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK



100-YEAR RECURRENCE INTERVAL FLOODPLAIN-PLANNED LAND USE, EXISTING DRAINAGE AND CHANNEL CONDITIONS

1.80 APPROXIMATE EXISTING CHANNEL CENTERLINE AND RIVER MILE STATIONING

EXISTING STRUCTURE TO BE FLOODPROOFED

EXISTING STRUCTURE TO BE ELEVATED

EXISTING STRUCTURE TO BE REMOVED

12 EXISTING STORM SEWER OR CULVERT TO BE RETAINED (SIZE IN INCHES)

EXISTING MANHOLE

EXISTING JUNCTION BOX

RCP REINFORCED CONCRETE PIPE

CMP CORRUGATED METAL PIPE

CMPA CORRUGATED METAL PIPE ARCH

NOTE: THERE IS NO CHANGE BETWEEN THE 100-YEAR RECURRENCE INTERVAL FLOODLANDS UNDER PLANNED LAND USE AND EXISTING CHANNEL CONDITIONS, AND THE 100-YEAR RECURRENCE INTERVAL FLOODLANDS UNDER PLANNED LAND USE, ALTERNATIVE DRAINAGE AND CHANNEL CONDITIONS.

GRAPHIC SCALE
0 200 400 FEET

Source: SEWRPC.

floodproofing, $40,000 for elevation, and $178,000 for structure removal. The average annual flood damage abatement benefit was estimated at $31,400, yielding a benefit-cost ratio of 0.78.

An alternative to floodproofing or elevating structures in the primary flood hazard area would be to purchase and remove those structures. If all 16 structures located in the primary flood hazard area were purchased and removed, the estimated capital cost would be $2,025,200. Adding that cost to the estimated $160,000

Table 109

PRINCIPAL FEATURES, COSTS, AND BENEFITS OF THE FLOODLAND MANAGEMENT ALTERNATIVES FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK SUBWATERSHED

Alternative			Economic Analysis[a]									
											Nontechnical and Noneconomic Considerations	
Number	Name	Item	Capital Cost (thousands)	Annual Amortized Capital Cost (thousands)	Annual[b] Operation and Maintenance Cost (thousands)	Total[c] Annual Cost (thousands)	Annual[c] Benefits (thousands)	Excess of Annual Benefits Over Costs (thousands)	Benefit-Cost Ratio	Benefit-Cost Ratio Greater than 1.0	Positive	Negative
- -	No action	- -	- -	- -	- -	$ 31.4[d]	- -	- -	- -	No	- -	Continue to incur average annual flood damages of $31,400
1	Structure Floodproofing, Elevation, and Removal[e]	a. Floodproof 22 residential structures b. Elevate one residential structure c. Remove two residential structures	$ 414 40 178	$ 40.1	- -	$ 40.1	$31.4	-$ 8.7	0.78	No	Immediate partial flood relief at discretion of property owners Most of the costs would be borne by the beneficiaries	Complete, voluntary implementation unlikely, and, therefore, a significant flood problem would remain. Some floodproofing may be applied without adequate professional advice and, as a result, structure damage may occur
		Subtotal	$ 632	- -	- -	- -	- -	- -	- -	- -	- -	- -
2	Combination Detention Storage, Storm Sewer Improvement, and Structure Floodproofing and Removal	a. Provide detention storage north of CTH K b. Inlet pipe for detention c. Land acquisition d. Replace five-foot-diameter culvert under CTH K e. Improve storm sewer f. Floodproof three residential structures g. Remove two residential structures	$ 482 65 39 8 349 53 178	$ 74.5	$5.80	$ 80.3	$31.4	-$ 48.9	0.39	No	Achieves a relatively high level of reduction in the size of the floodplain Village would have control over implementation of storm sewer component Immediate partial flood relief at discretion of some property owners Some of the costs would be borne by the beneficiaries	Complete, voluntary implementation unlikely, and, therefore, some flood problems would remain Would require purchase of private property for detention basin Some floodproofing may be applied without adequate professional advice and, as a result, structure damage may occur
		Subtotal	$1,174	- -	- -	- -	- -	- -	- -	- -	- -	- -
2-1	Combination Detention Storage and Storm Sewer Improvement	a. Provide detention storage north of CTH K b. Inlet pipe for detention c. Land acquisition d. Replace five-foot-diameter culvert under CTH K e. Replace storm sewer f. Replace pipe north of 62nd Street g. Remove one residential structure	$ 482 65 39 8 964 266 65	$120.0	$5.70	$125.7	$31.4	-$ 94.3	0.25	No	Achieves a relatively high level of reduction in the size of the floodplain Village would have control over implementation of storm sewer component	Would require purchase of private property for detention basin
		Subtotal	$1,889	- -	- -	- -	- -	- -	- -	- -	- -	- -
2-2	Combination Detention Storage and Structure Floodproofing and Removal	a. Provide detention north of CTH K b. Inlet pipe for detention c. Land acquisition d. Replace five-foot-diameter culvert under CTH K e. Floodproof twenty residential structures f. Remove two residential structures	$ 482 65 39 8 407 178	$ 74.9	$5.60	$ 80.5	$31.4	-$ 49.1	0.39	No	Immediate partial flood relief at discretion of some property owners Much of the cost would be borne by the beneficiaries	Would require purchase of private property for detention basin Complete, voluntary implementation unlikely, and, therefore, some flood problems would remain. Some flood-proofing may be applied without adequate professional advice and, as a result, structure damage may occur
		Subtotal	$1,179	- -	- -	- -	- -	- -	- -	- -	- -	- -
3	Combination Storm Sewer Improvement and Limited Structure Floodproofing and Removal	a. Replace storm sewer b. Replace pipe north of 62nd Street c. Remove one residential structure d. Floodproof three residential structures	$1,293 266 65 41	$105.7	$0.08	$105.8	$31.4	-$ 74.4	0.30	No	Achieves the greatest degree of reduction in the size of the floodplain Village would have control over implementation of storm sewer component Immediate partial flood relief at discretion of some property owners Some of the cost would be borne by the beneficiaries	Complete, voluntary implementation unlikely, and, therefore, some flood problems would remain. Some floodproofing may be applied without adequate professional advice and, as a result, structure damage may occur
		Subtotal	$1,665	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 109 (continued)

Alternative			Economic Analysis[a]								Nontechnical and Noneconomic Considerations	
Number	Name	Item	Capital Cost (thousands)	Annual Amortized Capital Cost (thousands)	Annual[b] Operation and Maintenance Cost (thousands)	Total[c] Annual Cost (thousands)	Annual[c] Benefits (thousands)	Excess of Annual Benefits Over Costs (thousands)	Benefit-Cost Ratio	Benefit-Cost Ratio Greater than 1.0	Positive	Negative
3-1	Combination Storm Sewer Improvement and Structure Floodproofing and Removal	a. Replace storm sewer b. Floodproof six residential structures c. Remove two residential structures	$ 752 95 178	$ 65.1	$0.13	$ 65.2	$31.4	-$ 33.8	0.48	No	Village would have control over implementation of storm sewer component Immediate partial flood relief at discretion of some property owners Some of the cost would be borne by the beneficiaries	Complete, voluntary implementation unlikely, and, therefore, some flood problems would remain. Some floodproofing may be applied without adequate professional advice and, as a result, structure damage may occur
		Subtotal	$1,025	- -	- -	- -	- -	- -	- -	- -	- -	- -
4	Combination Diversion, Storm Sewer Improvement, and Structure Floodproofing and Removal	a. Install 4,450-foot-long pipe along north side of CTH K b. Replace five-foot-diameter culvert under CTH K c. Improve storm sewer d. Floodproof three residential structures e. Remove two residential structures	$2,550 8 349 53 178	$199.3	$1.40	$200.7	$31.4	-$169.3	0.16	No	Achieves a relatively high level of reduction in the size of the floodplain Village would have control over implementation of storm sewer component Immediate partial flood relief at discretion of some property owners Some of the cost would be borne by the beneficiaries	Complete, voluntary implementation unlikely, and, therefore, some flood problems would remain. Some floodproofing may be applied without adequate professional advice and, as a result, structure damage may occur
		Subtotal	$3,138	- -	- -	- -	- -	- -	- -	- -	- -	- -
4-1	Combination Diversion and Storm Sewer Improvement	a. Install 4,450-foot-long pipe along north side of CTH K b. Replace five-foot-diameter culvert under CTH K c. Replace storm sewer d. Replace pipe north of 62nd Street e. Remove one residential structure	$2,550 8 964 266 65	$244.7	$1.40	$246.1	$31.4	-$214.7	0.13	No	Achieves a relatively high level of reduction in the size of the floodplain Village would have control over implementation of storm sewer component Immediate partial flood relief at discretion of one owner	- -
		Subtotal	$3,853	- -	- -	- -	- -	- -	- -	- -	- -	- -

[a] *Economic analyses are based on an annual interest rate of 6 percent, a 50-year amortization period and project life, and an* Engineering News Record *1999 Construction Cost Index of 7022.*

[b] *Negative costs were noted when the replacement component was estimated to have a lower operation and maintenance cost than that of the existing facility.*

[c] *Annual benefits and costs used in the benefit-cost analysis include only the direct benefits derived from the abatement of monetary flood damages and the direct costs attendant to implementation of the floodland management measures, including capital and operation and maintenance costs. Environmental and recreational benefits and costs were not addressed in the cost-benefit analysis, since these represent intangible benefits and, therefore, cannot be readily quantified.*

[d] *The total cost of this alternative consists of the average annual monetary flood damages.*

[e] *If all 16 structures in the primary flood hazard area were purchased and removed and all nine structures in the secondary flood hazard area were floodproofed, the total capital cost would be $2,185,000, the average annual cost would be $138,700, and the estimated benefit-cost ratio would be 0.23.*

Source: SEWRPC.

cost of floodproofing for the nine residences in the secondary flood hazard area yields a total capital cost of $2,185,000. Utilizing an annual interest rate of 6 percent and a project life of 50 years, the average annual cost is estimated at $138,700. Based on the estimated average annual flood damage abatement benefit of $31,400, the benefit-cost ratio would be 0.23 under this scenario.

Alternative Plan No. 2: Combination Detention Storage, Storm Sewer Improvement, and Structure Floodproofing and Removal

A floodland management plan consisting of a combination of detention storage, storm sewer improvement, and structure floodproofing and removal was prepared and evaluated for Unnamed Tributary No. 6 to Brighton Creek. As shown on Map 70, a detention basin would be located just north of CTH K (60th Street) and east of the tributary. The proposed basin, which would store runoff from the entire 0.74-square-mile tributary drainage area upstream of CTH K, would have a storage capacity of about 13 acre-feet and a maximum pond area of about 4.5 acres, during the 100-year flood. The existing 24-inch-diameter corrugated metal pipe (CMP) culvert under CTH K would be retained to serve as the detention basin outlet. That culvert discharges to a tributary to Unnamed Tributary No. 6. A proposed 250-foot-long, 53-inch-wide by 34-inch-high elliptical reinforced concrete pipe (RCP) would be installed along the north side of CTH K to divert runoff from the stream to the detention basin during flood events with recurrence intervals longer than one year. The existing 60-inch-diameter CMP culvert under CTH K would be replaced by a 15-inch-diameter RCP culvert, which would restrict the amount of flow passing downstream in the existing channel, facilitating the diversion while maintaining the low-flow regime of the channel.

Since the diversion of flow to the detention basin would only occur during floods with recurrence intervals greater than one year, the basin would not be effective in reducing nonpoint source pollution from most of the runoff events occurring each year. If the basin were designed to receive flow during events with recurrence intervals of one year or less, nonpoint source pollution control could be achieved, but the flow in the unnamed tributary from the area upstream of CTH K would be eliminated. To preserve the low flow regime in the tributary, the detention basin was not designed to provide control of nonpoint source pollution.

This alternative also calls for the replacement of the existing 36-inch-diameter CMP and 30-inch-diameter RCP storm sewer pipes between 236th and 235th Avenues with 300 lineal feet of 36-inch-diameter RCP storm sewer. In addition, 750 lineal feet of new 48-inch-diameter RCP storm sewer would be constructed parallel to the existing 36-inch-diameter RCP storm sewer, beginning at 235th Avenue and extending east to the storm sewer outfall.

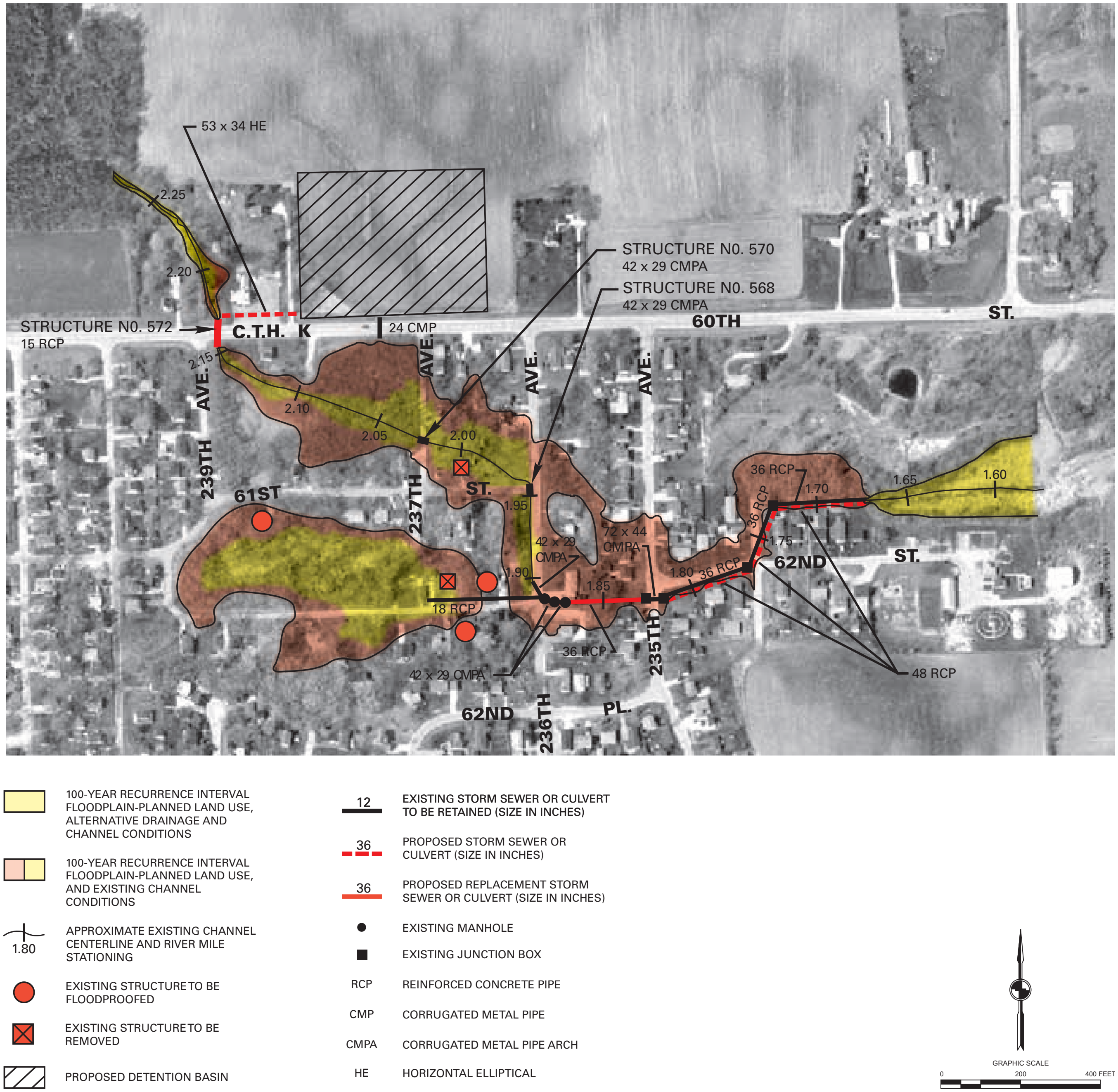
The existing 18-inch-diameter RCP and 24-inch-diameter CMP which are located along the north side of 62nd Street and west of 236th Avenue would be retained under this alternative. These pipes, which serve as an outlet to the tributary drainage area west of 236th Avenue and south of 61st Street, restrict the flow and cause ponding of runoff in that area. The hydraulic restriction and resultant ponding serve to reduce downstream peak flows, but also create the potential for flooding of four residential structures. Of these four structures, two are located in the primary flood hazard area and two are located in the secondary flood hazard area. Under this alternative, three of those residential structures would be floodproofed and one would be removed. This alternative plan also calls for the removal of one residential structure located in the primary flood hazard area northeast of the intersection of 61st Street and 237th Avenue.

Implementation of this alternative would essentially eliminate all damages to structures attendant to floods up to, and including, the 100-year recurrence interval event. In addition, this alternative would abate the residual problems associated with flooding of streets and yards.

Utilizing an annual interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative is estimated at $80,300. This cost consists of the amortization of the $1,174,000 capital cost—$482,000 for the construction of the detention basin and its outlet structure, $65,000 for the

Map 70

ALTERNATIVE PLAN NO. 2
COMBINATION DETENTION STORAGE, STORM SEWER IMPROVEMENT, AND STRUCTURE FLOODPROOFING AND REMOVAL FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK



Source: SEWRPC.

detention basin inlet structure, $39,000 for land acquisition for the detention basin, $8,000 for culvert replacement, $349,000 for storm sewer improvements, $53,000 for structure floodproofing, and $178,000 for structure removal—and a $5,800 increase in annual operation and maintenance costs. The average annual flood damage abatement benefit was estimated at $31,400, resulting in a benefit-cost ratio of 0.39.

Subalternative Plan No. 2-1: Combination Detention Storage and Storm Sewer Improvement

The measures called for under this subalternative plan are shown on Map 71. Aside from the features described below, this subalternative plan is identical to Alternative Plan No. 2.[32]

This subalternative plan calls for the replacement of the existing 18-inch-diameter RCP and the 24-inch-diameter CMP which are located along the north side of 62nd Street and west of 236th Avenue. The replacement storm sewer would consist of 340 lineal feet of 10-foot-wide by three-foot-high concrete box. The increase in conveyance capacity provided by this storm sewer replacement would prevent ponding of runoff in the area west of 236th Avenue and south of 61st Street, but would cause increased downstream peak flows. Therefore, this subalternative also calls for the replacement of the storm sewer between the intersection of 62nd Street and 236th Avenue and the outfall east of 234th Avenue with, from upstream to downstream, 350 lineal feet of five-foot-wide by three-foot-high concrete box, 50 lineal feet of double five-foot-wide by three-foot-high concrete box, and 750 lineal feet of double six-foot-wide by three-foot-high concrete box storm sewer. The existing 10-foot-long, 42-inch-wide by 29-inch-high corrugated metal pipe arch located at the inlet of the storm sewer would be retained under this subalternative.

This plan also calls for the removal of the residential structure located in the primary flood hazard area northeast of the intersection of 61st Street and 237th Avenue. The potential for flooding damages to the four private residences which are located west of 236th Avenue and south of 61st Street, and would have to be floodproofed or removed under Alternative Plan No. 2, would be eliminated under this plan.

Implementation of this subalternative would essentially eliminate all damages to structures attendant to floods up to, and including, the 100-year recurrence interval event. In addition, this alternative would eliminate nearly all of the residual problems associated with flooding of streets and yards.

Utilizing an annual interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this subalternative is estimated at $125,700. This cost consists of the amortization of the $1,889,000 capital cost—$482,000 for the construction of the detention basin and its outlet structure, $65,000 for the detention basin inlet structure, $39,000 for land acquisition for the detention basin, $8,000 for culvert replacement, $964,000 for storm sewer improvements, $266,000 for replacement of pipes north of 62nd Street, and $65,000 for structure removal—and a $5,700 increase in annual operation and maintenance costs. The average annual flood damage abatement benefit was estimated at $31,400, resulting in a benefit-cost ratio of 0.25.

Subalternative Plan No. 2-2: Combination Detention Storage and Structure Floodproofing and Removal

The measures called for under this subalternative plan are shown on Map 72. A detention basin would be located just north of CTH K (60th Street) and east of the tributary.[33] The proposed basin, which would store runoff from the entire 0.74-square-mile tributary drainage area upstream of CTH K, would have a storage capacity of about 13 acre-feet and a maximum pond area of about 4.5 acres, during the 100-year flood. The existing 24-inch-diameter CMP culvert under CTH K would be retained to serve as the detention basin outlet. That culvert discharges to a tributary to Unnamed Tributary No. 6. A proposed 250-foot-long, 53-inch-wide by 34-inch-high elliptical RCP would be installed along the north side of CTH K to divert runoff from the stream to the detention basin during flood events with recurrence intervals longer than one year. The existing 60-inch-diameter CMP culvert under CTH K would be replaced by a 15-inch-diameter RCP culvert, which would restrict the amount of flow passing downstream in the existing channel, facilitating the diversion while maintaining the low-flow regime of the channel.

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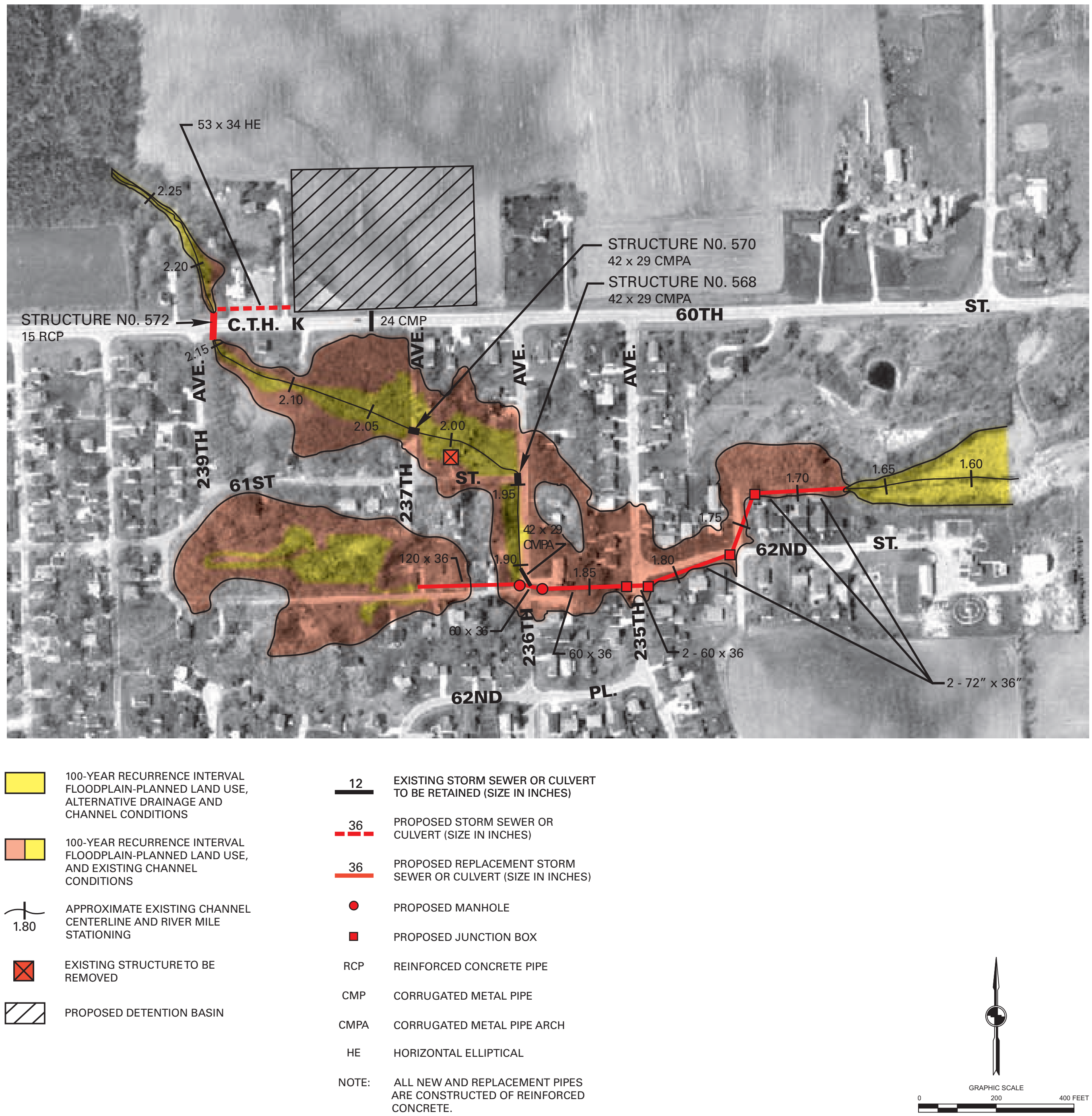
[32]*As for Alternative Plan No. 2, to preserve the low-flow regime in the tributary, the detention basin would not be designed to provide control of nonpoint source pollution.*

[33]*Ibid.*

Map 71

ALTERNATIVE PLAN NO. 2-1
COMBINATION DETENTION STORAGE AND STORM SEWER IMPROVEMENT
FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK

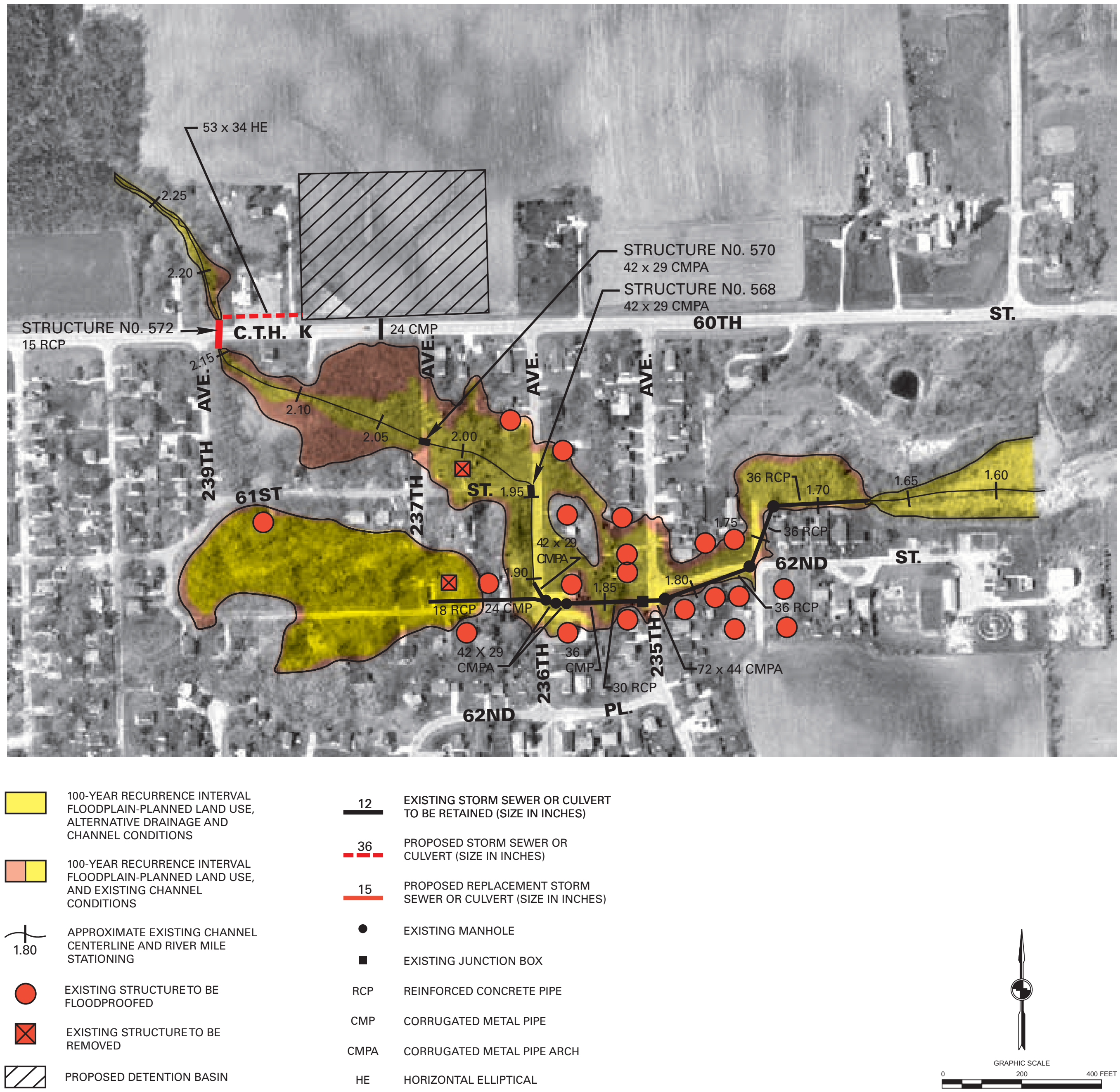


Source: SEWRPC.

The existing 18-inch-diameter RCP and 24-inch-diameter CMP which are located along the north side of 62nd Street and west of 236th Avenue would be retained under this subalternative. As explained in the description of Alternative Plan No. 2, those pipes, which serve as an outlet to the tributary drainage area west of 236th Avenue and south of 61st Street, restrict the flow and cause ponding of runoff in that area. The hydraulic restriction and resultant ponding reduce downstream peak flows.

Map 72

SUB-ALTERNATIVE PLAN NO. 2-2
COMBINATION DETENTION STORAGE AND STRUCTURE FLOODPROOFING AND REMOVAL FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK



Source: SEWRPC.

The hydraulic analysis of flow conditions under this subalternative indicated that 10 structures may be expected to be located in the primary flood hazard area, and 12 may be expected to be located in the secondary flood hazard area along Unnamed Tributary No. 6 to Brighton Creek. Of the 10 structures in the primary flood hazard area, eight would have to floodproofed and two would have to be removed under this subalternative. All 12 structures in the secondary flood hazard area would have to be floodproofed.

Implementation of this subalternative would essentially eliminate all future flood damages to the existing private residences along this reach of Unnamed Tributary No. 6 to Brighton Creek attendant to floods up to, and including, the 100-year recurrence interval event. However, residual problems associated with flooding of streets and yards would not be mitigated.

Assuming that the structure floodproofing measures called for under this subalternative would be fully implemented, and utilizing an annual interest rate of 6 percent and a project life and amortization period of 50 years, the average annual cost is estimated at $80,500. This cost consists of the amortization of the $1,179,000 capital cost—$482,000 for the construction of the detention basin and its outlet structure, $65,000 for the detention basin inlet structure, $39,000 for land acquisition for the detention basin, $8,000 for culvert replacement, $407,000 for structure floodproofing, and $178,000 for structure removal—and a $5,600 increase in annual operation and maintenance costs. The average annual flood damage abatement benefit was estimated at $31,400, resulting in a benefit-cost ratio of 0.39.

Alternative Plan No. 3: Combination Storm Sewer Improvement and Limited Structure Floodproofing and Removal

This floodland management alternative plan is shown on Map 73, and calls for the replacement of the storm sewer trunk between the intersection of 62nd Street and 236th Avenue and the outfall east of 234th Avenue with, from upstream to downstream, 10 lineal feet of five-foot-wide by three-foot-high concrete box, 350 lineal feet of eight-foot-wide by three-foot-high concrete box, 300 lineal feet of double seven-foot-wide by three-foot-high concrete box, and 500 lineal feet of double nine-foot-wide by three-foot-high concrete box storm sewer. The existing 18-inch-diameter RCP and the 24-inch-diameter CMP, located along the north side of 62nd Street and west of 236th Avenue, would be replaced under this plan with 340 lineal feet of 10-foot-wide by three-foot-high concrete box storm sewer.

This alternative plan also calls for the removal of one residence located northeast of the intersection of 61st Street and 237th Avenue, and the floodproofing of three other residences located upstream of 61st Street crossing of Unnamed Tributary No. 6 to Brighton Creek.

Implementation of this alternative would essentially eliminate all damages to structures attendant to floods up to, and including, the 100-year recurrence interval event. In addition, this alternative would abate the residual problems associated with flooding of streets and yards.

Utilizing an annual interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative is estimated at $105,800. This cost consists of the amortization of the $1,665,000 capital cost—$1,293,000 for storm sewer improvements, $266,000 for replacement of pipes north of 62nd Street, $41,000 for structure floodproofing, and $65,000 for structure removal—and a $80 increase in annual operation and maintenance costs. The average annual flood damage abatement benefit was estimated at $31,400, resulting in a benefit-cost ratio of 0.30.

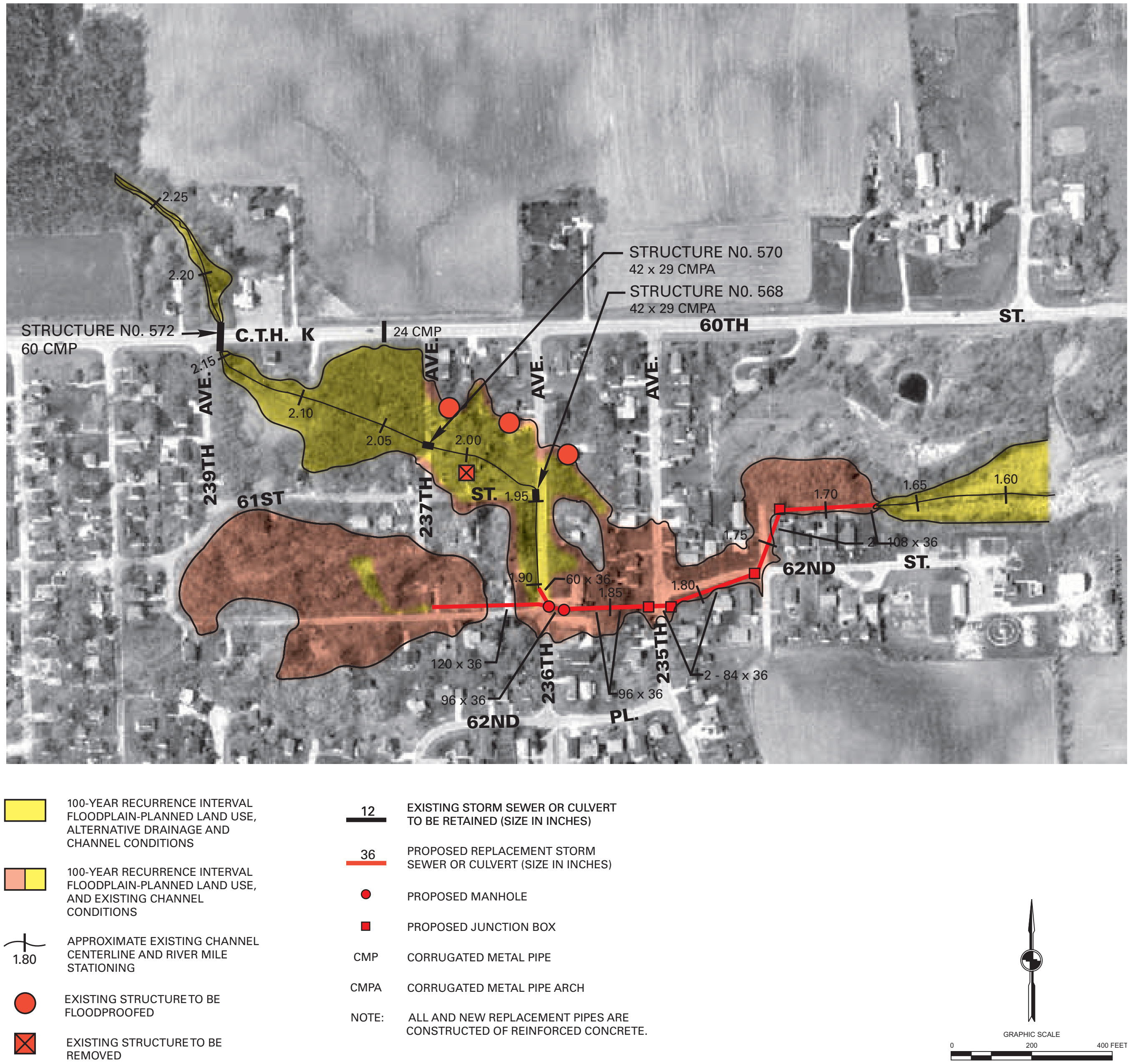
Subalternative Plan No. 3-1: Combination Storm Sewer Improvement and Structure Floodproofing and Removal

This subalternative plan is shown on Map 74, and calls for the replacement of the existing storm sewer between the intersection of 62nd Street and 236th Avenue and the outfall east of 234th Avenue with, from upstream to downstream, 70 lineal feet of five-foot-wide by three-foot-high concrete box, 300 lineal feet of six-foot-wide by three-foot-high concrete box, 50 lineal feet of eight-foot-wide by three-foot-high concrete box, and 750 lineal feet of nine-foot-wide by three-foot-high concrete box storm sewer.

The existing 18-inch-diameter RCP and 24-inch-diameter CMP which are located along the north side of 62nd Street and west of 236th Avenue would be retained under this subalternative. As explained in the description of Alternative Plan No. 2, these pipes, which serve as an outlet to the tributary drainage area west of 236th Avenue and south of 61st Street, restrict the flow and cause ponding of runoff in that area. The hydraulic restriction and

Map 73

ALTERNATIVE PLAN NO. 3
STORM SEWER IMPROVEMENT AND LIMITED STRUCTURE FLOODPROOFING AND REMOVAL FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK

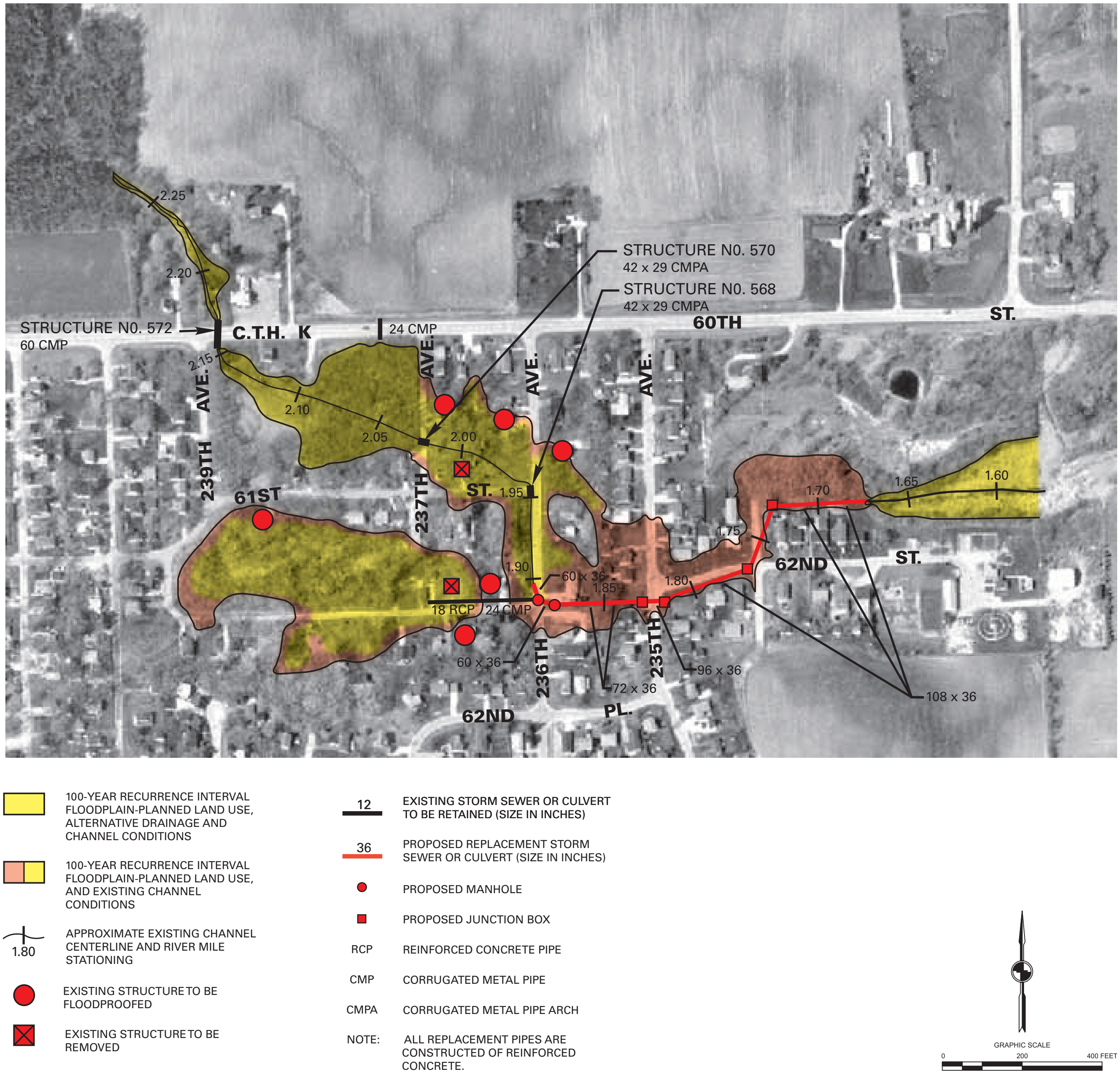


Source: SEWRPC.

resultant ponding reduce downstream peak flows, but also create potential flooding to four residential structures. Of those four structures, two may be expected to be located in the primary flood hazard area, and two may be expected to be located in the secondary flood hazard area. This subalternative plan calls for the floodproofing of three of those residential structures and the removal of one.

Map 74

SUB-ALTERNATIVE PLAN NO. 3-1
COMBINATION STORM SEWER IMPROVEMENT AND LIMITED STRUCTURE FLOODPROOFING AND REMOVAL FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK



Source: SEWRPC.

This plan also calls for the removal of the residential structure located in the primary flood hazard area northeast of the intersection of 61st Street and 237th Avenue, and the floodproofing of three additional residential structures located upstream of 61st Street crossing of Unnamed Tributary No. 6 to Brighton Creek.

Implementation of this subalternative would essentially eliminate all damages to structures attendant to floods up to, and including, the 100-year recurrence interval event. In addition, this alternative would abate the residual problems associated with flooding of streets and yards.

Utilizing an annual interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this subalternative is estimated at $65,200. This cost consists of the amortization of the $1,025,000 capital cost—$752,000 for storm sewer improvements, $95,000 for structure floodproofing, and $178,000 for structure removal—and a $130 increase in annual operation and maintenance costs. The average annual flood damage abatement benefit was estimated at $31,400, resulting in a benefit-cost ratio of 0.48.

Alternative Plan No. 4: Combination Diversion, Storm Sewer Improvement, and Structure Floodproofing and Removal

An alternative floodland management plan consisting of a combination of flow diversion, storm sewer improvement, and structure floodproofing and removal was prepared and evaluated for Unnamed Tributary No. 6 to Brighton Creek. This alternative plan is shown on Map 75. Under this alternative plan, during storms with recurrence intervals longer than one year, runoff from the entire tributary drainage area upstream of CTH K (60th Street) would be intercepted and conveyed to the east in a proposed 4,450-foot-long reinforced concrete pipe. The proposed pipe would be installed along the north side of CTH K and would consist of two sections. The first section of the pipe would be 240 feet long and would have a diameter of 42 inches, the second section would be 4,210 feet long and would have a diameter of 60 inches.

The proposed pipe would terminate about 500 feet west of the downstream CTH K crossing of Unnamed Tributary No. 6 to Brighton Creek. Discharge from the pipe would be conveyed to Brighton Creek in the existing roadside swale along CTH K. Stormwater inlet capacity would be provided along the diversion pipe to intercept runoff which would otherwise flow south in an existing 24-inch-diameter CMP culvert under CTH K about 130 feet west of the intersection with 237th Avenue and also over the roadway at the intersection of CTH K and 237th Avenue.

The existing 60-inch-diameter CMP culvert under CTH K would be replaced by a 15-inch-diameter RCP culvert, which would restrict the amount of flow passing downstream in the existing channel, while maintaining the low-flow regime of the channel.

Similar to Alternative Plan No. 2, this alternative plan also calls for the replacement of the existing 36-inch-diameter CMP and 30-inch-diameter RCP storm sewer between 236th and 235th Avenues with 300 lineal feet of 36-inch-diameter RCP storm sewer. In addition, 750 lineal feet of new 48-inch-diameter RCP storm sewer would be constructed parallel to the existing 36-inch-diameter RCP storm sewer, beginning at 235th Avenue and extending east to the storm sewer outfall.

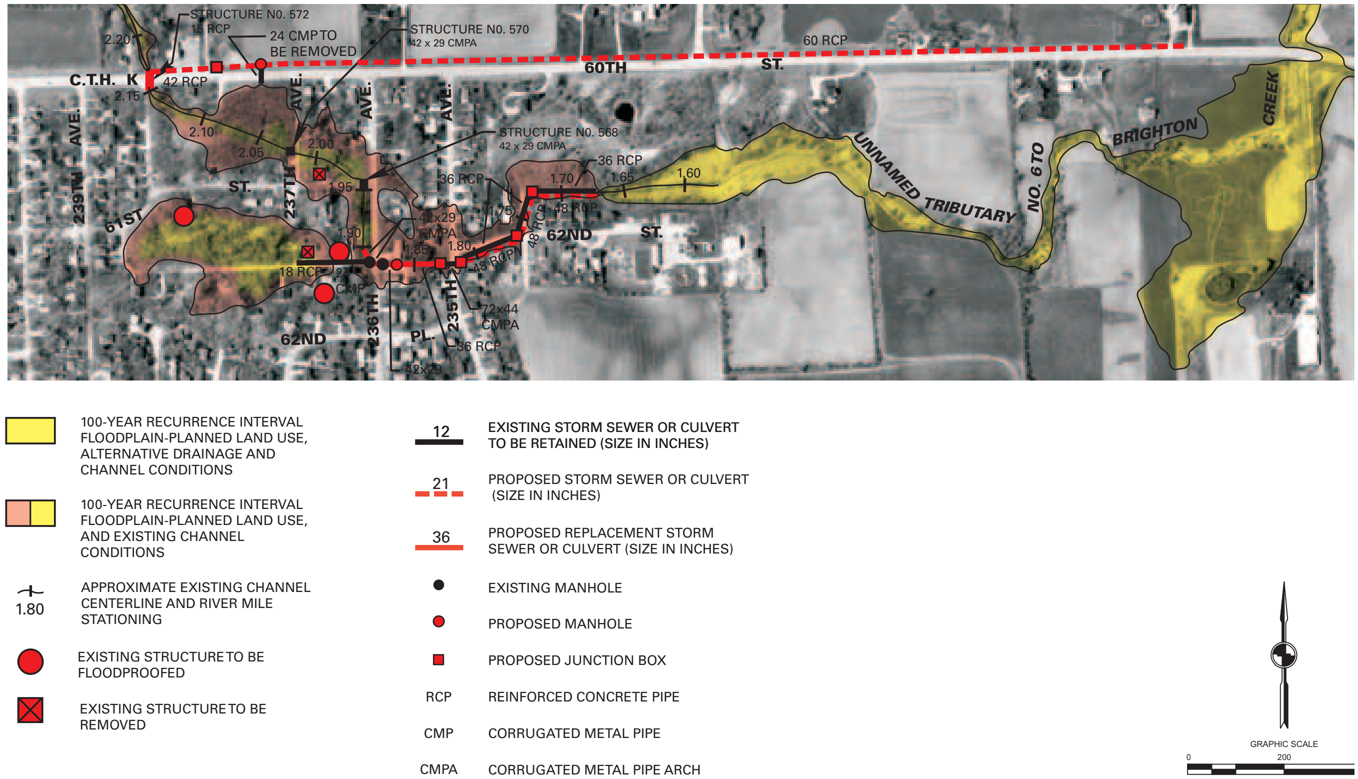
The existing 18-inch-diameter RCP and 24-inch-diameter CMP which are located along the north side of 62nd Street and west of 236th Avenue would be retained under this alternative. As explained in Alternative Plan No. 2 above, those pipes, which serve as an outlet to the tributary drainage area west of 236th Avenue and south of 61st Street, restrict the flow and cause ponding of runoff in that area. The hydraulic restriction and resultant ponding reduce downstream peak flows, but also create potential flooding to four residential structures. Of those four structures, two may be expected to be located in the primary flood hazard area, and two may be expected to be located in the secondary flood hazard area. This alternative plan calls for the floodproofing of three of those residential structures and the removal of one. This alternative plan also calls for the removal of the residential structure located in the primary flood hazard area northeast of the intersection of 61st Street and 237th Avenue.

Implementation of this alternative would essentially eliminate all damages to structures attendant to floods up to, and including, the 100-year recurrence interval event. In addition, this alternative would significantly reduce residual problems associated with street and yard flooding.

Utilizing an annual interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative is estimated at $200,700. This cost consists of the amortization of the $3,138,000 capital cost—$2,550,000 for construction of pipe along north side of CTH K, $8,000 for culvert replacement, $349,000 for storm sewer improvements, $53,000 for structure floodproofing, and $178,000 for structure

Map 75

SUB-ALTERNATIVE PLAN NO. 4
COMBINATION DIVERSION, STORM SEWER IMPROVEMENT, AND STRUCTURE FLOODPROOFING AND REMOVAL FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK



Source: SEWRPC.

removal—and a $1,400 increase in annual operation and maintenance costs. The average annual flood damage abatement benefit was estimated at $31,400, resulting in a benefit-cost ratio of 0.16.

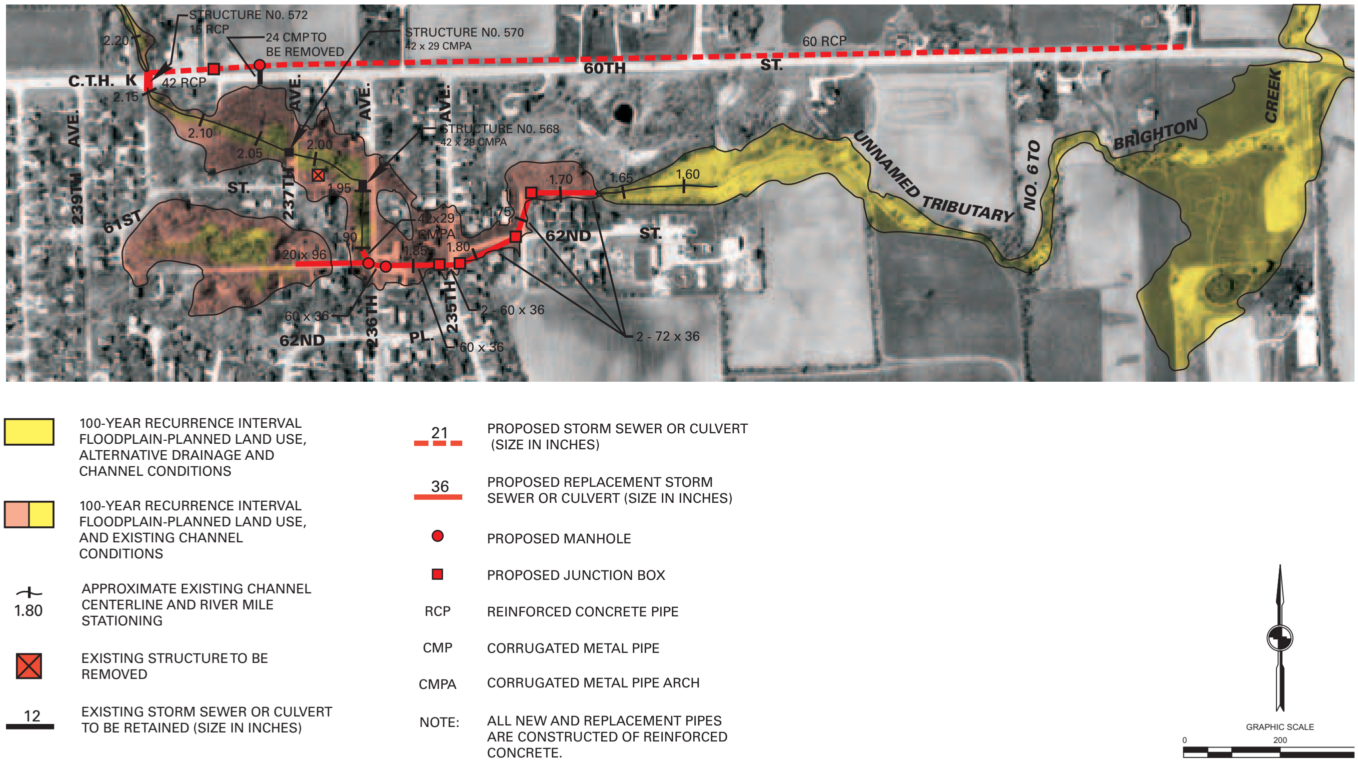
Subalternative Plan No. 4-1: Combination Diversion and Storm Sewer Improvement

The proposed measures called for under this subalternative plan are shown on Map 76. Aside from the features discussed below, this subalternative plan is identical to Alternative Plan No. 4—Combination Diversion, Storm Sewer Improvement, and Structure Floodproofing and Removal.

This subalternative plan calls for the replacement of the existing 18-inch-diameter RCP and the 24-inch-diameter CMP which are located along the north side of 62nd Street and west of 236th Avenue. The replacement storm sewer would consist of 340 lineal feet of 10-foot-wide by three-foot-high concrete box. The increase in conveyance capacity provided by this storm sewer replacement would prevent ponding of runoff in the area west of 236th Avenue and south of 61st Street, but would cause increased downstream peak flows. Therefore, this subalternative also calls for the replacement of the storm sewer between the intersection of 62nd Street and 236th Avenue and the outfall east of 234th Avenue with, from upstream to downstream, 350 lineal feet of five-foot-wide by three-foot-high concrete box, 50 lineal feet of double five-foot-wide by three-foot-high concrete box, and 750 lineal feet of double six-foot-wide by three-foot-high concrete box storm sewer. The existing 10-foot-long, 42-inch-wide by 29-inch-high corrugated metal pipe arch located at the inlet of the storm sewer would be retained under this subalternative.

Map 76

SUB-ALTERNATIVE PLAN NO. 4-1
COMBINATION DIVERSION AND STORM SEWER IMPROVEMENT
REMOVAL FOR UNNAMED TRIBUTARY NO. 6 TO BRIGHTON CREEK



Source: SEWRPC.

The potential for flooding damages to the four private residences located west of 236th Avenue and south of 61st Street, and which would have to be floodproofed or removed under Alternative Plan No. 4, would be eliminated under this subalternative plan. This subalternative plan also calls for the removal of the residential structure located in the primary flood hazard area northeast of the intersection of 61st Street and 237th Avenue.

Implementation of this subalternative would essentially eliminate all damages to structures attendant to floods up to, and including, the 100-year recurrence interval event. In addition, this alternative would eliminate nearly all of the residual problems associated with street and yard flooding.

Utilizing an annual interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative is estimated at $246,100. This cost consists of the amortization of the $3,853,000 capital cost—$2,550,000 for construction of pipe along north side of CTH K, $8,000 for culvert replacement, $964,000 for storm sewer improvements, $266,000 for replacement of pipes north of 62nd Street, and $65,000 for structure removal—and $1,400 increase in annual operation and maintenance costs. The average annual flood damage abatement benefit was estimated at $31,400, resulting in a benefit-cost ratio of 0.13.

Evaluation of Floodland Management Alternative Plans for Unnamed Tributary No. 6 to Brighton Creek in the Village of Paddock Lake

In selecting recommended floodland management measures for Unnamed Tributary No. 6 to Brighton Creek, the costs; environmental and aesthetic impacts; implementability; and noneconomic, or intangible, benefits of each alternative plan were considered.

All the floodland management alternative plans developed for Unnamed Tributary No. 6 to Brighton Creek are considered technically feasible. The economic analysis indicated that none of the alternatives has a benefit-cost ratio of one or more.

The “no action” alternative plan, while offering the lowest cost, does nothing to alleviate the existing flood problem, and therefore does not represent a sound approach to floodland management. Furthermore, the flooding problems will become more severe as development occurs in the area.

Implementation of Alternative Plan No. 1, Alternative Plan No. 2, Alternative Plan No. 2-2, Alternative Plan No. 3-1, or Alternative Plan No. 4, would not result in any increase in downstream peak flows. However, implementation of Alternative Plan No. 2-1, Alternative Plan No. 3, or Alternative Plan No. 4-1, would result in increases in downstream 100-year recurrence interval peak flows of 7, 39, and 7 percent, respectively. Although downstream structure flooding problems would not be expected due to the increased flows, increases in 100-year flood stages of more than 0.01 foot may be expected. Therefore, implementation of Alternative Plan Nos. 2-1, 3, or 4-1 may require making appropriate legal arrangements with property owners in downstream areas in accordance with the Kenosha County zoning ordinance and Chapter NR 116 of the Wisconsin Administrative Code.

Alternative Plan No. 1—Structure Floodproofing, Elevation and Removal—has the highest benefit-cost ratio compared to the other alternatives considered. The total annual cost for this alternative is a little over one-half of the total annual cost of the next least costly alternative plan considered. Assuming full implementation of this alternative plan, structural flood damages would essentially be eliminated during floods with recurrence intervals up to, and including, 100 years. This alternative plan, however, presents several problems in implementation. First, complete implementation of a voluntary structure floodproofing and elevation program is unlikely and, with partial implementation, the Village of Paddock Lake would be left with a residual problem whenever a major flood event occurs. Second, even if a voluntary structure floodproofing and elevation program were completely carried out, the areas concerned in the Village of Paddock Lake would still be subjected to extensive overland flooding that would hamper routine access to and from some riverine area structures, continue to close local streets to automobile traffic, and interfere with the rapid movement of emergency vehicles. Furthermore, road and yard damages and yard cleanup costs would remain under the structure floodproofing, elevation, and removal alternative. Finally, some floodproofing may be applied without adequate professional advice. As a result, structure damage may occur, and Village officials are likely to be asked to assist in resolution of the problem. Because of potential problems with implementation and residual damages, this alternative was eliminated from further consideration.

Subalternative Plan No. 2-1—Combination Detention Storage and Storm Sewer Improvement; Alternative Plan No. 3—Combination Storm Sewer Improvement and Structure Floodproofing and Removal; and Subalternative Plan No. 4-1—Combination Diversion and Storm Sewer Improvement, were not considered further due to their relatively low benefit-cost ratios and to the attendant potential to increases in the 100-year recurrence interval flood stages downstream of the project area.

Subalternative Plan No. 2-2—Combination Detention Storage and Structure Floodproofing and Removal was eliminated from further consideration based on its relatively significant reliance on floodproofing and its inability to substantially reduce residual street and yard flooding. Alternative Plan No. 4—Combination Diversion, Storm Sewer Improvement, and Structure Floodproofing and Removal was also eliminated from further consideration based on its low benefit-cost ratio.

The two remaining alternatives, following the process of elimination, are Alternative Plan No. 2—Combination Detention Storage, Storm Sewer Improvement, and Structure Floodproofing and Removal and Subalternative Plan No. 3-1—Combination Storm Sewer Improvement and Structure Floodproofing and Removal. Neither of these alternatives would increase 100-year recurrence interval flood stages on Unnamed Tributary No. 6 to Brighton Creek downstream of the project area. Alternative No. 2 would provide a greater reduction in residual damages due to yard and street flooding and it would rely less on structure floodproofing than would Subalternative No. 3-1.

Conclusions and Preliminary Recommended Floodland Management Plan for Unnamed Tributary No. 6 to Brighton Creek in the Village of Paddock Lake

Based upon the description and evaluation of alternative plans presented above, the following conclusions and recommendations are made:

- A full range of alternative plans was evaluated, including an alternative relying entirely on floodproofing, elevation, and removal of floodprone structures and alternatives relying primarily on detention and conveyance structural components.
- Under any of the alternatives considered, the cost of the flood control measures exceeds the quantifiable benefits associated with mitigation of the flood problems, as is often the case with flood abatement projects. However, the benefits are based only upon the avoidance of direct monetary expenditures to restore flood damaged property. Given that there are other nonquantifiable considerations resulting from flood conditions, such as the impacts on emergency services; loss of wages; property devaluation; transportation disruption; and psychological stress, a case can be made to implement a flood abatement project even when the readily quantifiable costs exceed the readily quantifiable benefits.
- The alternative providing for floodproofing, elevation, and removal of floodprone structures was estimated to have the lowest cost. However, that alternative does not provide mitigation of yard and street flooding. In addition, experience has indicated that implementation of this alternative would be highly unlikely, since it relies on voluntary homeowner efforts. Thus, there is likely to be, at best, only limited reduction in the flooding problems.
- The provision of storage to reduce the flows from the upstream reaches north of 60th Street (CTH K) does offer some flood abatement benefits. However, such storage alone does not substantially solve the flooding problems.
- In order to significantly mitigate the flooding problems, it is necessary to install supplemental conveyance capacity, in addition to providing upstream detention. Accordingly, Alternative Plan No. 2—Combination Detention Storage, Storm Sewer Improvement, and Structure Floodproofing and Removal—which has the second highest benefit-cost ratio, was selected by the Watershed Committee as the recommended plan for the resolution of flooding problems along Unnamed Tributary No. 6 to Brighton Creek in the Village of Paddock Lake.[34]

ALTERNATIVE FLOODLAND AND STORMWATER MANAGEMENT PLANS FOR UNNAMED TRIBUTARY NO. 1 TO HOOKER LAKE IN THE TOWN OF SALEM

The Flood Problem

The hydrologic-hydraulic simulation of Unnamed Tributary No. 1 to Hooker Lake under both existing and planned land use conditions and existing channel and drainage conditions indicated that the potential exists for flood damage to two houses along the shoreline of Hooker Lake on the north side of 83rd Street. Under existing conditions, a 36-inch-diameter, 312-foot-long CMP culvert is located between the houses. That culvert conveys

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[34]*Implementation of the recommended plan may require a permit from the WDNR.*

flow in Unnamed Tributary No. 1 to Hooker Lake from the south side of 83rd Street to the Lake. In addition to having inadequate hydraulic capacity to prevent flooding of the adjacent houses during a 100-year flood, the culvert was also found to have inadequate capacity to prevent overtopping of 83rd Street during the 10-year flood. The standards set forth in Appendix C call for the provision of adequate hydraulic capacity to avoid overtopping of collector streets, such as 83rd Street, during a 10-year flood.

Average annual monetary flood damages attributable to primary and secondary structural flooding were estimated at \$3,400 under both existing and planned land use and conditions with existing channel conditions. Under existing and planned land use conditions with existing channel and drainage conditions, flood damages of about \$8,500, \$32,000, and \$35,000 may be expected to be incurred during the 10-, 50-, and 100-year recurrence interval flood events, respectively. Flood damages would not be expected during a two-year flood.

No Action Alternative
If no action were taken to reduce flood damages, there would be no monetary benefits, and the average annual cost would be equivalent to the average annual flood damages under planned land use and existing channel and drainage conditions, or \$3,400.

Alternative Plan No. 1: Structure Floodproofing
A structure floodproofing alternative floodland management plan was prepared and evaluated to determine if such an approach would be a technically feasible and economically sound solution to the flood damage problems along Unnamed Tributary No. 1 to Hooker Lake. Floodproofing was assumed to be feasible at each of the two potentially flooded buildings.

Future flood damage to the two existing private residences could be virtually eliminated through floodproofing. However, residual problems associated with flooding of 83rd Street and of yards would not be mitigated.

Assuming that these structure floodproofing measures would be fully implemented, and utilizing an annual interest rate of 6 percent and a project life and amortization period of 50 years, the average annual cost is estimated at \$2,800, consisting entirely of the amortization of the \$44,000 capital cost for floodproofing. The average annual flood damage abatement benefit was estimated at \$3,400, yielding a benefit-cost ratio of 1.2.

Alternative Plan No. 2: Culvert Improvement
A floodland management plan consisting of replacement of the existing 36-inch-diameter culvert under 83rd Street was prepared and evaluated for Unnamed Tributary No. 1 to Hooker Lake. It was determined that replacement of the existing culvert with one 42-inch-diameter RCP and one 48-inch diameter RCP, each 312 feet long, as shown on Map 77, would resolve the potential flooding problem at the two houses during floods with recurrence intervals up to, and including, 100 years, and would also provide adequate hydraulic capacity to meet the collector street overtopping standard cited previously.[35] In addition, this alternative would abate the residual problems associated with flooding of streets and yards.

Utilizing an annual interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of this alternative is estimated at \$7,100. This cost consists of the amortization of the \$110,000 capital cost for the replacement culverts and a \$90 increase in annual operation and maintenance costs. The average annual flood damage abatement benefit was estimated at \$3,400, resulting in a benefit-cost ratio of 0.48.

[35]*In order to resolve the potential flooding problems, this alternative avoids overtopping of 83rd Street during the 100-year flood. Thus, the amount of hydraulic capacity provided exceeds that necessary to meet the 10-year flood overtopping standard.*

Map 77

CULVERT IMPROVEMENT ALTERNATIVE
FOR UNNAMED TRIBUTARY NO. 1 TO HOOKER LAKE

Source: SEWRPC.

Evaluation of Floodland Management Alternative Plans for Unnamed Tributary No. 1 to Hooker Lake
In selecting recommended floodland management measures for Unnamed Tributary No. 1 to Hooker Lake, the costs; environmental and aesthetic impacts; implementability; and noneconomic, or intangible, benefits of each alternative plan were considered.

All the floodland management alternative plans developed for Unnamed Tributary No. 1 to Hooker Lake are considered technically feasible.

The “no action” alternative plan has the lowest cost, but it was eliminated from consideration because it does nothing to alleviate the existing flood problem, and therefore does not represent a sound approach to floodland management.

Neither of the two remaining alternative plans would create an increase in downstream peak flows.[36]

Alternative Plan No. 1—Structure Floodproofing—has a benefit-cost ratio greater than one and an average annual cost that is about 40 percent of the capital cost of the culvert improvement alternative. Assuming full implementation of the floodproofing alternative plan, structural flood damages would essentially be eliminated during floods with recurrence intervals up to, and including, 100 years. Generally, complete implementation of a voluntary structure floodproofing program can be difficult and, with partial implementation, there would be a residual problem whenever a major flood event occurs. However, because only two properties are involved, implementation may be more likely. If the voluntary structure floodproofing program were completely carried out, there would still be limited residual yard and street flooding. A possible negative aspect of a flood-proofing program is that some floodproofing may be applied without adequate professional advice. As a result, structure damage may occur, and Town and County officials are likely to be asked to assist in resolution of the problem. Because of potential problems with implementation and residual damages, this alternative was eliminated from further consideration.

Alternative Plan No. 2—Culvert Improvement—has a benefit cost ratio of about 0.5. This alternative plan would not rely on floodproofing and would, therefore, provide a greater reduction in residual damages due to yard and street flooding than would the floodproofing alternative. Because the culvert under 83rd Street is deteriorated, its replacement is warranted on that basis, as well as to enable satisfaction of the general road overtopping standard adopted under this watershed study.

Conclusions and Preliminary Recommended Floodland Management Plan for Unnamed Tributary No. 1 to Hooker Lake

Based upon the description and evaluation of alternative plans presented above, the following conclusions and recommendations are made:

- The alternative providing for floodproofing, elevation, and removal of floodprone structures was estimated to have the lowest cost. However, that alternative does not provide mitigation of yard and street flooding. In addition, experience has indicated that implementation of this alternative may be highly unlikely, or may done improperly, since it relies on voluntary homeowner efforts.
- The flooding problems can be fully mitigated and the overtopping standard applicable to 83rd Street can be met through the provision of additional hydraulic capacity. Accordingly, Alternative Plan No. 2—Culvert Improvement—was selected by the Watershed Committee as the recommended plan for the resolution of flooding problems along Unnamed Tributary No. 1 to Hooker Lake.[37]

ADDITIONAL RECOMMENDATIONS RELATED TO STORMWATER AND FLOODLAND MANAGEMENT

Bridge and Culvert Alteration or Replacement for Transportation Purposes

Bridges and culverts that are inadequately designed from a hydraulic perspective can significantly increase flood stages and areas of inundation, and may be subject to closure during major flood events, thereby adversely

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[36]*The culverts that are recommended under the culvert improvement alternative would discharge directly to Hooker Lake and any slight increases in flood flows at the culvert outfalls would be attenuated by the large amount of floodwater storage capacity in the Lake.*

[37]*Implementation of the recommended plan may require a permit from the WDNR.*

affecting the operation of the highway transportation system. In order to identify floodprone reaches of the watershed, bridges that may cause or aggravate existing flood problems must be identified. The purpose of this section is to identify those bridges and culverts that may be expected to interfere with the operation of the highway and railroad transportation systems during major flood events by virtue of inadequate hydraulic capacity and overtopping of the approach roads or of the structure.

The watershed development objectives and supporting principles and standards set forth in Appendix C-4 specify that bridges shall accommodate, according to the categories listed below, the designated flood events without overtopping of the related roadway or railroad track and without the resultant disruption of traffic by floodwaters. The categories and designated flood events are:

1. Land access and collector streets, used or intended to be used primarily for access to abutting properties—a 10-year recurrence interval flood discharge.
2. Arterial streets and highways, other than freeways and expressways, used or intended to be used primarily to carry heavy volumes of fast, through traffic—a 50-year recurrence interval flood discharge.
3. Freeways, expressways, and railways—a 100-year recurrence interval flood discharge.

It is evident that the severity of the flood recommended to be passed by a bridge or culvert without overtopping increases in proportion to the importance of the crossing in the regional transportation system. The relative importance, or functional classification, of each roadway stream crossing—that is, the classification as a land access collector street, arterial street and highway, or freeway or expressway—is recommended in the adopted regional transportation system plan. The bridge standards are intended to assure that a sufficient number of critical river crossings will remain passable during major flood events so that the regional highway and railroad transportation systems can function properly.

The existing bridges and culverts in the watershed that have substandard capacity during major flood events were identified using the information contained within the hydrologic-hydraulic summary tables set forth in Appendices F and G in combination with the bridge standards. As set forth in Table 110 and Appendix G, 25 bridges or culverts may be expected to have substandard hydraulic characteristics under planned land use and existing channel conditions.[38] However, as indicated in Table 110, if the recommended floodland and stormwater management plan elements were fully implemented, only 12 of those structures would have inadequate hydraulic capacity under planned land use conditions. It is recommended that when the bridges that could have adequate hydraulic capacity if this plan is fully implemented are modified or replaced by local or State highway agencies as a part of highway improvement programs, the status of implementation of the floodland and stormwater management recommendations of this plan be evaluated for the area tributary to the structures in question. If the plan recommendations have been substantially implemented, it may be possible to avoid designing larger structures in those cases where plan implementation would eliminate the need for such structures. If an adequate level of plan implementation has not occurred in the tributary area, it is recommended that the crossings be designed to provide adequate hydraulic capacity based on planned land, existing channel condition flows.

The location and design of all new bridges and culverts, as well as the design of replacements of or modifications to existing bridges or culverts, should be based upon the applicable objectives and standards as set forth in Appendix C-4 of this report. Of particular importance is the standard requiring all new or replacement bridges and culverts to be designed to accommodate the 100-year recurrence interval peak flood discharge under planned land

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[38]*Of the total number of substandard bridges and culverts, seven are located on land access and collector streets where the 10-year recurrence interval standard is applicable; 17 are located on arterial streets and highways other than freeways and expressways where the 50-year recurrence interval standard is applicable; and one is located on a freeway where the 100-year recurrence interval standard is applicable.*

Table 110

STREAM CROSSINGS IN THE DES PLAINES RIVER WATERSHED HAVING SUBSTANDARD HYDRAULIC CAPACITIES[a]

Structure Identification					Recommended Design Frequency (years)	Hydraulic Inadequacy		Would Hydraulic Capacity Meet Standard If Recommended Floodland and Stormwater Management Plans Were Fully Implemented?
Stream	Number[b]	Name	River Mile	Civil Division		Approach Road Overtopped	Bridge Deck Overtopped	
Des Plaines River	100	122nd Street/CTH ML	0.69	Village of Pleasant Prairie	50	X	- -	Yes
	115	IH 94/USH 41	6.36	Town of Bristol and Village of Pleasant Prairie[c]	100	X	- -	No
	120	120th Avenue/West Frontage Road	6.39	Town of Bristol and Village of Pleasant Prairie[c]	10	X	- -	No
Unnamed Tributary No. 1 to the Des Plaines River	1225	Springbrook Road/ CTH ML	1.06	Village of Pleasant Prairie	50	X	X	Yes
Unnamed Tributary No. 1A to the Des Plaines River	1245	Green Bay Road/ STH 31	0.69	Village of Pleasant Prairie	50	X	- -	Yes
Unnamed Tributary No. 1C to the Des Plaines River	1290	116th Street/Tobin Road	1.09	Village of Pleasant Prairie	50	X	X	No
	1295	Springbrook Road/ CTH ML	1.18	Village of Pleasant Prairie	50	X	- -	No
Unnamed Tributary No. 38 to the Des Plaines River	1620	STH 11	0.68	Town of Yorkville	50	X	X	No
Union Grove Industrial Tributary	1520	Schroeder Road/ CTH KR	1.25	Towns of Paris and Yorkville	50	X	X	Yes
Brighton Creek	505	60th Street/CTH K	1.14	Towns of Bristol and Paris	50	X	- -	No
	525	45th Street/CTH NN	6.21	Town of Brighton	50	X	- -	Yes
Unnamed Tributary No. 6 to Brighton Creek	560	60th Street/CTH K	0.84	Towns of Brighton and Salem	50	X	- -	Yes
	568	61st Street	1.95	Village of Paddock Lake	10	X	X	Yes
Unnamed Tributary No. 1 to Salem Branch of Brighton Creek	845	81st Street	0.87	Town of Bristol	10	X	- -	Yes
	865	85th Street/CTH AH	1.29	Town of Bristol	50	X	X	No
Unnamed Tributary No. 2 to Salem Branch of Brighton Creek	830	75th Street/STH 50 culvert inlet	0.61	Village of Paddock Lake and Town of Salem	50	X	- -	Yes
Unnamed Tributary No. 3 to Salem Branch of Brighton Creek	870	80th Place	0.18	Town of Salem	10	X	X	No
	880	83rd Street	0.55	Town of Salem	10	X	- -	No
Unnamed Tributary No. 1 to Hooker Lake	885	83rd Street culvert inlet	0.00	Town of Salem	10	X	X	Yes
	892	89th Street/CTH AH	0.84	Town of Salem	50	X	- -	No
Center Creek	610	144th Avenue	1.60	Town of Bristol	10	X	- -	No
Jerome Creek	947	93rd Street	4.45	Village of Pleasant Prairie	50	X	X	Yes
Unnamed Tributary No. 3 to Jerome Creek	966	Bain Station Road	0.48	Village of Pleasant Prairie	50	X	- -	Yes
Unnamed Tributary No. 4 to Jerome Creek	999	93rd Street	1.04	Village of Pleasant Prairie	50	X	X	Yes
Kilbourn Road Ditch	345	38th Street/CTH N	4.92	Town of Somers	50	X	X	No

[a]*This table identifies public bridges and culverts which, when considered in conjunction with their approach roadways, have substandard hydraulic capacities under planned buildout land use and existing channel conditions according to the water control facility standards set forth in Chapter X.*

[b]*Bridges and culverts are identified by structure number and are located on Map 38, Chapter V.*

[c]*Bridges are in the Town of Bristol. Roadway flooding locations are in the Village of Pleasant Prairie.*

Source: SEWRPC.

use conditions without raising the corresponding peak flood stage by 0.01 foot or more above the peak stage established in the adopted comprehensive watershed plan.[39] This provision is intended to ensure that new, modified, or replacement river crossings, including their approaches, will not aggravate existing flood problems, create new flood hazards, or unnecessarily complicate the administration of floodland regulations.

Preparation of Detailed Stormwater Management System Plans

It is recommended that detailed stormwater management system plans be prepared for the City of Kenosha; the Villages of Paddock Lake, Pleasant Prairie, and Union Grove; and urban areas in the Towns of Bristol, Dover, Mt. Pleasant, Salem, Somers, and Yorkville. Ideally, such plans would be prepared at a subwatershed scale. This would necessitate intergovernmental coordination on the part of the civil divisions within the subwatersheds. The stormwater management system plans should be prepared in the context of this watershed study. Where larger-scale stormwater management plans have already been developed, they should be evaluated in the context of the watershed study and updated and expanded as necessary to address stormwater quantity and quality issues on a subwatershedwide basis. Appendix L sets forth an outline of the contents of a sound stormwater management plan. It is recommended that these plans include a component which, where practical, promotes the implementation of stormwater source control or low impact development practices designed to maintain the pre-development hydrologic conditions, as described earlier in this chapter.

Recommended Nonstructural Floodland Management Measures

Of the 11 nonstructural floodland management measures set forth in Table 103 and discussed earlier in this chapter, two—structure floodproofing and/or elevation and structure removal—are major components of the recommended floodland management plan for the Des Plaines River watershed. An additional two—reservation of floodlands for recreation and related open space uses and floodland regulation—are particularly effective for minimizing the aggravation of existing problems and for preventing the development of future flood hazards. The seven remaining nonstructural measures, when used in combination, have the potential to prevent the aggravation of existing flood problems, minimize the development of future flood hazards, and help alleviate the monetary flood losses incurred by owners of floodprone property, and may substantially reduce the threat to life and health of residents of floodprone areas. The following section describes the recommended application of the two primary nonstructural floodland management measures—reservation of open floodlands for recreational and related open space uses and floodland use regulation—and of the seven secondary measures.

Primary Measures

Reservation of Floodlands for Recreation and Related Open Space Uses

The land use plan element of the watershed plan recommends, as described in Chapter XI, the preservation in essentially natural open uses of 17.0 square miles of primary environmental corridor in the Des Plaines River watershed. These corridor lands follow the alignment of the Lower Des Plaines River, the Salem Branch of Brighton Creek, the lower reaches of Brighton Creek and Kilbourn Road Ditch, several tributary streams and wetlands adjacent to lakes and small streams in the watershed. They encompass much of the floodlands along the stream system. In addition, the land use plan recommends the preservation of about 6.4 square miles of secondary environmental corridor. These corridor lands generally follow the alignment of the upper reaches of 1) the Des Plaines River, 2) Brighton Creek, 3) Center Creek, 4) Jerome Creek, and 5) Kilbourn Road Ditch along with the lower reach of Dutch Gap Canal and numerous tributary streams in the watershed. Maintenance of existing public or private outdoor recreation and related open space lands and reservation—by public or private ownership, or by easement—of additional lands for these purposes constitute important means of implementing the recommended watershed plan. It is accordingly recommended that the use of floodland areas for outdoor recreation and related open space activities be encouraged not only to implement the recommended land use plan, but also to minimize the aggravation of existing flood problems and the development of new flood problems in the watershed.

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[39]*Larger flood stage increases may be acceptable if they do not create an additional flood hazard, and if appropriate legal arrangements are made with all affected local units of government and property owners.*

Floodland Regulations: The Wisconsin Floodplain Management Program
State Statutes require that all counties, cities, and villages with existing or potential flood hazards adopt reasonable and effective floodland regulations in accordance with the floodplain management program administered by the Wisconsin Department of Natural Resources. Within the watershed, all of the communities, except the Town of Dover, contain existing or potential identified flood hazard areas. All of those communities, except the Village of Paddock Lake, have adopted floodland regulations.[40] All of these zoning ordinances have been approved by the Wisconsin Department of Natural Resources. It is recommended that the required floodland and floodland-related land use regulations be designed not only to accommodate existing development, but to preserve the conveyance and storage capacity of the floodlands in order to abate future flood hazards and monetary flood damages, reduce the hazard to human health and safety caused by unwise occupation of the floodlands, and reduce the expenditures of public funds to secure the health and safety of floodland residents during periods of flooding. The entire floodplain should be preserved in essentially natural, open uses. Only where existing or committed development may warrant should filling and further development of the floodplain fringe area be permitted, and such filling should be offset by the provision of at least an equal volume of floodwater storage capacity.

It is recommended that the Village of Paddock Lake adopt a floodland zoning ordinance and that Kenosha and Racine Counties and each incorporated community in the watershed adopt in their ordinance the 100-year recurrence interval flood profiles and floodland maps developed for planned land use conditions under this watershed study. It is also recommended that each community that does not require the provision of compensatory floodland storage to offset the effects of the placement of fill in the floodplain adopt such a requirement.

The floodplain zoning ordinance adoption/amendment process involves review and approval of the hydrologic and hydraulic analyses, the resulting flood profiles, and the floodland maps by the WDNR. If requested to do so, the Regional Planning Commission staff will assist the Counties and the communities in submitting the necessary information and in obtaining approvals. With the assistance of the Commission staff, the Village of Pleasant Prairie obtained such approval for floodlands along about 30 miles of stream in the Village as delineated under this watershed study. The WDNR approval of the hydrologic analyses extended to all streams in the watershed that were analyzed under this watershed study. Thus, a significant component of the WDNR floodland review for the Counties and other communities in the watershed has already been completed.

Secondary Measures
Federal Flood Insurance
While the National Flood Insurance Program, as administered by the Federal Emergency Management Agency, does not solve flood problems or mitigate flood damages, it does insure qualifying structures against flood losses. It is therefore in the best interest of the communities in the Des Plaines River watershed to participate in the Federal Flood Insurance Program.

While the ultimate decision to purchase flood insurance remains with the individual property owners, initiative to establish the program within a particular community must be taken by the municipality having jurisdiction over zoning and building codes. The municipality must file a formal request with the Federal Emergency Management Agency for consideration for participation in the Flood Insurance Program, including in its application an account of the historic flood problems in the community and a map of the community on which are delineated those floodprone areas for which insurance is desired. Such application must also include copies of adopted floodland regulations or other adopted measures intended to prevent or reduce flood damages. The community or unit of government must also submit assurances of future compliance with sound floodland management practices, including resolutions indicating that flood problems will be continuously monitored and that such problems will be considered in all official actions affecting floodland use.

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[40]*Floodplains in unincorporated areas are regulated under the Kenosha and Racine County floodland zoning ordinances.*

Based on the hydrologic-hydraulic analyses conducted under the watershed study, existing or potential flood problems have been identified in the watershed portions of all civil divisions, except the Town of Dover. The only community that does not currently participate in the Federal Flood Insurance Program is the Village of Paddock Lake. It is recommended that the Village of Paddock Lake participate in the program.

Because of the availability of large-scale topographic mapping over the entire watershed and because more streams were studied in detail, the analyses conducted under the Des Plaines River watershed planning program are more complete and detailed than those conducted under Federal flood insurance studies. Therefore, it is recommended that the hydrologic-hydraulic data generated under the watershed planning program be used to update and amend the flood insurance studies as appropriate. As with procuring WDNR approval, if requested to do so, the Regional Planning Commission staff will assist the Counties and the communities in submitting the necessary information and in obtaining FEMA approvals. Finally, it is recommended that owners of property in floodprone areas purchase flood insurance to provide some financial relief for losses sustained during future floods.

Lending Institution Policies

As a result of the National Flood Insurance Program, private lending institutions in the Southeastern Wisconsin area have generally assumed the responsibility for determining whether or not a property is in a floodprone area and, if so, whether flood insurance needs to be purchased before a mortgage is granted for a structure on the property. It is recommended that lending institutions continue to determine the floodprone status of properties prior to the granting of a mortgage, irrespective of the requirements of the National Flood Insurance Program, and that the principal source of flood hazard information within the Des Plaines River watershed be that developed under the watershed planning program and available through the counties and communities following local adoption and State and Federal approval of the information.

Community Utility Policies

As discussed earlier in this chapter, local communities may adopt policies relating to the extension of certain public utilities and facilities, such as sanitary sewers, water mains, and streets, in recognition of the likely influence of the location and size or capacity of such utilities and facilities on the location of new urban development. It is recommended that the policies of governmental units and agencies having responsibility for such utilities and facilities within the Des Plaines River watershed be formulated such that the size, location, and use of those utilities and facilities are consistent with the floodprone status of riverine areas. More particularly, it is recommended that these utility and facility policies be designed to complement the floodland regulation recommendations for the Des Plaines River watershed.

Land Use Controls Outside the Floodlands

As described in Chapter XI, between 1990 and the attainment of planned land use conditions, about 20.5 square miles of open lands throughout the watershed are proposed for urban development under the land use plan. In preparing plans for the development of these areas and for the redevelopment of local areas, it is recommended that the potential hydrologic impact of the proposed development or redevelopment be considered in addition to the relationship of such development and redevelopment to soil capabilities, long-established and planned utility systems, and the natural resource base. The alternatives set forth in this chapter are designed to accommodate the planned urban development set forth in the land use plan, as described in Chapter XI. Development beyond that recommended in the land use plan has not been considered and, thus, such development should be discouraged. If such development is unavoidable, it should be accompanied by mitigative measures to control runoff.

Emergency Programs

An emergency program to minimize the damage and disruption associated with flooding normally consists of a variety of measures that are tailored to the flood hazard characteristics of individual communities. It is particularly pertinent to note that the smaller streams in the urban portions of the Des Plaines River watershed are hydrologically and hydraulically "flashy" in that major flood events are likely to be caused by intense rainfall events that are unpredictable as to location and time of occurrence, and that there may be only a short period of time between the initial rise of floodwaters and the occurrence of peak stages. Therefore, it is not practicable to establish a system to predict the location, magnitude, and time of occurrence of peak flood stages along most streams in the watershed. Flood stages rise more slowly along the Des Plaines River main stem. However, because implementation of the recommended plan would eliminate the flood hazard to structures during events with recurrence intervals up to, and including, 100-years and because the existing system for closing roads and highways during periods of high water appears to function adequately, a flood warning system is not recommended for the Des Plaines River main stem.

It is recommended that in each watershed community where major flooding occurs, procedures be developed to provide floodland residents and other property owners with information about the location and extent of the flood hazard areas so that residents can take appropriate flood damage mitigation measures, including the implementation of the recommended structure floodproofing, elevation, or removal measures.

Community Education Programs
Public awareness of the possible effects on flood flows and stages of such actions as dumping of debris in a stream channel, localized channelization, and removal of obstructions to flow may serve to prevent an increase in flooding problems. It is recommended that residents of the Des Plaines River watershed be informed of the existence of this comprehensive watershed plan through the news media. Public reaction to the plan should be solicited through a public hearing on the plan. Information on plan activities during the period of plan implementation should be disseminated using 1) the “Ties to the Land” newsletter that is published six times a year by Kenosha County Land and Water Conservation, the Racine County Land Water Conservation Division, the University of Wisconsin Extension (UWEX), the U.S. Farm Service Agency, and the U.S. Natural Resources Conservation Service; 2) the “Urban/Rural Connection: newsletter that is published quarterly by the UWEX and that deals with issues of land use growth and management; 3) the Kenosha and Racine County government websites at http://www.co.kenosha.wi.us/index.phtml and http;//www.racineco.com, respectively; and 4) the UWEX website at http:/ww.uwex.edu/ces/cty/kenosha.

Channel Maintenance
As discussed earlier in this chapter, channel maintenance consisting of periodic removal of sediment deposits, heavy vegetation, and debris is necessary to: 1) maintain the integrity of the flood stage profiles developed under the watershed planning program and 2) reduce the probability that buoyant objects and debris will be carried downstream by floodwaters and accumulate at bridges and culvert inlets, thereby reducing the conveyance capacity of the bridges and culverts. It is recommended that the operations of the responsible governmental units and agencies be designed to include the conduct of such channel maintenance, including procuring any necessary permits from the WDNR.

Maintenance of Stream Gaging Network
Since 1961 the U.S. Geological Survey has operated, in cooperation with the Illinois Department of Transportation, either a continuous stage recorder and/or a crest stage gage at the Russell Road bridge that crosses the Des Plaines River about 0.8 mile downstream of the Wisconsin-Illinois state line. There are no stream gages in the watershed within Wisconsin.

By monitoring river flows and stages at points strategically located within the watershed, continuous-recording stream gaging stations, as well as partial record streamflow stations and crest stage stations, can provide critical data required for the rational management of the surface water resources of the watershed. Discharge-frequency relationships derived from data provided by continuous-recording stream gaging stations and by partial record stations, along with flood stage profiles from crest stage gages, can be used to periodically refine the hydrologic and hydraulic simulation submodels developed and used in the Des Plaines River watershed study. Such stream gaging records are also useful in bridge and culvert design and in water quality management planning. It is accordingly recommended that the continuous-recording gage installed at the Russell Road crossing of the Des Plaines River in Illinois remain in operation. It is also recommended that an additional continuous-recording gage be installed by the U.S. Geological Survey on the main stem of the Des Plaines River near the outlet of the Upper Des Plaines river subwatershed in the reach between CTH K and CTH N.[41] That gage would also be used for the recommended stream rehabilitation monitoring program described above.

SUMMARY OF THE RECOMMENDED FLOODLAND AND STORMWATER MANAGEMENT PLAN FOR THE DES PLAINES RIVER WATERSHED

Background

Floodland management may be defined as the planning and implementation of a combination of measures intended to reconcile the floodwater conveyance and storage function of floodlands with the space and related social and economic needs of society. This chapter presents the alternative and recommended floodland management plans for the comprehensive plan for the Des Plaines River watershed.

The available floodland management measures from which the recommended management plan element was synthesized may be broadly divided into two categories: nonstructural measures and structural measures. Eleven nonstructural measures were identified, consisting of: 1) floodland use regulation; 2) reservation and acquisition of floodlands for recreation and related open space use; 3) regulation of land use outside the floodlands; 4) structure floodproofing and/or elevation; 5) structure removal; 6) Federal flood insurance; 7) lending institution policies; 8) community utility policies; 9) emergency programs; 10) community education programs; and 11) channel maintenance. A total of five structural floodland management measures were identified for possible application, either individually or in various combinations, to specific floodprone reaches of the watershed, including: 1) stormwater or floodwater storage; 2) floodwater diversion; 3) dikes and floodwalls; 4) channel modification; and 5) bridge or culvert modification or replacement. Depending on the level of potential flood damages, structural measures may be more effective in achieving the objectives of floodland management in riverine areas that have already been urbanized, while nonstructural measures are preventive in that they are generally more effective in riverine areas that have not yet been developed for flood damage-prone uses, but have the potential for such development.

A hydrologic-hydraulic flood flow simulation model was used to quantitatively evaluate the impact of planned land use conditions on the flood flow behavior of the Des Plaines River watershed. The simulation model studies indicated that under planned land use and existing stormwater and floodland management conditions, and in the absence of measures to mitigate increases in flows, the peak 100-year recurrence interval flood flow along the lower 16 miles of the Des Plaines River in Wisconsin would only be expected to increase by up to 4 percent relative to 1990 conditions, with the average increase being about 2 percent. The two-year flood flow of the Des Plaines River at the state line would be expected to increase by about 8 percent relative to 1990 conditions, but the 100-year flood flow would only be expected to increase by about 1 percent. The two-year flood flow of the Dutch Gap Canal at the state line would be expected to increase by about 4 percent, but the 100-year flood flow would only be expected to increase by about 1 percent.

It is estimated that, in the absence of measures to mitigate increases in flows, the peak two-year flood flow of the Des Plaines River at the state line would be expected to increase by about 6 percent relative to estimated year 2002 conditions, but the 100-year flood flow would only be expected to increase by about 2 percent. The two-year

[41]*The establishment of a streamflow gage in this vicinity was recommended in the report titled,* An Integrated Water-Monitoring Network for Wisconsin, *that was prepared in 1997 by a project team that was formed by the U.S. Geological Survey and which included representatives from the U.S. Geological Survey, the U.S. Environmental Protection Agency, the National Weather Service, the Natural Resources Conservation Service, the Wisconsin Department of Natural Resources, the Wisconsin Department of Transportation, the Wisconsin Geological and Natural History Survey, the University of Wisconsin-Madison, the Milwaukee Metropolitan Sewerage District, the Wisconsin Valley Improvement Company, and the Southeastern Wisconsin Regional Planning Commission.*

flood flow of the Dutch Gap Canal at the state line would be expected to increase by about 3 percent, but the 100-year flood flow would not be expected to increase.

In order to compare the cost of alternative floodland management measures, the flood damage susceptibility of a river reach must be quantified in monetary terms. Information derived from the historic flood survey, combined with the results of hydrologic-hydraulic simulation modeling, indicated that on an average annual basis, the average annual monetary damages attributable to flood damages to crops and structures may be expected to approximate \$58,000 and \$91,000, respectively, under 1990 land use and existing channel conditions; and about \$70,000 and \$126,000, respectively, under planned land use and existing channel conditions.

Recommended Floodland Management Plan
A total of six alternative watershedwide floodland management measures—including a "no-action" alternative—were developed and evaluated for resolution of the flood problems of the Des Plaines River watershed. In addition, case-specific alternative plans were developed for Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake. After due consideration of the various technical and economic features of these alternatives, the Watershed Committee recommended implementation of the plan shown graphically on Map 78. That plan consists of the following components:

- Floodproofing 47 structures, including 30 houses, three commercial buildings, and 14 uninhabited agricultural buildings.
- Elevating four houses.
- Removing 17 structures, including 12 mobile homes, three houses, and two uninhabited agricultural buildings.
- Providing detention storage to control the runoff from areas of planned development. The post-development two-year storm peak flow release rate would be 0.04 cfs per acre of new development and the post-development 100-year storm peak flow release rate would be 0.30 cfs per acre of new development. Development projects for which this level of runoff control would apply should be further evaluated through preparation of detailed stormwater management plans as recommended below.
- Restoring 20 percent of the potential prairie areas in the watershed (six square miles).[42]
- Restoring all potential wetland areas within floodlands (3.1 square miles).[43]
- Providing a centralized detention storage basin along Unnamed Tributary No. 6 to Brighton Creek.
- Improving storm sewers in the Village of Paddock Lake along Unnamed Tributary No. 6 to Brighton Creek.
- Improved culvert capacity at a single location along Unnamed Tributary No. 1 to Hooker Lake.
- Instituting a monitoring program to assess sediment conditions along the Upper Des Plaines River.

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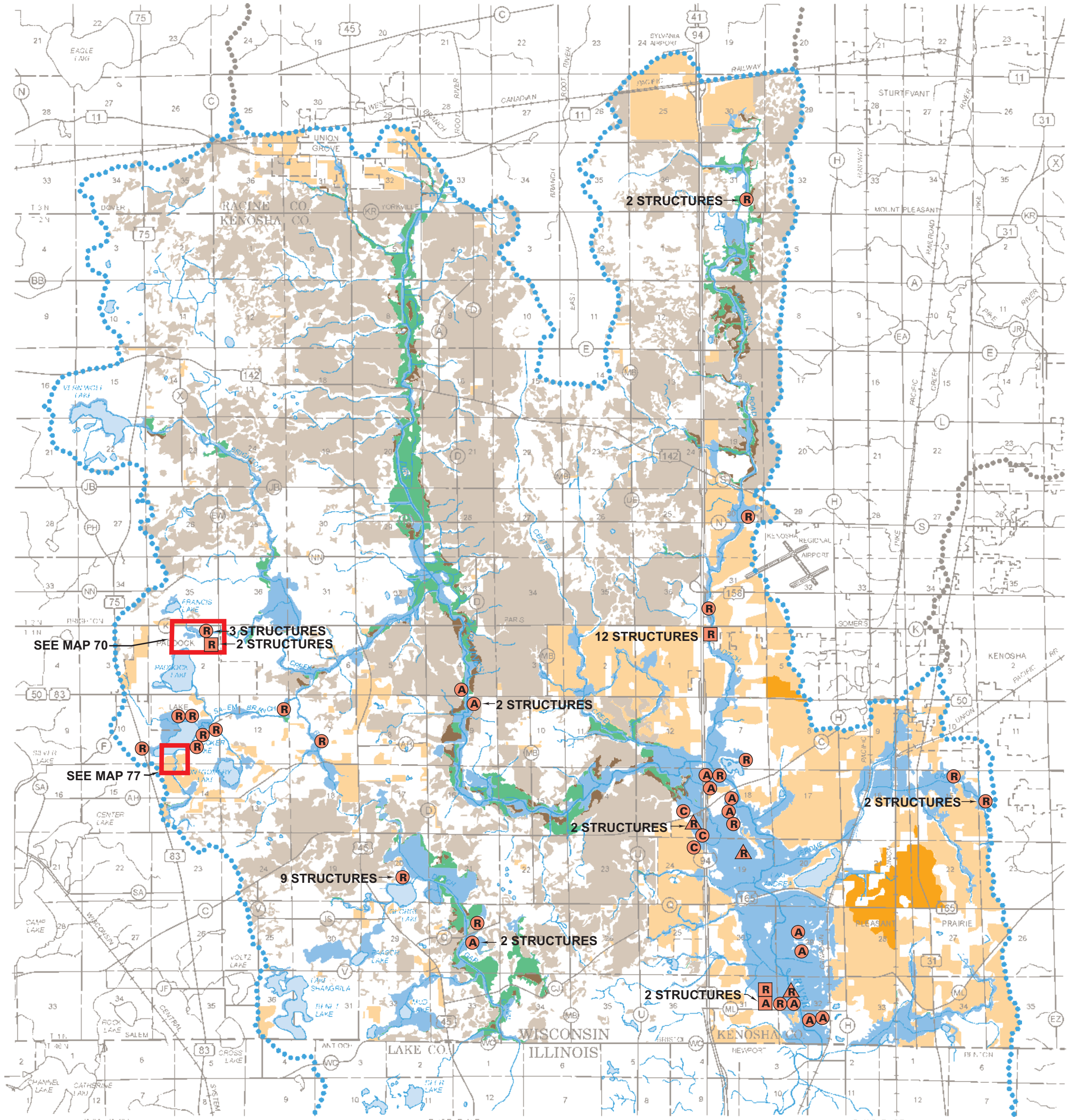
[42]*The overall recommended watershed plan set forth in Chapter XV of this report includes identification of target areas for prairie restoration.*

[43]*This recommendation does not preclude restoring wetlands in depressional areas located outside of floodlands. Such restoration could be beneficial for flood control and for local stormwater management considerations.*

Map 78

RECOMMENDED FLOODLAND AND STORMWATER MANAGEMENT MEASURES FOR THE DES PLAINES RIVER WATERSHED



100-YEAR RECURRENCE INTERVAL FLOODLANDS—PLANNED LAND USE AND EXISTING CHANNEL CONDITIONS

POTENTIAL WETLAND RESTORATION AREAS LOCATED WITHIN THE 100-YEAR RECURRENCE INTERVAL FLOODPLAIN

POTENTIAL PRAIRIE RESTORATION AREAS LOCATED OUTSIDE THE 100-YEAR RECURRENCE INTERVAL FLOODPLAIN

POTENTIAL PRAIRIE RESTORATION AREAS LOCATED WITHIN THE 100-YEAR RECURRENCE INTERVAL FLOODPLAIN

AREAS OF PLANNED URBAN DEVELOPMENT WHERE DETENTION STORAGE WOULD BE PROVIDED

MAJOR AREAS OF DEVELOPMENT SINCE 1990 THAT INCLUDE DETENTION STORAGE FACILITIES

STRUCTURE TO BE FLOODPROOFED

STRUCTURE TO BE ELEVATED

STRUCTURE TO BE REMOVED

STRUCTURE TYPE

A AGRICULTURAL

C COMMERCIAL

R RESIDENTIAL

GRAPHIC SCALE

0 1/2 1 MILE

0 2,000 4,000 6,000 FEET

The recommended floodland and stormwater management plan element calls for structure floodproofing, elevation ,and removal; detention storage to control runoff from new development (100-year storm release rate=0.3 cfs/acre, two-year storm release rate =0.04 cfs/acre); prairie restoration on six square mile of agricultural land (20 percent of the potential restoration area); wetland restoration within floodlands (3.1 square miles); specific measures along Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake; and initiation of a monitoring program to assess sediment conditions along the Upper Des Plaines River.

Source: SEWRPC.

Utilizing an interest rate of 6 percent and an amortization period and project life of 50 years, the average annual cost of the recommended floodland and stormwater management plan was estimated to potentially range from $4,973,000 to $6,975,000, depending on the level of maintenance of the restored wetlands and prairies. This cost consists of the amortization of the $61,764,000 capital cost, the $640,000 annual land rental cost for restored prairie and wetland areas, and the $411,000 to $2,413,000 annual operation and maintenance cost.[44] The capital, rental, and operation and maintenance costs, which are summarized in Table 111, include:

Des Plaines River Watershed Outside of Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake

- $37,300,000[45] for the construction of detention facilities to control runoff from new development during storms with recurrence intervals up to, and including, 100 years.
- $14,735,000 for restoration of prairies over a 6.0-square-mile area,
- $6,520,000 for restoration of 3.1 square miles of wetlands within the 100-year floodplain, and
- $645,000 for floodproofing,
- $290,000 for structure elevation,
- $935,000 for structure removal,

Unnamed Tributary No. 6 to Brighton Creek

- $482,000 for the construction of the detention basin and its outlet structure,
- $65,000 for the detention basin inlet structure,
- $39,000 for land acquisition for the detention basin,
- $8,000 for culvert replacement,
- $349,000 for storm sewer improvements,
- $53,000 for structure floodproofing, and
- $178,000 for structure removal.

Unnamed Tributary No. 1 to Hooker Lake

- $110,000 capital cost for the replacement culverts.

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[44]*The lower maintenance cost assumes a minimal level of wetland and prairie maintenance, consisting primarily of periodic mowing. The higher cost assumes intensive active management, including periodic burning, weed and herbicide management, mowing, brush reduction, buffer/shoreline plantings, and monitoring of vegetation and hydrology. Actual maintenance costs would be expected to fall within the range cited.*

[45]*This equals the total cost for control of storms with recurrence intervals ranging from two through 100 years according to the recommendations of this plan minus the cost for control of a two-year storm according to the requirements of Chapter NR 151 of the* Wisconsin Administrative Code. *It is appropriate to exclude the cost for the level of two-year control required under NR 151, since that cost would be incurred independent of implementation of this plan.*

Table 111

PRINCIPAL FEATURES, COSTS, AND BENEFITS OF THE RECOMMENDED FLOODLAND MANAGEMENT PLAN FOR THE DES PLAINES RIVER WATERSHED

Component Description	Economic Analysis[a]						
	Capital Cost[b]		Annual Amortized Capital Cost (thousands)	Annual Operation and Maintenance and Land Rental Costs (thousands)	Total[c] Annual Cost (thousands)	Annual[c] Benefits (thousands)	Benefit-Cost Ratio
	Item	(thousands)					
Watershedwide							
a. Provide onsite detention storage facilities for planned new development	Detention facilities, including land cost	$37,300[d]					
b. Restore prairie conditions on 6.0 square miles of agricultural land	Prairie Restoration	14,735					
c. Restore wetland conditions on 3.1 square miles of agricultural land in the 100-year floodplain	Wetland Restoration	6,520					
d. Floodproof 44 residential, commercial, and agricultural structures	Floodproofing	645					
e. Elevate four residential structures	Elevation	290					
f. Remove 15 residential and agricultural structures	Removal	935					
g. Upper Des Plaines River sediment monitoring	Stream flow and water quality gage	15					
	Stream channel cross-sections	40[e]					
	Subtotal	$60,480	$3,840	$1,045 to $3,047[e]	$4,885 to $6,887[e]	- -	- -
Unnamed Tributary No. 6 to Brighton Creek							
a. Provide detention storage north of CTH K	- -	$ 482					
b. Inlet pipe for detention	- -	65					
c. Land acquisition	- -	39					
d. Replace five-foot-diameter culvert under CTH K	- -	8					
e. Improve storm sewer	- -	349					
f. Floodproof three residential structures	- -	53					
g. Remove two residential structures	- -	178					
	Subtotal	$ 1,174	$74	$6	$80	- -	- -
Unnamed Tributary No. 1 to Hooker Lake							
a. Replace existing 312-foot-long, 36-inch-diameter culvert under 83rd Street with one 42-inch-diameter reinforced concrete pipe (RCP) and one 48-inch-diameter RCP, each 312 feet long	- -	$ 110					
	Subtotal	$ 110	$7	$0.1	$7.1	- -	- -
	Total	$61,764	$3,922	$1,051 to $3,053[f]	$4,973 to $6,975[f]	$126[g] 35[h]	- -
					Total	$161	0.02 to 0.03

[a]*Economic analyses are based on an annual interest rate of 6 percent and a 50-year amortization period and project life.*

[b]*Based upon 1999* Engineering News-Record *Construction Cost Index of 7022. Includes engineering, administration, and contingencies.*

[c]*Annual benefits and costs used in the benefit-cost analysis include only the direct benefits derived from the abatement of monetary flood damages, and the direct costs attendant to implementation of the floodland management measures, including capital and operation and maintenance costs. Environmental and recreational benefits and costs were not addressed in the benefit-cost analysis since these represent intangible benefits and costs and, therefore, cannot be readily quantified.*

[d]*Incremental cost between control of two-year and 100-year events.*

[e]*Cost of initial field survey, including establishment of horizontal and vertical control.*

[f]*Cost reflects range from minimal wetland and prairie operation and maintenance to active management.*

[g]*Reduction in structure flooding damages.*

[h]*Reduction in agricultural flooding damages.*

Source: SEWRPC.

Annual Costs

- An estimated annual restored prairie and wetland land rental cost of $640,000 under the USDA Conservation Reserve Program,

- An estimated annual maintenance cost of $357,000 for detention storage to serve planned development,

- An estimated annual maintenance cost of from $10,000 to $690,000 for restored wetlands, depending on the level of maintenance,

- An estimated annual maintenance cost of $19,000 to $1,340,000 for restored prairies, depending on the level of maintenance,

- An estimated $5,800 increase in annual operation and maintenance costs for the stormwater management system along Unnamed Tributary No. 6 to Brighton Creek,

- An estimated $90 increase in annual operation and maintenance costs for the culvert in Unnamed Tributary No. 1 to Hooker Lake at 83rd Street.

The average annual flood abatement benefit to structures was estimated at $126,000, and the average annual flood abatement benefit to cropland was estimated at $35,000, yielding total annual benefit of $161,000 and a benefit cost ratio of from 0.02 to 0.03. Therefore, the recommended floodland and stormwater management plan as described herein, while technically feasible, was found to have a benefit-cost ratio less than one. However, there would also be substantial environmental benefits resulting from the recommended prairie and wetland restorations and the high degree of control of peak rates of runoff from new development that are not directly quantifiable monetarily.

Table 112 shows that in general the impact of the recommended plan on reducing flood flows relative to planned land use conditions without the recommended measures in place is greatest along small streams, in headwaters areas, and along the Upper Des Plaines River. For the 1.01- and two-year floods, the decreases in peak flows under recommended plan conditions would generally range from about 10 to 50 percent. For the ten- through 100-year floods, the decreases in peak flows under recommended plan conditions would generally range from about 0 to 50 percent, with decreases in flow being less overall than for the more-frequent events. Along some larger tributaries to the Des Plaines River, where future urban development is to be located near the downstream reaches, significant localized flow reductions may be attained. Such reductions occur along the Salem Branch of Brighton Creek, Kilbourn Road Ditch, and Jerome Creek.

As seen from Table 113, on the Des Plaines River main stem at the state line, comparison of the computed peak 100-year flood flow under planned land use and recommended plan conditions to the 100-year flow under 1990 land use, drainage, and channel conditions indicates a decrease of about 2 percent. Comparison of the two-year flood flows indicates an increase of about 6 percent relative to 1990 conditions. On the Dutch Gap Canal at the state line, comparison of the computed peak 100-year flood flow under planned land use and recommended plan conditions to the 100-year flow under 1990 land use, drainage, and channel conditions indicates no change. Comparison of the two-year flood flows indicates an increase of about 2 percent relative to 1990 conditions. As noted above, relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the hydrologic model. Thus, under the recommended plan, the goal of maintaining the peak 100-year flood flow at 1990 existing levels at the state line would essentially be met for the 100-year floods on the Des Plaines River and Dutch Gap Canal and for the two-year flood on the Dutch Gap Canal. A slight

Table 112

FLOOD DISCHARGES FOR THE DES PLAINES RIVER WATERSHED

COMPARISON OF PLANNED LAND USE AND EXISTING CHANNEL CONDITIONS WITH PLANNED LAND USE CONDITIONS AND IMPLEMENTATION OF THE RECOMMENDED FLOODLAND AND STORMWATER MANAGEMENT MEASURES[a,b,c,d]

Upper Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
68	14.810	0.7 mile upstream of 60th Street (CTH K)	57	48	-16	192	178	-7	420	392	-7	702	646	-8	847	774	-9
62	16.140	370 feet upstream of CTH N	46	39	-15	163	146	-10	379	342	-10	665	595	-11	818	730	-11
58	17.571	0.7 mile downstream of Burlington Road (STH 142)	59	42	-29	237	192	-19	609	521	-14	1150	1000	-13	1460	1280	-12
54	18.110	0.2 mile downstream of Burlington Road (STH 142)	58	40	-31	229	183	-20	586	496	-15	1100	958	-13	1390	1220	-12
50	18.916	0.6 mile upstream of Burlington Road (STH 142)	59	38	-36	233	179	-23	585	489	-16	1080	945	-13	1360	1200	-12
44	19.350	1.1 miles upstream of Burlington Road (STH 142)	58	35	-40	223	165	-26	552	452	-18	1010	872	-14	1260	1110	-12
29	20.163	Private drive	76	30	-61	228	134	-41	470	344	-27	758	635	-16	905	794	-12
16	20.594	0.6 mile downstream of County Line Road	21	10	-52	73	49	-33	158	127	-20	261	234	-10	313	293	-6
8	21.196	County Line Road	9	4	-56	41	27	-34	112	86	-23	218	182	-17	279	239	-14
2	21.791	0.6 mile upstream of County Line Road	1	1	0	15	14	-7	62	58	-6	155	145	-6	216	203	-6

Unnamed Tributary No. 37 to the Upper Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
12	0.045		16	6	-63	44	19	-57	93	43	-54	157	77	-51	190	95	-50

Table 112 (continued)

Unnamed Tributary No. 38 to the Upper Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
6	0.004		9	3	-67	29	13	-55	66	33	-50	118	62	-47	146	79	-46
4	0.673		13	4	-69	34	11	-68	71	22	-69	117	36	-69	142	44	-69

Union Grove Industrial Tributary																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
28	0.008	40 feet upstream confluence with the Des Plaines River	57	19	-67	163	83	-49	339	215	-37	557	405	-27	671	511	-24
27	1.245		75	21	-72	208	83	-60	430	212	-51	709	401	-43	856	510	-40
26	1.524	0.3 mile upstream of Schroeder Road (Hwy KR)	73	19	-74	186	60	-68	359	133	-63	562	230	-59	665	282	-58

Fonk's Tributary																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
20	0.027		6	4	-33	36	26	-28	117	94	-20	255	215	-16	340	291	-14

Table 112 (continued)

			Lower Des Plaines River														
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
384	0.000	Wisconsin-Illinois state line	218	246	13	855	844	-1	1620	1550	-4	2290	2200	-4	2570	2470	-4
362	1.323	0.6 mile upstream of 122nd Street (CTH ML)	222	247	11	869	855	-2	1670	1590	-5	2380	2280	-4	2690	2570	-4
358	2.267	0.7 mile downstream of STH 165	225	202	-10	872	846	-3	1690	1640	-3	2450	2330	-5	2780	2620	-6
304	3.213	0.3 mile upstream of STH 165	196	185	-6	796	773	-3	1600	1530	-4	2360	2240	-5	2700	2540	-6
298	4.659	1.0 mile downstream of Wilmot Road (CTH C)	209	180	-14	787	738	-6	1590	1480	-7	2410	2200	-9	2790	2520	-10
216	6.297	210 feet downstream of 120th Avenue (East Frontage Road)	127	121	-5	553	535	-3	1120	1080	-4	1650	1600	-3	1880	1820	-3
172	7.261	0.9 mile upstream of 120th Avenue (West Frontage Road)	126	117	-7	533	511	-4	1090	1050	-4	1640	1580	-4	1890	1810	-4
170	8.491	1.3 miles downstream of 160th Avenue (CTH MB)	126	116	-8	528	506	-4	1090	1050	-4	1640	1580	-4	1890	1810	-4
166	9.627	0.2 mile downstream of 160th Avenue (CTH MB)	123	113	-8	503	483	-4	1050	1010	-4	1610	1540	-4	1870	1780	-5
162	11.334	1.5 miles upstream of 160th Avenue (CTH MB)	121	110	-9	492	471	-4	1040	998	-4	1620	1540	-5	1900	1800	-5
156	12.600	0.4 mile downstream of 75th Street (STH 50)	120	107	-11	478	454	-5	1020	974	-5	1610	1530	-5	1890	1790	-5
154	13.569	0.5 mile upstream of 75th Street (STH 50)	119	107	-10	478	452	-5	1030	978	-5	1640	1550	-5	1930	1810	-6
152	14.140	50 feet upstream of 60th Street (CTH K)	118	106	-10	478	452	-5	1030	978	-5	1640	1550	-5	1930	1810	-6

			Unnamed Tributary No. 1 to the Des Plaines River														
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
408	0.000		31	21	-32	110	64	-42	270	144	-47	500	250	-50	629	307	-51
407	0.572		73	20	-73	228	92	-60	458	226	-51	716	392	-45	842	478	-43
399	0.681		48	13	-73	166	70	-58	351	178	-49	563	313	-44	668	383	-43
398	0.772		25	5	-80	63	17	-73	110	37	-66	158	62	-61	180	75	-58
396	1.384		8	2	-75	27	7	-74	56	16	-71	89	27	-70	105	33	-69

Table 112 (continued)

Unnamed Tributary No. 1a to the Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
404	0.049		11	4	-64	33	16	-52	66	36	-45	102	59	-42	120	70	-42
402	0.701		3	3	0	7	7	0	13	13	0	19	19	0	22	22	0
400	0.966		10	10	0	19	19	0	31	31	0	44	44	0	49	49	0

Unnamed Tributary No. 1b to the Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
392	0.080		25	9	-64	106	55	-48	249	147	-41	425	265	-38	515	327	-37
390	0.613		25	9	-64	109	55	-50	256	150	-41	436	273	-37	528	337	-36

Unnamed Tributary No. 1c to the Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
389	0.025		19	5	-74	81	33	-59	197	98	-50	346	191	-45	425	243	-43
388	1.037		7	4	-43	25	15	-40	54	35	-35	89	60	-33	108	73	-32

Unnamed Tributary No. 1e to the Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
380	1.300		46	8	-83	120	48	-60	218	115	-47	319	189	-41	366	224	-39
374	1.939		21	5	-76	55	20	-64	93	43	-54	129	68	-47	144	81	-44
372	2.567		1	1	0	7	7	0	17	17	0	27	27	0	32	32	0

Table 112 (continued)

Unnamed Tributary No. 1f to the Des Plaines River

			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
378	0.081		5	3	-40	26	24	-8	65	62	-5	112	109	-3	135	132	-2

Unnamed Tributary No. 2 to the Des Plaines River

			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
368	1.063		31	5	-84	79	14	-82	149	30	-80	229	49	-79	268	60	-78
366	1.600		4	2	-50	17	4	-76	43	9	-79	78	15	-81	98	19	-81

Unnamed Tributary No. 2a to the Des Plaines River

			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
364	0.060		4	0	-100	10	1	-90	21	3	-86	35	4	-89	42	5	-88

Unnamed Tributary No. 7 to the Des Plaines River

			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
340	0.598		88	14	-84	221	75	-66	400	171	-57	591	272	-54	682	318	-53
338	0.831		68	8	-88	162	56	-65	275	134	-51	384	214	-44	434	250	-42

Table 112 (continued)

Pleasant Prairie Tributary

			Recurrence Interval (years) 1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
302	0.110		112	17	-85	245	73	-70	385	166	-57	509	276	-46	562	332	-41

Center Creek

			Recurrence Interval (years) 1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
214	0.202	1,070 feet upstream confluence with the Des Plaines River	38	25	-34	189	149	-21	459	383	-17	780	668	-14	941	812	-14
206	1.338	0.3 mile downstream of 144th Avenue	26	20	-23	128	114	-11	346	321	-7	656	613	-7	828	774	-7
204	2.360	Private drive 0.1 mile upstream of 75th Street (STH 50)	20	15	-25	110	100	-9	326	311	-5	654	631	-4	844	814	-4
192	3.642	0.1 mile downstream of 60th Street (CTH K)	7	7	0	73	70	-4	267	253	-5	586	554	-5	773	731	-5

Unnamed Tributary No. 1 to Center Creek

			Recurrence Interval (years) 1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
212	0.041		14	4	-71	65	30	-54	168	86	-49	308	160	-48	383	198	-48
210	0.888		18	3	-83	63	12	-81	140	28	-80	238	50	-79	289	62	-79

Unnamed Tributary No. 4 to Center Creek

			Recurrence Interval (years) 1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
200	0.071		14	2	-86	43	7	-84	88	17	-81	142	30	-79	169	37	-78
198	0.471		12	1	-92	34	5	-85	67	11	-84	105	19	-82	124	24	-81

Table 112 (continued)

Unnamed Tributary No. 5 to Center Creek

HSPF Model Reach #	River Mile	Location	1.01 Planned Land Use	1.01 Recommended Plan (planned land use)	1.01 Percent Difference	2 Planned Land Use	2 Recommended Plan (planned land use)	2 Percent Difference	10 Planned Land Use	10 Recommended Plan (planned land use)	10 Percent Difference	50 Planned Land Use	50 Recommended Plan (planned land use)	50 Percent Difference	100 Planned Land Use	100 Recommended Plan (planned land use)	100 Percent Difference
202	0.000		10	3	-70	31	14	-55	69	38	-45	118	69	-42	144	86	-40
201			1	1	0	11	10	-9	30	28	-7	50	47	-6	59	56	-5

Brighton Creek

HSPF Model Reach #	River Mile	Location	1.01 Planned Land Use	1.01 Recommended Plan (planned land use)	1.01 Percent Difference	2 Planned Land Use	2 Recommended Plan (planned land use)	2 Percent Difference	10 Planned Land Use	10 Recommended Plan (planned land use)	10 Percent Difference	50 Planned Land Use	50 Recommended Plan (planned land use)	50 Percent Difference	100 Planned Land Use	100 Recommended Plan (planned land use)	100 Percent Difference
148	0.306	1,620 feet upstream confluence with the Des Plaines River	70	65	-7	309	292	-6	676	638	-6	1070	1010	-6	1250	1180	-6
146	1.350	0.5 mile downstream of Bristol Road (USH 45)	65	61	-6	328	303	-8	736	681	-7	1170	1080	-8	1370	1270	-7
114	3.165	0.5 mile downstream of 60th Street (CTH K)	41	33	-20	213	192	-10	496	459	-7	808	750	-7	956	887	-7
113	4.649	60th Street (CTH K)	29	27	-7	170	165	-3	429	418	-3	735	713	-3	885	859	-3
112	5.100	0.5 mile upstream of 60th Street (CTH K)	23	23	0	149	146	-2	392	383	-2	690	673	-2	840	818	-3
96	6.031	0.2 mile downstream of 45th Street (CTH NN)	20	20	0	149	145	-3	442	428	-3	847	818	-3	1060	1030	-3
90	7.631	0.2 mile downstream of 31st Street (CTH JB)	17	16	-6	129	126	-2	386	375	-3	739	718	-3	927	900	-3

Unnamed Tributary No. 6 to Brighton Creek

HSPF Model Reach #	River Mile	Location	1.01 Planned Land Use	1.01 Recommended Plan (planned land use)	1.01 Percent Difference	2 Planned Land Use	2 Recommended Plan (planned land use)	2 Percent Difference	10 Planned Land Use	10 Recommended Plan (planned land use)	10 Percent Difference	50 Planned Land Use	50 Recommended Plan (planned land use)	50 Percent Difference	100 Planned Land Use	100 Recommended Plan (planned land use)	100 Percent Difference
110	0.590		9	8	-11	43	40	-7	100	94	-6	163	151	-7	193	178	-8
108	1.674		5	17	240	18	37	106	42	65	55	76	98	29	96	113	18[e]
106	2.152	60th Street (CTH K)	8	5	-38	21	8	-62	41	9	-78	65	9	-86	78	9	-88
104	2.330	League Lake outlet	1	1	0	2	2	0	5	5	0	8	8	0	10	10	0

Table 112 (continued)

Salem Branch of Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
144	0.077	4110 feet upstream confluence with the Des Plaines River	34	28	-18	133	117	-12	286	260	-9	455	422	-7	537	501	-7
132	0.600	160 feet downstream of 216th Avenue	23	20	-13	68	62	-9	128	120	-6	189	180	-5	218	208	-5
131	2.153	Reach 118, 126, and 130; 53 feet downstream of private bridge	30	20	-33	66	50	-24	111	89	-20	155	129	-17	176	148	-16
126	2.214	0.2 mile downstream of Hooker Lake outlet	6	5	-17	16	15	-6	31	29	-6	49	46	-6	58	53	-9
124	2.370	Hooker Lake outlet	5	5	0	15	14	-7	30	28	-7	46	43	-7	54	50	-7

Unnamed Tributary No. 1 to Salem Branch of Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
142	0.100		14	9	-36	64	54	-16	155	139	-10	266	244	-8	323	297	-8
140	1.167		5	3	-40	20	16	-20	46	39	-15	77	67	-13	92	81	-12

Unnamed Tributary No. 2 to Salem Branch of Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
118	0.019		18	11	-39	41	26	-37	69	46	-33	97	67	-31	110	76	-31
116	0.765	Paddock Lake outlet	7	7	0	13	13	0	19	19	0	25	25	0	27	27	0

Unnamed Tributary No. 3 to Salem Branch of Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
130	0.000		9	8	-11	20	17	-15	34	29	-15	48	42	-13	55	47	-15
128	0.896	Montgomery Lake outlet	9	9	0	15	15	0	21	20	-5	26	25	-4	28	28	0

Table 112 (continued)

Unnamed Tributary No. 1 to Hooker Lake

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01			2			10			50			100		
			Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
122	0.000		13	3	-77	46	23	-50	104	72	-31	180	139	-23	220	174	-21
120	0.835	CTH AH	1	1	0	14	12	-14	45	41	-9	88	82	-7	110	103	-6

Kilbourn Road Ditch

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01			2			10			50			100		
			Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
294	0.154		175	88	-50	478	319	-33	910	674	-26	1390	1070	-23	1620	1270	-22
291	1.022	0.3 mile downstream of 75th Street (STH 50)	177	85	-52	484	313	-35	919	666	-28	1390	1060	-24	1620	1250	-23
286	1.315	75th Street (STH 50)	160	80	-50	454	298	-34	872	642	-26	1330	1040	-22	1550	1230	-21
281	2.803	60th Street (CTH K)	113	67	-41	364	264	-27	743	598	-20	1170	1000	-15	1380	1210	-12
274	3.910	0.5 mile upstream of 52nd Street (STH 158)	94	58	-38	294	223	-24	626	526	-16	1030	916	-11	1240	1120	-10
270	4.920	38th Street (CTH N)	90	55	-39	297	229	-23	656	558	-15	1110	993	-11	1350	1230	-9
260	6.196	0.7 mile upstream of Burlington Road (STH 142)	88	44	-50	237	176	-26	471	415	-12	748	720	-4	890	880	-1
256	7.491	0.5 mile downstream of 12th Street (CTH E)	85	40	-53	217	153	-29	420	355	-15	659	613	-7	780	749	-4
250	8.009	12th Street (CTH E)	83	38	-54	211	145	-31	406	335	-17	634	577	-9	749	705	-6
232	10.090	0.7 mile downstream of County Line Road (CTH KR)	74	27	-64	172	88	-49	311	189	-39	465	313	-33	541	377	-30
226	11.717	0.2 mile downstream of Braun Road	73	18	-75	181	60	-67	346	129	-63	541	211	-61	639	253	-60
222	12.355	Private drive 0.4 mile upstream of Braun Road	69	19	-72	162	49	-70	289	88	-70	428	130	-70	495	150	-70

Unnamed Tributary No. 1 to Kilbourn Road Ditch

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01			2			10			50			100		
			Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
292	0.083		4	3	-25	14	9	-36	29	21	-28	48	36	-25	57	44	-23

Table 112 (continued)

Unnamed Tributary No. 2 to Kilbourn Road Ditch																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
892	0.000		14	7	-50	41	18	-56	85	38	-55	137	62	-55	163	75	-54

Unnamed Tributary No. 5 to Kilbourn Road Ditch																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
278	0.049		9	5	-44	32	24	-25	73	62	-15	125	115	-8	153	144	-6
276	0.841		0	0	0	5	5	0	24	23	-4	59	56	-5	81	78	-4

Unnamed Tributary No. 8 to Kilbourn Road Ditch																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
268	0.113		21	10	-52	99	70	-29	288	246	-15	590	556	-6	770	750	-3
266	0.750		8	8	0	80	74	-8	313	288	-8	749	690	-8	1030	947	-8

Unnamed Tributary No. 13 to Kilbourn Road Ditch																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
258	0.055		3	3	0	21	19	-10	74	68	-8	165	154	-7	221	209	-5

Table 112 (continued)

Unnamed Tributary No. 18 to Kilbourn Road Ditch																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
230	0.085		35	7	-80	108	41	-62	242	121	-50	421	243	-42	518	313	-40

Jerome Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
332	0.402	0.4 mile upstream confluence with the Des Plaines River	48	30	-38	104	72	-31	158	119	-25	202	160	-21	220	178	-19
330	0.813	0.3 mile downstream of 88th Avenue (CTH H)	53	30	-43	87	64	-26	110	92	-16	125	113	-10	131	121	-8
324	1.716	0.6 mile upstream of 88th Avenue (CTH H)	29	23	-21	47	44	-6	58	58	0	64	65	2	66	68	3
325	2.350	C&NW Railroad	37	24	-35	52	44	-15	62	58	-6	70	69	-1	72	72	0
312	2.550	0.1 mile downstream of Green Bay Road (STH 31)	52	44	-15	96	69	-28	149	95	-36	202	119	-41	226	129	-43
306	3.863	Private drive 0.6 mile downstream of 93rd Street	3	1	-67	12	4	-67	27	9	-67	49	15	-69	60	19	-68

Unnamed Tributary No. 2 to Jerome Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
322	0.010		7	2	-71	14	5	-64	20	11	-45	25	17	-32	27	20	-26

Unnamed Tributary No. 3 to Jerome Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50	100				
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
320	0.028		23	8	-65	29	16	-45	35	23	-34	39	29	-26	41	31	-24

Table 112 (continued)

HSPF Model Reach #	River Mile	Location	1.01 Planned Land Use	1.01 Recommended Plan (planned land use)	1.01 Percent Difference	2 Planned Land Use	2 Recommended Plan (planned land use)	2 Percent Difference	10 Planned Land Use	10 Recommended Plan (planned land use)	10 Percent Difference	50 Planned Land Use	50 Recommended Plan (planned land use)	50 Percent Difference	100 Planned Land Use	100 Recommended Plan (planned land use)	100 Percent Difference
Unnamed Tributary No. 4 to Jerome Creek																	
316	0.017		38	8	-79	104	32	-69	168	75	-55	219	128	-42	240	156	-35
314	0.950		47	8	-83	130	32	-75	256	75	-71	403	129	-68	476	157	-67

HSPF Model Reach #	River Mile	Location	1.01 Planned Land Use	1.01 Recommended Plan (planned land use)	1.01 Percent Difference	2 Planned Land Use	2 Recommended Plan (planned land use)	2 Percent Difference	10 Planned Land Use	10 Recommended Plan (planned land use)	10 Percent Difference	50 Planned Land Use	50 Recommended Plan (planned land use)	50 Percent Difference	100 Planned Land Use	100 Recommended Plan (planned land use)	100 Percent Difference
Unnamed Tributary No. 5 to Jerome Creek																	
310	0.080		8	2	-75	25	6	-76	52	15	-71	84	27	-68	100	33	-67

HSPF Model Reach #	River Mile	Location	1.01 Planned Land Use	1.01 Recommended Plan (planned land use)	1.01 Percent Difference	2 Planned Land Use	2 Recommended Plan (planned land use)	2 Percent Difference	10 Planned Land Use	10 Recommended Plan (planned land use)	10 Percent Difference	50 Planned Land Use	50 Recommended Plan (planned land use)	50 Percent Difference	100 Planned Land Use	100 Recommended Plan (planned land use)	100 Percent Difference
Dutch Gap Canal																	
460	0.000	Wisconsin-Illinois state line/ 128th Street (CTH WG)	53	50	-6	205	200	-2	431	424	-2	673	666	-1	787	781	-1
458	0.455	0.5 mile upstream of 128th Street (CTH WG)	31	30	-3	110	107	-3	212	207	-2	308	304	-1	351	347	-1
449	0.854	Reach 448 and 442; 0.2 mile downstream of 121st Street (CTH CJ)	29	26	-10	87	84	-3	162	160	-1	238	236	-1	273	272	0
442	1.588	0.5 mile downstream of 110th Street (CTH V)	13	12	-8	45	45	0	91	90	-1	138	137	-1	160	159	-1
434	3.452	0.6 mile downstream of 93rd Street (CTH C)	7	6	-14	21	21	0	40	39	-3	57	55	-4	64	63	-2

Table 112 (continued)

Mud Lake Outlet																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
448	0.000	Confluence with Dutch Gap Canal	22	19	-14	57	55	-4	90	89	-1	116	115	-1	126	125	-1
446	0.840	0.2 mile upstream of USH 45	29	22	-24	55	53	-4	75	75	0	89	90	1	94	95	1

Unnamed Tributary No. 3 to Dutch Gap Canal																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference	Planned Land Use	Recommended Plan (planned land use)	Percent Difference
432	0.076		8	8	0	28	27	-4	63	61	-3	106	104	-2	129	126	-2
424	0.569		3	2	-33	12	10	-17	29	26	-10	51	47	-8	62	58	-6

[a] *Recommended post-development release rates for new development: 100-year event = 0.3 cfs per acre; two-year event = 0.04 cfs per acre.*

[b] *Due to minor adjustments to the hydrologic model during the development of alternative plans, the flows in this table may not be exactly the same as those set forth at other locations in the watershed study report.*

[c] *The areas tributary to the following streams would either not have urban development under planned buildout land use conditions, or would have no significant new urban development between 1990 and the attainment of buildout conditions:*

- *Unnamed Tributary No. 9 to Brighton Creek*
- *Unnamed Tributary No. 15 to Kilbourn Road Ditch*
- *Unnamed Tributary No. 4 to Dutch Gap Canal*

Therefore, those streams are not included in this table.

[d] *Unnamed Tributary Nos. 5 and 5b to the Des Plaines River are not included in this table because their tributary area has become essentially fully developed since 1990 and because the streams flow into an existing detention basin which controls peak rates of runoff as specified under the overall stormwater management plan prepared for the Lakeview Corporate Park in the Village of Pleasant Prairie.*

[e] *This localized peak flow increase would only be expected in a relatively short reach of the stream downstream from the outfall of the existing channel enclosure in the Village of Paddock Lake. As seen from this table, downstream of that reach, the peak flow would decrease relative to the condition without the recommended plan implemented.*

Source: SEWRPC.

Table 113

FLOOD DISCHARGES FOR THE DES PLAINES RIVER WATERSHED

COMPARISON OF 1990 LAND USE AND CHANNEL CONDITIONS WITH PLANNED LAND USE CONDITIONS AND IMPLEMENTATION OF THE RECOMMENDED FLOODLAND AND STORMWATER MANAGEMENT MEASURES[a,b,c,d]

Upper Des Plaines River

			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
68	14.810	0.7 mile upstream of 60th Street (CTH K)	45	48	7	183	178	-3	413	392	-5	687	646	-6	825	774	-6
62	16.140	370 feet upstream of CTH N	35	39	11	150	146	-3	366	342	-7	646	595	-8	794	730	-8
58	17.571	0.7 mile downstream of Burlington Road (STH 142)	38	42	11	202	192	-5	576	521	-10	1130	1000	-12	1450	1280	-12
54	18.110	0.2 mile downstream of Burlington Road (STH 142)	36	40	11	192	183	-5	551	496	-10	1090	958	-12	1400	1220	-13
50	18.916	0.6 mile upstream of Burlington Road (STH 142)	34	38	12	188	179	-5	545	489	-10	1080	945	-13	1390	1200	-14
44	19.350	1.1 miles upstream of Burlington Road (STH 142)	32	35	9	174	165	-5	506	452	-11	1010	872	-14	1300	1110	-15
29	20.163	Private drive	27	30	11	141	134	-5	395	344	-13	768	635	-17	977	794	-19
16	20.594	0.6 mile downstream of County Line Road	9	10	11	51	49	-4	145	127	-12	278	234	-16	351	293	-17
8	21.196	County Line Road	4	4	0	29	27	-7	100	86	-14	219	182	-17	291	239	-18
2	21.791	0.6 mile upstream of County Line Road	1	1	0	15	14	-7	62	58	-6	155	145	-6	216	203	-6

Unnamed Tributary No. 37 to the Upper Des Plaines River

			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
12	0.045		5	6	20	20	19	-5	60	43	-28	125	77	-38	165	95	-42

Table 113 (continued)

Unnamed Tributary No. 38 to the Upper Des Plaines River																		
			Recurrence Interval (years)															
			1.01			2			10			50			100			
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
6	0.004		2	3	50	14	13	-7	45	33	-27	100	62	-38	130	79	-39
4	0.673		3	4	33	13	11	-15	35	22	-37	75	36	-52	100	44	-56

Union Grove Industrial Tributary																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
28	0.008	40 feet upstream confluence with the Des Plaines River	17	19	12	88	83	-6	256	215	-16	515	405	-21	667	511	-23
26	1.524	0.3 mile upstream of Schroeder Road (Hwy KR)	17	19	12	66	60	-9	172	133	-23	334	230	-31	428	282	-34

Fonk's Tributary																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
20	0.027		3	4	33	28	26	-7	108	94	-13	254	215	-15	347	291	-16

Table 113 (continued)

			Lower Des Plaines River														
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
384	0.000	Wisconsin-Illinois state line	171	246	44	797	844	6	1570	1550	-1	2240	2200	-2	2520	2470	-2
362	1.323	0.6 mile upstream of 122nd Street (CTH ML)	172	247	44	808	855	6	1610	1590	-1	2330	2280	-2	2620	2570	-2
358	2.267	0.7 mile downstream of STH 165	169	202	20	807	846	5	1630	1640	1	2380	2330	-2	2690	2620	-3
304	3.213	0.3 mile upstream of STH 165	158	185	17	744	773	4	1530	1530	0	2270	2240	-1	2590	2540	-2
298	4.659	1.0 mile downstream of Wilmot Road (CTH C)	151	180	19	718	738	3	1520	1480	-3	2300	2200	-4	2650	2520	-5
216	6.297	210 feet downstream of 120th Avenue (East Frontage Road)	118	121	3	537	535	0	1100	1080	-2	1630	1600	-2	1870	1820	-3
172	7.261	0.9 mile upstream of 120th Avenue (West Frontage Road)	116	117	1	519	511	-2	1080	1050	-3	1630	1580	-3	1880	1810	-4
170	8.491	1.3 miles downstream of 160th Avenue (CTH MB)	116	116	0	514	506	-2	1080	1050	-3	1630	1580	-3	1880	1810	-4
166	9.627	0.2 mile downstream of 160th Avenue (CTH MB)	110	113	3	491	483	-2	1040	1010	-3	1590	1540	-3	1840	1780	-3
162	11.334	1.5 miles upstream of 160th Avenue (CTH MB)	106	110	4	480	471	-2	1030	998	-3	1600	1540	-4	1860	1800	-3
156	12.600	0.4 mile downstream of 75th Street (STH 50)	102	107	5	465	454	-2	1010	974	-4	1590	1530	-4	1850	1790	-3
154	13.569	0.5 mile upstream of 75th Street (STH 50)	101	107	6	464	452	-3	1020	978	-4	1610	1550	-4	1880	1810	-4
152	14.140	50 feet upstream of 60th Street (CTH K)	101	106	5	464	452	-3	1020	978	-4	1610	1550	-4	1880	1810	-4

			Unnamed Tributary No. 1 to the Des Plaines River														
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
408	0.000		11	21	91	55	64	16	145	144	-1	267	250	-6	332	307	-8
407	0.572		8	20	150	90	92	2	281	226	-20	527	392	-26	651	478	-27
399	0.681		6	13	117	65	70	8	210	178	-15	398	313	-21	495	383	-23
398	0.772		2	5	150	19	17	-11	58	37	-36	108	62	-43	134	75	-44
396	1.384		1	2	100	6	7	17	17	16	-6	34	27	-21	43	33	-23

Table 113 (continued)

Unnamed Tributary No. 1a to the Des Plaines River

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01: 1990 Land Use	1.01: Recommended Plan (planned land use)	1.01: Percent Difference	2: 1990 Land Use	2: Recommended Plan (planned land use)	2: Percent Difference	10: 1990 Land Use	10: Recommended Plan (planned land use)	10: Percent Difference	50: 1990 Land Use	50: Recommended Plan (planned land use)	50: Percent Difference	100: 1990 Land Use	100: Recommended Plan (planned land use)	100: Percent Difference
404	0.049		3	4	33	18	16	-11	47	36	-23	83	59	-29	101	70	-31
402	0.701		2	3	50	6	7	17	12	13	8	18	19	6	21	22	5
400	0.966		9	10	11	18	19	6	29	31	7	40	44	10	45	49	9
401	1.113		2	3	50	15	18	20	47	49	4	90	90	0	113	113	0

Unnamed Tributary No. 1b to the Des Plaines River

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01: 1990 Land Use	1.01: Recommended Plan (planned land use)	1.01: Percent Difference	2: 1990 Land Use	2: Recommended Plan (planned land use)	2: Percent Difference	10: 1990 Land Use	10: Recommended Plan (planned land use)	10: Percent Difference	50: 1990 Land Use	50: Recommended Plan (planned land use)	50: Percent Difference	100: 1990 Land Use	100: Recommended Plan (planned land use)	100: Percent Difference
392	0.080		4	9	125	49	55	12	162	147	-9	307	265	-14	379	327	-14
390	0.613		4	9	125	50	55	10	167	150	-10	320	273	-15	397	337	-15

Unnamed Tributary No. 1c to the Des Plaines River

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01: 1990 Land Use	1.01: Recommended Plan (planned land use)	1.01: Percent Difference	2: 1990 Land Use	2: Recommended Plan (planned land use)	2: Percent Difference	10: 1990 Land Use	10: Recommended Plan (planned land use)	10: Percent Difference	50: 1990 Land Use	50: Recommended Plan (planned land use)	50: Percent Difference	100: 1990 Land Use	100: Recommended Plan (planned land use)	100: Percent Difference
389	0.025		2	5	150	26	33	27	92	98	7	192	191	-1	248	243	-2
388	1.037		3	4	33	15	15	0	39	35	-10	73	60	-18	90	73	-19

Unnamed Tributary No. 1e to the Des Plaines River

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years) 1.01: 1990 Land Use	1.01: Recommended Plan (planned land use)	1.01: Percent Difference	2: 1990 Land Use	2: Recommended Plan (planned land use)	2: Percent Difference	10: 1990 Land Use	10: Recommended Plan (planned land use)	10: Percent Difference	50: 1990 Land Use	50: Recommended Plan (planned land use)	50: Percent Difference	100: 1990 Land Use	100: Recommended Plan (planned land use)	100: Percent Difference
380	1.300		7	8	14	52	48	-8	142	115	-19	249	189	-24	302	224	-26
374	1.939		5	5	0	23	20	-13	57	43	-25	99	68	-31	120	81	-33
372	2.567		1	1	0	7	7	0	17	17	0	27	27	0	32	32	0

Table 113 (continued)

Unnamed Tributary No. 1f to the Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
378	0.081		3	3	0	24	24	0	64	62	-3	112	109	-3	136	132	-3

Unnamed Tributary No. 2 to the Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
368	1.063		4	5	25	17	14	-18	47	30	-36	91	49	-46	116	60	-48
366	1.600		1	2	100	5	4	-20	13	9	-31	27	15	-44	34	19	-44

Unnamed Tributary No. 2a to the Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
364	0.060		0	0	0	2	1	-50	5	3	-40	9	4	-56	10	5	-50

Unnamed Tributary No. 7 to the Des Plaines River																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
340	0.598		12	14	17	89	75	-16	236	171	-28	403	272	-33	482	318	-34
338	0.831		7	8	14	66	56	-15	177	134	-24	297	214	-28	351	250	-29

Table 113 (continued)

Pleasant Prairie Tributary																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
302	0.110		9	17	89	72	73	1	197	166	-16	344	276	-20	414	332	-20

Center Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
214	0.202	1,070 feet upstream confluence with the Des Plaines River	19	25	32	155	149	-4	418	383	-8	723	668	-8	869	812	-7
206	1.338	0.3 mile downstream of 144th Avenue	15	20	33	114	114	0	333	321	-4	630	613	-3	788	774	-2
204	2.360	Private drive 0.1 mile upstream of 75th Street (STH 50)	12	15	25	100	100	0	323	311	-4	655	631	-4	839	814	-3
192	3.642	0.1 mile downstream of 60th Street (CTH K)	7	7	0	72	70	-3	262	253	-3	574	554	-3	758	731	-4

Unnamed Tributary No. 1 to Center Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
212	0.041		2	4	100	35	30	-14	127	86	-32	257	160	-38	325	198	-39
210	0.888		1	3	200	19	12	-37	78	28	-64	165	50	-70	212	62	-71

Unnamed Tributary No. 4 to Center Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
200	0.071		1	2	100	16	7	-56	58	17	-71	116	30	-74	146	37	-75
198	0.471		1	1	0	12	5	-58	40	11	-73	79	19	-76	100	24	-76

Table 113 (continued)

Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
148	0.306	1,620 feet upstream confluence with the Des Plaines River	61	65	7	296	292	-1	660	638	-3	1040	1010	-3	1220	1180	-3
146	1.350	0.5 mile downstream of Bristol Road (USH 45)	57	61	7	310	303	-2	716	681	-5	1150	1080	-6	1340	1270	-5
114	3.165	0.5 mile downstream of 60th Street (CTH K)	33	33	0	203	192	-5	483	459	-5	779	750	-4	914	887	-3
113	4.649	60th Street (CTH K)	29	27	-7	169	165	-2	425	418	-2	725	713	-2	873	859	-2
112	5.100	0.5 mile upstream of 60th Street (CTH K)	23	23	0	148	146	-1	388	383	-1	683	673	-1	831	818	-2
96	6.031	0.2 mile downstream of 45th Street (CTH NN)	20	20	0	148	145	-2	437	428	-2	836	818	-2	1050	1030	-2
90	7.631	0.2 mile downstream of 31st Street (CTH JB)	17	16	-6	128	126	-2	381	375	-2	726	718	-1	909	900	-1

Unnamed Tributary No. 6 to Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
110	0.590		8	8	0	41	40	-2	99	94	-5	164	151	-8	194	178	-8
108	1.674		5	17	240	18	37	106	42	65	55	76	98	29	96	113	18[e]
106	2.152	60th Street (CTH K)	3	5	67	14	8	-43	34	9	-74	63	9	-86	78	9	-88
104	2.330	League Lake outlet	1	1	0	2	2	0	5	5	0	8	8	0	10	10	0

Salem Branch of Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
144	0.077	4110 feet upstream confluence with the Des Plaines River	24	28	17	118	117	-1	277	260	-6	456	422	-7	543	501	-8
132	0.600	160 feet downstream of 216th Avenue	17	20	18	62	62	0	124	120	-3	189	180	-5	219	208	-5
131	2.153	Reach 118, 126, and 130; 53 feet downstream of private bridge	17	20	18	51	50	-2	97	89	-8	147	129	-12	171	148	-13
126	2.214	0.2 mile downstream of Hooker Lake outlet	4	5	25	14	15	7	29	29	0	46	46	0	55	53	-4
124	2.370	Hooker Lake outlet	4	5	25	13	14	8	28	28	0	44	43	-2	52	50	-4

Table 113 (continued)

Unnamed Tributary No. 1 to Salem Branch of Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
142	0.100		8	9	13	56	54	-4	151	139	-8	269	244	-9	329	297	-10
140	1.167		2	3	50	17	16	-6	44	39	-11	77	67	-13	93	81	-13

Unnamed Tributary No. 2 to Salem Branch of Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
118	0.019		10	11	10	27	26	-4	55	46	-16	86	67	-22	102	76	-25
116	0.765	Paddock Lake outlet	6	7	17	12	13	8	17	19	12	23	25	9	25	27	8

Unnamed Tributary No. 3 to Salem Branch of Brighton Creek																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
130	0.000		7	8	14	17	17	0	31	29	-6	47	42	-11	54	47	-13
128	0.896	Montgomery Lake outlet	8	9	13	14	15	7	20	20	0	25	25	0	27	28	4

Unnamed Tributary No. 1 to Hooker Lake																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
122	0.000		2	3	50	29	23	-21	99	72	-27	192	139	-28	241	174	-28
120	0.835	CTH AH	1	1	0	12	12	0	43	41	-5	86	82	-5	109	103	-6

Table 113 (continued)

Kilbourn Road Ditch																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
294	0.154		59	88	49	301	319	6	721	674	-7	1210	1070	-12	1450	1270	-12
291	1.022	0.3 mile downstream of 75th Street (STH 50)	57	85	49	299	313	5	720	666	-8	1210	1060	-12	1450	1250	-14
286	1.315	75th Street (STH 50)	55	80	45	286	298	4	690	642	-7	1160	1040	-10	1400	1230	-12
281	2.803	60th Street (CTH K)	49	67	37	264	264	0	650	598	-8	1110	1000	-10	1340	1210	-10
274	3.910	0.5 mile upstream of 52nd Street (STH 158)	44	58	32	215	223	4	554	526	-5	1000	916	-8	1250	1120	-10
270	4.920	38th Street (CTH N)	43	55	28	223	229	3	592	558	-6	1100	993	-10	1370	1230	-10
260	6.196	0.7 mile upstream of Burlington Road (STH 142)	36	44	22	171	176	3	432	415	-4	779	720	-8	964	880	-9
256	7.491	0.5 mile downstream of 12th Street (CTH E)	33	40	21	146	153	5	366	355	-3	661	613	-7	819	749	-9
250	8.009	12th Street (CTH E)	32	38	19	137	145	6	344	335	-3	622	577	-7	772	705	-9
232	10.090	0.7 mile downstream of County Line Road (CTH KR)	20	27	35	76	88	16	187	189	1	339	313	-8	422	377	-11
226	11.717	0.2 mile downstream of Braun Road	14	18	29	50	60	20	119	129	8	211	211	0	262	253	-3
222	12.355	Private drive 0.4 mile upstream of Braun Road	16	19	19	50	49	-2	112	88	-21	192	130	-32	236	150	-36

Unnamed Tributary No. 1 to Kilbourn Road Ditch																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
292	0.083		2	3	50	10	9	-10	25	21	-16	45	36	-20	55	44	-20

Unnamed Tributary No. 5 to Kilbourn Road Ditch																	
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
278	0.049		5	5	0	25	24	-4	65	62	-5	130	115	-12	160	144	-10
276	0.841		0	0	0	5	5	0	25	23	-8	60	56	-7	80	78	-3

Table 113 (continued)

Unnamed Tributary No. 8 to Kilbourn Road Ditch

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years)														
			1.01			2			10			50			100		
			1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
268	0.113		9	10	11	75	70	-7	280	246	-12	645	556	-14	875	750	-14
266	0.750		8	8	0	80	74	-8	310	288	-7	745	690	-7	1020	947	-7

Unnamed Tributary No. 13 to Kilbourn Road Ditch

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years)														
			1.01			2			10			50			100		
			1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
258	0.055		2	3	50	20	19	-5	70	68	-3	165	154	-7	220	209	-5

Unnamed Tributary No. 18 to Kilbourn Road Ditch

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years)														
			1.01			2			10			50			100		
			1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
230	0.085		5	7	40	40	41	3	145	121	-17	325	243	-25	435	313	-28

Jerome Creek

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years)														
			1.01			2			10			50			100		
			1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
332	0.402	0.4 mile upstream confluence with the Des Plaines River	26	30	15	78	72	-8	137	119	-13	191	160	-16	215	178	-17
330	0.813	0.3 mile downstream of 88th Avenue (CTH H)	29	30	3	71	64	-10	106	92	-13	131	113	-14	141	121	-14
324	1.716	0.6 mile upstream of 88th Avenue (CTH H)	20	23	15	40	44	10	55	58	5	66	65	-2	70	68	-3
325	2.350	C&NW Railroad	22	24	9	43	44	2	59	58	-2	71	69	-3	75	72	-4
312	2.550	0.1 mile downstream of Green Bay Road (STH 31)	41	44	7	72	69	-4	108	95	-12	143	119	-17	159	129	-19
306	3.863	Private drive 0.6 mile downstream of 93rd Street	1	1	0	5	4	-20	16	9	-44	31	15	-52	39	19	-51

Table 113 (continued)

Unnamed Tributary No. 2 to Jerome Creek

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years): 1.01			2			10			50			100		
			1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
322	0.010		2	2	0	7	5	-29	14	11	-21	21	17	-19	25	20	-20

Unnamed Tributary No. 3 to Jerome Creek

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years): 1.01			2			10			50			100		
			1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
320	0.028		6	8	33	17	16	-6	26	23	-12	33	29	-12	35	31	-11

Unnamed Tributary No. 5 to Jerome Creek

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years): 1.01			2			10			50			100		
			1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
310	0.080		-1	2	- -	8	6	-25	27	15	-44	54	27	-50	67	33	-51

Dutch Gap Canal

HSPF Model Reach #	River Mile	Location	Recurrence Interval (years): 1.01			2			10			50			100		
			1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
460	0.000	Wisconsin-Illinois state line/ 128th Street (CTH WG)	49	50	2	197	200	2	421	424	1	665	666	0	782	781	0
458	0.455	0.5 mile upstream of 128th Street (CTH WG)	29	30	3	108	107	-1	210	207	-1	309	304	-2	353	347	-2
449	0.854	Reach 448 and 442; 0.2 mile downstream of 121st Street (CTH CJ)	26	26	0	84	84	0	161	160	-1	238	236	-1	274	272	-1
442	1.588	0.5 mile downstream of 110th Street (CTH V)	13	12	-8	45	45	0	91	90	-1	138	137	-1	160	159	-1
434	3.452	0.6 mile downstream of 93rd Street (CTH C)	7	6	-14	21	21	0	39	39	0	56	55	-2	64	63	-2

Table 113 (continued)

			Mud Lake Outlet														
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
448	0.000	Confluence with Dutch Gap Canal	18	19	6	54	55	2	90	89	-1	117	115	-2	128	125	-2
446	0.840	0.2 mile upstream of USH 45	19	22	16	52	53	2	77	75	-3	92	90	-2	98	95	-3

			Unnamed Tributary No. 3 to Dutch Gap Canal														
			Recurrence Interval (years)														
			1.01			2			10			50			100		
HSPF Model Reach #	River Mile	Location	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference	1990 Land Use	Recommended Plan (planned land use)	Percent Difference
432	0.076		8	8	0	28	27	-4	62	61	-2	106	104	-2	129	126	-2
424	0.569		2	2	0	10	10	0	28	26	-7	50	47	-6	62	58	-6

[a] *Recommended post-development release rates for new development: 100-year event = 0.3 cfs per acre; two-year event = 0.04 cfs per acre.*

[b] *Due to minor adjustments to the hydrologic model during the development of alternative plans, the flows in this table may not be exactly the same as those set forth at other locations in the watershed study report.*

[c] *The areas tributary to the following streams would either not have urban development under planned buildout land use conditions, or would have no significant new urban development between 1990 and the attainment of buildout conditions:*

- *Unnamed Tributary No. 9 to Brighton Creek*
- *Unnamed Tributary No. 15 to Kilbourn Road Ditch*
- *Unnamed Tributary No. 4 to Dutch Gap Canal*

Therefore, those streams are not included in this table.

[d] *Unnamed Tributary Nos. 5 and 5b to the Des Plaines River are not included in this table because their tributary area has become essentially fully developed since 1990 and because the streams flow into an existing detention basin which controls peak rates of runoff as specified under the overall stormwater management plan prepared for the Lakeview Corporate Park in the Village of Pleasant Prairie.*

[e] *This localized peak flow increase would only be expected in a relatively short reach of the stream downstream from the outfall of the existing channel enclosure in the Village of Paddock Lake. As seen from this table, downstream of that reach, the peak flow would decrease relative to the condition without the recommended plan implemented.*

Source: SEWRPC.

increase in the peak two-year flood flow on the Des Plaines River at the state line might be expected.[46] Furthermore, it should be noted that the recommended plan would also provide for essentially no increase, or a decrease, in flood flows for the two- through 100-year floods on the Des Plaines River and Dutch Gap Canal as compared to current 2002 conditions. Thus, a standard of maintaining peak two- through 100-year flood flows at their existing (2002) level would be met.

The following additional floodland and stormwater management measures are recommended:

- When the 25 bridges or culverts listed in Table 110 and Appendix G are modified or replaced by local or State highway agencies as a part of highway improvement programs, the crossings should be designed to provide adequate hydraulic capacity in accordance with recommended standards. The adequacy of the bridges or culverts should be evaluated based on the level of implementation of the recommended floodland and stormwater management plan elements at the time highway improvements are being considered. If the recommended floodland and stormwater management plan elements were fully implemented, 13 of those 25 structures would have adequate hydraulic capacity under planned land use conditions. If the plan recommendations have been substantially implemented, it may be possible to avoid designing larger structures at those locations. If an adequate level of plan implementation has not occurred in the tributary area, it is recommended that the crossings be designed to provide adequate hydraulic capacity based on planned land, existing channel condition flows.
- Preparing detailed subwatershedwide stormwater management system plans for the City of Kenosha; the Villages of Paddock Lake, Pleasant Prairie, and Union Grove; and urban areas in the Towns of Bristol, Dover, Mt. Pleasant, Salem, Somers, and Yorkville. Those plans should incorporate and/or refine the watershed study recommendation for a two-year storm release rate of 0.04 cfs per acre of new development and a 100-year storm release rate of 0.3 cfs per acre.
- Encouraging the use of floodland areas for outdoor recreation and related open space activities.
- Adoption of a floodland zoning ordinance by the Village of Paddock Lake and participation by the Village in the National Flood Insurance Program.
- Adoption of the 100-year recurrence interval flood profiles and floodland maps developed for planned land use conditions under this watershed study. Kenosha and Racine Counties and each incorporated community in the watershed should adopt the maps and profiles for local zoning purposes.
- Amending local floodland zoning ordinances to require the provision of compensatory floodland storage to offset the effects of the placement of fill in the floodplain.
- Updating the Federal flood insurance studies for the Counties and communities in the watershed using the floodland maps and profiles developed under the watershed study.

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[46]*In addition to Dutch Gap Canal, Unnamed Tributary No. 1 to the Des Plaines River also flows from Wisconsin to Illinois before joining the main stem of the Des Plaines River in Illinois. As seen from Table 113, under recommended plan conditions, the peak 100-year flood flow in this stream at the state line would be expected to decrease by about 8 percent relative to 1990 land use conditions. The peak two-year flood flow in this stream at the state line would be expected to increase by about 16 percent relative to 1990 conditions. That increase is probably overstated because a significant portion of the area tributary to the stream is located in Illinois and no controls were assumed on peak rates of runoff from Illinois. The Lake County, Illinois stormwater management ordinance requires a two-year post-development release rate of 0.04 cfs/acre, which is the same as that recommended under this watershed plan. Application of such a release rate in the Illinois portion of this subwatershed would serve to reduce the peak two-year flood flows below the flows estimated for Unnamed Tributary No. 1 to the Des Plaines River where it flows from Wisconsin to Illinois.*

- Purchase of Federal flood insurance by property owners in floodprone areas.
- Determination by lending institutions of the floodprone status of properties prior to granting a mortgage.
- Formulation, or continuation, of governmental and agency policies such that the location, use, and size of public utilities and facilities are consistent with the floodprone status of riverine areas identified under this watershed study.
- Consideration by local communities of the potential hydrologic impact of proposed development or redevelopment and recognition that planned development should occur according to the land use plan recommended under this watershed study.
- Revising local policies and regulations to encourage low impact source controls and stormwater management practices designed to maintain pre-development hydrologic conditions.
- Providing property owners with information about the extent of flood hazard areas.
- Publicizing the watershed study through the news media, a public hearing, and the "Ties to the Land" and "Urban/Rural Connection" newsletters, the websites for Kenosha and Racine Counties, and the University of Wisconsin Extension.
- Incorporating channel maintenance functions in the operations of the responsible governmental units.
- Maintaining the U.S. Geological Survey stream gage on the Des Plaines River at Russell, Illinois, and establishing and maintaining a continuous recording gage on the Des Plaines River near the outlet of the Upper Des Plaines River subwatershed.

Chapter XIII

RECOMMENDED WATER QUALITY MANAGEMENT MEASURES

INTRODUCTION

The inventory and analysis phases of the Des Plaines River watershed planning program identified flooding and water pollution as important water resource problems in the watershed. The principal purpose of the watershed planning program is to develop a workable plan for the resolution of these problems. The recommended water quality management plan to address problems of point and nonpoint source pollution of the streams and lakes in the watershed is presented in this chapter.

The water quality management plan element for the watershed, as described herein, is a system level plan and, as such, has three functions:

- Identification of the type and sources of water pollution in the watershed;
- Determination of the levels of abatement of those sources required to achieve the established water use objectives and supporting standards for the watershed; and
- Recommendation of the best means for achieving the required level of pollution abatement considering technical practicality, economic feasibility, and environmental impact.

The recommended water quality management plan was formulated to:

- Address the water quality problems caused by both point and nonpoint sources of pollution as described in detail in Chapter VII.
- Satisfy, to the degree possible, the water use objectives and supporting water quality standards as presented in Chapter X and Appendix C of this report.[1,2]

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[1]*In general, the recommended water use objectives call for the maintenance of a healthy warmwater fishery along the main stem of the Des Plaines River and its major tributaries. Limited aquatic life and limited forage fish objectives are recommended for selected smaller tributaries.*

[2]*The formulation of objectives and standards may have to be an iterative process in which, as a result of plan design and evaluation, certain objectives initially proposed may have to be revised or discarded because their* *(Footnote continued on page 530)*

- Be consistent with the recommendations of the 1995 regional water quality management plan update.[3]

- Recognize the land and water resource management plans prepared for Kenosha and Racine Counties in 2000.[4]

- Enable attainment of the State of Wisconsin agricultural and nonagricultural nonpoint source pollution control performance standards that are effective as of October 1, 2002.

The water quality management plan elements prepared under other Commission, County, and local plans include recommendations for the abatement of the point and nonpoint sources of pollution within the Region and the Des Plaines River watershed, such as sanitary sewer overflows, private wastewater treatment plant discharges, industrial wastewater discharges, malfunctioning septic tank system discharges, stormwater runoff from rural and urban lands, soil erosion, and livestock waste runoff. The water quality management measures described herein are refinements of these recommendations which have been developed under other programs and, in most cases, represent ongoing committed or required future actions under these other programs.

RECOMMENDED PLAN TO CONTROL POINT SOURCES OF POLLUTION

Public Sewage Treatment Plants and Associated Sewer Service Area

A 1992 sanitary sewerage and water supply system plan[5] which was completed for the greater Kenosha area, and adopted as an amendment to the adopted regional water quality management plan in March 1996, recommends the abandonment of the sewage treatment plant serving Village of Pleasant Prairie Sewer Utility District D and the treatment plant serving the former Village of Pleasant Prairie Sanitary District No. 73-1.[6] Those plants are being phased out, and agreements are in place for abandonment before the year 2010. Upon abandonment of those plants, their former service areas would be served by the Kenosha Water Utility, which discharges treated wastewater to Lake Michigan. Along with abandonment of those plants, this watershed plan recommends construction of the intercommunity trunk sewers needed to provide service, as shown on Map 79.

In 1989, the Village of Pleasant Prairie obtained permission to divert up to 3.2 million gallons per day from Lake Michigan for its use and to discharge treated wastewater from the District D and District 73-1 treatment plants to the Mississippi River basin. The diversion was made to address a significant public health concern associated with the radium contamination of Pleasant Prairie’s water supply. The approval was based on the understanding that the diversion would be eliminated by the year 2010. Upon abandonment of the District D and District 73-1 treatment plants, the entire area now served by those plants would then be served by the regional wastewater and water treatment facilities of the Kenosha Water Utility. Thus, any water taken from Lake Michigan to serve the

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satisfaction has been proven unrealistic; new objectives may be suggested; and conflicts between inconsistent objectives may be balanced out. This formulation of objectives and standards must proceed hand in hand with plan design and evaluation.

[3]*SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report*, March 1995.*

[4]*SEWRPC Community Assistance Planning Report, No. 255,* A Land and Water Resource Management Plan for Kenosha County: 2000-2004, *September 2000; SEWRPC Community Assistance Planning Report, No. 259,* A Land and Water Resource Management Plan for Racine County: 2000-2004, *September 2000.*

[5]*Ruekert & Mielke, Inc.,* A Coordinated Sanitary Sewer and Water Supply System Plan for the Greater Kenosha Area*, 1992.*

[6]Amendment to the Regional Water Quality Management Plan-2010, Greater Kenosha Area, *adopted by the Southeastern Wisconsin Regional Planning Commission, March 1996.*

portion of the Village of Pleasant Prairie in the Des Plaines River watershed would be discharged back to Lake Michigan as treated wastewater, eliminating the current water diversion.

As discussed in Chapter VII, portions of the sewer service area lying west of IH 94 and east of the Canadian Pacific Railway line have been connected to the Kenosha sewage system. Thus, the diversion of water has been reduced from that which was approved on an interim basis. Abandonment of the two Pleasant Prairie plants and elimination of the diversion is expected to occur over the period 2007 to 2010.

With regard to the Village of Paddock Lake and the Town of Bristol Utility District No. 1 public treatment plants which are recommended to be maintained in the Des Plaines River watershed, it is noted that both plants currently have recorded monthly average flows which approach or exceed the average design capacity of the plant as shown on Table 72. Thus, facility planning programs have been initiated to explore plant expansion alternatives for both plants.

The existing and planned future sewer service areas associated with each of the public sewage treatment plants in the Des Plaines River watershed are shown on Map 79.

Private Sewage Treatment Facilities

As described in Chapter VII, five private sewage treatment plants are currently in operation within the Des Plaines River watershed, generally serving isolated enclaves of urban land uses, including two mobile home parks and one industry: Hickory Haven Mobile Home Park, Rainbow Lake Manor Mobile Home Park, the Bong Recreational Area,[7] the Brightondale County Park, and the Kenosha Beef International Company. These facilities, which serve isolated land uses are located beyond the current limits of the planned sanitary public sewer service areas and are recommended to be retained, with the exceptions of the Hickory Haven Mobile Home Park—located in close proximity to the planned Union Grove Sewer Service Area—and the Rainbow Lake Manor Mobile Home Park—located in close proximity to the planned Bristol service area, which have the potential to be consolidated with public treatment facilities. Thus, it is recommended that, when each of these two private plants require significant upgrading or modification, detailed facility planning be conducted to evaluate the alternative of connecting these two land uses to the adjacent public sanitary sewer systems. For the remaining three private sewage treatment plants, the need for upgrading and the level of treatment should be formulated on a case-by-case basis during plan implementation as part of the Wisconsin Pollution Discharge Elimination System (WPDES) permitting process.[8]

Management of Solids from Public and Private Sewage Treatment Plants

It is recommended the public and private sewage treatment plants in the watershed continue to implement the plant-specific sludge management plans that have been prepared for them as a part of the WPDES discharge permitting process.

Intercommunity Trunk Sewers

Based upon the aforementioned 1992 sanitary sewer and water supply system plan for the greater Kenosha area, the regional water quality management plan and this watershed plan recommend that two new trunk sewers be constructed to convey wastewater from the Pleasant Prairie portion of the service area to the City of Kenosha sewerage system.

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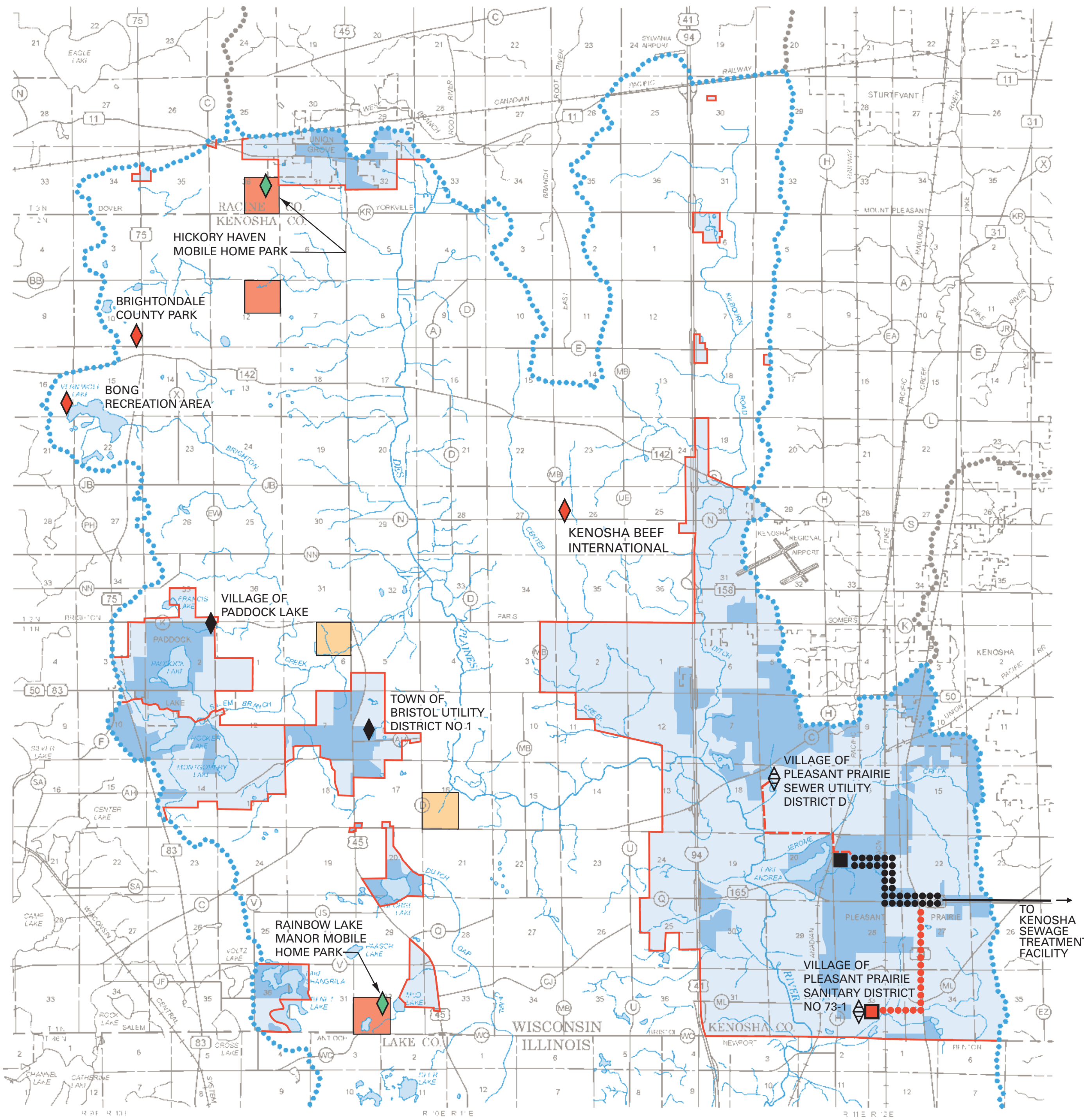
[7]*Despite its physical location within the Des Plaines River watershed, treated effluent from the Bong Recreational Area facility is discharged to the Fox River basin via Peterson Creek.*

[8]*As described in Chapter IX of this report, the WPDES was established by the Wisconsin Legislature in direct response to the requirements of the Federal Water Pollution Control Act of 1972.*

Map 79

RECOMMENDED POINT SOURCE POLLUTION CONTROL MEASURES FOR THE DES PLAINES WATERSHED



EXISTING SANITARY SEWER SERVICE AREA

PLANNED SANITARY SEWER SERVICE AREA

PLANNED SANITARY SEWER SERVICE AREA BOUNDARY

URBAN DENSITY DEVELOPMENT OUTSIDE OF PLANNED SEWER SERVICE AREA AS OF 1975

ADDITIONAL URBAN DENSITY DEVELOPMENT OUTSIDE OF PLANNED SEWER SERVICE AREA SINCE 1975

EXISTING PUBLIC SEWAGE TREATMENT FACILITY

EXISTING PRIVATE SEWAGE TREATMENT FACILITY

EXISTING PRIVATE SEWAGE TREATMENT FACILITY TO EVALUATE CONNECTION TO PUBLIC SYSTEM

PUBLIC SEWAGE TREATMENT FACILITY TO BE ABANDONED

EXISTING LIFT OR PUMPING STATION

EXISTING GRAVITY SEWER

EXISTING FORCE MAIN

PROPOSED LIFT OR PUMPING STATION

PROPOSED GRAVITY SEWER

PROPOSED FORCE MAIN

NOTE: CONTROL OF TREATMENT FACILITY AND INDUSTRIAL POINT SOURCE DISCHARGES WOULD BE ACCOMPLISHED UNDER THE WPDES PROGRAM.

GRAPHIC SCALE
0 1/2 1 MILE
0 2,000 4,000 6,000 FEET

Source: SEWRPC.

Regulation of Sewage Treatment Facilities and Industrial Discharges
The WPDES program requires a State permit for the discharge of any pollutant into the waters of the State, including the groundwaters. More specifically, permits are required for discharges from municipal sewage treatment plants and associated collection systems, private wastewater treatment facilities, and industrial establishments. The permits may specify abatement requirements and provide a schedule of compliance, setting forth dates by which specific elements of the permit must be responded to. The water quality management element of the Des Plaines River watershed plan recommends that these sources of wastewater continue to be regulated and controlled to acceptable levels on a case-by-case basis through the operation of the WPDES.

RECOMMENDED PLAN TO CONTROL NONPOINT SOURCES OF POLLUTION

Land and Water Resource Management Plan Recommendations
In September of 2000, both Racine and Kenosha Counties adopted land and water resource management plans (LWRMP) that specifically addresses problems of nonpoint source pollution. These plans not only identify the causes of nonpoint source pollution, but make several recommendations regarding nonpoint source pollution abatement. The recommendations contained in those plans were developed by watershed and included specific recommended goals, objectives, and actions for agricultural and urban areas. Table 114 illustrates the goals, objectives, and actions that are set forth in the LWRMP and that are recommended under the Des Plaines River watershed study. The urban recommendations focus primarily on practicing more effective stormwater management, reducing construction site erosion, managing onsite sewage disposal systems, and related educational land management activities. The agricultural recommendations focus on reducing nonpoint source pollution from sediment and livestock manure through a variety of governmental and individual actions and on implementing best management practices (BMPs). Appendix M describes measures and BMPs to control soil erosion and washoff of nonpoint source pollutants from agricultural lands. An economic analysis of agricultural conservation practices is set forth in Appendix K. Appendix L describes the essential components of a sound stormwater management plan to address both stormwater drainage and urban nonpoint source pollution control. The preparation of such plans is an important recommendation for the urban and urbanizing portions of the watershed. Table 114 also includes recommendations for onsite sewage disposal system management, water quality and wildlife habitat improvement, as well as recommendations for education of the public on natural resource and environmental issues.

Other Pollution Control Measures
Although reductions in nonpoint source loadings through the measures described above may provide the necessary surface water quality improvement for most pollutants, some additional control measures will be necessary in order to achieve the water use objectives for the Des Plaines River watershed. These measures include additional source controls to eliminate toxic and hazardous substances from surface waters in order to protect the development of a desired fishery. Accidental spills with attendant intermittent discharges through surface runoff, as well as floor drains connected to surface water and surface drainage systems, are other sources of toxic and hazardous substances which should be controlled. Spill prevention and control plans should be developed for all situations under which such spills could occur. Floor drains and drainage pumps in industrial facilities which collect grease, oil, chemicals, and other toxic and hazardous substances should be altered as necessary to eliminate discharge to storm sewers and surface watercourses. Possible alternatives include discharge to sanitary sewer systems for treatment at, and disposal through, public sewage treatment plants, pretreatment prior to discharge, or elimination of the discharge entirely through process modifications.

WATER QUALITY MONITORING PROGRAM

As described in Chapter VII of this report, a variety of surface water quality monitoring programs have been carried out within the Des Plaines River watershed. A well-planned and executed water quality monitoring program can serve two important functions for the water quality management plan element of the comprehensive plan for the watershed. First, water quality monitoring can perform a surveillance function in that periodic sampling and analysis of the stream system can detect undesirable levels of pollutants and help to determine the

Table 114

AGRICULTURAL AND URBAN NONPOINT SOURCE RECOMMENDATIONS FOR THE DES PLAINES RIVER WATERSHED

Goals and Objectives	County Actions and Individual Best Management Practices
Agriculture[a] I. Reduce agricultural nonpoint source pollution A. Reduce soil erosion to or below T, and to one-third to one-half T on fields in water quality management areas (WQMA) as required by State[b] and County[c] performance standards	1. Encourage landowners to develop farm conservation plans on critical agricultural fields and develop practices as needed a. Practice conservation tillage to leave 30 percent or more residue b. Use no-till practices for fields in WQMA if practical c. Practice crop rotations to minimize soil loss d. Contour farm if practical e. Establish permanent vegetation in concentrated flow channels f. Rotationally graze horses and cattle where practical 2. Conduct annual cropland erosion survey to monitor erosion levels
B. Reduce soil delivery rate by 50 percent on riparian fields	1. Work with the County Departments of Planning and Development and local municipalities to encourage installation of buffers on riparian lands 2. Seek funding to support actions related to buffers a. Establish appropriate buffers around riparian tillage fields in accordance with NRCS standards b. Appropriately maintain riparian buffers as needed to include mowing in some cases after the wildlife nesting season to control undesirable vegetation as needed for proper management c. Strip cropping if practical
C. Reduce nutrients and other pollutant loading nonpoint sources in the Des Plaines River watershed by about 25 percent and by about 75 and 50 percent for the Hooker and George Lake drainage areas, respectively[d]	1. Work with producers, and agricultural supply companies to encourage soil testing and appropriate nutrient and chemical application rates a. Soil test farm fields and develop a nutrient management plan for all fields in the watershed b. Account for legumes and manure before applying fertilizer c. Install diversions around barnyards and paddocks d. Utilize integrated pest management to reduce the amount of applied chemicals
D. Manage manure and livestock access to water resources in accordance with State performance standards	1. Monitor manure management activities within the watershed a. Locate manure stack areas outside of WQMA b. Install fencing to properly manage livestock and horses in areas with water resources c. Limit manure applications in WQMA d. Limit manure applications on highly erodible lands
II. Reduce sedimentation in agricultural drainageways and implement the recommendations of the comprehensive plan for the Des Plaines River watershed to alleviate poor drainage conditions	1. Reduce sediment delivery from fields by following aforereferenced individual best management practices to reduce soil erosion 2. Clean out accumulated sediment from agricultural drainageways as needed, incorporating the proper permitting process and associated sediment removal actions
Nonagricultural and Urban Land Uses I. Reduce nonpoint source pollution from nonagricultural land uses by 20 to 80 percent[e] and meet the pollutant reduction goals set forth in the regional water quality management plan	1. Work with the County Departments of Planning and Development and local municipalities to promote adopting a buffer requirement for urban riparian lands to reduce sedimentation into water resources 2. Work with the County Departments of Planning and Development and local municipalities to amend existing ordinances to require buffer establishment in areas of shoreline redevelopment
A. Reduce construction site erosion	1. Work with the County Departments of Planning and Development and municipalities to establish consistent stormwater management and construction site erosion control ordinance requirements and policies 2. Develop a program to monitor construction sites to ensure proper installation and maintenance of erosion control measures 3. Work with the County Departments of Planning and Development and municipalities to review and revise ordinances to encourage developers and contractors to remove the minimum amount of vegetation necessary during construction

Table 114 (continued)

Goals and Objectives	County Actions and Individual Best Management Practices
Nonagricultural and Urban Land Uses (continued) B. Manage stormwater runoff more effectively	1. Work with the County Departments of Planning and Development and municipalities to develop a comprehensive coordinated program to implement detailed stormwater management plans by logical subwatershed areas for urban and urbanizing regions within the Des Plaines River watershed. The detailed stormwater management plans should be developed within the framework of the Des Plaines River watershed study; should be designed to meet the requirements of the performance standards for urban, urbanizing, and redeveloping areas as set forth in Chapter NR 151 of the *Wisconsin Administrative Code*; and should be designed to achieve the pollutant reduction goals set forth in the regional water quality management plan 2. Work with local municipalities to develop programs to routinely inspect, remove sediment, and otherwise maintain stormwater detention basins and other facilities 3. Encourage municipalities to take responsibility for maintenance of major stormwater management facilities 4. Continue implementation of local road deicing salt reduction programs and pursue suitable alternatives to current practices on roads maintained by Kenosha and Racine Counties.
II. Encourage urban-density land use to be confined to within the identified urban service areas A. Limit agricultural rezonings to planned urban service areas[f,g]	1. Incorporate the LWRMP goals and objectives into land use planning programs
Onsite Sewage Disposal System Management I. Identify failing onsite sewage disposal system for maintenance or replacement	1. Continue the County comprehensive onsite sewage disposal system management programs and expand to address provisions of Comm 83 as needed 2. Identify septic systems that are failing, and determine which onsite sewage disposal systems are no longer in compliance with State codes 3. Identify and secure funding to help offset the cost of repair and replacement of onsite sewage disposal systems
Water Quality and Wildlife Habitat I. Improve overall water quality and wildlife habitat in the Des Plaines River watershed	
A. Reduce erosion from unstable streambanks	1. Seek funding to assist landowners to stabilize critical erosion sites as identified in Chapter VII of this report
B. Reduce sedimentation of wetlands	1. Work with County Departments of Planning and Development and municipalities to amend existing ordinances to establish a setback from wetlands[h]
C. Continue to support the acquisition and preservation of environmental corridors and important identified natural and critical species habitat areas[i]	
D. Obtain and review current water quality data and plan to obtain supplemental and future data as needed to assess current conditions, including chloride levels, and to monitor progress on nonpoint source reduction program effectiveness	1. Encourage lake districts and lake associations to take an active role in obtaining water quality data
E. Encourage riparian buffer establishment	1. Work with County Departments of Planning and Development and municipalities to encourage adoption of buffer requirements on riparian lands in accordance with Chapter NR 115 of the *Wisconsin Administrative Code* and other appropriate rules and guidance 2. Seek funding to support actions related to buffers 3. Identify rural riparian landowners and inform them about available cost-share programs for buffer installation
Education I. Increase education and awareness on natural resources and the environment A. Provide information to agricultural producers on the environmental and economic benefits of nutrient management and erosion control	1. Develop and offer nutrient management short courses and informational material to agricultural producers 2. Distribute informational materials to producers on the financial and economic benefits of reducing erosion

Table 114 (continued)

Goals and Objectives	County Actions and Individual Best Management Practices
Education (continued)	
B. Work with agricultural supply businesses, lawn maintenance companies, and golf course superintendents to promote the principals of nutrient and chemical management	1. Work with area coops and other suppliers to develop seminars targeted to nutrient and agri-chemical management and regulations, as well as area lawn companies and golf-course superintendents
C. Provide information to area contractors and developers on appropriate best management practices for stormwater management and erosion control	1. Hold short courses on appropriate construction site erosion control for builders and developers
D. Provide information to riparian property owners and landscape contractors on the effectiveness of riparian buffers and design options	1. Hold seminars targeted towards landscape contractors on the effectiveness of riparian buffers and potential design options for residential and business situations 2. Assist in developing demonstration sites to illustrate sound riparian land management and buffer establishment
E. Utilize existing programs to promote an in-school curriculum for schools within the watershed	1. Utilize existing programs to help implement a curriculum to inform students on identifying natural resources, understanding their function and role in the environment, and ways to manage and restore those resources
F. Provide information to watershed residents about appropriate yard management practices	1. Distribute informational materials to homeowners on pet waste, leaf and grass clipping disposal, lawn fertilization techniques, and the problems associated with dumping chemicals directly into storm sewers

[a] *A comprehensive list and explanation of agricultural conservation practices, is available from the U.S. Natural Resources Conservation Service, the County Land Conservation Department, or the University of Wisconsin-Extension Service.*

[b] *Chapter 92 of the* Wisconsin Statutes*, proposed amended Chapter ATCP 50 of the* Wisconsin Administrative Code*, and Chapter NR 151, of the* Wisconsin Administrative Code.

[c] *SEWRPC Community Assistance Planning Report No. 164,* Kenosha County Agricultural Soil Erosion Control Plan*, April 1989, and SEWRPC Community Assistance Planning Report No. 160,* Racine County Agricultural Soil Erosion Control Plan*, July 1988.*

[d] *Information, including descriptions and effectiveness of urban and rural best management practices, is included in the Wisconsin Department of Natural Resources,* The Wisconsin Stormwater Manual*; SEWRPC Technical Report No. 31,* Costs of Urban Nonpoint Source Water Pollution Control Measures*, June 1991; and SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report*, March 1995.*

[e] *Based upon proposed amended Chapter ATCP 50 of the* Wisconsin Administrative Code*, and Chapter NR 151, of the* Wisconsin Administrative Code *and the recommendations in the Regional Water Quality Management Plan.*

[f] *Apply principles of farmland and rural open space preservation as identified in SEWRPC Community Assistance Planning Report No. 45,* A Farmland Preservation Plan for Kenosha County, Wisconsin*, June 1981, and SEWRPC Community Assistance Planning Report No. 46,* A Farmland Preservation Plan for Racine County, Wisconsin*, August 1981.*

[g] *Apply recommendations set forth in SEWRPC Community Assistance Planning Report No. 212,* A Comprehensive Plan for the Kenosha Urban Planning District, Kenosha County, Wisconsin*, March 1996.*

[h] *The Village of Pleasant Prairie currently has a 25-foot setback from zoned wetlands.*

[i] *SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, September 1997.*

Source: SEWRPC.

probable source and thereby facilitate corrective action. Second, the water quality monitoring effort, using historic and existing data as a benchmark, can be used to demonstrate and document improvements in the water quality of the watershed as recommended plan elements are implemented. It is recommended that water quality monitoring of streams in the watershed be reinstated as recommended under the Kenosha and Racine County LWRMP. It is also recommended that the collection of lake water quality data be continued under the WDNR Self-Help Lake Monitoring Program, supplemented by more-detailed trophic state index (TSI) monitoring funded in part under the Chapter NR 190 Lake Management Planning Grant Program.

LAKES MANAGEMENT

The previous section includes recommendations related to nonpoint source pollution abatement measures related to the entire watershed, including the areas draining to lakes. Information on the lakes fishery, and related recommendations is included in Chapter XIV. Appendix N includes more comprehensive lakes management plan recommendations for the lakes in the Des Plaines River watershed.

SUMMARY

The water quality management plan elements include those related to the control of point and nonpoint sources of pollution, as well as measures related to water quality monitoring. Data on the implementation status and costs of the water quality plan elements is included in Chapter XVI, "Plan Implementation."

The following water quality management measures are recommended to control point sources of pollution:

- The abandonment of the sewage treatment plant serving Village of Pleasant Prairie Sewer Utility District D and the treatment plant serving the former Village of Pleasant Prairie Sanitary District No. 73-1.

- The completion of the facility planning programs to explore plant expansion and upgrading alternatives for the Village of Paddock Lake and the Town of Bristol Utility District No. 1 public treatment plants which are recommended to be maintained in the watershed.

- At the time that significant upgrading or modification is required for the private sewage treatment facilities serving the Hickory Haven Mobile Home Park—located in close proximity to the planned Union Grove Sewer Service Area—and the Rainbow Lake Manor Mobile Home Park—located in close proximity to the planned Bristol service area, detailed facility planning should be conducted to evaluate the alternative of connecting these two land uses to the adjacent public sanitary sewer systems.

- For the remaining three private sewage treatment plants, serving the Bong Recreational Area, Brightondale County Park, and the Kenosha Beef International Company, the need for upgrading and the level of treatment should be formulated on a case-by-case basis during plan implementation as part of the Wisconsin Pollution Discharge Elimination System (WPDES) permitting process.

- Public and private sewage treatment plants in the watershed should continue to implement the plant-specific sludge management plans that have been prepared for them as a part of the WPDES discharge permitting process.

- Discharges from municipal sewage treatment plants and associated collection systems, private wastewater treatment facilities, and industrial establishments should continue to be regulated and controlled to acceptable levels on a case-by-case basis through the operation of the WPDES.

Table 114 illustrates the rural and urban nonpoint source pollution reduction goals, objectives, and actions that are set forth in the Land and Water Resource Management Plans for Kenosha and Racine Counties and that are recommended under the Des Plaines River watershed study. The urban recommendations focus primarily on practicing more effective stormwater management, reducing construction site erosion, and making sound land use decisions. The agricultural recommendations focus on reducing nonpoint source pollution from sediment and livestock manure through a variety of governmental and individual actions and best management practices (BMPs). Table 114 also includes recommendations for onsite sewage disposal system management and water quality and wildlife habitat improvement.

It is also recommended that additional source controls be implemented to eliminate toxic and hazardous substances from surface waters in order to protect the development of a desired fishery. Such controls would include those to prevent and control spills and to eliminate illicit connections between floor drains and drainage pumps in industrial and municipal facilities and storm sewers/surface watercourses.

It is also recommended that comprehensive lake management plans be prepared for each major lake in the watershed as described in Appendix N. In addition, it is recommended that lake management planning and supporting monitoring be conducted for lakes less than 50 acres in size where such activities are deemed important for lake protection purposes.

Chapter XIV

RECOMMENDED FISHERIES MANAGEMENT MEASURES

INTRODUCTION

The maintenance and rehabilitation of the warmwater fishery in the watershed is an important component of this watershed plan which follows logically from the plan recommendations to improve water quality through the control of point and nonpoint source pollution from agricultural and urban sources. This chapter sets forth the recommended fisheries management plan element which was developed to be consistent with, and to complement, the other plan recommendations regarding water quality, stormwater and floodland management, and open space preservation.

POTENTIAL FOR FISHERIES DEVELOPMENT

Historical Findings

Review of the fishery data collected in the Des Plaines River basin between 1906 and 1994 (see Table 24 in Chapter III of this report and Appendix B) indicates an apparent loss of nine species and an overall decrease in fish species diversity throughout the watershed during this time period. Most notable were losses of species, such as the creek chubsucker, longear sunfish, redfin shiner, least darter, and lake chubsucker. This pattern of species loss is not limited to the Des Plaines River watershed. For example, the current distribution of longear sunfish within Southeastern Wisconsin is approximately 25 percent of their reported historical distribution.[1] Longear sunfish, extirpated from both the Root and Des Plaines Rivers, are currently limited to two sites on the Upper Milwaukee River and one site on the Lower Mukwonago River.

The decline in longear sunfish and other species throughout the Des Plaines River watershed has been attributed primarily to habitat loss and degradation as a consequence of human activities within the watershed.[2] The human activities primarily contributing to fisheries habitat loss and degradation include:

- Ditching and realignment of stream channels contributing to bank instability as shown on Map 37;
- Construction of hydraulic structures as shown on Map 38 in Chapter V of this report, fragmenting habitat and obstructing fish movements;

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[1]*Laura Stremick,* "Status and Factors Influencing the Distribution and Abundance of Longear Sunfish in Southeastern Wisconsin," *Masters Thesis, University of Wisconsin-Milwaukee, 1996.*

[2]Ibid.

- Agricultural and construction site runoff to streams, causing high levels of sediment delivery (Table 80), sediment deposition (Map 51), turbidity (Table 25), and nutrient concentrations (Table 81);
- Introduction of exotic species, such as carp, as shown on Map 80 and in Table 115; and
- Past encroachment into floodlands resulting in the loss of riparian and shoreland wetland vegetation within the watershed as summarized in Chapter III.[3]

Existing Fishery

Despite the declines in the occurrence of certain species as noted above, the 1994 fish population survey of the Des Plaines River and its major tributary streams demonstrated a fairly diverse fish community, as shown on Map 80, indicative of warmwater lowland stream systems in Southeastern Wisconsin.[4] Map 80 shows a wide range in the distribution and abundance of reproducing populations of forage fish, rough fish, and gamefish species throughout the Des Plaines River watershed as indicated by the presence of both adult and juvenile individuals among these groups of fishes. Map 80 also indicates the proportion and extent of establishment of the exotic invasive carp species (both adult and juvenile) in the watershed. In addition, significant populations of both adult and juvenile pirate perch, a species of special concern, continue to occur in portions of the system, even though populations of some of these species have been absent in the lower reaches of the system, within Illinois, for more than two decades.[5]

Recent electrofishing and habitat surveys conducted from 1999 through 2001 by the Wisconsin Department of Natural Resources (WDNR) indicate that some portions of the Des Plaines River watershed may not be as degraded, in terms of overall fish abundance and diversity, as previously indicated (see Chapter III). Comparison of historical and 1994 fish survey results for the watershed with 1999 to 2001 survey results demonstrates an increase in species numbers and diversity: 36 species at seven stations, with six intolerant (this total includes two species not previously recorded), 14 tolerant, 12 very tolerant, and six additional species never recorded previously in the watershed (see Table 24, Chapter III). The recent survey averaged more than 16 species per station with six of these being intolerant species, which is greater than any other sampling period in history including the 1906 and 1928 surveys. Among the 36 species found within this recent survey several have not been found in decades and some are new records for the Des Plaines River watershed. Intolerant species, such as the largescale stoneroller and spotted sucker, have not been found in the watershed since 1976 and rock bass have not been recorded since 1906, while smallmouth bass (Micropterous dolomieu) and banded darter (Etheostoma zonale) have never been recorded. Tolerant species, such as grass pickerel and yellow perch, have not been recorded since 1979 and 1980, respectively; and very tolerant species, such as brown bullhead, have not been recorded since 1979. Six new species, including smallmouth bass and banded darter (see intolerant species above), goldfish (Carassius auratus), blackside darter (Percina maculata), stonecat (Noturus flavus), and orange spotted sunfish (Lepomis humilis), were recorded. In addition, 2,769 fish were captured at these seven sample sites, which is 137 more fish than in 1994. Only one fish was found to exhibit eroded fins and no individuals were found to contain lesion or tumor deformities indicative of highly degraded waters.

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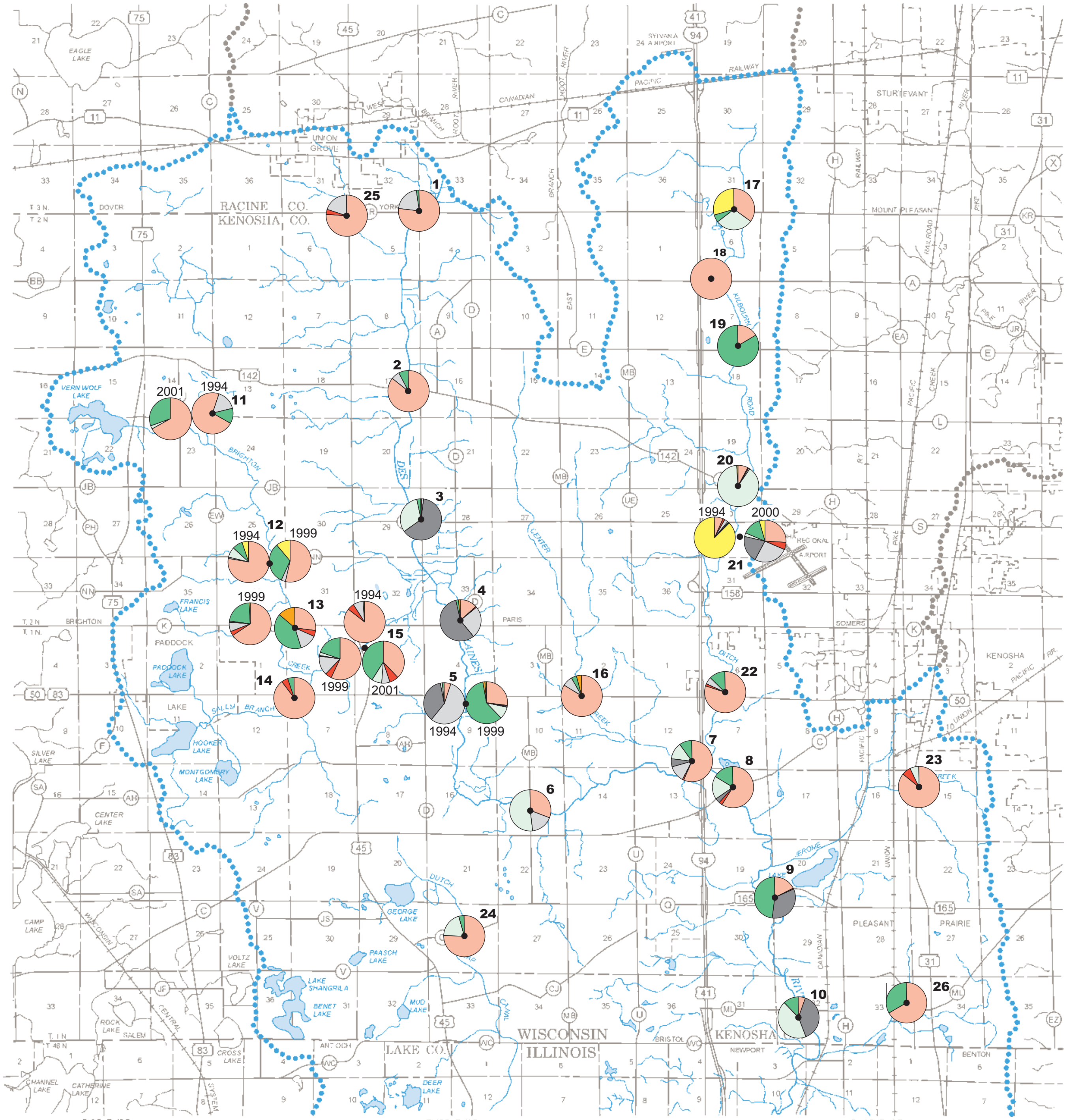
[3]*Current local floodland zoning ordinances and State wetland regulations have largely halted such encroachment. In unincorporated areas of Kenosha and Racine Counties and in the Village of Pleasant Prairie, in instances where the placement of fill in nonwetland portions of the floodplain is permitted, it must be offset by the provision of compensatory floodwater storage volume in the floodplain.*

[4]*John Lyons, "Correspondence Between the Distribution of Fish Assemblages in Wisconsin Streams and Omernik's Ecoregions,"* American Midland Naturalist*, Vo.l. 122, 1989, pp. 163-182.*

[5]*Roy C. Heidinger, "Fishes in the Illinois Portion of the Upper Des Plaines River,"* Transactions of the Illinois State Academy of Science*, Vol. 82, Nos. 1 and 2, 1989.*

Map 80

DOMINANT FISH SPECIES ASSEMBLAGES AMONG SURVEY STATIONS IN THE DES PLAINES RIVER WATERSHED: 1994-2001



MINNOWS

- MINNOWS
- DARTERS

ROUGH FISH

- SUCKERS
- CARP

GAME FISH

- BULLHEAD
- SUNFISH
- PIKE

SPECIES OF SPECIAL CONCERN

- PIRATE PERCH

21 FISH SURVEY STATION LOCATION AND IDENTIFICATION NUMBER

NOTE: SAMPLE SITES INDICATE DATA FROM 1994 FISHERIES SURVEY, UNLESS OTHERWISE INDICATED.

ADDITIONAL INFORMATION ON HISTORIC FISH SURVEYS IS PROVIDED IN THE "FISHERY" SECTION OF CHAPTER III, "DESCRIPTION OF THE WATERSHED: MAN-MADE FEATURES AND NATURAL RESOURCES BASE," AND IN APPENDIX B, "FINDINGS OF FISH SURVEYS CONDUCTED IN THE DES PLAINES RIVER WATERSHED: 1906-1994."

GRAPHIC SCALE

0 1/2 1 MILE

0 2,000 4,000 6,000 FEET

Source: SEWRPC

Table 115

COMPARISON OF POTENTIAL HABITAT LIMITATIONS, SPECIAL FEATURES, AND FISHERY STATUS AMONG THE MAJOR STREAMS AND TRIBUTARIES WITHIN THE DES PLAINES RIVER WATERSHED: 1994-2001

		Potential Habitat Limitations							Special Features		Fishery Status		
		Physical[a]			Chemical			Biological					
Waterbody	WQAA[b]	Sedimentation[c]	Channelization	Bank Stability[d]	Nutrients[e]	Water Clarity[f]	Metals[e]	Exotic Species (Carp)	Number of Major and Minor Lakes	Number of Major and Perennial Tributaries	Threatened, Endangered, and Species of Special Concern	Game Fish Species	Forage Fish Species
Stream Reach													
Des Plaines River Upstream of Confluence with Brighton Creek	1, 2	Yes	Yes	Yes	Yes	Yes	No	Yes[g]	0	12, 4	No	Yes[g]	Yes[g]
Des Plaines River Downstream of Confluence with Brighton Creek	3, 4	Yes	Yes	No	Yes	No	No	Yes[g]	1	9, 9	No	Yes[g]	Yes[g]
Brighton Creek	5, 6	No	No	Yes	Yes	Yes	No	Yes[h]	2	4, 4	Yes[i,k]	Yes[g]	Yes[g]
Salem Branch	7	Unknown	No	Yes	Yes	Yes	No	No	3	5	Yes[i]	Yes[g]	Yes[g]
Center Creek	8	No	Yes	Yes	Yes	Yes	No	No	0	5	No	Yes	Yes
Kilbourn Road Ditch	9	No	Yes	Yes	Yes	Yes	No	Yes[k]	0	14	Yes[i,k]	Yes[g]	Yes[g]
Dutch Gap Canal	10	Yes	Yes	Unknown	Yes	No	No	No	4	3	Yes[i]	Yes	Yes
Major Tributary													
Union Grove Tributary	1	No	Yes	Yes	Yes	Yes	No	No	0	--	No	Yes	Yes
Jerome Creek	4	Unknown	Yes	Yes	Yes	No	No	No	0	--	No	Yes	Yes
Pleasant Prairie Tributary	4	Yes	Yes	Unknown	Yes	No	No	Yes	0	--	Yes[j]	Yes	Yes
Unnamed Tributary No. 1 to the Des Plaines River	4	Yes	Yes	Yes	Yes	No	No	No	0	--	No	Yes	Yes
Major Lake													
Lake Andrea	4	- -	- -	- -	Yes	Yes	Unknown	Unknown	- -	- -	No	Yes[k]	Yes[k]
Benet/Shangrila Lake	10	- -	- -	- -	Yes	Yes	Unknown	No[a,i]	- -	- -	Yes[i]	Yes[i]	Yes[i]
George Lake	10	- -	- -	- -	Yes	Yes	Unknown	Yes[a,i]	- -	- -	Yes[i]	Yes[i]	Yes[i]
Hooker Lake	7	- -	- -	- -	Yes	Yes	Unknown	Yes[a,i]	- -	- -	Yes[i]	Yes[i]	Yes[i]
Paddock Lake	7	- -	- -	- -	Yes	Yes	Unknown	Yes[a,i]	- -	- -	Yes[i]	Yes[i]	Yes[i]
Vern Wolf Lake	5	- -	- -	- -	Yes	Yes	Unknown	Yes[a]	- -	- -	No	Yes[l]	Yes[l]

[a] *Physical limitations also include migratory barriers to fisheries movements such as debris jams, beaver dams, culverts, or other obstructions contributing to habitat fragmentation, although not enough information is known to assess the current extent of this problem within the watershed.*

[b] *Water Quality Analysis Area corresponding to the major subbasins utilized for hydrological and water quality modeling in Chapter VII.*

[c] *Survey by the Southeastern Wisconsin Regional Planning Commission, 1996 and 1999, as summarized on Map 51.*

[d] *Survey by the Southeastern Wisconsin Regional Planning Commission, 1999, as summarized on Map 52.*

[e] *Data assembled or collected by the Southeastern Wisconsin Regional Planning Commission, 1964 through 2001, as summarized in Table 70.*

[f] *Stream water clarity based upon observations by the Southeastern Wisconsin Regional Planning Commission; lake water clarity based upon Secchi disk transparency values.*

[g] *Samples included young-of-year and juveniles of these species, indicating the presence of a reproducing population.*

[h] *Reported sighting, but no fishes were caught during the sampling program in 1994.*

[i] *Historic report: fishes reported from surveys conducted between 1960 and 1980.*

[j] *Current report: fishes captured during the 1994 Regional Planning Commission Survey reported in Appendix B.*

[k] *Survey by the Wisconsin Department of Natural Resources.*

[l] *Reported in Wisconsin Department of Natural Resources Publication PUBL-FH-800 99Rev,* Wisconsin Lakes, *1999.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

Although the pirate perch, a State species of special concern, has been collected within the Des Plaines River system with decreasing frequency since 1928, the recent fish survey indicates that they continue to be found in abundance within Kilbourn Road Ditch and Brighton Creek, as well as the Lower Des Plaines River where it has not been observed since the 1965-1979 collections. In addition, the high proportion of smallmouth bass, which has never been recorded within this watershed, indicates a significant potential for enhancing the recreational fishery within Brighton Creek and the Lower Des Plaines River. Smallmouth bass have been recorded in the Des Plaines River downstream of the Wisconsin-Illinois border since at least since 1978[6] and their abundance

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[6] *Lake County Forest Preserve District, "Des Plaines River Aquatic Study," February 1978.*

within Brighton Creek may represent immigration from these downstream areas. Smallmouth bass, as well as the banded darter, are ranked as intolerant species and their presence is indicative of good or improved water quality or habitat within Brighton Creek and potentially the Lower Des Plaines River.[7]

The Commission staff used an Index of Biotic Integrity (IBI) to classify the fishery and environmental quality in this warmwater stream system using the 1999 to 2001 fish survey data from the sampling locations shown on Map 80.[8] The IBI consists of a series of fish community attributes that reflect basic structural and functional characteristics of biotic assemblages: species richness and composition, trophic and reproductive function, and individual abundance and condition.[9] IBI results indicate a fair to good classification for Brighton Creek and a fair classification for the Lower Des Plaines River. The IBI results are consistent with the overall fishery ranking of 1994, as shown in Table 27. The Kilbourn Road Ditch, based on one sampling location, received a poor IBI classification that is worse than the overall fair ranking of the fishery based on the 1994 assessment (Table 27). However, macroinvertebrate data as shown in Figure 70 and discussed below suggest that Kilbourn Road Ditch may only be moderately impaired.

Although the fish IBI is useful for assessing environmental quality and biotic integrity in warmwater streams, it is most effective when used in combination with additional data on physical habitat, water quality, macroinvertebrates, and other biota when evaluating a site.[10] Hence, supplemental data for macroinvertebrates and mussel surveys conducted by the WDNR for the abovementioned sites are summarized below.

Macroinvertebrate Data

Recent macroinvertebrate surveys conducted from 1999 through 2001 by the WDNR show that sites are generally classified as moderately impaired within the Des Plaines River watershed, except for one nonimpaired site on Brighton Creek and one severely impaired site on the Lower Des Plaines River (Figure 70). The biological assessment rating for macroinvertebrate taxa is based upon modified rapid bioassessment protocol criteria for screening water quality that include the following benthic community attributes:[11] taxa richness (total number of families); Ephemeroptera, Plecoptera, and Trichoptera (EPT) index (total number of families of Ephemeroptera, Plecoptera, and Trichoptera); percent dominance (percent dominated by one family); percent EPT (percent of families comprised of Ephemeroptera, Plecoptera, and Trichoptera); and Hilsenhoff Biotic Index[12] (Family Biotic

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[7]*John Lyons, "Using the Index of Biotic Integrity (IBI) to Measure Environmental Quality in Warmwater Streams of Wisconsin," United States Department of Agriculture,* General Technical Report NC-149*, 1992.*

[8]Ibid.

[9]*John Lyons,* General Technical Report NC-149, op. cit*. The Wisconsin IBI described here consists of 10 basic metrics, plus two additional metrics (termed "correction factors") that affect the index only when they have extreme values. These 12 metrics are: Species Richness and Composition—total number of native species, darter species, sucker species, sunfish species, intolerant species, and percent (by number of individuals) that are tolerant species; Trophic and Reproductive Function—percent that are omnivores, insectivores, top carnivores, and simple lithophilous spawners; and Fish Abundance and Condition—number of individuals (excluding tolerant species) per 300 meters sampled and percent with deformities, eroded fins, lesions, or tumors (DELT). The last two metrics are not normally included in the calculation of the IBI, but they can lower the overall IBI score if they have extreme values (very low number of individuals or high percent DELT fish).*

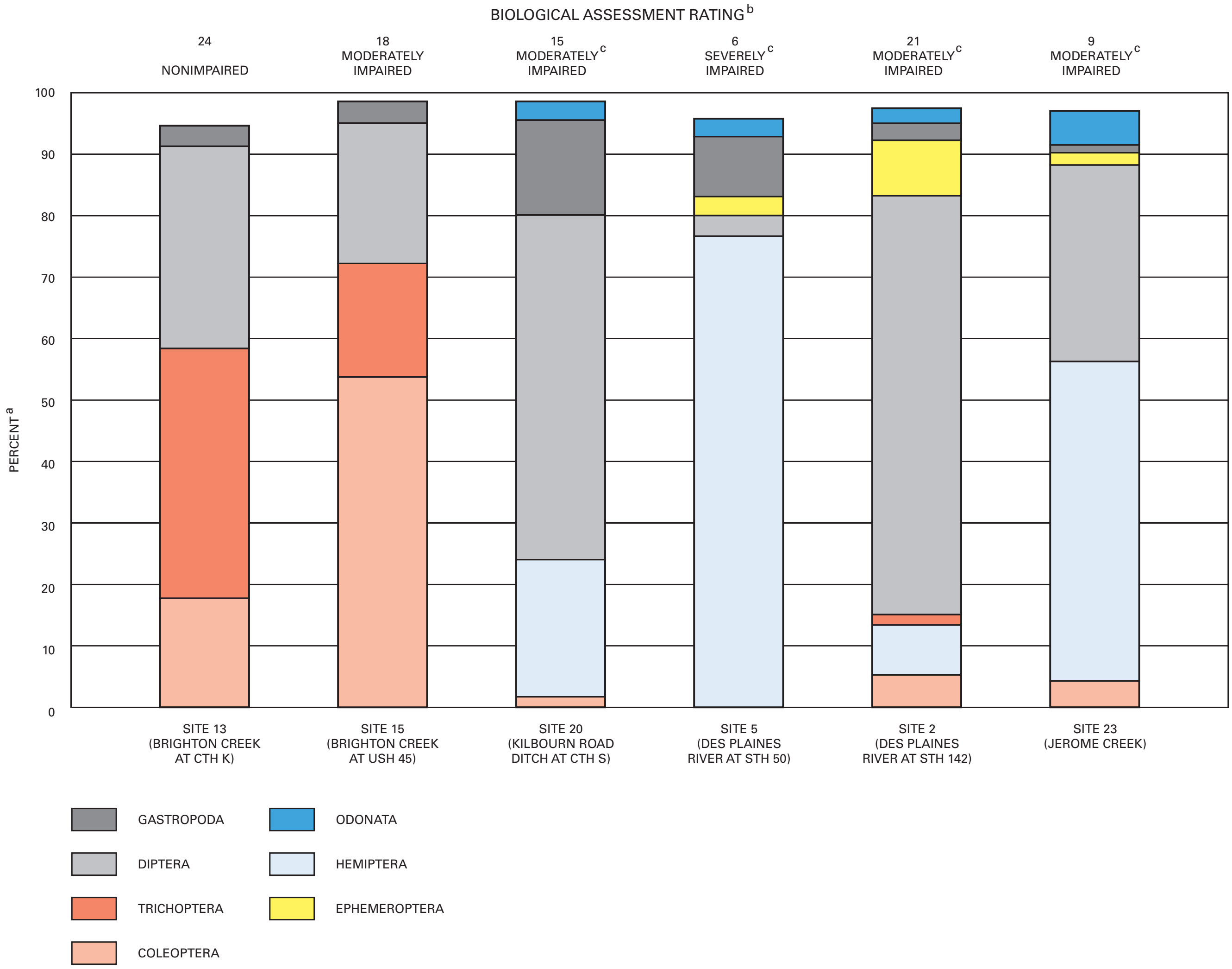
[10]*John Lyons,* General Technical Report NC-149, op. cit.

[11]*New Jersey Department of Environmental Protection, Bureau of Freshwater and Biological Monitoring,* http://www.state.nj.us/dep/watershedmgt/bfbm/rbptable1.html*, January, 2002.*

[12]*William L. Hilsenhoff, "Rapid Field Assessment of Organic Pollution with Family-Level Biotic Index," University of Wisconsin, Madison, 1988.*

Figure 70

PERCENT COMPOSITION OF DOMINANT MACROINVERTEBRATE TAXA AND BIOLOGICAL ASSESSMENT RATING[a] AMONG SITES WITHIN THE DES PLAINES RIVER WATERSHED: 1999-2001



[a] *Based upon modified criteria for screening water quality set forth in the New Jersey Department of Environmental Protection, Bureau of Freshwater and Biological Monitoring, http://www.state.nj.us/dep/watershedmgt/bfbm/.*

[b] *Hemiptera (bugs) taxa are not incorporated into the biological assessment calculation.*

[c] *These sites represent a different habitat type than that sampled in locations within Brighton Creek--being sampled in habitats comprised of snags that consist of entrained suspended or bottom debris that include leaves, sticks, twigs, or other vegetation. This type of habitat is generally much more variable in macroinvertebrate abundance and diversity and rated as poorer quality compared to samples taken from riffle habitats that are typically dominated by gravel substrates, such as the sites collected on Brighton Creek.*

[d] *Taxa comprised of less than 5 percent of the total abundance are not included in the percent composition.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

Index). A nonimpaired benthic community is defined as comparable to other undisturbed stream systems, and is characterized by a maximum taxa richness, balanced taxa groups, and good representation of intolerant individuals. Moderately impaired sites are characterized by reduced macroinvertebrate richness, in particular EPT taxa, accompanied by reduced community composition balance and reduction in the number of intolerant taxa. Severely impaired sites are characterized by a dramatic change in the benthic community structure typically dominated by few very abundant taxa that are tolerant to poor water quality conditions.

Mussel Data
Recent mussel surveys were conducted from 1999 through 2001 by the WDNR among five sites throughout the Brighton Creek subwatershed. Five species of mussels were collected, including fat mucket, white heelsplitter, giant floater, round pigtoe, and slippershell. The round pigtoe is a species of special concern and slippershell species is threatened, imperiled within the State of Wisconsin. The presence of these species further indicates that Brighton Creek may have much higher water quality and habitat available to aquatic organisms than previously thought, containing some of the rarest mussel species in Southeastern Wisconsin.

Summary and Conclusions
The fishery throughout the Des Plaines River watershed has been demonstrated to be significantly impacted in terms of a loss in intolerant species, habitat, and degraded water quality conditions, as discussed in Chapter III and summarized in Table 115. Recent data presented above demonstrates that some portions of the watershed, particularly within some areas of Brighton Creek, may contain greater potential for fisheries development than previously thought. However, none of the sites received an excellent IBI rating, and nearly all of the areas sampled indicated some level of impairment with associated imbalance in trophic structure and signs of deterioration, including decreased species richness and loss of intolerant individuals. The historic and recent data inventories demonstrate the importance of incorporating the following elements in an assessment of the fishery development potential within the Des Plaines River watershed and they form the basis for the recommended fisheries rehabilitation program set forth below:

- Development of clear objectives for assessment and monitoring;
- Inclusion of multiple biological indices, as well as habitat and water quality assessments, in the sampling scheme; and
- Inclusion of tributaries, as well as main channel reaches within the survey, as the former may function as source areas for critical species habitat in terms of food, growth, and reproduction of either gamefish and/or other endangered, threatened, or species of special concern.

In order to develop a set of complementary management measures that will result in the maintenance and rehabilitation of a warmwater fishery within this watershed, it is necessary to identify the problems that have adversely affected the fishery. These are summarized in Table 115. Only by understanding these problems is it possible to consider the changes in land and water resources management that could result in improvement of fish habitat. Specific problems include:

1. Physical Habitat Limitations
   Encroachment upon, and degradation of, natural stream channels, including small tributaries and shoreland wetlands, through urban and rural development and construction of agricultural and residential drainage systems that have artificially modified the natural drainage patterns within the system and have limited habitat for aquatic and terrestrial life. Such modifications not only limit the quality and quantity of available instream fisheries habitat through degradation of water quality, loss of shelter/cover, diminution of food production, and reduction of spawning opportunities, but also occur as a consequence of potentially controllable human activities that:
   a. Destabilize streambanks and increase erosion;
   b. Remove instream vegetation and bank cover that provide fish with shelter from predators, food, spawning areas, and protection from floods;
   c. Create ditches and channels of uniform depth (as opposed to the naturally occurring, alternating riffle and pool habitat), modify stream velocity or flow regime, modify bottom substrate composition, and fragment fish populations by creating barriers to migration and movement through culvert and bridge construction; and
   d. Deposit excessive silt and materials that create obstructions and limit the potential for maintaining healthy fish and macroinvertebrate populations.

2. Chemical Habitat Limitations
   Pollutant loads to streams and wetlands that reduce the ability of fishes to spawn and limit the habitat for juvenile gamefish species such as northern pike.

3. Biological Habitat Limitations
   Introduction of exotic species, such as carp, and modification of fish community composition through stocking of gamefish species.

In urbanizing areas, such as portions of the Des Plaines River watershed, it may not be practicable to limit, much less reverse, the historic trends in some of these factors. For example, limited modifications of nonnavigable streams for stormwater management and agricultural drainage purposes may be expected to continue. Similarly, fluctuations in streamflow cannot be completely avoided in an urbanizing watershed, where stream systems continue to serve urban stormwater drainage purposes. On the other hand, remaining wetlands can be protected, sediment and pollutant loadings can be reduced, and habitat rehabilitation measures can be undertaken as recommended under this watershed plan.

RECOMMENDED FISHERIES REHABILITATION PLAN ELEMENT

Fisheries Management Objectives

Based upon the fishery, watershed, and water quality inventories, set forth in the adopted regional water quality management plan, the Commission has recommended that the majority of the Des Plaines River and its tributaries be managed for warmwater sport fish and full recreational uses. With the exception of the Fonk's Tributary, the Union Grove Industrial Tributary, the Mud Lake Tributary, and an unnamed tributary draining to Center Creek (Kenosha Beef International), all shown on Map 59, the streams of the Des Plaines River watershed are recommended to be managed for warmwater sportfish.

The measures that would be required to maintain and rehabilitate the fishery in the Des Plaines River watershed as a warmwater sport fishery include implementation of measures to address the principal issues of concern identified above. A number of factors were considered in identifying and prioritizing stream reaches for the maintenance and rehabilitation of the fishery in the Des Plaines River basin. These factors include environmental considerations, such as fisheries assessments and macroinvertebrate assessments, as well as physical and legal considerations, such as position within the watershed and priority relative to overall stormwater management actions. Specifically, these measures would seek to address recommendations by the WDNR for habitat improvement of warmwater stream systems.[13] These recommended actions include: 1) enhanced streambank stability, 2) limitation of instream sediment deposition, 3) implementation of mitigation techniques to moderate the effects of channelization, and 4) restoration of instream and riparian habitat.[14] Inherent in these priority actions are the improvement of water quality, including water clarity, and improvement of the quality and availability of food organisms for fish species.

Approaches to Developing Fisheries Management Measures

Subwatershed Approach

Fish management measures are recommended to be implemented on a subwatershed basis, as set forth in Table 116. Therefore, implementation of management measures on the Upper Des Plaines River (upstream of the confluence with Brighton Creek), Brighton Creek, Salem Branch, Center Creek, and other major tributary subwatersheds are recommended to precede implementation of measures on the Lower Des Plaines River subwatershed. More specifically, within each of these subwatersheds, the recommended approach begins with the

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[13]*Wisconsin Department of Natural Resources Technical Bulletin No. 169,* A Review of Fisheries habitat Improvement Projects in Warmwater Streams, with Recommendations for Wisconsin*, 1990.*

[14]Ibid.

Table 116

RECOMMENDED FISHERIES HABITAT MANAGEMENT MEASURES FOR STREAMS AND LAKES WITHIN THE DES PLAINES RIVER WATERSHED

Management Elements	Description	Potential Application and Effectiveness[a]	Stream Reach[b]											Major Lake					
			Des Plaines River Upstream of Confluence with Brighton Creek	Des Plaines River Downstream of Confluence with Brighton Creek	Brighton Creek	Salem Branch	Center Creek	Kilbourn Road Ditch	Dutch Gap Canal	Union Grove Tributary	Jerome Creek	Pleasant Prairie Tributary	Unnamed Tributary No. 1 to the Des Plaines River	Lake Andrea	Benet/ Shangrila Lake	George Lake	Hooker Lake	Paddock Lake	Vern Wolf Lake
Tier 1 Watershed Management[c]																			
Best Management Practices: Agriculture	See Chapter XIII	Individual or systematic approaches to compensate, mitigate, or protect impacts from nonpoint source pollution as set forth in the land and water resource management plans for Kenosha and Racine Counties[d]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	- -	- -
Best Management Practices: Urban	See Chapter XIII	Individual or systematic approaches to compensate, mitigate, or protect impacts from nonpoint source pollution as set forth in the land and water resource manage-ment plans[d]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -
Best Management Practices: Stormwater[e]	See Chapter XIII	Individual or systematic approaches to manipulation of watershed features for the purpose of controlling stream flow and improving physical, chemical, and biological functions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -
Monitoring and Evaluation	Physical, chemical, and biological monitoring	Conducted to evaluate and adjust implementtation of best management practices	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -
Public Informational Programming	Increase educational awareness on natural resources and the environment	As set forth in the land and water resource management plans[d]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tier 2 Stream Corridor and Lake Management[c]																			
Develop Site-Specific Management Plan	Development of site-specific management measures to protect and effectively manage the quality of the land and water resources in an environmentally sound manner as recommended in the adopted regional water quality management plan[f]	Site-specific management plans allow selection of appropriate Tier 3 and Tier 4 management measures or combinations thereof to address concerns within individual lakes or stream segments	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	Yes	- -

Table 116 (continued)

Management Elements	Description	Potential Application and Effectiveness[a]	Stream Reach[b]											Major Lake					
			Des Plaines River Upstream of Confluence with Brighton Creek	Des Plaines River Downstream of Confluence with Brighton Creek	Brighton Creek	Salem Branch	Center Creek	Kilbourn Road Ditch	Dutch Gap Canal	Union Grove Tributary	Jerome Creek	Pleasant Prairie Tributary	Unnamed Tributary No. 1 to the Des Plaines River	Lake Andrea	Benet/ Shangrila Lake	George Lake	Hooker Lake	Paddock Lake	Vern Wolf Lake
Tier 2 ()continued)																			
Riparian Buffers	Vegetation along waterbody margins to protect these habitats by reducing sediment, organic material, nutrients, pesticides and other pollutants	Applicable on areas adjacent to permanent or intermittent streams, lakes, ponds, wetlands, and areas with ground water recharge	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	Yes	- -
Livestock Exclusion and Management	Exclusion fencing and managed grazing to protect and improve riparian vegetation and water quality	Suitable where livestock grazing is having detrimental impacts on streambank stability, vegetative growth, and water quality	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Maintenance of Hydraulic Connections	Maintain hydraulic connectivity to allow sufficient movement of water for aquatic organisms to utilize multiple areas of the watershed for food, shelter, and reproduction	Used to prevent losses of aquatic habitat quality, availability and diversity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Stream Meander Restoration	Convert straight channelized stream reaches into meandering stream system to improve channel stability, habitat quality, aesthetics, and other corridor functions or values	Used to create a more stable stream system with improved habitat quality, availability, and diversity	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Sediment Removal	Removal of excessive sediments from the bottom of a stream or lake system via natural processes, sediment traps, hydraulic jets, sieves, pumps, or backhoe to improve water quality and habitat quality	Used to create improved water quality and habitat quality, availability, and diversity. However, this technique may not be appropriate if the source(s) of sedimentation have not been addressed	Main channel: Yes Smaller tributaries: No	Main channel: Yes Smaller tributaries: No	No	- -	No	No	Yes	No	No	No	No	- -	- -	Yes[a]	- -	- -	- -
Tier 3																			
Streambank and Shoreline Treatment[g,h]																			
Riprap	Appropriately sized rock placed at the toe of the slope to height needed to stabilize the slope and promote sediment deposition	Utilized in areas where the streambank or shoreline is being undermined by toe scour, and where vegetation cannot be used	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	Yes	- -

Table 116 (continued)

Management Elements	Description	Potential Application and Effectiveness[a]	Stream Reach[b]											Major Lake					
			Des Plaines River Upstream of Confluence with Brighton Creek	Des Plaines River Downstream of Confluence with Brighton Creek	Brighton Creek	Salem Branch	Center Creek	Kilbourn Road Ditch	Dutch Gap Canal	Union Grove Tributary	Jerome Creek	Pleasant Prairie Tributary	Unnamed Tributary No. 1 to the Des Plaines River	Lake Andrea	Benet/ Shangrila Lake	George Lake	Hooker Lake	Paddock Lake	Vern Wolf Lake
Tier 3 (continued)																			
Tree Revetments and Brush Bundles	Single or multiple inter-connected trees or bundles of tree branches attached at the toe of the stream-bank or shoreline to reduce flow velocities along eroding banks, trap sediment, and provide substrate for plant establishment	Within streams it is more appropriate in areas where stream-bank heights are less than 12 feet and bankfull velocities under six feet per second	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Log, Rootwad, Brush and Boulder Revetments	Logs, rootwads, brush, and boulders are placed in various combinations adjacent to a streambank or shoreline to stabilize the bank, increase scour, and improve habitat	Has been used to enhance fisheries habitat availability and diversity	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Cribwalls	Box like interconnected logs that are anchored to the bank. Usually filled with rocks and/or with dirt and planted with live stakes or cuttings	Provides protection along streambank or shorelines in areas with near vertical banks and options to sloping the banks are limited	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Gabions	A rectangular wire cage or basket filled with rocks and soil attached together to form a wall of protection. Live branch cuttings or other vegeta-tion can be placed in the soil layer of each basket to take root and bind the structure to the slope	Useful for protecting steep slopes with active scouring and undercutting occurring	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Coconut Fiber Roll	Cylindrical structures comprised of coconut husk fibers wrapped with twine woven from coconut material, which are 100 percent bio-degradable, to protect banks from erosion while trapping sediment and encouraging plant growth	Appropriate where moderate toe stabilization is required in conjunction with restoration of the streambank or shoreline, which allows for minimal disturbance of the area	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	Yes	- -
Branch Packing, Brush Mattresses	Variable combinations of live stakes, fascines, and branch cuttings, and backfill that stabilize and revegetate the bank	Forms immediate protective cover that can also be used to repair patches of scoured voids in banks. Reinforcement with some type of additional toe protect-tion is often needed	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	Yes	- -

Table 116 (continued)

Management Elements	Description	Potential Application and Effectiveness[a]	Stream Reach[b]											Major Lake					
			Des Plaines River Upstream of Confluence with Brighton Creek	Des Plaines River Downstream of Confluence with Brighton Creek	Brighton Creek	Salem Branch	Center Creek	Kilbourn Road Ditch	Dutch Gap Canal	Union Grove Tributary	Jerome Creek	Pleasant Prairie Tributary	Unnamed Tributary No. 1 to the Des Plaines River	Lake Andrea	Benet/ Shangrila Lake	George Lake	Hooker Lake	Paddock Lake	Vern Wolf Lake
Tier 3 (continued)																			
Bank Shaping and Revegetation	Regrading streambanks or shorelines to a stable slope, placing topsoil and other materials needed for sustaining plant growth, and selecting, installing and establishing appropriate plant species	Most appropriate in areas where moderate erosion and channel migration are anticipated. Reinforcement with some type of additional toe protection is often needed	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	Yes	- -
Live Stakes, Post Plantings	Live woody cuttings that are tamped or planted into the soil to root and grow to stabilize the soil, trap sediment, and provide shade	Appropriate where site conditions contain moderate slopes and minor bank sloughing is occurring	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	Yes	- -
Live Fascines	Live branch cuttings bound together into cylindrical bundles and place along shallow trenches on slopes to reduce longitudinal erosion	Utilized to trap and hold soil on streambank or shoreline by reducing the slope length into a parallel series of shorter slopes along the bank acting as dam-like structures	Yes	Limited, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	Yes	Yes	Yes	Yes	- -
Tier 4																			
Instream and Lake Treatmenth,[i] Boulder Clusters	Individual or groups of boulder clusters placed in random areas of the stream base flow channel to provide cover, create scour holes, and heterogeneity of flow	Can be used in a variety of riffle, run, and pool habitat types to create instream cover. Best results are found in areas with average flows exceeding two feet per second and in streams with a low bed material load	Yes	Main Channel: No Limited to smaller tributaries, where necessary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Weirs or Sills, Grade Stabilization Structure, Low Head Dam, Check Dam, K-Dams, Wedge Dam	Structure that completely spans the channel and causes a sudden drop in channel elevation of less than five feet. Built of logs, rock, gabions, concrete, or sheet metal. May be notched to concentrate flow	Appropriate in stabilizing stream gradient and reducing headcutting. Effective in changing scour and deposition patterns within the stream and creating downstream pool habitat, however, these may become migratory barriers to some fish species	Limited, where necessary	Main channel: No Limited to bridge and culvert crossings, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	- -	- -	- -	- -	- -	- -

Table 116 (continued)

Management Elements	Description	Potential Application and Effectiveness[a]	Stream Reach[b]: Des Plaines River Upstream of Confluence with Brighton Creek	Des Plaines River Downstream of Confluence with Brighton Creek	Brighton Creek	Salem Branch	Center Creek	Kilbourn Road Ditch	Dutch Gap Canal	Union Grove Tributary	Jerome Creek	Pleasant Prairie Tributary	Unnamed Tributary No. 1 to the Des Plaines River	Major Lake: Lake Andrea	Benet/ Shangrila Lake	George Lake	Hooker Lake	Paddock Lake	Vern Wolf Lake
Tier 4 (continued)																			
Channel Constrictor	Log structures that are built suspended above the stream bottom at the water surface parallel to each other along opposite sides of each bank. This constriction of the flow increases velocity and scouring action that creates a narrow, deep channel with overhead cover	Appropriate in straight reaches of stream channel to increase habitat availability and diversity. Often necessary to reinforce structure with riprap	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Cross Channel Log/ Bank Revetment	Log and rock structure constructed to protect the outside bank of a stream meander and create pool habitat with cover	Appropriate at natural bends that lack stream cover and/or just at the downstream end of obvious breaks in stream gradient such as at the end of riffle habitats. Often necessary to reinforce structure with riprap	Yes	Main Channel: No Limited to smaller tributaries, where necessary	Limited, where necessary	Limited	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Revetments	See Log, Rootwad, Brush and Boulder Revetments above	See Log, Rootwad, Brush and Boulder Revetments above	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Half and Whole Log Cover	A log split lengthwise or whole log that is anchored to the substrate so that there is a narrow gap between the log and the substrate	Appropriate use to increase in-stream cover, but not recommended in streams with high bed load material	Yes	Main Channel: No Limited to smaller tributaries, where necessary	Yes	- -	Yes	Yes	No	Yes	- -	No	No	- -	- -	- -	- -	- -	- -
Wing Deflectors	A structure composed of logs, rocks, gabions, or other structures that protrude from the streambank and are used to force the current away from the bank. Can be a single wing (one side of channel only) or double wing (both sides of the channel)	Appropriate in channels with low physical habitat diversity, especially those with limited stable pool habitats	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Sediment Traps	A large hole dug in the stream channel to catch fine sediment as it moves downstream, which is periodically cleaned out	Appropriate to use in reducing instream sedimentation by changing scour and deposition patterns through removal of sediments from the system	Main channel: Yes Smaller tributaries: No	Main channel: Yes Smaller tributaries: No	No	- -	No	No	- -	No	- -	No	No	- -	Yes	Yes	Yes	Yes	- -

Table 116 (continued)

Management Elements	Description	Potential Application and Effectiveness[a]	Stream Reach[b]											Major Lake					
			Des Plaines River Upstream of Confluence with Brighton Creek	Des Plaines River Downstream of Confluence with Brighton Creek	Brighton Creek	Salem Branch	Center Creek	Kilbourn Road Ditch	Dutch Gap Canal	Union Grove Tributary	Jerome Creek	Pleasant Prairie Tributary	Unnamed Tributary No. 1 to the Des Plaines River	Lake Andrea	Benet/ Shangrila Lake	George Lake	Hooker Lake	Paddock Lake	Vern Wolf Lake
Tier 4 (continued)																			
Obstruction Removal[j]	Removal of major blockages of large accumulations of lodged trees, beaver dams, sediment, and other debris that span the entire stream width causing unacceptable flow problems	No stream work, including bank clearing, reposition-ing, or removal of material, should be allowed except at specific locations where unacceptable flow problems occur or may occur in the near future	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	- -	- -	- -	- -	- -	- -
Lunker Structures	A plank and log, free-standing, box-like structure with open sides that is installed just below the water at the toe of the bank, and is covered with riprap, soil, and vegetation to protect the bank and provide cover	Appropriate along outside bends of streams where water depths can be main-tained at or above the top of the structure. Not recommended in streams with heavy bed loads	Main channel: Yes Smaller tribu-taries: No	Main channel: Yes Smaller tribu-taries: No	Yes	No	No	Main Channel: Yes Smaller tributarie s: No	No	No	No	No	No	- -	- -	- -	- -	- -	- -
Log Cribs	Usually made of green, cedar logs fastened together in a crib shape and held down with stone or concrete blocks	Appropriate for inland lake use to enhance cover for fishes. However, they can interfere with naviga-tion if improperly placed in unsuitable areas	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary	Limited, where necessary

NOTE: The costs of best management practices are set forth in Chapter XV, "Recommended Comprehensive Plan," and Chapter XVI, "Plan Implementation."

[a] *For additional information consult the Stream Corridor Restoration: Principles, Processes, and Practices FISRWG (10/1998). By the Federal Interagency Stream Restoration Working Group (FISRWG)(15 Federal agencies of the U.S. government). GPO Item No. 0120-A; SuDocs No. A 57.6/2:EN 3/PT.653. ISBN-0-934213-59-3. http://www.usda.gov/stream_restoration/Water. Survey by the Southeastern Wisconsin Regional Planning Commission, 1996 and 1999, as summarized on Map VII-11.*

[b] *Measures may be needed along smaller tributaries in these subwatersheds, as well as along the main streams listed.*

[c] *Center for Watershed Protection, "Rapid Watershed Planning Handbook: A Comprehensive Guide for Managing Urbanizing Watersheds," Ellicott City, Maryland, October 1998.*

[d] *EWRPC Community Assistance Planning Report No. 255, A Land and Water Resource Management Plan for Kenosha County: 2000-2004, September 2000, and SEWRPC Community Assistance Planning Report No. 259, A Land and Water Resource Management Plan for Racine County: 2000-2004, September 2000.*

[e] *The costs of these best management practices are set forth in Chapter XV," Recommended Comprehensive Plan," and Chapter XVI, "Plan Implementation," of this report.*

[f] *SEWRPC Memorandum Report No. 99, A Regional Water Quality Management Plan for Southeastern Wisconsin: an Update and Status Report, March 1995.*

[g] *Minnesota Department of Natural Resources, "Landscaping for Wildlife and Water Quality," Nongame Wildlife Program—Section of Wildlife, Minnesota Department of Natural Resources, ISBN 0-9647451-2-7; University of Wisconsin-Extension, Wisconsin Department of Natural Resources, Minnesota Department of Natural Resources, and Burnett County Land and Water Conservation Department, "Shorelands—Techniques and Strategies for Protection and Recovery Workshop," February 24, 1999.*

[h] *Department of Natural Resources Technical Bulletin No. 169, "A Review of Fisheries Habitat Improvement Projects in Warmwater Streams, with Recommendations for Wisconsin," Madison, Wisconsin, 1990.*

[i] *Waushara County Land Conservation Department, "Fluvial Geomorphology Workshop," Wautoma, Wisconsin, September 13-17, 1999; C. J. Hunter, "Better Trout Habitat: A Guide to Stream Restoration and Management," Island Press, Washington D.C., 1991; Department of Natural Resources Technical Bulletin No. 179, "Evaluation of Trout Habitat Structures in Three High-Gradient Stream in Wisconsin," Madison, Wisconsin, 1992; Bureau of Fisheries Management Department of Natural Resources Administrative Report N0. 27, "Unit habitat Construction of Habitat Improvement Structures for Wisconsin Coulee Streams," Madison, Wisconsin, August 1988; Ann L. Riley, "Restoring Streams in Cities: A Guide for Planners, Policy Makers, and Citizens," Island Press, 1998; State of California Resources Agency Department of Fish and Game, "California Salmonid Stream Habitat Restoration Manual," Second Edition, October 1994.*

[j] *Stream Renovation Guidelines Committee, The Wildlife Society, American Fisheries Society, and International Association of Fish and Wildlife Agencies, "Stream Obstruction Removal Guidelines," Bethesda, Maryland, 1983.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

implementation of management measures within the headwater streams and continues over time to the main channel, as shown in Table 116. It is also envisioned that management measures could be implemented in several subwatersheds simultaneously, and within multiple tributary areas in these subwatersheds, especially when implementing some of the larger-scale management elements (see Tier 1 and 2 in Table 116). Specific actions to stabilize streambanks and restore and protect streambank habitat, pursuant to the WDNR-recommended actions for habitat improvement of warmwater stream systems, are included within this approach. Modifications in stream morphology and channel configuration will then benefit downstream stream segments as flow velocities and stream structure is modified. This approach is also consistent with the water quality analysis areas that correspond to the major subwatersheds, as shown in Table 115 and outlined in Chapter VII.

Tiered Approach

Superimposed on the subwatershed approach is a tiered approach to the implementation of recommended management actions, as indicated in Table 116. This approach recommends that specific larger-scale actions be implemented prior to local-level actions being considered for implementation. As noted below, the recommended first- and second-tier management measures generally correspond to watershed- and subwatershed-level management measures, including the development of subwatershed-level management plans for specific stream reaches, the implementation of nonpoint source pollution abatement practices and stormwater management measures, and other management measures in both urban and rural areas as a precursor to the implementation of more localized management measures within the Des Plaines River watershed. Within the recommended subwatershed approach set forth in Table 116, and included within the second tier of recommended management measures, are specific actions that include establishing new riparian buffer zones, or protecting existing zones, as set forth in the adopted land and water resource management plans for Racine and Kenosha Counties and recommended under this watershed study; restoration of the hydraulic and hydrologic integrity of the tributary stream systems comprising the Des Plaines River drainage system; and related subwatershed-scale activities. Site-specific management plans prepared pursuant to the recommended second-tier management measures would then be implemented at identified locations within the tributary streams draining to the Des Plaines River as appropriate. As shown in Table 116, Tiers 3 and 4 provide management measures for streambank and shoreline and instream treatments, respectively. Any bank stabilization treatment or instream structure must be biologically suitable, both hydrologically and structurally, for the specific physical conditions of that site. Inappropriate structures can lead to undesirable, accelerated erosion or deposition, displacement or replacement of beneficial species, or physical structure failure. The knowledge of channel response to artificially placed structures must be used to select, design, and place improvement structures.

Many of the Tier 1 and Tier 2 measures are integral components of the water quality management plan described in Chapter XIII of this report. Implementation of these measures will commence upon adoption of this plan by the Counties and the municipalities. The effectiveness of the Tier 3 and 4 measures would be maximized if they are implemented following implementation of Tier 1 and 2 measures, especially following the Tier 2 element of developing a site-specific fishery management plan. However, it is not essential that each tier be implemented on a watershed-wide basis, or even a subwatershed-wide basis, prior to beginning to implement the next tier in the sequence. In certain areas, all of the Tier 1 and 2 activities would not be applicable. In another possible case, Tier 1 and 2 measures may be in place for a subbasin within a subwatershed but not for the remainder of the subwatershed. In that case, Tier 3 and 4 measures could readily be initiated in that subbasin even though the remainder of the subwatershed had not yet fully implemented Tier 1 and 2 actions. The same reasoning can be applied to the case of a subwatershed within the watershed. There may be instances when implementation of Tier 3 and 4 activities would be appropriate even in the absence of Tier 1 and 2 activities. In summary, the establishment of the four-tier approach is intended to provide guidance, focus, and structure to the fishery management process, but it is not intended to inflexibly dictate a sequential set of steps from which there can be no deviation.

Table 116 provides a list of commonly used structural enhancement designs that can be applied to a wide range of stream types and indicates their potential application within specific subbasins and lakes within the watershed. The notes on the potential application and effectiveness of given structure types, set forth within the table, are intended to provide general information to address known problems. The potential effectiveness of specific, recommended fishery habitat measures should be further refined through detailed, site-specific analysis prior to their selection. Table 116 does not incorporate an assessment of the suitability or biological effectiveness for mitigating the limiting factors within particular stream reaches, their costs or difficulty of construction, or their cost/benefit relationships. However, the effectiveness of any particular measure is often enhanced when used in combination with other management measures, such as bank stabilization using soil bioengineering systems and vegetative plantings, as well as other instream measures that appropriately direct and manipulate flows.

The stream restoration techniques shown in Table 116 can be broken down into two broad categories: conventional engineering or "hard" techniques, and biological engineering (bio-engineering) or "soft" techniques. Conventional engineering techniques generally involve building or placing permanent structures in or adjacent to the watercourse. Examples of conventionally engineered structures include concrete retaining walls and revetments, log crib walls and timber bulkheads, riprap, and gabions that are used to stabilize shorelands. Bio-engineering techniques focus on encouraging natural, largely vegetative, approaches to resolving shoreland stabilization concerns. Examples of bio-engineered approaches include such activities as planting of shoreland vegetation for erosion control and the use of coconut fiber matting and bundles of live willow stakes to simultaneously reduce shoreline erosion and establish riparian vegetation. With bio-engineering, the entire streambank is treated as an ecological unit. A variety of plants are used, not only to provide ground cover, but also to 1) establish root systems that limit soil loss; 2) provide riparian wildlife habitat; 3) improve water quality, as the vegetation uses nutrients and other potential contaminants for growth; and 4) provide shade and cover for fish.

Both categories of restoration techniques are considered viable within the context of the Des Plaines River basin. There are circumstances where engineered approaches are clearly necessary or preferable to bio-engineered approaches. These include portions of the stream system that are subject to high flow volumes, that have high gradients, or that have rapidly fluctuating or "flashy" flows. However, in low gradient areas, which include the majority of the Des Plaines River system, a variety of bio-engineered techniques can be used to accomplish the necessary degree of bank stabilization.[15] In addition, traditional "hard" treatments can be used in combination with bio-engineered techniques. For example, rock riprap can be used to protect the toe of the bank, a zone of high stress that is frequently undercut by currents and is often under water for most of the year, and designed in combination with vegetative plantings on the upper portions of the bank that provide protection and environmental benefits.[16] Notwithstanding the type of streambank protection used, general requirements, such as toe protection, measures to control streambed degradation, and protection at the upstream and downstream limits of the measures to prevent flanking and the ultimate failure of the measures, will be required.

The specific measures set forth in Table 116 would not only protect and enhance the remnant populations of threatened and endangered species and species of special concern in the streams listed above, but also include measures to protect and rehabilitate instream and riparian habitat within the subwatersheds as recommended in the regional natural areas and critical species protection and management plan.[17]

Indicators

Development and implementation of an appropriate, ongoing monitoring and evaluation strategy to establish baseline conditions and to assess progress toward the rehabilitation of the stream and lake fishery within the Des Plaines River watershed is recommended. This strategy should include, not only fisheries and fish habitat surveys, but also water quality and physical habitat assessments, as set forth below. Citizen participation in monitoring programs should be encouraged both through the existing WDNR Self-Help Monitoring Program for lakes, and through classroom-related activities, such as Adopt-A-Lake and Project WET (Water Education for Teachers), to augment and supplement agency-based monitoring programs.

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[15]*University of Wisconsin-Madison, College of Engineering, The Department of Engineering Professional Development,* "Urban Channel Design and Rehabilitation," *February 1-2, 1999.*

[16]Ibid.

[17]*SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, September 1997.*

Given that the fisheries of the numerous unnamed tributaries to the Des Plaines River are largely unknown, it is further recommended that assessments be initiated to identify the nature and composition of the fish communities in these reaches. Based upon data recorded from the major named tributary streams to the main stem of the Des Plaines River, these tributary streams may contain additional remnant populations of threatened or endangered species or species of special concern, as well as other native species of fishes that could be critical for the maintenance of a sustainable fishery in the main stem of the River. These tributary streams could also provide essential habitat and contain a potential inoculum of species into the main stem of the system. These tributary streams generally contain higher-quality habitat, refugia, and stock of food organisms than is currently present within the main stem of the River.

It is further recommended that the fisheries management program for the Des Plaines River watershed incorporate fisheries management activities on the major lakes. These lake ecosystems can provide critical habitat for the maintenance of a sustainable fishery and a potential inoculum of these species into the system, as the lakes may also contain more suitable or varied habitat, refugia, and stocks of food organisms than is currently present within the stream system. This is especially significant in the case of rock bass, for example, which are extremely sensitive to suspended sediment concentrations in aquatic ecosystems. In this situation, the lakes may provide a refuge for populations of these fishes and support their reintroduction into the tributary stream systems of the Des Plaines River watershed as water quality conditions warrant.

It should be noted that the Des Plaines River and its major tributaries are expected to support a very similar fish community, consistent with the similar water quality conditions observed throughout the watershed. However, turbidity and sediment movement and deposition characteristics vary within the watershed, with the tributary streams generally having greater water clarity than the main stem. These water quality conditions, which are forecast to improve further, based on implementation of the recommendations of this watershed study, are supportive of the recommended fish management approach set forth above.

Synergy Between Fisheries Management and Water Quality and Quantity Management

The water pollution abatement measures recommended in this watershed plan constitute basic fishery enhancement measures. Improvement in water quality conditions may be expected to be accompanied by an improved fishery, as has been observed in those reaches in which sewage treatment plants have been upgraded or abandoned as recommended in the regional water quality management plan. Examples of this relationship include the recommended upgrading of specific reaches of tributaries to the Des Plaines River from limited aquatic life and limited forage fish designations to warmwater sportfish designations. These proposed changes reflect the upgrading or abandonment of specific point source discharges within the watershed. The affected reaches and tributaries are listed in Table 98 and can be identified through comparison of Maps 56 and 59. Nevertheless, certain additional measures should be taken in order to prevent the further decline of the fishery in the watershed and, to the extent practicable, rehabilitate the warmwater fishery and enhance the sport fishery. These measures complement the land use, park and open space, floodland management, and water pollution abatement elements of the watershed plan, and include nonpoint source pollution abatement measures, as well as habitat rehabilitation measures.

Recommended Specific Fisheries Management Actions

It is recommended that subwatershed-level fishery management plans be developed based on existing and new survey data, with specific goals and objectives to implement appropriate management actions beginning in the headwater reaches of priority stream segments and continuing downstream to, and including, the main stem of the Des Plaines River. Such plans would be based on the determination and quantification of specific physical, chemical, and biological limitations to the fishery within the context of the Water Quality Analysis Areas (WQAAs), shown on Map 55, inclusive of tributary streams and lake systems. Generalized physical, chemical, and biological limitations to the fishery are set forth in Table 115, and provide guidance for the development of a more-specific assessment program. The subwatershed-level plans would also require that detailed fisheries and habitat surveys be conducted in those WQAAs where adequate data are not currently available and the updating of data where such data may not reflect the current condition of the fishery, in accordance with WDNR monitoring protocols.[18] Detailed surveys of macroinvertebrate populations, an important food source for a sustainable fishery, should also be conducted.

It is further recommended that the proposed fisheries management program be developed in a phased manner. To this end, initial actions to protect, preserve, and propagate the remnant populations of species of special concern in the Kilbourn Road Ditch and Brighton Creek subwatersheds, as well as in the Lower Des Plaines River between its confluences with the Kilbourn Road Ditch and Brighton Creek, are recommended. In addition, given the need to implement measures to improve agricultural drainage from lands along the Upper Des Plaines River, complementary fisheries management actions are recommended to be initiated in the Upper Des Plaines River subwatershed. In this reach, the objectives of the fisheries management program are coincident with those of the program to improve agricultural drainage in that the reduction of sediment inputs from the drainage area tributary to the Upper Des Plaines River, rehabilitation of the streambed morphometry by removal of accumulated sediment, and control of beavers and beaver dams to reduce submergence of drain tile outfalls and to facilitate fish passage are shared management objectives.

Actions to protect, preserve, and propagate remnant populations involve the protection and restoration of instream habitat. Protection measures include the provision of adequate shoreland vegetative buffer zones. Vegetated buffers should be comprised of native plant species tolerant of variable water level conditions. Many species suited to the hydrology and climatic conditions of Southeastern Wisconsin are described in relevant shoreland vegetation brochures published by the University of Wisconsin-Extension.[19] Recommended minimum buffer widths set forth in Chapter XIII of this report, pursuant to Chapter NR 115 of the Wisconsin Administrative Code, are 35 feet from the Ordinary High Water Mark (OHWM), although greater widths can provide greater benefit both from the perspective of sediment, nutrient, and pollutant load reduction and of wildlife habitat. Greater vegetated buffer widths would be consistent with the recommended floodland wetland and floodland management measures set forth in this plan.

Within the streamcourse, management measures are recommended to restore the natural pool-riffle character of streams in the watershed. Implementation of measures to restore the pool-riffle character of these streamcourses will help to mitigate the ditching and realignment of channels that have degraded fish and wildlife habitat. Deepening and straightening streams as an agricultural drainage measure has not only resulted in the modification of fish habitat, but has encouraged scour and down cutting of streams, destabilizing streambanks, and resulting in sediment deposition in downstream stream segments. These actions, too, have resulted in a uniform streambed cross-section and loss of natural meanders. Actions to restore a more natural aspect to the priority streams must be subject to more detailed local-level planning and design which considers a variety of management measures. The least intensive measures include the placement of brush bundles within the streamcourse to concentrate flows and restore instream habitat to specific stream segments. The brush bundles can be created locally, and can be placed by volunteers. By increasing the velocity of water flow through the low-flow constrictions created by the brush bundles, the streamcourse naturally scours accumulated sediments from the streambed. Alternatively, accumulated sediments can also be removed mechanically in certain situations. As described under the floodland

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[18]*Wisconsin Department of Natural Resources,* Guidelines for Assessing Fish Communities of Wadable Streams in Wisconsin*, June 2000; Wisconsin Department of Natural Resources,* Guidelines for Evaluating Habitat of Wadable Streams*, June 2000.*

[19]*University of Wisconsin-Extension Publication No. GWQ014,* Shoreline Plants and Landscaping*, and related publications in the Yard Care and the Environment series; see also The Wisconsin Lakes Partnership,* Shorelandscaping: A Guide for Waterfront Property Owners*…; and Wisconsin Association Lakes, Inc.,* The Shoreland Friends Guidebook: Environmental Education For Owners of Shoreland Property*, June 2000.*

management recommendations set forth previously in this chapter, such removal is only recommended to be considered along the Upper Des Plaines River if there are locations where natural sediment removal does not prove to be effective.[20]

The creation of pools within the river reaches between riffles is anticipated to occur naturally. For this reason, the siting of the proposed riffles should be subject to detailed site investigations and design. Artificial deepening of the streambed is not anticipated to be necessary, making this option one of relatively low capital cost. The recreation of a pool-riffle system within the streamcourses will better provide the variety of habitat areas, including habitat for fish food organisms and shelter for young-of-the-year and juvenile fishes, necessary for natural reproduction and nurturing to occur.

Management measures are recommended to include protection of existing, remnant populations of threatened and endangered species, and species of special concern. These populations include pirate perch within the Kilbourn Road Ditch, Brighton Creek, Lower Des Plaines River, and Pleasant Prairie Tributary; least darter in Paddock Lake; and lake chubsucker in Hooker, Montgomery, and Paddock Lakes at the headwaters of the Salem Branch of Brighton Creek; the round pigtoe and slippershell mussel species within Brighton Creek; and lake chubsucker in the Lake Shangrila-Benet Lake system and in George Lake, both of which drain to the Dutch Gap Canal. Reaches within which these populations have been identified are set forth in this watershed plan, the adopted regional natural areas and critical species habitat protection and management plan for Southeastern Wisconsin,[21] and data provided by the WDNR.

Management measures also are recommended to control the extent and spread of common carp throughout the Upper and Lower Des Plaines River subwatersheds. It is recommended that a fisheries management program be implemented to determine the abundance, distribution, and ability for reproduction of carp within these reaches of the River. This program is recommended to develop appropriate measures to limit the spread of these exotic fishes and minimize the potential damage to native fisheries that is known to occur in reaches where carp form a dominant element of the fish population. Control of these exotic species is a prerequisite for the reintroduction native fishes and the restoration of appropriate habitat within the Upper Des Plaines River.

Recommended Ancillary Fisheries Management Measures
In addition to the actions recommended above, the following ancillary components are recommended:

- Implementation of appropriate management measures within the subwatershed-level plans in multiple phases, commencing with the priority headwater areas having established and self-reproducing populations of desirable fish species, and extending downstream to the main stem of the Des Plaines River. Measures should emphasize enhancement of existing populations. Within the main stem of the Des Plaines River, management measures should also address ways and means of limiting the exotic carp populations observed in the lower reaches of the River.

- Inclusion of consideration of fisheries management within the detailed stormwater management programs that are recommended to be conducted within the framework of this watershed plan. Such consideration would encourage the use of measures that promote streamcourse structure and function, provide habitat and food stocks, and restore natural vegetation and vegetated buffers along stream corridors and lake shores. Ideally, the stormwater management planning for a given subwatershed

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[20]*Mechanical sediment removal in navigable waters of the State requires a WDNR permit. Revegetation of the sediment removal site may be required in order to limit opportunities for invasive species to encroach into the area. Sediment removal may require specialized equipment, a confined disposal facility (CDF) for collection and dewatering of the removed material within a reasonable distance from the project site, and a greater financial investment in equipment and personnel.*

[21]*SEWRPC Planning Report No. 42, op. cit.*

would be conducted concurrently, and in coordination with the subwatershed-level fishery management plans that are recommended above.

- Promotion of local support for fisheries management and environmentally sensitive and sustainable measures through targeted informational programming and creation of opportunities for public participation in decision-making processes. Such opportunities for shared decision-making include the creation of citizen advisory committees, completion of memoranda of understanding with lake and river organizations within the basin, and participation in programs, such as Adopt-A-Lake, Project WET, Project WILD, and Project Learning Tree (PLT) programs, and related school-based programming. A sound and vocal base of public support for a fisheries rehabilitation project will benefit all aspects of watershed management.

- Development and implementation of an appropriate, ongoing monitoring and evaluation strategy to establish baseline conditions and to assess progress toward the rehabilitation of the stream and lake fishery within the Des Plaines River watershed. This strategy should include, not only fisheries and fish habitat surveys, but also water quality and physical habitat assessments. Citizen participation in monitoring programs should be encouraged both through the existing WDNR Self-Help Monitoring Program for lakes, and through classroom-related activities, such as Adopt-A-Lake and Project WET.

PROJECT PRIORITIZATION

The major river reaches, tributaries and lakes within the Des Plaines River watershed have been assigned high, moderate, and low priorities for implementation of the fisheries management restoration recommendations set forth in Table 116. These priorities were based upon the fishery, watershed, and surface water quality inventories including the instream sediment depth and streambank erosion inventories and analysis set forth in Chapter VII of this report. Specifically, this prioritization is based upon the protection and preservation of the existing fisheries and potential enhancement of the fisheries through habitat improvement throughout the Des Plaines River watershed.

Highest priority is given to those stream reaches for which there are current records[22] of the presence of threatened and endangered species and species of special concern and to those stream reaches directly adjacent to such areas. In addition, greater priority is given to stream reaches within which current records indicate the presence of sustainable and reproducing populations of higher quality game fishes, and those reaches within which there is a significant likelihood that such populations could be preserved and enhanced through fisheries management actions. Further, consideration was given to the relative position of the stream reaches within the watershed and to the potential for the specific stream reaches to be effectively managed to create and maintain conditions conducive to establishing and sustaining populations of threatened and endangered species, species of special concern, and higher quality game fishes. Explicit recognition is given to those stream reaches that flow into stream reaches having a higher priority based upon the foregoing factors. Lake ecosystems were assessed independently, although analogous issues were considered. In assigning recommended priorities, current fisheries and water quality assessments applicable to the Des Plaines River system were reviewed,[23] and recommended priorities established that are consistent with these assessments.

It should be emphasized that the establishment of these priorities does not preclude the implementation of restoration projects within any part of the watershed, even of those projects that may be located along stream

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[22]*Records obtained during the 1994 fish population survey or more recently during surveys conducted by the Wisconsin Department of Natural Resources, Illinois Department of Natural Resources and Environmental Protection Agency, and U.S. Army Corps of Engineers since the year 2000.*

[23]*See Wisconsin Department of Natural Resources Publication No. PUB-WT-254-2000,* Wisconsin Water Quality Assessment, Report to Congress 2000*, December 2000; Illinois Environmental Protection Agency,* Illinois Water Quality Report 2002*, July 2002*

reaches or within lakes that are indicated below to be of medium- or low-priority. Indeed, medium- or low-priority projects might be implemented ahead of higher-priority projects if there are circumstances favorable to project implementation, such as the availability of funds or willingness of the local governmental unit and/or the riparian owner to implement projects. The establishment of the priorities set forth below was undertaken with the knowledge that any improvements in the fishery within the upstream reaches of the Des Plaines River system will

benefit downstream reaches. As the attendant water quality and in-stream habitat restoration measures indicated as essential elements of the fisheries management program are implemented within the watershed, the consequent improvements in fish habitat will serve to increase the potential range and sustainability of all fishes within the system.

The restoration priorities for streams and lakes within the Des Plaines River watershed are outlined below.

High Priority

Stream Reach

- Upper Des Plaines River upstream of the confluence with Brighton Creek
- Brighton Creek
- Salem Branch
- Center Creek
- Kilbourn Road Ditch

Moderate Priority

Stream Reach

- Lower Des Plaines River downstream of the confluence with Brighton Creek to the confluence with Kilbourn Road Ditch
- Union Grove Tributary
- Jerome Creek
- Pleasant Prairie Tributary
- Unnamed Tributary No. 1 to the Des Plaines River

Major Lake

- Lake Andrea
- Benet/Shangrila Lake
- George Lake
- Hooker Lake
- Paddock Lake
- Vern Wolf Lake

Low Priority

Stream Reach

- Lower Des Plaines River downstream of the confluence with Kilbourn Road Ditch
- Dutch Gap Canal

It should be noted that there are ongoing activities on North Mill Creek, the downstream reaches of the Dutch Gap Canal, being conducted by the Illinois Department of Natural Resources, the Lake County Stormwater Management Commission, and others. One downstream resource area, known as the Redwing Slough, has been identified as an important natural resource area containing endangered species. Another area, Rasmussen Lake, has been identified as having high quality riparian habitat. In addition, a water resources action strategy is proposed to be developed for North Mill Creek. Because of the ongoing activities in Illinois, there is a need to coordinate the current watershed plan recommendations for Wisconsin presented herein with the related programs and findings in Illinois. Thus, it is recommended that the recommendations for the Dutch Gap Canal, including its priority regarding fishery management, should be periodically reevaluated and refined as needed based upon consideration of both the Wisconsin and Illinois findings and activities.

PLAN IMPLEMENTATION AND COSTS

Material and labor costs for bio-engineering and conventional hard armoring restoration techniques can vary substantially depending on availability of materials, hauling distances, labor rates, geographic area, and other factors. Nonetheless, given the design guidance currently available, the planning and design costs of both approaches, the costs of preparing the project site, and the costs of mobilizing personnel and equipment should be about the same. Cost differentials, however, are likely to affect implementation and maintenance of the various structures. Based upon current experiences in implementing stream restoration projects throughout the United States, bio-engineered structures and supporting practices, while varying somewhat in cost, have been determined to typically cost less than conventional structural alternatives.[24] In addition, bio-engineered structures also provide an array of ancillary benefits having greater longevity than could be anticipated from more conventional practices, including enhanced wildlife and fish habitat, improved aesthetics, and added water quality benefits.[25]

Structural measures vary in cost depending upon the specific action measures proposed to be implemented. As noted, a portion of the cost is associated with the cost of transporting personnel, equipment, and materiel to the project site. Recent cost estimates for the installation of riprap range from $200 to $250 per linear foot of shoreline.[26] These costs include grading, placement of geofabric, and armoring. Costs of gabion baskets ranged from $120 to $150 per linear foot.[27] Cost estimates provided from other, similar projects indicated the costs of engineered structures to range from about $45 to $165 per linear foot under both rural and urban conditions.[28] Higher costs were incurred in urban areas reflecting the constraints imposed upon construction by existing infrastructure, such as sewer lines, gas lines, and power line utilities. as well as space limitations.

Bio-engineered measures also vary in cost depending upon the specific measures proposed to be implemented. As with structural measures, a portion of the cost is also associated with the cost of transporting personnel, equipment, and materiel to the project site. Recent cost estimates range from $2.00 per linear foot to $120 per linear foot.[29] As with conventionally engineered projects, urban projects would be expected to have somewhat higher costs, averaging $218 per linear foot, than rural projects, which averaged about $106 per linear foot.[30] Project costs also varied with respect to the type of fish habitat being created or restored, ranging from about $100 per linear foot in warmwater systems, to about $120 per linear foot in coldwater systems.[31] Costs of specific bio-engineered alternatives ranged from about $5.00 per linear foot for coconut fiber matting, to about $8.00 to $16

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[24]*Dennis M. King, Curtis C. Bohen, and Mark L. Kraus, (draft)* Stream Restoration: The Costs of Engineered and Bio-Engineered Alternatives*, April 1994.*

[25]*MD Eastern Shore RC&D Council, Inc.,* Stream Restoration Using Bioengineering Techniques, "A Demonstration Project," Rock Creek Park, City of Frederick*, 2001.*

[26]Ibid.

[27]Ibid.

[28]*North Carolina Department of Environment and Natural Resources Wetlands Restoration Program,* A Preliminary Analysis of Stream Restoration Costs in the North Carolina Wetlands Restoration Program*, 2002.*

[29]*Kevin L. Piper, J. Chris Hoag, Hollis H. Allen, Gail Durham, J. Craig Fischenich, and Robert O. Anderson,* Bioengineering as a Tool for Restoring Ecological Integrity to the Carson River, *Wetlands Regulatory Assistance Program Report No. ERDC TN-WRAP-01-05, September 2001; MD Eastern Shore RC&D Council, Inc*. op. cit.*; North Carolina Department of Environment and Natural Resources Wetlands Restoration Program,* op. cit.

[30]*North Carolina Department of Environment and Natural Resources Wetlands Restoration Program, op. cit.*

[31]Ibid.

per linear foot for live stakes.[32] Coconut fiber rolls for bank toe protection was reported to cost about $45 per linear foot, while stone utilized for the same purpose was estimated to cost about $60 per square foot.[33] Such costs will vary depending upon the particular measures selected, location, and scope of the project.

In all cases, the actual cost can be reduced, for example, by the use of volunteers to undertake plantings or the use of native materials where rock used in gabion baskets can be obtained locally and the baskets assembled on site. In-kind contributions in terms of labor, plant materials, grading, and other services have been documented to contribute up to about $30 per linear foot, or about 25 percent of the project cost.[34] Potential funding for the implementation of stream management measures is available through the Wisconsin Department of Natural Resources Chapter NR 195 river protection and planning grant program and other programs, as discussed in Chapter XVI of this report.

Based upon the above information, an average cost to implement the recommended fisheries habitat restoration measures is estimated to be $550,000 per mile. However, the total costs of project implementation will be dependent upon site-specific management plans developed on a subwatershed basis for the streams listed in Table 116, as well as upon site-specific considerations, as discussed above. As an example, establishment of nonstructural riparian buffers versus instream placement of structural measures, such as wing deflectors, will affect the overall costs, not only in terms of the costs of materials, but also in terms of engineering complexity, capability of utilizing volunteers, and permitting requirements, all of which add cost to structural measures. In addition, the aforementioned aspect of local support, as described in the Recommended Ancillary Fisheries Management Measures section, can not only reduce the total cost of project implementation, but also affect the ultimate success of that implementation.

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[32]*MD Eastern Shore RC&D Council, Inc., op. cit.; Watershed Protection Techniques,* Bioengineering in Four Mile Run, Virginia*, Volume I(4): pages 173-175.*

[33]*MD Eastern Shore RC&D Council, Inc.,* op. cit.

[34]*Kevin L. Piper, et al.,* op. cit.

Chapter XV

RECOMMENDED COMPREHENSIVE PLAN[1]

INTRODUCTION

The comprehensive plan for the Des Plaines River watershed is comprised of four major elements: 1) a land use element, including a park and related open space preservation subelement; 2) a supporting floodland and stormwater management element composed of structural and nonstructural subelements; 3) a supporting water quality management element composed of point and nonpoint source pollution abatement subelements; and 4) a fisheries management element. The land use element refines and details the adopted regional land use plan and the adopted regional park and open space plan. The water quality management plan element is based upon and refines and details the adopted regional water quality management plan. The floodland and stormwater management plan element was synthesized by combining aspects of the watershedwide alternatives with the best floodland and stormwater management alternatives for two specific tributary streams. The fisheries management plan element was developed as a logical outgrowth of the floodland and water quality management elements. The selection of the components of the recommended plan was based upon careful evaluation of the tangible and intangible factors involved, with primary emphasis upon the degree to which the various alternatives met the established watershed development objectives. The various plan elements are closely interrelated. For example:

- The land use and park and open space recommendations regarding preservation of primary environmental corridors provide a framework for implementation of the prairie and wetland restoration recommendations of the floodland and stormwater management element.

- The prairie and wetland restoration recommendations of the floodland and stormwater management element provide hydrologic benefits while also serving to meet the water quality management plan recommendations regarding the establishment of riparian buffers and improving wildlife habitat.

- The provision of runoff controls from new development as recommended under the floodland and stormwater management element can be accomplished with multi-purpose facilities that also control nonpoint source pollution as recommended under the water quality management element.

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[1]*The recommended plan was presented at a public hearing on March 18, 2003. The comments at the public hearing did not result in substantive changes to the plan. The public hearing process and comments are summarized in Chapter XVII, "Summary and Conclusions."*

- The successful implementation of the fisheries element is dependent on implementation of certain components of the water quality element related to control of nonpoint source pollution.

This chapter describes the recommended comprehensive watershed development plan as synthesized from the best of the alternatives considered, discusses the basis for the synthesis, and analyzes the attendant costs. In addition, the chapter evaluates the ability of the recommended plan to meet the adopted watershed development objectives and standards and discusses the likely consequences of not implementing the plan.

BASIS FOR PLAN SYNTHESIS

The watershed development objectives which the comprehensive plan for the Des Plaines River watershed is designed to meet are set forth in Chapter X and Appendix C of this report. That chapter also sets forth the standards for relating these objectives to the physical development proposals which constitute the plan, thereby facilitating evaluation of the ability of each of the alternative plan proposals to meet the chosen objectives.

The four preceding chapters describe various approaches and alternative plans considered for the resolution of the water-related problems of the watershed, and identify the best land use, floodland and stormwater management, water quality management, and fishery management alternatives for inclusion in the comprehensive watershed plan. As already noted, this identification was based upon careful evaluation of the technical, economic, environmental, legal, financial, and administrative feasibility of the alternative plans, as well as on the basis of the ability of those plans to meet the applicable watershed development objectives and supporting standards. Devices used to actually test and evaluate alternative subelements ranged from the mathematical models used to simulate river performance to informal interagency meetings and formal public hearings.

No single land use or water management plan element can fully satisfy all of the watershed development objectives. The recommended comprehensive watershed plan must, therefore, consist of a combination of individual plan elements, with each plan element contributing to the extent practicable toward the satisfaction of the development objectives. As noted above, the various recommended plan alternatives, as set forth in Chapters XI, XII, XIII, and XIV of this report, are complementary in nature, and the recommended comprehensive watershed plan represents a synthesis of carefully coordinated individual plan elements which together should achieve the adopted watershed development objectives.

RECOMMENDED PLAN

Based upon the results of the analyses of the ability of the various plan elements to satisfy the watershed development objectives and to exhibit an acceptable benefit-cost relationship, including consideration of intangible and generally unquantifiable benefits, the specific plan elements set forth below are recommended for inclusion in the comprehensive plan for the Des Plaines River watershed.

Recommended Land Use Plan Element

Overall Land Use

The adopted regional land use plan, as refined and detailed under the watershed study, is recommended for adoption as the land use element of the Des Plaines River watershed plan (see Map 81).[2] This land use plan element envisions use of a combination of public acquisition and public regulation of private holdings of land to guide the spatial distribution of land uses within the watershed in order to achieve a safer, more healthful, more pleasant, and more efficient land use pattern while meeting the forecast land use demand. The land use plan emphasizes continued

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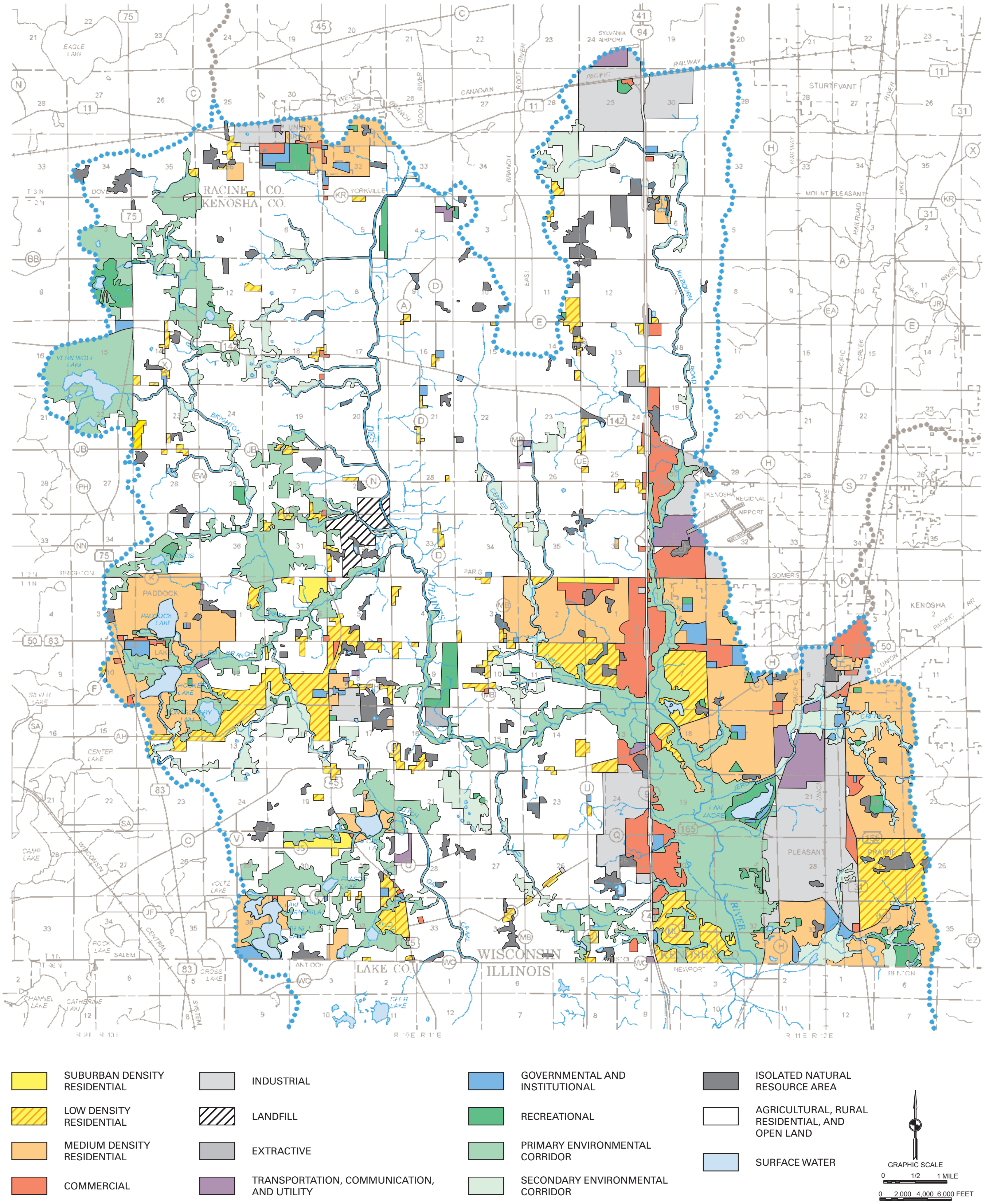
[2]*The recommended land use plan shown graphically on Map 81 is a refinement of that shown on Map 60 in that, 1) where appropriate, the primary environmental corridors in planned urban service areas have been refined to precisely reflect the final l00-year recurrence interval floodplain boundaries as determined under the floodland and stormwater management plan element, and 2) it reflects recent land use plan amendments adopted by the Village of Pleasant Prairie.*

Map 81

FINAL RECOMMENDED LAND USE PLAN FOR THE DES PLAINES RIVER WATERSHED



Source: SEWRPC.

reliance on the urban land market to determine the location, intensity, and character of future development within the Region and the watershed for residential, commercial, and industrial land uses. It does, however, propose to regulate in the public interest the effect of this market on development in order to provide for a more orderly and economical land use pattern and in order to avoid the intensification of developmental and environmental problems within the Region and the watershed.

Urban Development

Forecasts indicate that based on the adopted high-growth centralized development land use alternative, the population of the Des Plaines River watershed may be expected to increase from the 1990 level of about 19,650 persons to a plan design year 2010 level of about 33,500 persons, a 70 percent increase. Employment may be expected to increase from the 1990 level of about 8,200 jobs to a plan design year 2010 level of about 36,700 jobs, a 348 percent increase. The Des Plaines River watershed is still largely in rural land uses. About 12.5 square miles, or 9.4 percent of the watershed, was devoted to urban uses in 1990. An additional 8.7 square miles of land are forecast to be converted from rural to urban use by 2010, resulting in 16 percent of the watershed in urban uses. An additional 11.8 square miles are forecast to be converted from rural to urban use from 2010 until the planned urban service areas are fully developed, resulting in 25 percent of the watershed being in urban uses. It is estimated that full development of the planned urban service area, as shown on Map 81, would not occur before the year 2030.

As indicated in Table 99 in Chapter XI of this report, about 7.9 square miles, or about 6 percent, of the total area of the watershed, were devoted to residential use in 1990. About 3.8 square miles are proposed to be added to the existing stock of residential land in the watershed between the years 1990 and 2010, an increase of about 50 percent. As shown on Map 81, this new residential development is proposed to occur primarily at medium and low densities, with lot sizes ranging from approximately 6,200 to 19,000 square feet per dwelling unit in medium-density areas and 19,000 square feet to 1.5 acres per dwelling unit in low-density areas. The new residential development would be located in areas served, or proposed to be served, by a full range of public utilities and essential urban services. The remaining 4.9 square miles of land proposed to be converted from rural to urban use within the watershed by the year 2010 would be used for commercial, industrial, governmental and institutional, recreational, and transportation, communication, and utility land uses as required to meet the gross demand for land generated by the resident population and employment levels anticipated within the watershed.

As indicated on Map 81 and in Table 99, the plan envisions continued residential development within the planned urban service areas after the year 2010. This would occur through the infilling of the designated residential reserve areas within the watershed. Under the buildout alternative, an additional 6.5 square miles of land would be developed for residential use after the year 2010. The remaining 5.3 square miles of land proposed to be converted from rural to urban use after the year 2010 would be used for commercial, industrial, governmental and institutional, recreational, and transportation, communication, and utility land uses as required to meet the gross demand for land generated by the resident population and employment levels anticipated within the watershed.

Agricultural and Other Open Land Use

As already noted, the recommended land use plan for the year 2010 would require the conversion to urban use of about 8.9 square miles of land presently devoted to agricultural and other open land uses. The existing stock of such land within the watershed would accordingly decrease from about 93.5 square miles in 1990 to about 84.6 square miles in 2010. The continued planned urban development envisioned beyond 2010 would result in an additional 11.8 square miles of agricultural and open lands being converted to urban uses.

Park and Open Space Plan

As discussed earlier in this report, a regional park and open space plan was completed and adopted by the Commission in 1977 and includes recommendations affecting the Des Plaines River watershed. The regional park and open space plan is composed of two principal elements—an open space preservation plan element and an outdoor recreation plan element. The regional plan was subsequently refined through the adoption of the Kenosha County park and open space plan in 1988 and an updated Racine County park and open space plan as amended in 2001. The plan for that portion of Kenosha County lying east of IH 94/USH 41 was updated in 1995 as part of the comprehensive plan for the Kenosha Urban Planning District.

The open space preservation plan element recommends the continued maintenance and preservation in essentially open uses of all remaining primary environmental corridor lands within the Region and the watershed. The preservation of the primary environmental corridors in essentially natural open uses—and thereby the preservation of the attendant recreational, aesthetic, ecological, and cultural values in accordance with regional and watershed development objectives—is essential to the maintenance of a wholesome environment within the Region and the watershed. As shown on Map 81, the primary environmental corridors of the watershed are located in association with the major perennial streams, lakes, and wetland areas of the watershed, including along the lower reaches of the Des Plaines River, along the lower reaches of Kilbourn Ditch, and along Brighton Creek and the Salem Branch of Brighton Creek. In 1990, about 16.8 square miles, or about 13 percent, of the total watershed area, were encompassed by the primary environmental corridors.

The plan recommends that approximately 0.2 square mile of floodlands adjacent to the Des Plaines River in the southwestern portion of the Village of Pleasant Prairie, which are currently in agricultural or other open uses, be restored to a wetland condition, thereby becoming part of the environmental corridor network. As noted below in the section describing the recommended floodland and stormwater management plan element, it is also recommended that there be restoration of significant areas of wetlands and prairies in addition to the small amount of wetland restoration called for under the park and open space plan subelement. Those restorations would be accomplished in areas that could be designated as primary environmental corridors. Thus, the total size of the primary environmental corridors within the watershed would therefore increase significantly under the recommended plan when those areas are considered.

The plan recommends that about 5.1 square miles of the primary environmental corridor lands located east of IH 94/USH 41 be preserved through continued public or public-interest ownership or be publicly acquired, as shown on Map 82. Similarly, about 3.3 square miles of primary environmental corridor lands outside the Kenosha Urban Planning District, constituting about 19 percent of primary corridors within the watershed, are recommended to be preserved through continued public or public interest ownership or be publicly acquired under the recommended outdoor recreation plan element. Thus, a total of 8.4 square miles, or about 49 percent, of the primary environmental corridors of the watershed, are recommended to be protected through public or public-interest ownership. An additional 1.5 square miles, or about 9 percent, of primary environmental corridor lands are privately owned but are currently in, and are anticipated to remain in, compatible outdoor recreation use. The remaining 7.1 square miles, or 42 percent, of primary environmental corridors are located in areas that are not anticipated to be developed for urban uses or needed for future trail development and should be protected through public conservancy zoning.[3]

Secondary environmental corridors and isolated natural areas are also shown on Map 81. About 6.4 square miles, or about 5 percent, of the total area of the watershed, were encompassed within secondary environmental corridors in 1990. About 3.0 square miles, comprising about 2 percent of the watershed, were encompassed within isolated natural resource areas in 1990. The secondary environmental corridors and isolated natural resource areas are expected to remain virtually unchanged during the plan period, and should be protected by appropriate local zoning and official mapping.

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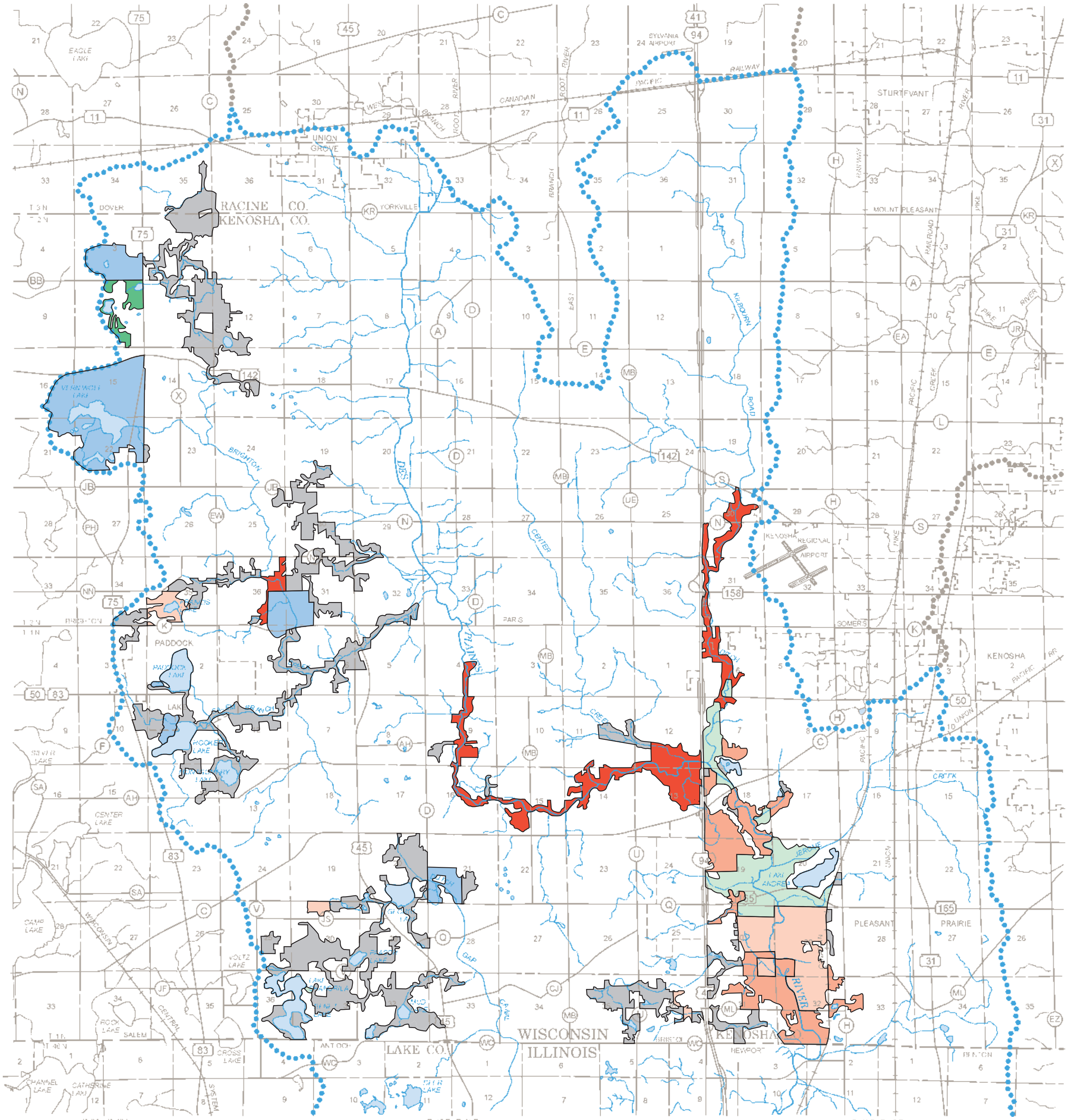
[3]*The areal extent of primary environmental corridors as quantified here does not include any of those areas designated for wetland and prairie restoration under the recommended floodland and stormwater management plan element, although, as noted above, restoration of much of that land may result in the expansion of the primary environmental corridors. Much of the 3.1 square miles of recommended wetland restoration could be incorporated into expanded primary environmental corridors. The amount of prairie restoration that would serve to expand such corridors would be dependent on the location of the restoration sites. The lands on which corridor expansions would be achieved through restorations would be enrolled in the U.S. Department of Agriculture Conservation Reserve Program or they would have conservation easements placed on them.*

Map 82

PRIMARY ENVIRONMENTAL CORRIDOR PRESERVATION RESPONSIBILITIES UNDER THE OPEN SPACE PRESERVATION ELEMENT OF THE DES PLAINES RIVER WATERSHED PLAN



EXISTING PUBLIC INTEREST OWNERSHIP

- COUNTY
- CITY, VILLAGE, OR TOWN
- OTHER

PROPOSED ADDITIONAL PUBLIC INTEREST OWNERSHIP

- COUNTY
- CITY, VILLAGE, OR TOWN

EXISTING COMPATIBLE OUTDOOR RECREATION USE (PRIVATE OWNERSHIP)

PROPOSED PUBLIC LAND USE REGULATION (PRIVATE OWNERSHIP)

SURFACE WATER

GRAPHIC SCALE

0 1/2 1 MILE

0 2,000 4,000 6,000 FEET

Source: SEWRPC.

Accordingly, it is recommended that secondary environmental corridors in developing areas be considered for preservation in natural, open use or incorporated in local plans as drainageways, stormwater detention or retention areas, or as local parks or recreation trails. It is also recommended that isolated natural resource areas be preserved in natural open uses insofar as practicable, being incorporated in local plans as parks and open space reservations or stormwater detention or retention areas as appropriate. About 365 acres, or about 9 percent, of secondary environmental corridor lands within the watershed, are recommended for public acquisition to accommodate recreation trail facilities under the outdoor recreation plan element.[4] In addition, about 28 acres of isolated natural resource area are recommended for public acquisition as part of the new community park in the Village of Pleasant Prairie, which is also described under the urban outdoor recreation plan element. Other public acquisition of secondary environmental corridors and isolated natural resource areas should be identified on the basis of detailed neighborhood unit development plans.

The outdoor recreation plan element of this plan is composed of both an areawide, resource-oriented component, containing recommendations for the provision of major parks, recreation corridors, and associated park and trail facilities, and an urban-oriented component, containing recommendations for the provision of community and neighborhood parks, park facilities, and local trails. Areawide and local outdoor recreation sites and trails recommended by this plan are shown on Map 83. As shown on that map, the outdoor recreation plan element recommends the following with respect to areawide parks and trails:

- Continued maintenance of Brighton Dale and Bristol Woods Parks, both of which are owned and operated by Kenosha County.

- Continued maintenance of Bong State Recreational Area.

- Continued development of Prairie Springs Park in the Village of Pleasant Prairie.

- The development of a regulation 18-hole golf course in the southwestern portion of the Village of Pleasant Prairie. The golf course would either be developed by Kenosha County or through a public/private partnership.

- The development of an areawide recreation trail system consisting of about 36.5 linear miles of trails, including about 27.9 miles of off-street trails and about 8.6 miles of trails within highway rights-of-way. Within Kenosha County, the recommended areawide recreation trail system includes about 32.2 linear miles of trails, including about 23.6 miles of off-street trails and about 8.6 miles of trails within highway rights-of-way. Within Racine County, the system includes about 4.3 miles of trails, all of which are proposed to be located off-street.

As further shown on Map 83, the outdoor recreation plan element recommends the following with respect to local parks and trails:

- Development of one community park in the south-central portion of the Village of Pleasant Prairie and maintenance of one existing community park in the Town of Bristol.

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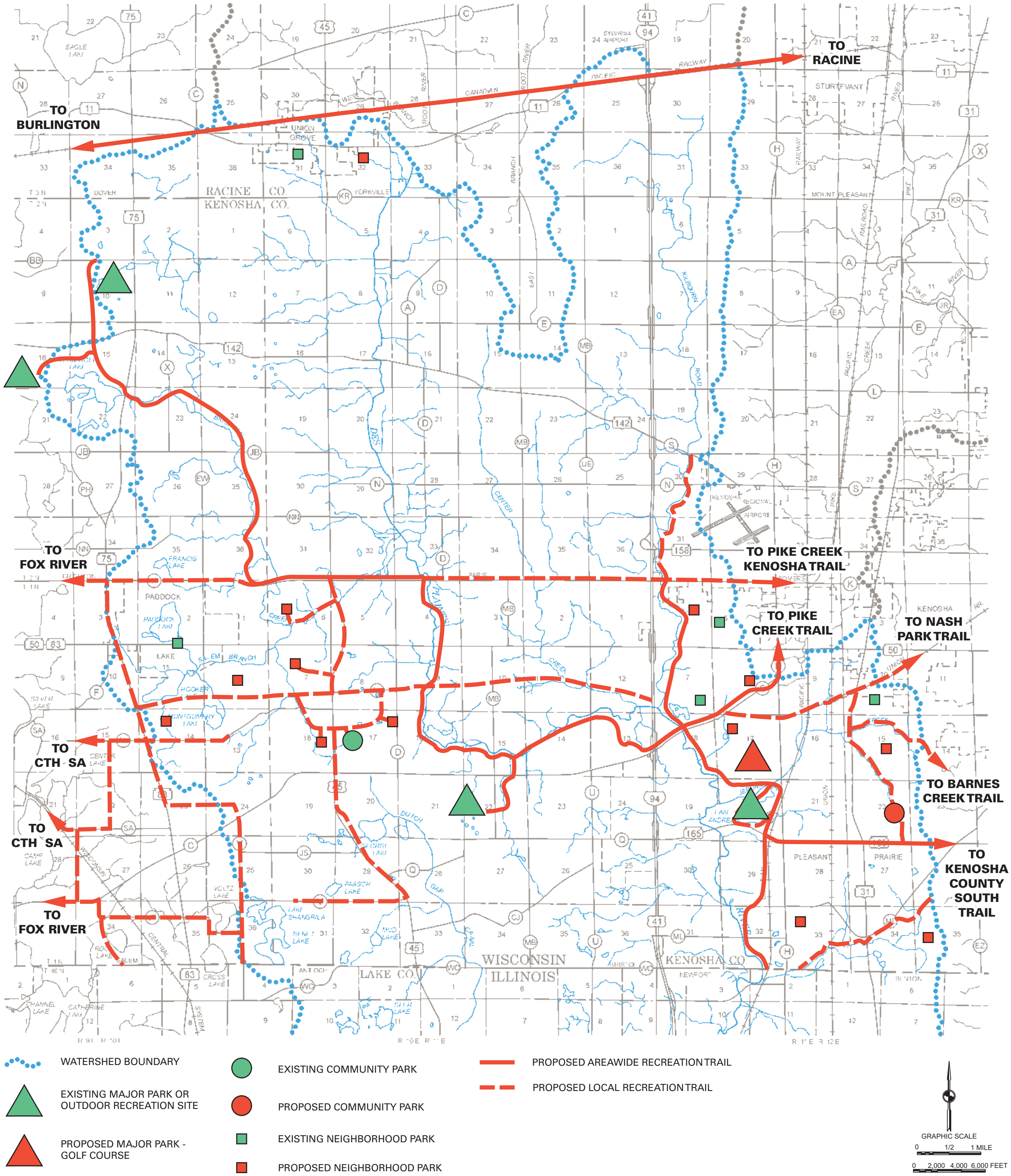
[4]*Kenosha County currently owns a 332-acre parcel of secondary environmental corridor located on the east side of the Des Plaines River south of CTH K; however, it is not anticipated that this parcel will be needed for the development of the Des Plaines River Trail. It should be noted, however, that detailed engineering studies must be conducted prior to trail construction, and that the trail locations shown in the plan are, therefore, subject to change.*

Map 83

FINAL RECOMMENDED PARKS AND RECREATION TRAIL SYSTEM UNDER THE OUTDOOR RECREATION ELEMENT OF THE DES PLAINES RIVER WATERSHED PLAN



Source: SEWRPC

- Maintenance of five existing neighborhood parks, four in Kenosha County and one in Racine County. Development of 13 new neighborhood parks, including one new park in the far western portion of the City of Kenosha; five new parks in the Village of Pleasant Prairie; one new park within Racine County adjacent to the Village of Union Grove; and six new parks within Kenosha County—two in the Town of Salem and four in the Town of Bristol. It is recommended that each new neighborhood park be about 10 acres in size and be developed with playfields, a playground, a softball diamond, basketball goals, and picnicking facilities.

- Development of a network of 44 miles of local trails that connects to and supplements the areawide trail system. Eighteen miles of those trails would be located off-street and about 26 miles would be located within highway rights-of-way.

As set forth in Table 117, development and acquisition costs attendant to the areawide aspects of the park and open space plan are estimated at $16.9 million, including: 1) $5.3 million for the purchase of land for the preservation of primary environmental corridors; 2) $0.5 million for the development of additional facilities at Prairie Springs Park in the Village of Pleasant Prairie;[5] 3) $6.2 million for the acquisition and development of one 18-hole County golf course; and 4) $4.9 million for the acquisition and development of areawide trails.[6] About $14.0 million of these costs are reflected in the total cost of the County park and open space plans, the Kenosha Urban Planning District plan, and the regional bicycle and pedestrian facilities plan and are not, therefore, considered to be additional costs in the Des Plaines River watershed plan. The recommended park and open space plan element would achieve the park, outdoor recreation, and open space preservation objectives and standards formulated under the watershed study, meeting the existing and anticipated future recreation needs within the watershed in an efficient and effective manner.

Recommended Stormwater and Floodland Management Plan Element

The recommended floodland management plan element for the Des Plaines River watershed, as set forth on Map 84, includes the application of both structural and nonstructural measures for the abatement of damages in floodprone areas of the watershed, the improvement of stormwater management facilities, requirements for control of runoff from areas of future development, restoration of prairies and wetlands on agricultural lands, and the prevention of future floodprone development. A basic nonstructural plan element consists of the land use development proposals contained in the land use element of the watershed plan. The extent and placement of incremental urban development over the planning period is critical if the intensification of the existing and the creation of new flood damage problems in the watershed are to be avoided, since such extent and placement directly affect the hydrologic and hydraulic behavior of the watershed. In this respect, preservation of the primary environmental corridors is of particular importance and affects not only the hydrologic and hydraulic behavior of the stream system but also water quality conditions. Preservation of floodlands in open uses lying outside the environmental corridors is also critical as is encouraging the use of floodland areas for outdoor recreation and related open space activities.

In addition to the land use development proposals, the plan recommends that existing and probable future flood problems in the watershed be resolved through a combination of prairie and wetland restoration; controls on peak

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[5] *The development of four play fields at Prairie Springs Park as recommended in Chapter XI of this report has been substantially completed. The development costs set forth here are for paving, lights, a pavilion with restrooms, and a playground.*

[6] *The costs of local recreational trails and neighborhood and community parks are not included in the costs set forth here.*

Table 117

SCHEDULE OF COSTS OF THE RECOMMENDED PLAN FOR THE DES PLAINES RIVER WATERSHED BY PLAN ELEMENT AND YEAR: 2003-2030

		Park and Open Space Plan Element										
		Primary Environmental Corridor	Areawide Recreation Trails			Major Parks[a]	Golf Course[a]			Park and Open Space Subtotal		
Calendar Year	Project Year	Land Acquisition	Land Acquisition	Development	Total	Development	Land Acquisition	Development	Total	Land Acquisition	Development	Total
2003	1	$ 187,500	$ 37,000	$ 139,000	$ 176,000	$190,000	$ 33,000	$ 189,000	$ 222,000	$ 257,500	$ 518,000	$ 775,500
2004	2	187,500	37,000	139,000	176,000	330,000	33,000	189,000	222,000	257,500	658,000	915,500
2005	3	187,500	37,000	139,000	176,000	- -	33,000	189,000	222,000	257,500	328,000	585,500
2006	4	187,500	37,000	139,000	176,000	- -	33,000	189,000	222,000	257,500	328,000	585,500
2007	5	187,500	37,000	139,000	176,000	- -	33,000	189,000	222,000	257,500	328,000	585,500
2008	6	187,500	37,000	139,000	176,000	- -	33,000	189,000	222,000	257,500	328,000	585,500
2009	7	187,500	37,000	139,000	176,000	- -	33,000	189,000	222,000	257,500	328,000	585,500
2010	8	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2011	9	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2012	10	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2013	11	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2014	12	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2015	13	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2016	14	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2017	15	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2018	16	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2019	17	187,500	36,000	139,000	175,000	- -	33,000	189,000	222,000	256,500	328,000	584,500
2020	18	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2021	19	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2022	20	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2023	21	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2024	22	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2025	23	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2026	24	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2027	25	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2028	26	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2029	27	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
2030	28	187,500	36,000	138,000	174,000	- -	33,000	189,000	222,000	256,500	327,000	583,500
Total	- -	$5,250,000	$1,015,000	$3,881,000	$4,896,000	$520,000	$924,000	$5,292,000	$6,216,000	$7,189,000	$9,693,000	$16,882,000
Annual Average	- -	$ 187,500	$ 36,300	$ 138,600	$ 174,900	$ 18,600	$ 33,000	$ 189,000	$ 222,000	$ 256,800	$ 346,200	$ 602,900

		Floodland and Stormwater Management Plan Element										
						Prairie Restoration						
		Structure Floodproofing, Elevation, and Removal	Detention Storage for New Development[b]				Land Rental/ Easement Options[c]		Operation and Maintenance		Prairie Restoration Subtotal	
Calendar Year	Project Year	Capital	Capital	Operation and Maintenance	Total	Capital[d]	Enrollment in Conservation Reserve Program	Purchase of Conservation Easements	Lower Limit	Upper Limit	Lower Limit	Upper Limit
2003	1	$ 405,000	$ 1,333,000	$ 380,000	$ 1,713,000	$ 527,000	$ 15,000	$ 616,000	$ 1,000	$ 48,000	$ 543,000	$1,191,000
2004	2	405,000	1,333,000	380,000	1,713,000	527,000	30,000	616,000	1,000	96,000	558,000	1,239,000
2005	3	405,000	1,333,000	380,000	1,713,000	527,000	45,000	615,000	2,000	144,000	574,000	1,286,000
2006	4	405,000	1,333,000	380,000	1,713,000	527,000	60,000	615,000	3,000	191,000	590,000	1,333,000
2007	5	405,000	1,332,000	380,000	1,712,000	527,000	75,000	615,000	3,000	239,000	605,000	1,381,000
2008	6	0	1,332,000	380,000	1,712,000	527,000	90,000	615,000	4,000	287,000	621,000	1,429,000
2009	7	0	1,332,000	380,000	1,712,000	527,000	105,000	615,000	5,000	335,000	637,000	1,477,000
2010	8	0	1,332,000	380,000	1,712,000	526,000	120,000	615,000	5,000	383,000	651,000	1,524,000
2011	9	0	1,332,000	380,000	1,712,000	526,000	135,000	615,000	6,000	431,000	667,000	1,572,000
2012	10	0	1,332,000	380,000	1,712,000	526,000	150,000	615,000	7,000	479,000	683,000	1,620,000
2013	11	0	1,332,000	380,000	1,712,000	526,000	165,000	615,000	7,000	526,000	698,000	1,667,000
2014	12	0	1,332,000	380,000	1,712,000	526,000	180,000	615,000	8,000	574,000	714,000	1,715,000
2015	13	0	1,332,000	380,000	1,712,000	526,000	195,000	615,000	9,000	622,000	730,000	1,763,000
2016	14	0	1,332,000	380,000	1,712,000	526,000	211,000	615,000	10,000	670,000	747,000	1,811,000
2017	15	0	1,332,000	380,000	1,712,000	526,000	226,000	615,000	10,000	718,000	762,000	1,859,000
2018	16	0	1,332,000	380,000	1,712,000	526,000	241,000	615,000	11,000	766,000	778,000	1,907,000
2019	17	0	1,332,000	380,000	1,712,000	526,000	256,000	615,000	12,000	814,000	794,000	1,955,000
2020	18	0	1,332,000	380,000	1,712,000	526,000	271,000	615,000	12,000	861,000	809,000	2,002,000
2021	19	0	1,332,000	380,000	1,712,000	526,000	286,000	615,000	13,000	909,000	825,000	2,050,000
2022	20	0	1,332,000	380,000	1,712,000	526,000	301,000	615,000	14,000	957,000	841,000	2,098,000
2023	21	0	1,332,000	380,000	1,712,000	526,000	316,000	615,000	14,000	1,005,000	856,000	2,146,000
2024	22	0	1,332,000	380,000	1,712,000	526,000	331,000	615,000	15,000	1,053,000	872,000	2,194,000
2025	23	0	1,332,000	380,000	1,712,000	526,000	346,000	615,000	16,000	1,101,000	888,000	2,242,000
2026	24	0	1,332,000	380,000	1,712,000	526,000	361,000	615,000	16,000	1,149,000	903,000	2,290,000
2027	25	0	1,332,000	380,000	1,712,000	526,000	376,000	615,000	17,000	1,196,000	919,000	2,337,000
2028	26	0	1,332,000	380,000	1,712,000	526,000	391,000	615,000	18,000	1,244,000	935,000	2,385,000
2029	27	0	1,332,000	380,000	1,712,000	526,000	406,000	615,000	18,000	1,292,000	950,000	2,433,000
2030	28	0	1,332,000	380,000	1,712,000	526,000	421,000	615,000	19,000	1,340,000	966,000	2,481,000
Total	- -	$2,025,000	$37,300,000	$10,640,000	$47,940,000	$14,735,000	$6,105,000	$17,222,000	$276,000	$19,430,000	$21,116,000	$51,387,000
Annual Average	- -	$ 72,300	$ 1,332,100	$ 380,000	$ 1,712,100	$ 526,300	$ 218,000	$ 615,000	$ 9,900	$ 693,900	$ 754,100	$ 1,835,300

Table 117 continued)

Calendar Year	Project Year	Floodland and Stormwater Management Plan Element (continued)												
			Wetland Restoration						Centralized Detention Storage and Storm Sewer Improvements Along Unnamed Tributary No. 6 to Brighton Creek			Culvert Replacement Along Unnamed Tributary No. 1 to Hooker Lake		
			Land Rental/Easement Options[c]		Operation and Maintenance		Wetland Restoration Subtotal							
		Capital[e]	Enrollment in Conservation Reserve Program	Purchase of Conservation Easements	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Capital	Operation and Maintenance	Total	Capital	Operation and Maintenance	Total
2003	1	$ 232,000	$ 8,000	$ 283,000	$ 1,000	$ 25,000	$ 241,000	$ 540,000	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
2004	2	232,000	16,000	283,000	1,000	49,000	249,000	564,000	471,500	- -	471,500	110,000	100	110,100
2005	3	232,000	23,000	283,000	1,000	74,000	256,000	589,000	471,500	6,000	477,500	0	100	100
2006	4	232,000	31,000	283,000	1,000	99,000	264,000	614,000	0	6,000	6,000	0	100	100
2007	5	232,000	39,000	282,000	2,000	123,000	273,000	637,000	0	6,000	6,000	0	100	100
2008	6	232,000	47,000	282,000	2,000	148,000	281,000	662,000	0	6,000	6,000	0	100	100
2009	7	233,000	54,000	282,000	3,000	173,000	290,000	688,000	0	6,000	6,000	0	100	100
2010	8	233,000	62,000	282,000	3,000	197,000	298,000	712,000	0	6,000	6,000	0	100	100
2011	9	233,000	70,000	282,000	3,000	222,000	306,000	737,000	0	6,000	6,000	0	100	100
2012	10	233,000	78,000	282,000	4,000	247,000	315,000	762,000	0	6,000	6,000	0	100	100
2013	11	233,000	85,000	282,000	4,000	271,000	322,000	786,000	0	6,000	6,000	0	100	100
2014	12	233,000	93,000	282,000	4,000	296,000	330,000	811,000	0	6,000	6,000	0	100	100
2015	13	233,000	101,000	282,000	5,000	321,000	339,000	836,000	0	6,000	6,000	0	100	100
2016	14	233,000	109,000	282,000	5,000	346,000	347,000	861,000	0	6,000	6,000	0	100	100
2017	15	233,000	116,000	282,000	5,000	370,000	354,000	885,000	0	6,000	6,000	0	100	100
2018	16	233,000	124,000	282,000	6,000	395,000	363,000	910,000	0	6,000	6,000	0	100	100
2019	17	233,000	132,000	282,000	6,000	420,000	371,000	935,000	0	6,000	6,000	0	100	100
2020	18	233,000	140,000	282,000	6,000	444,000	379,000	959,000	0	6,000	6,000	0	100	100
2021	19	233,000	147,000	282,000	7,000	469,000	387,000	984,000	0	6,000	6,000	0	100	100
2022	20	233,000	155,000	282,000	7,000	494,000	395,000	1,009,000	0	6,000	6,000	0	100	100
2023	21	233,000	163,000	282,000	8,000	518,000	404,000	1,033,000	0	6,000	6,000	0	100	100
2024	22	233,000	171,000	282,000	8,000	543,000	412,000	1,058,000	0	6,000	6,000	0	100	100
2025	23	233,000	178,000	282,000	8,000	568,000	419,000	1,083,000	0	6,000	6,000	0	100	100
2026	24	233,000	186,000	282,000	9,000	592,000	428,000	1,107,000	0	6,000	6,000	0	100	100
2027	25	233,000	194,000	282,000	9,000	617,000	436,000	1,132,000	0	6,000	6,000	0	100	100
2028	26	233,000	202,000	282,000	9,000	642,000	444,000	1,157,000	0	6,000	6,000	0	100	100
2029	27	233,000	209,000	282,000	10,000	666,000	452,000	1,181,000	0	6,000	6,000	0	100	100
2030	28	233,000	217,000	282,000	10,000	691,000	460,000	1,206,000	0	6,000	6,000	0	100	100
Total	- -	$6,518,000	$3,150,000	$7,900,000	$147,000	$10,020,000	$9,815,000	$24,438,000	$943,000	$156,000	$1,099,000	$110,000	$2,700	$112,700
Annual Average	- -	$ 232,800	$ 112,500	$ 282,100	$ 5,300	$ 357,900	$ 350,500	$ 872,800	$ 33,700	$ 5,600	$ 39,300	$ 3,900	$ 100	$ 4,000

Calendar Year	Project Year	Floodland and Stormwater Management Plan Element (continued)									
		Upper Des Plaines River Sediment Monitoring			Floodland and Stormwater Management Subtotal					Total	
						Land Rental/Easement Options		Operation and Maintenance			
		Capital[f]	Operation and Maintenance	Total	Capital	Enrollment in Conservation Reserve Program	Purchase of Conservation Easements	Lower Limit	Upper Limit	Lower Limit	Upper Limit
2003	1	$ 0	- -	- -	$ 2,497,000	$ 23,000	$ 899,000	$ 382,000	$ 453,000	$ 2,902,000	$ 3,849,000
2004	2	40,000	$ 12,000[g]	$ 52,000	2,968,500	46,000	899,000	394,100	537,100	3,558,600	4,554,600
2005	3	0	12,000	12,000	3,118,500	68,000	898,000	401,100	616,100	3,437,600	4,482,600
2006	4	0	12,000	12,000	2,497,000	91,000	898,000	402,100	688,100	2,990,100	4,083,100
2007	5	0	12,000	12,000	2,496,000	114,000	897,000	403,100	760,100	3,013,100	4,153,100
2008	6	0	12,000	12,000	2,091,000	137,000	897,000	404,100	833,100	2,632,100	3,821,100
2009	7	0	19,000	19,000[h]	2,092,000	159,000	897,000	413,100	913,100	2,664,100	3,902,100
2010	8	0	19,000	19,000	2,091,000	182,000	897,000	413,100	985,100	2,686,100	3,973,100
2011	9	0	19,000	19,000	2,091,000	205,000	897,000	414,100	1,058,100	2,710,100	4,046,100
2012	10	0	12,000	12,000	2,091,000	228,000	897,000	409,100	1,124,100	2,728,100	4,112,100
2013	11	0	12,000	12,000	2,091,000	250,000	897,000	409,100	1,195,100	2,750,100	4,183,100
2014	12	0	12,000	12,000	2,091,000	273,000	897,000	410,100	1,268,100	2,774,100	4,256,100
2015	13	0	12,000	12,000	2,091,000	296,000	897,000	412,100	1,341,100	2,799,100	4,329,100
2016	14	0	12,000	12,000	2,091,000	320,000	897,000	413,100	1,414,100	2,824,100	4,402,100
2017	15	0	12,000	12,000	2,091,000	342,000	897,000	413,100	1,486,100	2,846,100	4,474,100
2018	16	0	12,000	12,000	2,091,000	365,000	897,000	415,100	1,559,100	2,871,100	4,547,100
2019	17	0	12,000	12,000	2,091,000	388,000	897,000	416,100	1,632,100	2,895,100	4,620,100
2020	18	0	12,000	12,000	2,091,000	411,000	897,000	416,100	1,703,100	2,918,100	4,691,100
2021	19	0	12,000	12,000	2,091,000	433,000	897,000	418,100	1,776,100	2,942,100	4,764,100
2022	20	0	12,000	12,000	2,091,000	456,000	897,000	419,100	1,849,100	2,966,100	4,837,100
2023	21	0	12,000	12,000	2,091,000	479,000	897,000	420,100	1,921,100	2,990,100	4,909,100
2024	22	0	12,000	12,000	2,091,000	502,000	897,000	421,100	1,994,100	3,014,100	4,982,100
2025	23	0	12,000	12,000	2,091,000	524,000	897,000	422,100	2,067,100	3,037,100	5,055,100
2026	24	0	12,000	12,000	2,091,000	547,000	897,000	423,100	2,139,100	3,061,100	5,127,100
2027	25	0	12,000	12,000	2,091,000	570,000	897,000	424,100	2,211,100	3,085,100	5,199,100
2028	26	0	12,000	12,000	2,091,000	593,000	897,000	425,100	2,284,100	3,109,100	5,272,100
2029	27	0	12,000	12,000	2,091,000	615,000	897,000	426,100	2,356,100	3,132,100	5,344,100
2030	28	0	12,000	12,000	2,091,000	638,000	897,000	427,100	2,429,100	3,156,100	5,417,100
Total	- -	$40,000	$345,000	$385,000	$61,671,000	$9,255,000	$25,122,000	$11,566,700	$40,593,700	$82,492,700	$127,386,700
Annual Average	- -	$ 1,400	$ 12,300	$ 13,800	$ 2,202,500	$ 330,500	$ 897,200	$ 413,100	$ 1,449,800	$ 2,946,200	$ 4,549,500

Table 117 (continued)

Calendar Year	Project Year	Nonpoint Source Pollution Abatement for New Development[i,j]				Total Plan Costs				
							Operation and Maintenance		Land Rental/Easement Options	
		Capital	Operation and Maintenance[k]	Administrative and Planning Costs[l]	Subtotal	Capital	Lower Limit	Upper Limit	Enrollment in Conservation Reserve Program	Purchase of Conservation Easements
2003	1	$ 781,000	$ 8,000	$ 122,200[m]	$ 911,200	$ 3,278,000	$ 390,000	$ 461,000	$ 23,000	$ 899,000
2004	2	781,000	16,000	122,200[m]	919,200	3,899,500	410,100	553,100	46,000	899,000
2005	3	781,000	24,000	78,200	883,200	3,749,500	425,100	640,100	68,000	898,000
2006	4	781,000	32,000	78,200	891,200	3,278,000	434,100	720,100	91,000	898,000
2007	5	781,000	40,000	78,200	899,200	3,277,000	443,100	800,100	114,000	897,000
2008	6	781,000	48,000	78,200	907,200	2,872,000	452,100	881,100	137,000	897,000
2009	7	781,000	56,000	78,200	915,200	2,873,000	469,100	969,100	159,000	897,000
2010	8	781,000	64,000	78,200	923,200	2,872,000	477,100	1,049,100	182,000	897,000
2011	9	781,000	72,000	78,200	931,200	2,872,000	486,100	1,130,100	205,000	897,000
2012	10	781,000	80,000	78,200	939,200	2,872,000	489,100	1,204,100	228,000	897,000
2013	11	781,000	88,000	78,200	947,200	2,872,000	497,100	1,283,100	250,000	897,000
2014	12	781,000	96,000	78,200	955,200	2,872,000	506,100	1,364,100	273,000	897,000
2015	13	781,000	104,000	78,200	963,200	2,872,000	516,100	1,445,100	296,000	897,000
2016	14	781,000	112,000	78,200	971,200	2,872,000	525,100	1,526,100	320,000	897,000
2017	15	781,000	120,000	78,200	979,200	2,872,000	533,100	1,606,100	342,000	897,000
2018	16	781,000	128,000	78,200	987,200	2,872,000	543,100	1,687,100	365,000	897,000
2019	17	781,000	136,000	78,200	995,200	2,872,000	552,100	1,768,100	388,000	897,000
2020	18	781,000	144,000	78,200	1,003,200	2,872,000	560,100	1,847,100	411,000	897,000
2021	19	781,000	152,000	78,200	1,011,200	2,872,000	570,100	1,928,100	433,000	897,000
2022	20	781,000	160,000	78,200	1,019,200	2,872,000	579,100	2,009,100	456,000	897,000
2023	21	781,000	168,000	78,200	1,027,200	2,872,000	588,100	2,089,100	479,000	897,000
2024	22	781,000	176,000	78,200	1,035,200	2,872,000	597,100	2,170,100	502,000	897,000
2025	23	781,000	184,000	78,200	1,043,200	2,872,000	606,100	2,251,100	524,000	897,000
2026	24	781,000	192,000	78,200	1,051,200	2,872,000	615,100	2,331,100	547,000	897,000
2027	25	781,000	200,000	78,200	1,059,200	2,872,000	624,100	2,411,100	570,000	897,000
2028	26	781,000	208,000	78,200	1,067,200	2,872,000	633,100	2,492,100	593,000	897,000
2029	27	781,000	216,000	78,200	1,075,200	2,872,000	642,100	2,572,100	615,000	897,000
2030	28	781,000	224,000	78,200	1,083,200	2,872,000	651,100	2,653,100	638,000	897,000
Total	- -	$21,868,000	$3,248,000	$2,277,600	$27,393,600	$83,539,000	$14,814,700	$43,841,700	$9,255,000	$25,122,000
Annual Average	- -	$ 781,000	$ 116,000	$ 81,300	$ 978,300	$ 2,983,500	$ 529,100	$ 1,565,800	$ 330,500	$ 897,200

Calendar Year	Project Year	Total Plan Costs (continued)								
					Capital; Development; Rental, Easements, and/or Acquisitions; Nonpoint Source Administrative and Planning		Operation and Maintenance		Total	
		Park and Open Space Land Acquisition	Park and Open Space Development	Nonpoint Source Administrative and Planning Costs	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
2003	1	$ 257,500	$ 518,000	$ 122,200	$ 4,198,700	$ 5,074,700	$ 390,000	$ 461,000	$ 4,588,700	$ 5,535,700
2004	2	257,500	658,000	122,200	4,983,200	5,836,200	410,100	553,100	5,393,300	6,389,300
2005	3	257,500	328,000	78,200	4,481,200	5,311,200	425,100	640,100	4,906,300	5,951,300
2006	4	257,500	328,000	78,200	4,032,700	4,839,700	434,100	720,100	4,466,800	5,559,800
2007	5	257,500	328,000	78,200	4,054,700	4,837,700	443,100	800,100	4,497,800	5,637,800
2008	6	257,500	328,000	78,200	3,672,700	4,432,700	452,100	881,100	4,124,800	5,313,800
2009	7	257,500	328,000	78,200	3,695,700	4,433,700	469,100	969,100	4,164,800	5,402,800
2010	8	256,500	328,000	78,200	3,716,700	4,431,700	477,100	1,049,100	4,193,800	5,480,800
2011	9	256,500	328,000	78,200	3,739,700	4,431,700	486,100	1,130,100	4,225,800	5,561,800
2012	10	256,500	328,000	78,200	3,762,700	4,431,700	489,100	1,204,100	4,251,800	5,635,800
2013	11	256,500	328,000	78,200	3,784,700	4,431,700	497,100	1,283,100	4,281,800	5,714,800
2014	12	256,500	328,000	78,200	3,807,700	4,431,700	506,100	1,364,100	4,313,800	5,795,800
2015	13	256,500	328,000	78,200	3,830,700	4,431,700	516,100	1,445,100	4,346,800	5,876,800
2016	14	256,500	328,000	78,200	3,854,700	4,431,700	525,100	1,526,100	4,379,800	5,957,800
2017	15	256,500	328,000	78,200	3,876,700	4,431,700	533,100	1,606,100	4,409,800	6,037,800
2018	16	256,500	328,000	78,200	3,899,700	4,431,700	543,100	1,687,100	4,442,800	6,118,800
2019	17	256,500	328,000	78,200	3,922,700	4,431,700	552,100	1,768,100	4,474,800	6,199,800
2020	18	256,500	327,000	78,200	3,944,700	4,430,700	560,100	1,847,100	4,504,800	6,277,800
2021	19	256,500	327,000	78,200	3,966,700	4,430,700	570,100	1,928,100	4,536,800	6,358,800
2022	20	256,500	327,000	78,200	3,989,700	4,430,700	579,100	2,009,100	4,568,800	6,439,800
2023	21	256,500	327,000	78,200	4,012,700	4,430,700	588,100	2,089,100	4,600,800	6,519,800
2024	22	256,500	327,000	78,200	4,035,700	4,430,700	597,100	2,170,100	4,632,800	6,600,800
2025	23	256,500	327,000	78,200	4,057,700	4,430,700	606,100	2,251,100	4,663,800	6,681,800
2026	24	256,500	327,000	78,200	4,080,700	4,430,700	615,100	2,331,100	4,695,800	6,761,800
2027	25	256,500	327,000	78,200	4,103,700	4,430,700	624,100	2,411,100	4,727,800	6,841,800
2028	26	256,500	327,000	78,200	4,126,700	4,430,700	633,100	2,492,100	4,759,800	6,922,800
2029	27	256,500	327,000	78,200	4,148,700	4,430,700	642,100	2,572,100	4,790,800	7,002,800
2030	28	256,500	327,000	78,200	4,171,700	4,430,700	651,100	2,653,100	4,822,800	7,083,800
Total	- -	$7,189,000	$9,693,000	$2,277,600	$111,953,600	$127,820,600	$14,814,700	$43,841,700	$126,768,300	$171,662,300
Annual Average	- -	$ 256,800	$ 346,200	$ 81,300	$ 3,998,300	$ 4,565,000	$ 529,100	$ 1,565,800	$ 4,527,400	$ 6,130,800

NOTE: Costs represent 2002 conditions. 2002 *Engineering News-Record* Construction Cost Index=7,710.

Table 117 Footnotes (continued)

[a]*Village of Pleasant Prairie.*

[b]*Incremental cost between control of two- and 100-year events.*

[c]*Cost distributions are based on the assumption that the conversion of the recommended land area is achieved in equal annual amounts over the 28-year plan implementation period.*

[d]*Cost to establish prairies.*

[e]*Cost to establish wetlands.*

[f]*Cost to install continuous recording water quality and streamflow gauge and for initial Upper Des Plaines River stream channel field surveys and establishment of horizontal and vertical control.*

[g]*Annual cost to maintain streamflow gauge.*

[h]*Beginning of three-year monitoring period following assumed implementation of significant measures to reduce sediment loads to the Des Plaines River.*

[i]*The costs of measures to control nonpoint source pollution from areas of existing development, and refinements to the costs for control of runoff from new development, will be addressed under the recommended detailed stormwater management plans. The controls on runoff from existing and new development are mandated under Chapter NR 151 of the* Wisconsin Administrative Code*, and they would be designed to be consistent with the requirements of Chapter NR 151.*

[j]*The costs of controls on runoff from agricultural lands would be determined under the recommended detailed farm plans.*

[k]*Assumed that the new development provided with nonpoint source controls is evenly distributed over the 28-year planning period.*

[l]*The Kenosha County cost is about 93 percent of these annual amounts. The Racine County cost is about 7 percent. The $78,200 base cost in each year was determined from costs in the County Land and Water Resources Management Plans. Those costs were adjusted to year 2002 and apportioned based on the land area of the Des Plaines River watershed in each County. The Land and Water Resources Management Plans cover the period from 2001-2004. Those administrative costs that could appropriately be applied in the remaining years of the Des Plaines River watershed study planning period were identified and assigned from 2005 through 2030.*

[m]*Includes the costs for developing county-wide ordinances for 1) construction site erosion control, 2) stormwater management from urban development, and 3) establishment of riparian buffers on agricultural lands.*

Source: SEWRPC.

rates of runoff from areas of new development; structure floodproofing, elevation, and removal; and specific structural measures along Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake. This recommended plan consists of the following components:[7]

- Floodproofing 51 structures, including 32 houses, three commercial buildings, two recreational buildings, and 14 uninhabited agricultural buildings.[8]

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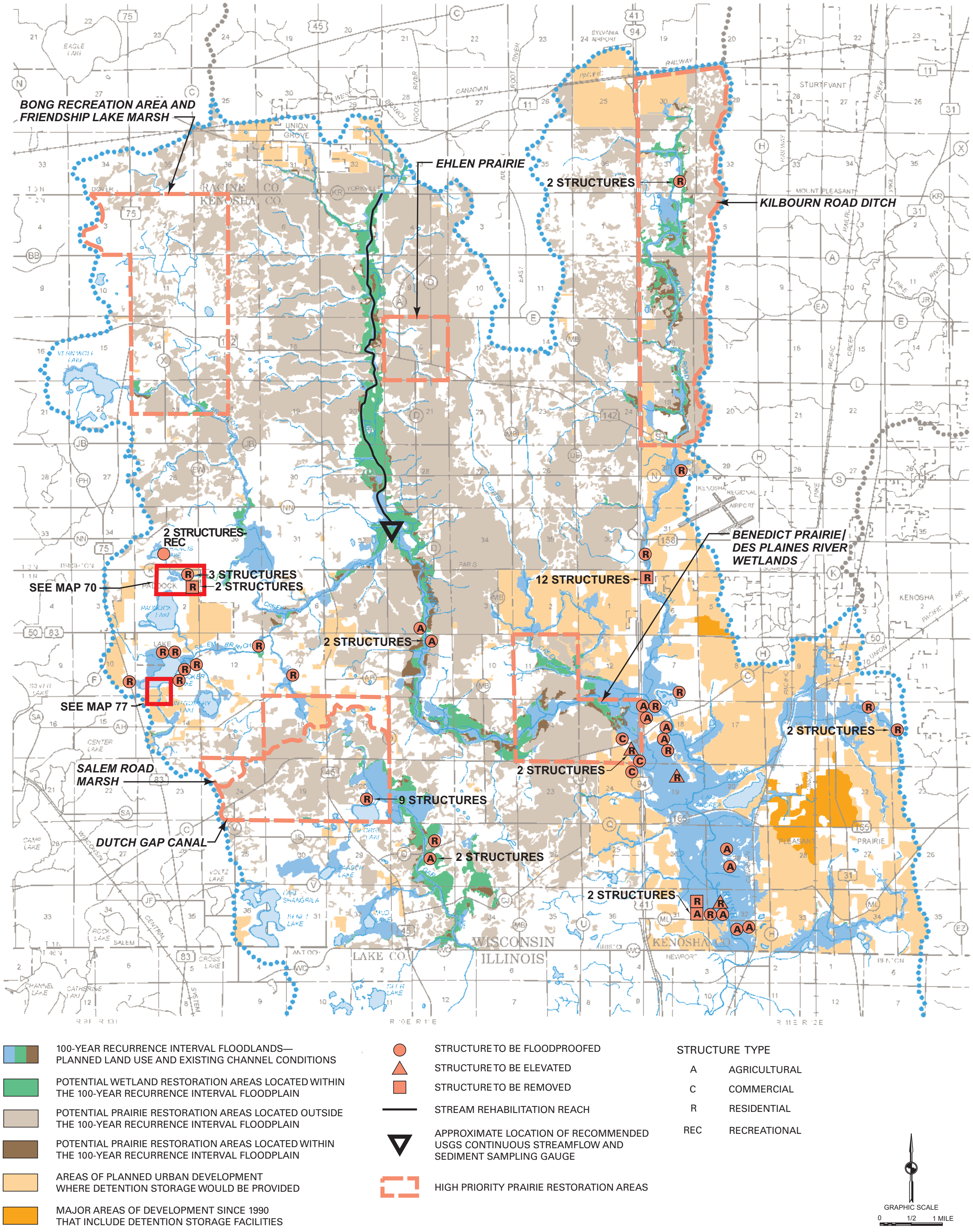
[7]*Candidate buildings for floodproofing, elevation, or removal were determined using large-scale topographic maps compiled at a scale of one inch equals 200 feet and a contour interval of two feet, digital orthophotographs compiled at a scale of one inch equals 400 feet, and the 100-year recurrence interval floodplain delineations prepared under this watershed study for planned land use and existing channel conditions. Prior to undertaking any structure floodproofing, elevation, or removal it is essential each structure to be considered for such actions be field surveyed. Such surveys should establish low building entry elevations for floodwaters and other information as may be necessary to determine the necessary case-specific floodproofing, elevation, or removal procedures.*

[8]*The total number of buildings to be floodproofed is four greater than was called for in Chapter XII, "Alternative and Recommended Floodland and Stormwater Management Measures." Two recreational buildings located along the east side of Francis Lake in the Town of Brighton have been added based on their location along the edge of the 100-year floodplain as delineated on the County large-scale two-foot contour interval topographic maps. Also, two houses located west of 192nd Avenue in the area north of George Lake were added based on information provided by the staff of the Town of Bristol, indicating that this area is hydraulically connected to the Dutch Gap Canal through an agricultural drain tile. Because of that connection, the area is included in the 100-year recurrence interval floodplain based on backwater from Dutch Gap Canal. The recommended field surveys to establish low building entry elevations for floodwaters and possible floodproofing requirements will verify the floodproofing needs at all four of those buildings.*

Map 84

RECOMMENDED FLOODLAND AND STORMWATER MANAGEMENT PLAN ELEMENT FOR THE DES PLAINES RIVER WATERSHED: 2030



Source: SEWRPC.

- Elevating four houses.

- Removing 17 structures, including 12 mobile homes, three houses, and two uninhabited agricultural buildings.

- Providing detention storage to control the runoff from areas of planned development. The post-development two-year storm peak flow release rate would be 0.04 cfs per acre of new development and the post-development 100-year storm peak flow release rate would be 0.30 cfs per acre of new development. Development projects for which this level of runoff control would apply should be further evaluated through preparation of detailed stormwater management plans as recommended below.

- Restoring 20 percent of the potential prairie areas in the watershed (six square miles). High-priority areas to be considered for prairie restoration are shown on Map 84. The procedure for establishing prairie restoration priorities is described in the following section of this report.[9]

- Restoring all potential wetland areas within floodlands (3.1 square miles).[10]

- Providing a centralized detention storage basin along Unnamed Tributary No. 6 to Brighton Creek.

- Improving storm sewers in the Village of Paddock Lake along Unnamed Tributary No. 6 to Brighton Creek.

- Improved culvert capacity at a single location along Unnamed Tributary No. 1 to Hooker Lake.

- Instituting a monitoring program to assess sediment conditions along the Upper Des Plaines River.

Implementation of this floodland management plan element would result in the abatement of all flood damages in the watershed caused by flood events up to and including the 100-year recurrence interval event under planned land use conditions, representing full development of the planned urban service areas. Implementation of the floodland management plan element will not, however, serve to eliminate local stormwater drainage problems in the watershed. The abatement of those problems should be addressed through the preparation of stormwater management system plans as described later in this chapter.

Establishment of Prairie Restoration Priorities

High-priority areas for prairie restoration, as shown on Map 84, were identified as a subset of all of the candidate areas based on meeting one or more of the following criteria as set forth in Table 118:

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[9]*In addition to the recommended prairie restoration, there are 536 acres, or 0.8 square mile, of grasslands in areas of existing public ownership; 162 acres, or 0.25 square mile, of in areas of proposed public ownership; and 461 acres, or 0.7 square mile, in areas of existing public interest ownership. It would be expected that those grasslands would be preserved over time.*

[10]*The preliminary draft* Wisconsin Land Legacy Report, *issued by the Wisconsin Department of Natural Resources in November 2002, "identif(ies) the places most important in meeting Wisconsin's conservation and recreation needs over the next 50 years." The draft report identifies the Des Plaines River Floodplain and the George Lake Wetland as "present(ing) a very good opportunity to restore wetlands." That identification is consistent with the recommendations of this watershed study which call for wetland restoration in floodplains along the Des Plaines River and in the vicinity of George Lake, as well as in other floodplain areas throughout the watershed.*

Table 118

CHARACTERIZATION OF HIGH-PRIORITY PRAIRIE RESTORATION SITES IN THE DES PLAINES RIVER WATERSHED

Site	Criteria				
	1	2	3	4	5
Benedict Prairie/ Des Plaines River Wetlands	- -	X	X	X	X
Bong Recreation Area and Friendship Lake Marsh	X	X	- -	X	X
Dutch Gap Canal	- -	- -	- -	X	X
Ehlen Prairie	- -	X	- -	X	X
Kilbourn Road Ditch...	- -	- -	X	X	X
Salem Road Marsh...	- -	X	- -	- -	X

NOTE: Criteria are as follows:

1. Areas that are located within the grassland reserve sites that are recommended to be established near the Bong State Recreation Area under the SEWRPC regional natural areas plan (PR No. 42).

2. Areas that are located near known natural areas whose restoration would enhance or complement those natural areas.

3. Areas whose restoration would enhance habitat and natural character along a major stream corridor.

4. Areas which would provide the opportunity to establish riparian buffers.

5. Significant potential restoration areas that are needed to provide the hydrologic benefits envisioned under the recommended plan.

Source: SEWRPC.

1. Areas that are located within the grassland reserve sites that are recommended to be established near the Bong State Recreation Area under the SEWRPC regional natural areas plan (PR No. 42).[11,12]

2. Areas that are located near known natural areas as listed in Table 16 and shown graphically on Map 21 of Chapter III of this report, and whose restoration would enhance or complement those natural areas.

3. Areas whose restoration would enhance habitat and natural character along a major stream corridor.

4. Areas which would provide the opportunity to establish riparian buffers.

5. Significant potential restoration areas that are needed to provide the hydrologic benefits envisioned under the recommended plan. This criterion relates to the need to have prairie restoration sites scattered throughout the watershed in order to approximate the flood flow and volume reductions anticipated under the recommended plan.

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[11]*SEWRPC Planning Report No. 42 (PR No. 42),* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin*, September 1997.*

[12]*The November 2002 draft WDNR* Wisconsin Land Legacy Report *identifies the Bong Grassland, including the area surrounding the Bong State Recreational Area, as an area where agricultural land, grasslands, and wetlands could be preserved "through purchase of development rights…combined with fee and easement acquisition." That identification is consistent with the recommendations of this watershed study regarding prairie restoration in the Bong area.*

Costs of the Recommended Floodland and Stormwater Management Plan Element

As set forth in Table 117, implementation of the recommended floodland and stormwater management plan element is anticipated to have a total capital cost ranging from $70.9 to $86.8 million including 1) $2.0 million for structure floodproofing, elevation, and removal; 2) $37.3 million for detention storage to control peak rates of runoff from new development; 3) $20.8 to $32.0 million for prairie restoration, depending on whether lands are enrolled in the U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP) or easements and development rights are purchased; 4) $9.7 to $14.4 million for wetland restoration, depending on whether lands are enrolled in the CRP or easements and development rights are purchased; 5) $1.0 million for floodland and stormwater measures along Unnamed Tributary No. 6 to Brighton Creek; 6) $0.1 million for culvert replacement along Unnamed Tributary No. 1 to Hooker Lake; and 7) $0.04 million for streamflow and sediment monitoring on the Upper Des Plaines River. The overall average annual operation and maintenance would range from $413,100 to $1,449,800.[13] The estimated $37.3 million cost of detention storage, or 43 to 53 percent of the total capital cost, would be borne by the private sector as a cost of land development.

Impacts of Recommended Land Use and Floodland and Stormwater Management Plans on Flood Flows and Stages

Implementation of the recommended land use and floodland and stormwater management plans may be expected to have an impact on flood flows and stages in the Des Plaines River watershed. The impacts of plan implementation on the peak 1.01- through 100-year recurrence interval floods are given for selected locations along the stream system of the Des Plaines River watershed in Tables 112 and 113 of Chapter XII of this report.

Table 112 shows that in general the impact of the recommended plan on reducing flood flows relative to planned land use conditions without the recommended measures in place is greatest along small streams, in headwaters areas, and along the Upper Des Plaines River. For the 1.01- and two-year floods, the decreases in peak flows under recommended plan conditions would generally range from about 10 to 50 percent. For the 10- through 100-year floods, the decreases in peak flows under recommended plan conditions would generally range from about 0 to 50 percent, with decreases in flow being less overall than for the more-frequent events.

As seen from Table 113, on the Des Plaines River main stem at the state line, comparison of the computed peak 100-year flood flow under planned land use and recommended plan conditions to the 100-year flow under 1990 land use, drainage, and channel conditions indicates a decrease of about 2 percent. Comparison of the two-year flood flows indicates an increase of about 6 percent relative to 1990 conditions. On the Dutch Gap Canal at the state line, comparison of the computed peak 100-year flood flow under planned land use and recommended plan conditions to the 100-year flow under 1990 land use, drainage, and channel conditions indicates no change. Comparison of the two-year flood flows indicates an increase of about 2 percent relative to 1990 conditions. Relatively small changes in flow of up to several percent are considered to be insignificant given the degree of accuracy of the hydrologic model. Thus, under the recommended plan, the goal of maintaining the peak 100-year flood flow at 1990 existing levels at the state line would essentially be met for the 100-year floods on the Des Plaines River and Dutch Gap Canal and for the two-year flood on the Dutch Gap Canal. A slight increase in the peak two-year flood flow on the Des Plaines River at the state line might be expected.[14] Furthermore, it should be

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[13]*The lower maintenance cost assumes a minimal level of wetland and prairie maintenance, consisting primarily of periodic mowing. The higher cost assumes intensive active management, including periodic burning, weed and herbicide management, mowing, brush reduction, buffer/shoreline plantings, and monitoring of vegetation and hydrology. Actual maintenance costs would be expected to fall within the range cited.*

[14]*In addition to Dutch Gap Canal, Unnamed Tributary No. 1 to the Des Plaines River also flows from Wisconsin to Illinois before joining the main stem of the Des Plaines River in Illinois. As seen from Table 113, under recommended plan conditions, the peak 100-year flood flow in this stream at the state line would be expected to decrease by about 8 percent relative to 1990 land use conditions. The peak two-year flood flow in this stream at the state line would be expected to increase by about 16 percent relative to 1990 conditions. That increase is probably overstated because a significant portion of the area tributary to the stream is located in Illinois and no controls were assumed on peak rates of runoff from Illinois. The Lake County, Illinois stormwater management (footnote continued)*

noted that the recommended plan would also provide for essentially no increase, or a decrease, in flood flows for the two- through 100-year floods on the Des Plaines River and Dutch Gap Canal as compared to current 2002 conditions. Thus, a standard of maintaining peak two- through 100-year flood flows at their existing (2002) level would be met.

Reevaluation of Stream Rehabilitation Options for Improving Agricultural Drainage, Instream and Riparian Habitat, and Fishery

During the final stages of the watershed plan preparation, questions were raised during one of the Des Plaines River Watershed Committee plan review meetings regarding the potential for including in the recommended plan a means of providing for short-term removal of accumulated sediment from the upper reaches of the Des Plaines River watershed. In support of that prospect, testimony was presented which noted that the sediment accumulation was an unnatural condition which impeded agricultural drainage and was a detriment to fish and aquatic life habitat. In some cases, it was reported that efforts to establish buffer area vegetation were failing due to poor drainage conditions. Because these questions were raised, it was deemed appropriate to reevaluate the recommendation relating to stream rehabilitation. That reevaluation is documented in this section.

As described in detail in Chapter XII, "Alternative and Recommended Floodland and Stormwater Management Measures," an alternative floodland management plan was developed which consisted of stream rehabilitation along the main stem of the Upper Des Plaines River.[15] The channelized, 6.3-mile-long reach of the Upper Des Plaines River upstream of its confluence with Brighton Creek was selected for rehabilitation because:

- Significant sediment accumulation on the streambed was documented in this reach;
- The ability to rehabilitate the fishery in this reach is in part dependent on physical rehabilitation of the channel, including control of sediment delivered to the channel and removal of accumulated sediment in the channel; and
- Rehabilitation of the channel offers an opportunity to improve drainage from agricultural lands where drain tile outfalls are obstructed by sediment and beaver dams and debris blockages create backwater at drain tile outlets and along tributary agricultural drainage channels.

Instream rehabilitation of the main stem of the Upper Des Plaines River would only be successful if external sources of sediment delivery to the River are controlled. Thus, it is considered sound to precede any such rehabilitation with sediment source controls. For purposes of this planning, it is assumed that a prerequisite of any major stream rehabilitation would include: 1) development of farm conservation plans or resource management systems[16] for 75 percent of the agricultural land area that is within the Upper Des Plaines River

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ordinance requires a two-year post-development release rate of 0.04 cfs/acre, which is the same as that recommended under this watershed plan. Application of such a release rate in the Illinois portion of this subwatershed would serve to reduce the peak two-year flood flows below the flows estimated for Unnamed Tributary No. 1 to the Des Plaines River where it flows from Wisconsin to Illinois.

[15] *The Upper Des Plaines River is the reach upstream of the confluence with Brighton Creek.*

[16] *A farm plan is required for lands enrolled in USDA farm programs. Resource management systems are combinations of practices that will achieve significant reductions in soil loss. An effective resource management system may incorporate different strategies including 1) crop management, which may consist of reduced tillage, crop rotation, soil building crops, and nutrient management and 2) erosion control practices that may include buffer strips, vegetated banks, restricted livestock access, cover crops, residue cover, and grassed waterways. Farmers work cooperatively with the U.S. Natural Resources Conservation Service to implement resource management systems, but such systems are voluntarily put in place.*

subwatershed and which contains highly erodible soils as shown on Map 85,[17] and 2) implementation of streambank stabilization measures, or committed plans for such measures to be carried out as part of the stream rehabilitation program, along 75 percent of the stream length in the Upper Des Plaines River watershed that is identified as having high or medium streambank erosion potential on Map 85. That level of control of erosion from agricultural lands and streambanks would be supplemented by more stringent local construction erosion control requirements as required under Chapter NR 151, "Runoff Management," of the *Wisconsin Administrative Code*.

Map 85 indicates there is substantial achievement of the goal of having formal farm conservation plans or informal resource management systems on 75 percent of the lands with highly erodible soils in the Upper Des Plaines River subwatershed. Approximately 26 percent of the agricultural lands with highly erodible soils have conservation plans in place and about 25 percent have resource management systems. Thus, a total of 51 percent of the highly erodible soils in the subwatershed have practices applied to reduce erosion, meaning that two-thirds of the 75 percent goal has been reached.

Two options have been considered as the means to carry out stream rehabilitation in the Upper Des Plaines River:

- Rehabilitation relying initially on natural processes, followed, if needed, by selected mechanical removal.

- Mechanical removal.

Both approaches would be preceded by an initial stream channel clearing and maintenance program for beaver dams, deadfalls, and other debris which can impede flow as described below.

Initial Channel Clearing for Control of Beavers, Beaver Dams, and Obstructions to Flow

Observations by riparian landowners and the Commission staff have verified that beaver dams in the Upper Des Plaines River have resulted in elevated water levels along appreciable stream reaches upstream of those dams. Submergence of drain tile outfalls and elevated water levels in agricultural drainage ditches result from the backwater created by beaver dams. The bed of the Upper Des Plaines River only drops about seven feet in the lower five miles, or 1.4 feet per mile. Thus, if a four-foot-high beaver dam were blocking the channel in that reach, the backwater effect of that dam would extend about 2.8 miles upstream of the dam. In addition, beaver dams promote siltation in the slow-flowing impoundments they create and they present barriers to fish migration. An important component of any effort to rehabilitate the stream and improve agricultural drainage is to establish a program to aggressively control beavers and to remove beaver dams. The recommended plan includes such a program.

As noted below, it is recommended that a regular stream channel maintenance program be undertaken throughout the major stream system of the Des Plaines River watershed. This would include the periodic removal of

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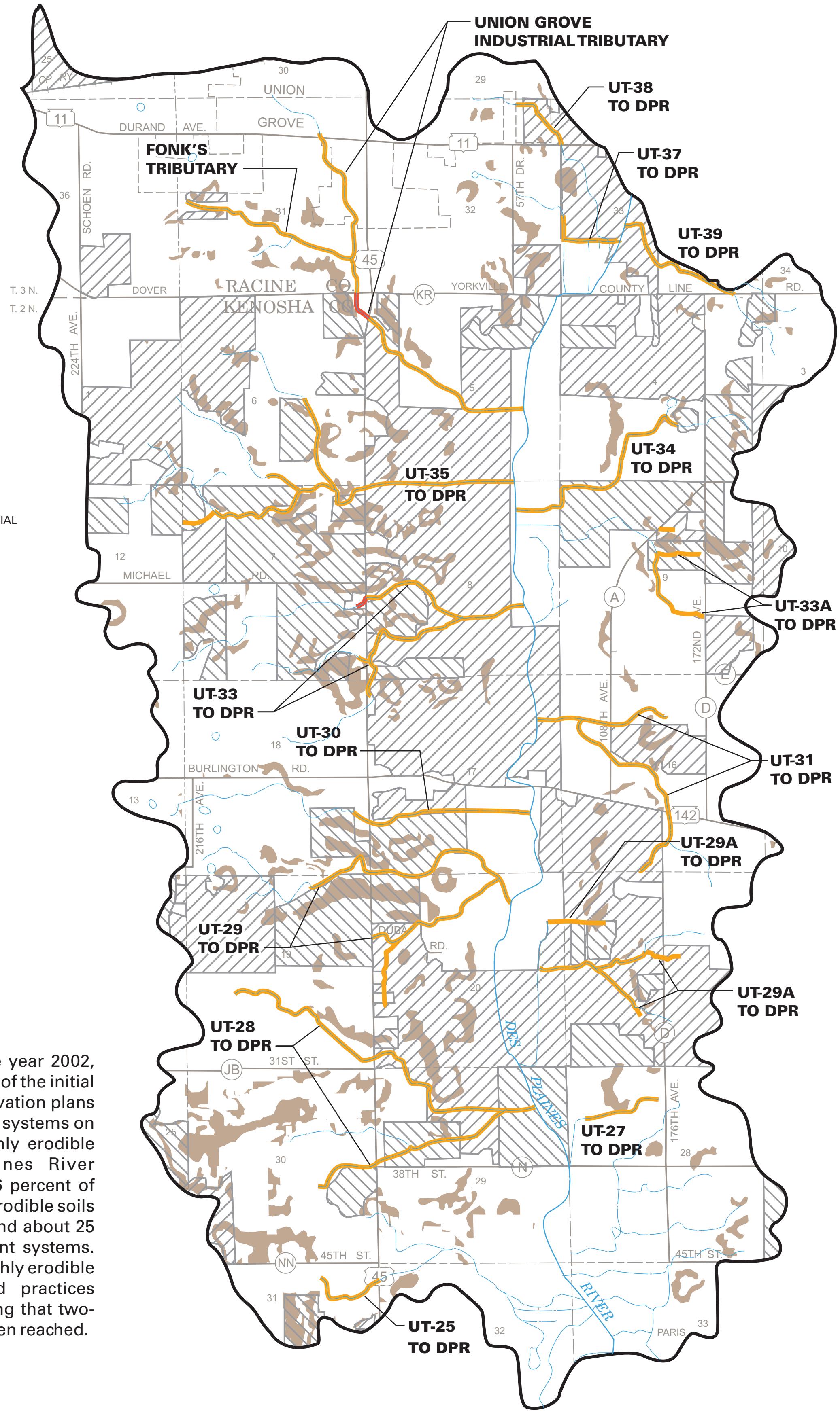
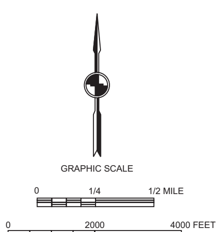
[17]*In mapping highly erodible soil types, the U.S. Natural Resources Conservation Service (NRCS) considers land slope, slope length, soil type, and a rainfall factor. The highly erodible soils (HES) identified on Map 85 were determined using the NRCS HES inventory and refining that inventory based on local NRCS field office guidance and joint field checks by NRCS and SEWRPC staff members. It should also be noted that, in general, removal of vegetative cover increases the potential for soil erosion, often necessitating agricultural practices to conserve soil even on soils not identified as being highly erodible.*

Map 85

RELATIONSHIP BETWEEN SOIL EROSION POTENTIAL AND COVERAGE BY FARM PLANS AND RESOURCE MANAGEMENT SYSTEMS FOR AGRICULTURAL LANDS IN THE UPPER DES PLAINES SUBWATERSHED: 2002





This map indicates that, as of the year 2002, there was substantial achievement of the initial goal of having formal farm conservation plans or informal resource management systems on 75 percent of the lands with highly erodible soils in the Upper Des Plaines River subwatershed. Approximately 26 percent of the agricultural lands with highly erodible soils had conservation plans in place and about 25 percent had resource management systems. Thus, a total of 51 percent of the highly erodible soils in the subwatershed had practices applied to reduce erosion, meaning that two-thirds of the 75 percent goal had been reached.

Source: SEWRPC.

localized sediment deposits, heavy vegetation,[18] debris, and beaver dams[19] from streams. Such a program is necessary to avoid adverse effects on agricultural drainage systems.

Sediment Removal Option 1—Natural Rehabilitation Program

The initially recommended floodland and stormwater management plan element, as described previously in this chapter, calls for a monitoring program to assess sediment conditions along the Upper Des Plaines River. Implementation of the components of that program could commence upon adoption of this watershed study. The initiation of that monitoring program would be one of the first steps in a relatively low-cost project intended to rehabilitate the Upper Des Plaines River through control of the sediment sources to the River and natural transport of deposited sediments, leading to the establishment of a more natural stream channel and a reduction in the sediment that has accumulated within the channel.[20] Minimal, low-cost measures would be constructed to establish riffles and promote formation of pools, to lower selected culverts, and to remove unpermitted culverts where appropriate.

The Upper Des Plaines River stream channel would be monitored for three years to 1) determine whether sediment was being removed through natural processes, 2) evaluate instream sediment concentrations relative to the baseline conditions, and 3) determine whether agricultural drainage was improving due to the combination of aggressive beaver and beaver dam control policies and less obstruction of drain tile outfalls by sediment. Such monitoring would include field surveys of the baseline cross-sections, continued collection of streamflow and suspended sediment data at the stream gauge, and surveys of farmers along the Upper Des Plaines River.

The costs associated with this option include $15,000 for the installation of a continuous streamflow and water quality monitoring gauge that would measure sediment concentrations in the River, $25,000 for field surveys to establish baseline stream channel cross-sections, and $50,000 for lowering culverts at nine private crossings. Thus, the total capital cost is estimated to be $90,000. Annual operation and maintenance costs are estimated at $19,000 for the stream gauge and resurveying baseline cross-sections. Because the stream channel would not be directly disturbed, the need for significant constructed rehabilitation measures might be avoided. If minor structures would be deemed necessary to promote the establishment of pools and riffles, a Chapter 30 permit would be required from the WDNR, but the issuance of such a permit would be expected to be routine, given the reasons for placing the structures and the minimal amount of disturbance involved in their placement. The effectiveness of this approach would be evaluated during a three-year monitoring program that would begin upon achievement of the 75 percent farm plan and bank stabilization goals. As previously noted, about 67 percent of the agricultural land management objective has been achieved through the development of conservation plans and the implementation of resource management systems.

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[18]*Permits for removal of sediment deposits may be required from the Wisconsin Department of Natural Resources under Chapter 30 of the* Wisconsin Statues*. Chapter NR 109 of the* Wisconsin Administrative Code *sets forth rules relative to vegetation management. Also, Section 12.18-2 of the Kenosha County zoning ordinance places restrictions on the removal of vegetation within 100 feet of the ordinary high water mark of navigable streams.*

[19]*The removal of debris jams and beaver dams do not require permits if bottom sediments are not directly disturbed.*

[20]*It is anticipated that, following substantial reductions in the sediment load to the stream from currently eroding farmland and streambanks, the energy available to transport sediment in the Des Plaines River will naturally transport the sediment accumulated along the streambed. The degree to which such transport is occurring would be monitored at the recommended streamflow/sediment gauge and additional mitigative measures to avoid excessive downstream sediment transport would be implemented if the sediment load were found to greatly differ from that expected to have been discharged historically.*

Sediment Removal Option 2—Mechanical Sediment Removal Approach

Another option for stream rehabilitation and improvement of agricultural drainage would be to mechanically remove sediment from the streambed, rather than relying on natural sediment transport processes. This approach could also be taken if the option that relies on natural processes were found to be inadequate following the monitoring period. In order for this approach to be effective, the same 75 percent farm plan and bank stabilization goals would have to be achieved to control sediment eroded from the tributary areas and streambanks prior to instream sediment removal. Thus, the difference in the total time needed to implement the overall stream rehabilitation project if mechanical sediment removal were done in place of natural removal would be at least a two-year reduction in time since the three-year monitoring period would be avoided, but a period of up to about one year might be required to complete the WDNR Chapter 30 permit process.[21] However, a much longer difference would occur if the natural processes sediment removal is a long-term phenomenon. The cost of mechanical sediment removal to attain the Upper Des Plaines River streambed profile shown on Figure 69, is estimated to be $350,000, including the cost for lowering the inverts of selected culverts.

It is considered very likely that stream rehabilitation measures would be required as a condition of the Chapter 30 permit. These costs would be dependent upon the requirements of the Wisconsin Department of Natural Resources. Such measures could involve significant costs over and above those associated with the fisheries management plan element. Because of the length of stream involved, these costs could range from $6.0 million to $12.7 million. Thus, the cost of mechanical sediment removal would be expected to far exceed the cost of the natural rehabilitation approach.

Wisconsin DNR Procedures Regarding Chapter 30 Permit for Mechanical Sediment Removal

Based on discussions with the staff of the WDNR, the process for consideration of an application to mechanically remove sediment from the bed of the Upper Des Plaines River is likely to involve the following steps:

- A stream assessment by the WDNR to determine whether the proposed sediment removal could be beneficial to the aquatic resource.
- An Environmental Assessment.
- Consideration of the permit application along with the stream and environmental assessments.
- Determination by the WDNR whether to issue a permit under Chapter 30 of the Wisconsin Statutes.

This process would be followed if extensive mechanical sediment removal were required in the event that the initially recommended natural rehabilitation process was unsuccessful, or if a decision were made to implement an approach different from the watershed study recommendation and propose extensive mechanical removal without attempting the natural process.

Department staff also indicated that applications for permits allowing for mechanical sediment removal would have to be preceded by a comprehensive program to control the sources of sediment to the streams, as recommended above.

Flood Flow Control Benefits of the Recommended Plan

As documented in Tables 112 and 113, under planned land use conditions, the recommended controls on runoff from new development along with the recommended levels of prairie and wetland restoration would be expected to 1) significantly reduce peak flood flows along the Upper Des Plaines River relative to uncontrolled planned land use conditions for flows with recurrence intervals ranging from one year (99 percent annual chance of occurrence) to 100 years (1 percent annual chance of occurrence) and 2) reduce peak flood flows along the Upper

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[21] *Under this option, the Chapter 30 permitting process would be more extensive than if minor instream structures were installed under the recommended natural approach because this option involves more extensive disturbance of the stream.*

Des Plaines River relative to 1990 land use conditions for flows with recurrence intervals ranging from two years (50 percent annual chance of occurrence) to 100 years. The flood flow reductions would translate to reduced extent and frequency of flooding of lands along the Upper Des Plaines River during infrequent floods, and would, therefore, also contribute to improved agricultural drainage conditions, even in the absence of the other recommended measures directed toward improving drainage.[22] However, the frequent annual or more frequent flooding is not expected to be reduced. Thus, nuisance-type frequent drainage problems will remain, but should not be appreciably worsened, as would be the case with no planned actions.

Evaluation of Stream Rehabilitation Options and Conclusion Regarding Options

The mechanical sediment removal option has the advantage of being a more direct and shorter-term means of improving the agricultural drainage conditions. In addition, the negative stream biological habitat conditions associated with sedimentation would be reduced sooner under that option. The negative aspects of this option relate to implementability associated with permitting and financing.

The need to obtain Chapter 30 permits for sediment removal can be time consuming and involve the need for a project sponsor and up-front permitting costs. In addition, the costs for sediment removal would most likely have to be borne locally by the landowners involved. Such costs would be locally unaffordable if significant stream rehabilitation work is required. Under the natural stream rehabilitation option, the project costs are lower and a higher potential exists for outside funding sources to carry out the programs. In addition, the costs are potentially lower if the natural processes option is effective albeit over a longer period of time.

Based upon the foregoing, the plan for natural stream rehabilitation, including improvement of agricultural drainage conditions, along with the recommended beaver dam removal and channel maintenance programs, is considered to be the best option for rehabilitation and improvement of drainage in the absence of new funding sources. If new funding sources were to become available, the process of stream rehabilitation through mechanical sediment removal and the associated constructed rehabilitation measures might be feasible.[23]

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[22]*As set forth in Tables 112 and 113, of Chapter XII, full implementation of the floodland and stormwater management measures recommended under this plan would be expected to achieve a significant reduction in flood flows along the upper and lower reaches of the Des Plaines River. Those measures would be adequate to offset possible flood flow increases that could result from implementation of the natural or mechanical sediment removal options. Sediment removal in the absence of the other recommended mitigating measures could result in increases in downstream 100-year flood stages along the Lower Des Plaines River because reduced flood stages in the sediment removal reach along the Upper Des Plaines River would result in reduced floodwater storage volumes in that reach, and that volume reduction could increase downstream flood flows somewhat. Flood stage increases along the Lower Des Plaines River would be relatively small, although possibly greater than or equal to the 0.01 foot criterion set forth in local zoning ordinances and Chapter NR 116 of the* Wisconsin Administrative Code*. The possible small increases in downstream flood stages for events with recurrence intervals longer than 10 years would be eliminated by full implementation of recommended floodland and stormwater management measures, including controls on runoff from new development and wetland and prairie restoration. However, depending on the status of implementation of the floodland and stormwater measures when the sediment removal program is put in place, some additional mitigation, such as the provision of compensatory floodwater storage volume, might be required to avoid possible 100-year flood stage increases of 0.01 foot or more. Because the plan calls for a high degree of control of peak rates of runoff from new development, the flood flow reductions that might be realized from wetland and prairie restoration are not factored into the plan as being necessary to offset downstream flow increases due to development. Thus, it is not envisioned that there would be any requirements to carry out wetland and prairie restoration. Rather, these measures would be carried out based upon their own merit and only when landowners choose to participate in the implementation.*

[23]*A possible funding source for the stream rehabilitation project might be Federal funds for implementation of projects identified under the Upper Des Plaines River Watershed Phase 2 Feasibility Study planning program that the U.S. Army Corps of Engineers is initiating along with Kenosha County; Cook and Lake Counties, Illinois; and the Illinois Department of Natural Resources. The objectives of that study are very similar to those of the (footnote continued)*

However, as noted above, that approach would be considerably more costly than a natural rehabilitation program, if such a program proves effective. Accordingly, it is recommended that the natural rehabilitation program be carried out as soon as possible following the plan completion. Given the current status of agricultural land management, it is concluded that the 75 percent farm management program is now nearly being met and should be achievable in the next few years. Thus, the program providing for beaver dam and debris removal followed by monitoring and other steps, including controls on streambank erosion, should be initiated as soon as project lead agencies and funding are established. After the three-year monitoring program, the potential need for mechanical sediment removal can be revisited.

Relationship of Wetland and Prairie Restoration to Stream Rehabilitation and Improvement of Agricultural Drainage

The recommended restoration of wetlands in the 100-year floodplains in the watershed, including along the Upper Des Plaines River, is intended to accomplish several objectives, including:

- Achieve an estimated average annual reduction in watershedwide agricultural flood damages of about \$35,000. This would be accomplished because floodprone land would be taken out of production, with the landowners being appropriately compensated upon a willing landowner basis.
- Contribute to reductions in flood flows.
- Improve habitat in the stream corridors.
- Provide a riparian buffer that would contribute to water quality improvements.

Prairie restorations would accomplish similar objectives, although the amount of reduction in flood damages is likely to be small because the prairie restoration areas are not normally floodprone agricultural lands and reductions in flood flows are relatively small.

Wetland and prairie restorations would be accomplished through enrollment of land in the USDA Conservation or Wetland Reserve Programs, through the purchase of conservation easements or development rights, or through outright purchase. The restorations would be voluntary, based on the landowner’s willingness to receive payments in turn for removing the land from agricultural production.

Bridge Replacement

It is recommended that bridges and culverts on the major stream system of the Des Plaines River watershed that have inadequate hydraulic capacity, as manifested by overtopping of the approach roadways or of the structures themselves, be eventually modified or replaced so as to eliminate interference with the operation of the highway and railroad transportation system. There are 176 hydraulically significant bridges and culverts on the major stream system of the watershed. Of this total, 151, or 86 percent, are hydraulically adequate, and need not be modified or replaced except as may be necessary for transportation purposes. Of the remaining 25 crossings, 12, representing 7 percent of the bridges and culverts, would be hydraulically adequate under recommended plan conditions, and the provision of additional hydraulic capacity would not be required if significant implementation of recommended floodland and stormwater measures had occurred in the area tributary to the structures. The remaining 13 crossings, representing 7 percent of the bridges and culverts, would be hydraulically inadequate under existing and recommended plan conditions and should be modified or replaced in the normal course of events as the transportation system is renewed. It is recommended that those crossings be designed to provide adequate hydraulic capacity based on planned land use, existing channel condition flows. The design of all new bridges within the watershed should be based upon the applicable objectives and standards set forth in Appendix C-4 of this report.

Wisconsin Des Plaines River watershed study, and it is intended that the Phase 2 study make maximum use of the Wisconsin study analyses and results presented herein. The Phase 2 study is only in its early stages and no specific recommendations have yet been formulated.

Floodland Regulations
It is recommended that Kenosha and Racine Counties, the City of Kenosha, and the Villages of Pleasant Prairie and Union Grove review and, as necessary, revise their floodland zoning regulations to reflect 1) the updated 100-year recurrence interval flood profiles and floodland maps developed for planned land use conditions under this watershed study, and 2) the floodland management concepts and recommendations set forth in this report. Such regulations should be explicitly designed to complement the recommended watershed land use plan element, as well as the floodland management measures recommended in this plan. In general, those floodlands lying within the 100-year recurrence interval flood hazard lines under planned land use and existing channel conditions that are presently neither developed for urban use, nor committed to such development by the recordation of land subdivision plats and the installation of municipal improvements, should be zoned so as to prohibit incompatible urban development. It is also recommended that:

- The Counties and the Village of Pleasant Prairie maintain and enforce their zoning ordinance requirement that any filling in the 100-year year flood fringe be offset by the provision of an equal volume of compensating storage.
- That the Village of Union Grove amend its ordinance to call for the provision of an equal volume of compensating storage to offset any filling in the 100-year flood fringe.
- That the Village of Paddock Lake adopt a floodplain zoning ordinance incorporating the 100-year flood profiles and floodplain boundary maps developed under the watershed study for Unnamed Tributary No. 6 to Brighton Creek, Unnamed Tributary No. 2 to the South Branch of Brighton Creek, Hooker Lake and Paddock Lake, and that the ordinance call for the provision of an equal volume of compensating storage to offset any filling in the 100-year flood fringe.

Those lands which would be removed from the floodplain upon implementation of the floodland and stormwater management recommendations outlined in the plan should be zoned as floodplains until those recommendations are implemented and local floodplain zoning ordinances are officially amended to change 100-year flood profiles and flood inundation areas.

Stormwater Management Plans and Regulations
It is recommended that stormwater management plans be prepared for areas of significant existing and/or planned urban development.[24] Priority should be given to those subwatersheds which experience serious drainage problems and those which are expected to develop first. It is recommended, therefore, that stormwater management system plans be prepared in the following order as shown on Map 86: 1) the Jerome Creek subwatershed in the Village of Pleasant Prairie; 2) the Lower Des Plaines River subwatershed in the Village of Pleasant Prairie and the Town of Bristol; 3) the lower portion of the Kilbourn Road Ditch subwatershed in the City of Kenosha, the Village of Pleasant Prairie, and the Town of Somers; 4) urbanizing areas in the Upper Des Plaines River watershed in the Village of Union Grove and the Towns of Dover and Yorkville; 5) urbanizing areas in the lower portion of the Center Creek subwatershed in the City of Kenosha and the Town of Bristol; 6) the Salem Branch of Brighton Creek subwatershed in the Village of Paddock Lake and the Towns of Bristol and Salem; and 7) the upper portion of the Kilbourn Road Ditch subwatershed in the Towns of Mt. Pleasant and Yorkville. For those subwatersheds which are located in more than one community, it is recommended that the preparation of the stormwater management plans be a joint effort of the communities concerned.

It is also recommended that Kenosha and Racine Counties and each incorporated municipality within the watershed adopt stormwater management ordinances. Such ordinances should address control of both water quantity and quality. Those ordinances should be adopted soon after adoption of the watershed study. Following completion of the stormwater management plans, revisions to the ordinances may be required to reflect the

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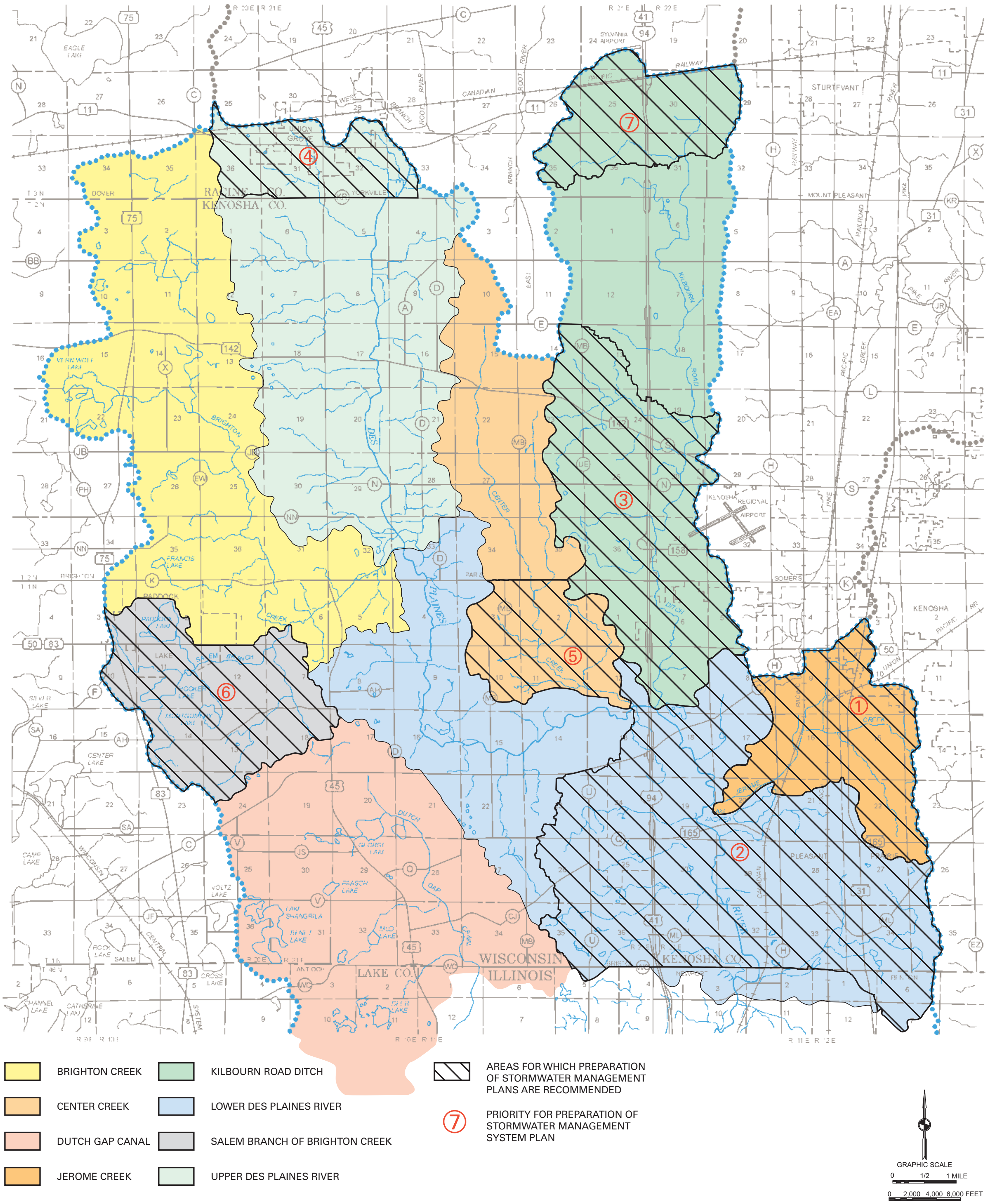
[24]*Appendix L of this report describes the essential components of a sound stormwater management plan to address both stormwater drainage and urban nonpoint source pollution.*

Map 86

SUBWATERSHED LOCATIONS FOR RECOMMENDED STORMWATER MANAGEMENT PLANS IN THE DES PLAINES RIVER WATERSHED



The Des Plaines River watershed plan recommends that stormwater management system plans be developed within the framework of the watershed plan to alleviate local stormwater management problems. These plans should be developed on a subwatershed basis, with priority being given to those areas which experience serious problems or may be expected to experience significant urbanization.

Source: SEWRPC.

detailed recommendations of those stormwater plans. The local ordinances should call for water quantity controls on new development that incorporate post-development release rates as recommended under this watershed study. It is recommended that the ordinances require controls to meet the recommended post-development two-year storm peak flow release rate of 0.04 cfs per acre of new development and the recommended post-development 100-year storm peak flow release rate of 0.30 cfs per acre of new development. Those release rates should be considered as maximums. They could be reduced if local stormwater management planning dictates more restrictive rates. It is also recommended that the ordinances be consistent with the nonpoint source pollution control standards set forth in Chapter NR 151, Runoff Management, of the *Wisconsin Administrative Code* [25,26] and that they include provision to encourage low impact source controls and stormwater management practices designed to maintain pre-development hydrologic conditions by promoting infiltration where appropriate.

Chapter NR 152 of the *Wisconsin Administrative Code*, "Model Ordinances for Construction Site Erosion Control and Storm Water Management," can serve as a guide for development of the water quality control sections of the ordinance. That model is consistent with the requirements of Chapter NR 151. The model can be revised to suit each community's needs and to incorporate water quantity controls.[27] In order to meet the intent of the recommended release rates, while avoiding placing burdensome requirements on small developments, small redevelopments, and small modifications or additions to existing developments, it is suggested that the local ordinances provide an exemption for developments that would create new impervious area less than a certain threshold. Typical impervious area thresholds range from 0.5 to 1.0 acre.

Channel Maintenance

It is recommended that a regular stream channel maintenance program be undertaken throughout the major stream system of the Des Plaines River watershed. This would include the periodic removal of localized sediment deposits,[28] heavy vegetation, debris, and beaver dams from all watercourses in the watershed, including bridge openings and culverts. Such a program is necessary to ensure the integrity of the stream bottom profile and to avoid adverse effects on agricultural drainage systems and urban stormwater management systems.

Flood Insurance

With the exception of the Village of Paddock Lake, all of the civil divisions located wholly or partly within the watershed have taken the necessary steps to make their residents eligible to participate in the Federal Flood Insurance Program. Flood insurance studies have been completed by FEMA for all of the communities in the watershed except the Village of Paddock Lake. It is recommended that Kenosha and Racine County, the City of Kenosha, and the Villages of Pleasant Prairie[29] and Union Grove apply to FEMA requesting review of the flood

[25]*One difference between the NR 151 requirements and the recommendations of this watershed plan is that the watershed plan recommends a post-development release rate of 0.04 cfs per acre for a two-year storm. That release rate is more restrictive than the level of control of a two-year storm required under NR 151.*

[26]*The construction erosion control requirements of Chapter NR 151 went into effect on October 1, 2002. The post-construction performance standards will take effect on October 1, 2004 for all projects that are required to meet the construction erosion control standards and that submit notices of intent on or after October 1, 2004.*

[27]*An additional model ordinance that could be consulted in developing local ordinances is "September 2002 Model Post-Construction Storm Water Management Ordinance for Communities Served by the Milwaukee Metropolitan Sewerage District," in progress. That model ordinance incorporates elements of the Chapter NR 152 model with a release rate approach similar to that recommended for the Des Plaines River watershed. Another ordinance that incorporates a release rate approach is "Lake County Watershed Development Ordinance," latest amendment August 14, 2001.*

[28]*A permit may be required from the Wisconsin Department of Natural Resources under Chapter 30 of the* Wisconsin Statues.

[29]*The Village of Pleasant Prairie submitted 100-year recurrence interval floodplain/floodway maps and supporting documentation developed under this watershed study to FEMA in October 1998, requesting a Physical Map Revision. As of June 2003, the FEMA map revision process was nearing completion.*

hazard data set forth in this report and revision of the local flood insurance studies to reflect the new flood hazard data. It is recommended that the Village of Paddock Lake participate in the National Flood Insurance Program and submit the floodland information developed under this watershed study for the lake and streams in the Village to FEMA for preparation of a flood insurance study and a Flood Insurance Rate Map. It is further recommended that owners of property in floodprone areas in the watershed purchase flood insurance to provide some financial relief for losses sustained in floods. Finally, as significant components of the recommended floodland and stormwater management measures are implemented, it is recommended that the communities apply to FEMA to make revisions and updates to the flood insurance studies.

Lending Institution Policies

It is recommended that lending institutions continue their practice of determining the floodprone status of properties prior to mortgage transactions and that the principal source of flood hazard information in the Des Plaines River watershed be that developed under the watershed study. That information will be available from the counties and municipalities following local adoption of the information.

Community Utility Policies

It is recommended that the policies of the governmental units and agencies within the watershed responsible for the design, construction, operation, and maintenance of public utilities and facilities—such as water supply and sewerage facilities, drainageways, and streets and highways—carry out those functions such that the location, use, and size of public utilities and facilities are consistent with both the floodprone status of riverine areas identified under this watershed study and the land use and floodland regulation recommendations for the Des Plaines River watershed.

Land Use Controls Outside Floodlands

It is recommended that local communities consider the potential hydrologic impact of proposed development or redevelopment and recognize that planned development should occur according to the land use plan recommended under this watershed study. If development beyond that recommended in the land use plan is unavoidable, it should be accompanied by mitigative measures to control runoff.

Emergency Programs

The smaller streams in the urban portions of the Des Plaines River watershed are hydrologically and hydraulically "flashy" in that major flood events are likely to be caused by intense rainfall events that are unpredictable as to location and time of occurrence, and that there may be only a short period of time between the initial rise of floodwaters and the occurrence of peak stages. Therefore, it is not practicable to establish a system to predict the location, magnitude, and time of occurrence of peak flood stages along most streams in the watershed. Flood stages rise more slowly along the Des Plaines River main stem. However, because implementation of the recommended plan would eliminate the flood hazard to structures during events with recurrence intervals up to, and including, 100-years and because the existing system for closing roads and highways during periods of high water appears to function adequately, a flood warning system is not recommended for the Des Plaines River main stem.

It is recommended that in each watershed community where major flooding occurs, procedures be developed to provide floodland residents and other property owners with information about the location and extent of the flood hazard areas so that residents can take appropriate flood damage mitigation measures, including the implementation of the recommended structure floodproofing, elevation, or removal measures.

Community Education Programs

It is recommended that residents of the Des Plaines River watershed be informed of the existence of this comprehensive watershed plan through the news media. Public reaction to the plan should be solicited through a public hearing on the plan. Information on plan activities during the period of plan implementation should be disseminated using 1) the "Ties to the Land" newsletter that is published six times a year by Kenosha County Land and Water Conservation, the Racine County Land Water Conservation Division, the University of Wisconsin Extension (UWEX), the U.S. Farm Service Agency, and the U.S. Natural Resources Conservation Service, 2) the "Urban/Rural Connection" newsletter that is published quarterly by the UWEX and that deals with issues of land use growth and management, 3) the Kenosha County government web site at http://www.co.kenosha.wi.us/index.phtml, 4) the Racine County government web site at http://www.racineco.com, and 5) the UWEX web site at http://www.uwex.edu/ces/cty/kenosha.

Maintenance of Stream Gaging Networks
The U.S. Geological Survey stream gaging station on the Des Plaines River at Russell, Illinois provides data essential to the rational management of the surface waters of the basin. It is recommended that operation of that continuous recorder continue and that a continuous recording gage be established and maintained near the outlet of the Upper Des Plaines River watershed.

Recommended Water Quality Management Plan Element
The adopted regional water quality management plan, as refined and detailed under the County land and water resource management plans and the watershed study, is recommended for adoption as the water quality management element of the Des Plaines River watershed plan. The plan contains recommendations for the abatement of pollution from public and private sewage treatment plants, industrial waste discharges; the control of pollution from nonpoint sources; and the development of a water quality monitoring program for the watershed.

Public Sewage Treatment Plants and Associated Sewer Service Area
It is recommended that the sewage treatment plant serving Village of Pleasant Prairie Sewer Utility District D and the treatment plant serving the former Village of Pleasant Prairie Sanitary District No. 73-1 be abandoned.[30] Those plants are being phased out, and agreements are in place for abandonment before the year 2010. Upon abandonment of those plants, their former service areas would be served by the Kenosha Water Utility, which discharges treated wastewater to Lake Michigan. Along with abandonment of those plants, this watershed plan recommends construction of the intercommunity trunk sewers needed to provide service. The final recommended point source pollution control plan components are shown on Map 87.

With regard to the Village of Paddock Lake and the Town of Bristol Utility District No. 1 public treatment plants, it is noted that each plant currently has recorded monthly average flows which approach or exceed the average design capacity of the plant. Thus, facility planning programs have been initiated to explore plant expansion alternatives for both plants. Based upon the currently adopted sewer service areas, the distances between the Paddock Lake and Bristol sewer service areas and between the Kenosha and Bristol sewer service areas, suggest that it may be cost-effective to plan for consolidation of sewage treatment facilities. This is not to say that regionalization will be cost-effective, but only that it should be explored. It is, therefore, recommended that a sewerage system plan evaluation be made to determine the best means of providing for sewage treatment for the Bristol and Paddock Lake sewer service areas, with that plan considering local plant(s) upgrading and expansion alternatives, as well as connection to the Kenosha sewerage system. Such a study could best be done under a cooperative planning program involving Kenosha County, the Town of Bristol, the Village of Paddock Lake, the City of Kenosha, SEWRPC, and the Wisconsin Department of Natural Resources.

Private Sewage Treatment Facilities
Five private sewage treatment plants are currently in operation within the Des Plaines River watershed, generally serving isolated enclaves of urban land uses, including two mobile home parks and one industry: Hickory Haven Mobile Home Park, Rainbow Lake Manor Mobile Home Park, the Bong Recreational Area, the Brightondale County Park, and the Kenosha Beef International Company. These facilities, which serve isolated land uses are located beyond the current limits of the planned sanitary public sewer service areas and are recommended to be retained, with the exceptions of the Hickory Haven Mobile Home Park—located in close proximity to the planned

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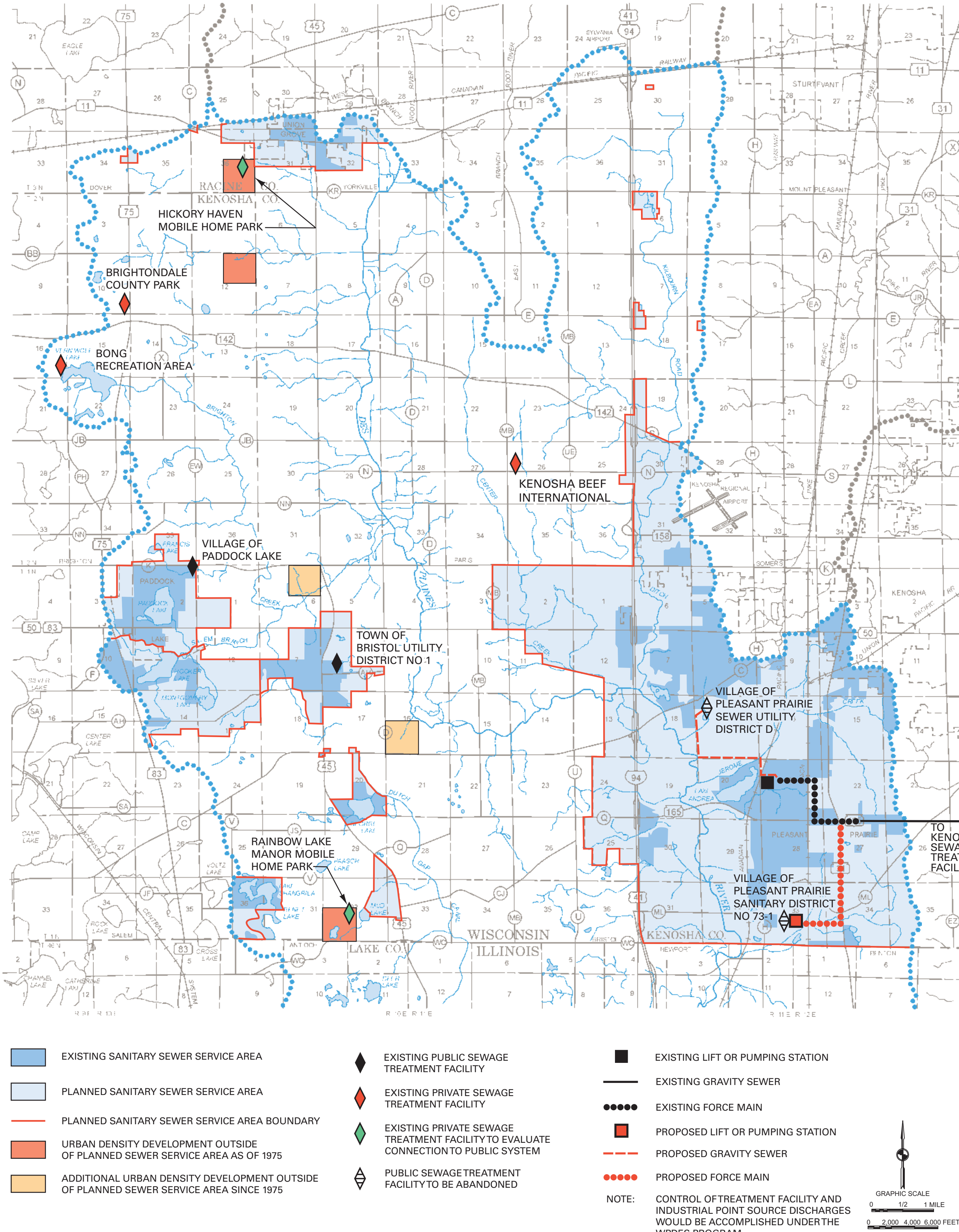
[30]Amendment to the Regional Water Quality Management Plan–2010, Greater Kenosha Area, *adopted by the Southeastern Wisconsin Regional Planning Commission, March 1996.*

Map 87

FINAL RECOMMENDED POINT SOURCE POLLUTION CONTROL MEASURES FOR THE DES PLAINES RIVER WATERSHED



Source SEWRPC.

Union Grove Sewer Service Area—and the Rainbow Lake Manor Mobile Home Park—located in close proximity to the planned Bristol service area, which have the potential to be consolidated with public treatment facilities. Thus, it is recommended that, when each of these two private plants require significant upgrading or modification, detailed facility planning be conducted to evaluate the alternative of connecting these two areas to the adjacent public sanitary sewer systems. For the remaining three private sewage treatment plants, the need for upgrading and level of treatment should be formulated on a case-by-case basis during plan implementation as part of the Wisconsin Pollution Discharge Elimination System (WPDES) permitting process.

Management of Solids from Public and Private Sewage Treatment Plants

It is recommended that the public and private sewage treatment plants in the watershed continue to implement the plant-specific sludge management plans that have been prepared for them as a part of the WPDES discharge permitting process.

Regulation of Sewage Treatment Facilities and Industrial Discharges

It is recommended that these sources of wastewater continue to be regulated and controlled to acceptable levels on a case-by-case basis through the operation of the Wisconsin Pollutant Discharge Elimination System (WPDES).

Control of Pollution from Nonpoint Sources

Table 114 in Chapter XIII of this report sets forth the agricultural and urban nonpoint source pollution control recommendations of the Des Plaines River watershed study. Those recommendations are consistent with the goals, objectives, and actions established under the land and water resource management plans adopted by Kenosha and Racine Counties in September of 2000.[31] The urban recommendations focus primarily on practicing more effective stormwater management, reducing construction site erosion, managing onsite sewage disposal systems, and related educational land management activities. The agricultural recommendations focus on reducing nonpoint source pollution from sediment and livestock manure through a variety of governmental and individual actions and on implementing best management practices (BMPs). Appendix M describes measures and BMPs to control soil erosion and washoff of nonpoint source pollutants from agricultural lands. An economic analysis of agricultural conservation practices is set forth in Appendix K. Appendix L describes the essential components of a sound stormwater management plan to address both stormwater drainage and urban nonpoint source pollution control.

Although reductions in nonpoint source loadings through the measures described in Table 114 may provide the necessary surface water quality improvement for most pollutants, some additional control measures will be necessary in order to achieve the water use objectives for the Des Plaines River watershed. These measures include additional source controls to eliminate toxic and hazardous substances from surface waters in order to protect the development of a desired fishery. It is recommended that local ordinances be reviewed to determine whether they address the following and that they be revised if they do not.

1. Control of accidental spills with attendant intermittent discharges through surface runoff, as well as floor drains connected to surface water and surface drainage systems.

2. The development of spill prevention and control plans.

3. The elimination of discharges to storm sewers and surface watercourses from floor drains and drainage pumps in industrial facilities which collect grease, oil, chemicals, and other toxic and hazardous substances.

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[31] *SEWRPC Community Assistance Planning Report, No. 255,* A Land and Water Resource Management Plan for Kenosha County: 2000-2004, *September 2000; SEWRPC Community Assistance Planning Report, No. 259,* A Land and Water Resource Management Plan for Racine County: 2000-2004, *September 2000.*

Recommended Lake Management Measures
Recommended lake management measures are set forth in Appendix N.

Development of Water Quality Monitoring Program
It is recommended that water quality monitoring of streams in the watershed be reinstated as recommended under the Kenosha and Racine County land and water resources management plans. It is also recommended that the collection of lake water quality data be continued under the WDNR Self-Help Lake Monitoring Program, supplemented by more-detailed trophic state index (TSI) monitoring funded in part under the Chapter NR 190 Lake Management Planning Grant Program.

Costs of the Recommended Water Quality Management Plan Element
As set forth in Table 117, implementation of the recommended water quality management plan element is anticipated to have an estimated capital cost $21.9 million, administrative and planning costs of $2.3 million,[32] and average annual operation and maintenance costs of about $116,000. The $21.9 million capital cost would be borne by the private sector as a cost of land development. According to information in the county land and water resource management plans, the current Kenosha County budget covers about 45 percent of the estimated annual administrative and planning costs required to implement the water quality management plan, and the current Racine County budget covers about 55 percent of those costs. The costs not currently budgeted for will be sought from outside sources and will be considered in subsequent County work planning and budgeting. Additional resources from Federal, State, and local levels of government and the private sector will be required to carry out the recommended water quality management plan.

Recommended Fisheries Management Plan Element
The maintenance and rehabilitation of the warmwater fishery in the watershed is an important component of this watershed plan which follows logically from the plan recommendations to improve water quality through the control of point and nonpoint source pollution from agricultural and urban sources and which is consistent with the water use objectives recommended under this watershed study. The fishery throughout the Des Plaines River watershed has been demonstrated to be significantly impacted in terms of a loss in intolerant species, habitat, and degraded water quality conditions. However, recent data demonstrates that some portions of the watershed, particularly within some areas of Brighton Creek, may contain greater potential for fisheries development than previously thought.

In order to enhance the fishery resource in the watershed, it is recommended that subwatershed-level fishery management plans be developed based on existing and new survey data, with specific goals and objectives to implement appropriate management actions beginning in the headwater reaches of priority stream segments and continuing downstream to, and including, the main stem of the Des Plaines River. It is recommended that the fish management measures set forth in Table 116 in Chapter XIV of this report be implemented on a subwatershed basis. The table sets forth a tiered approach that recommends the implementation of specific larger-scale actions prior to local-level actions. The larger-scale Tier 1 measures are consistent with the recommendations of the water quality management plan element regarding controls on nonpoint source pollution from rural and urban lands.

It is recommended that the subwatershed-level fishery management plans:

1. Incorporate recommendations to protect existing, remnant populations of threatened and endangered species, and species of special concern and to control the extent and spread of common carp throughout the Upper and Lower Des Plaines River subwatersheds.

2. Call for the implementation of appropriate management measures in multiple phases, commencing with the priority headwater areas that have established and self-reproducing populations of desirable

[32]*These costs do not include the planning costs associated with preparation of detailed stormwater management plans.*

fish species, and extending downstream to the main stem of the Des Plaines River. Measures should emphasize enhancement of existing populations.

3. Be coordinated with the detailed stormwater management plans to encourage the use of measures that promote streamcourse structure and function, provide habitat and food stocks, and restore natural vegetation and vegetated buffers along stream corridors and lake shores. Ideally, the stormwater management planning for a given subwatershed would be conducted concurrently, and in coordination with the subwatershed-level fishery management plans.

4. Promote local support for fisheries management and environmentally sensitive and sustainable measures through recommendations for targeted informational programming and creation of opportunities for public participation in decision-making processes.

5. Recommend development and implementation of an appropriate, ongoing monitoring and evaluation strategy to establish baseline conditions and to assess progress toward the rehabilitation of the stream and lake fishery within the Des Plaines River watershed. This strategy should include, not only fisheries and fish habitat surveys, but also water quality and physical habitat assessments. Citizen participation in monitoring programs should be encouraged.

The restoration priorities for streams and lakes within the Des Plaines River watershed are outlined below.

High Priority

Stream Reach

- Upper Des Plaines River upstream of the confluence with Brighton Creek
- Brighton Creek
- Salem Branch
- Center Creek
- Kilbourn Road Ditch

Moderate Priority

Stream Reach

- Lower Des Plaines River downstream of the confluence with Brighton Creek to the confluence with Kilbourn Road Ditch
- Union Grove Industrial Tributary
- Jerome Creek
- Pleasant Prairie Tributary
- Unnamed Tributary No. 1 to the Des Plaines River

Major Lake

- Lake Andrea
- Benet/Shangrila Lake
- George Lake
- Hooker Lake
- Paddock Lake
- Vern Wolf Lake

Low Priority

Stream Reach

- Lower Des Plaines River downstream of the confluence with Kilbourn Road Ditch
- Dutch Gap Canal

RECOMMENDED WATER USE OBJECTIVES

The watershed development objectives, principles, and standards used in the preparation of the comprehensive Des Plaines River watershed plan are set forth in Chapter X and Appendices C-1 through C-4 of this report. The recommended water use objectives are shown on Map 88. The recommended water quality standards attendant to those water use objectives are set forth in Table 96 in Chapter X.

COST ANALYSIS

In order to assist public officials in evaluating the recommended comprehensive Des Plaines River watershed plan, a preliminary capital improvement program with attendant operation and maintenance costs was prepared which, if followed, would result in total watershed plan implementation by the year 2030. The schedule of capital; land rental, easement, or acquisition; and operation and maintenance costs for the recommended watershed plan is set forth in Table 117.

The schedule assumes a 28-year plan implementation period beginning in 2003 and extending through the year 2030. The capital cost of implementing the entire Des Plaines River watershed plan, including capital projects; park development; land rental, easements, and/or acquisitions; and certain administrative and planning costs, is estimated to potentially range from $111.9 million to $127.8 million, depending on the degree to which lands are converted to prairies and wetlands through the U.S. Department of Agriculture Conservation Reserve Program or through purchase of easements and development rights. The capital cost represents an average annual capital expenditure over the 28-year period of about $4.0 to $4.6 million. About $16.9 million, or 13 to 15 percent of the totals, and representing an average annual expenditure of about $603,000 is required to implement the park and open space element of the plan, including the acquisition of primary environmental corridor lands; from about $70.9 to $86.8 million, or from about 63 to 68 percent of the total and representing an average annual expenditure of from about $2.5 to $3.1 million, is required for implementation of the floodland and stormwater management element of the plan; about $24.1 million, or from about 19 to 22 percent of the total, and representing an average annual expenditure of about $862,000, is required for implementation of the water quality management element of the plan.[33] The average annual operation and maintenance costs for the recommended plan components is estimated to range from $529,000 to $1,566,000, with those costs shared between the private and public sectors. The total capital investment and operation and maintenance cost required for plan implementation may be expected to approximate from $4.5 to $6.1 million on an average annual basis.

ABILITY OF THE RECOMMENDED COMPREHENSIVE PLAN TO MEET ADOPTED OBJECTIVES AND STANDARDS

The watershed development objectives and supporting standards were formulated early in the Des Plaines River watershed study as the second step in a seven-step planning process, and constitute the overall goals of the comprehensive plan. The objectives and standards established for the watershed planning program consist of objectives and standards adopted under related areawide land use, park and open space, and water pollution abatement planning programs, supplemented with objectives and standards developed under the Des Plaines River watershed planning program. The adopted watershed development objectives and supporting standards provide the basis for plan preparation, test, and evaluation. It is appropriate to determine how well the recommended

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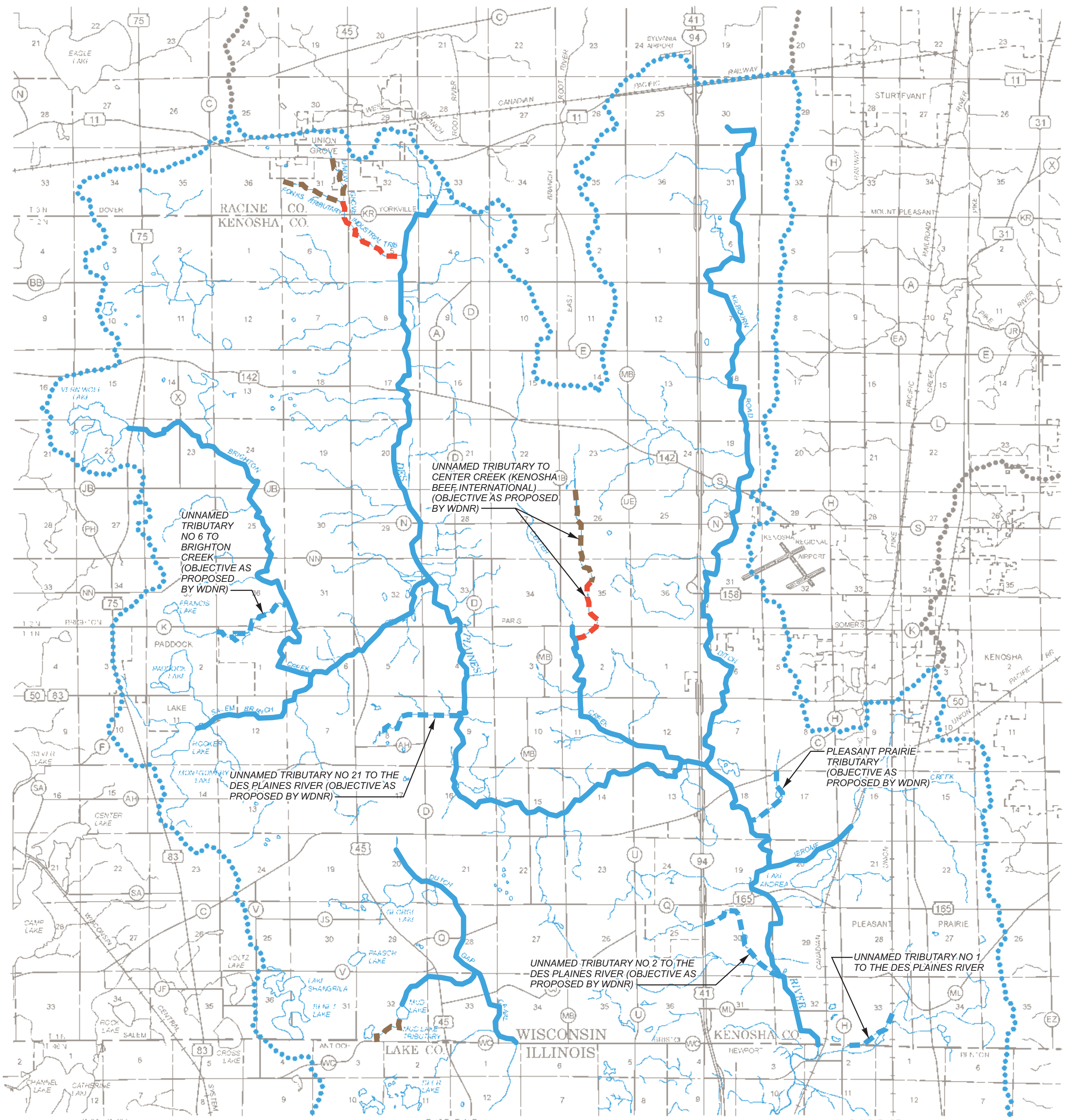
[33] *The costs of detailed stormwater and fisheries management measures will be determined under the detailed subwatershed-level stormwater and fisheries management plans that are recommended to be prepared. Thus, the watershed plan costs do not include those of stormwater management measures to address areas of existing development, nor the costs of fisheries management measures.*

Map 88

FINAL RECOMMENDED WATER USE OBJECTIVES FOR SURFACE WATERS IN THE DES PLAINES RIVER WATERSHED: 2010



BIOLOGICAL USE OBJECTIVES

- WARMWATER SPORT FISH COMMUNITY
- LIMITED FORAGE FISH COMMUNITY
- LIMITED AQUATIC LIFE

RECREATIONAL USE OBJECTIVES

- FULL RECREATIONAL USE
- LIMITED RECREATIONAL USE

NOTE: UNDER THE REGIONAL WATER QUALITY MANAGEMENT PLANNING PROGRAM, ANALYSES WERE CONDUCTED TO DETERMINE THE FEASIBILITY OF ACHIEVING A LEVEL OF WATER QUALITY THAT WOULD MAKE ALL SURFACE WATERS "FISHABLE AND SWIMMABLE" AS ENVISIONED BY THE U.S. CONGRESS IN PUBLIC LAW 92-500. APPROXIMATELY 62 MILES OF STREAM IN THE DES PLAINES RIVER WATERSHED ARE ASSIGNED WATER USE OBJECTIVES WHICH MEET THE NATIONAL GOAL OF "FISHABLE AND SWIMMABLE" WATER. AN ADDITIONAL 11 MILES OF STREAM ARE ASSIGNED OBJECTIVES WHICH DO NOT MEET THAT GOAL.

Source: Wisconsin Department of Natural Resources and SEWRPC.

Table 119

ABILITY OF THE RECOMMENDED COMPREHENSIVE PLAN FOR THE DES PLAINES RIVER WATERSHED TO MEET ADOPTED WATERSHED DEVELOPMENT OBJECTIVES AND STANDARDS

Objective Number	Objective Description	Standard		Degree to Which Standard is Met
Land Use Objectives				
1	A balanced allocation of space to the various land use categories which meets the social, physical, and economic needs of the regional population	Residential land allocation	High-density urban—eight net acres per 100 added dwelling units	Met[a]
			Medium-density urban—23 net acres per 100 added dwelling units	Met[a]
			Low-density urban—83 net acres per 100 added dwelling units	Met[a]
			Rural—500 net acres per 100 added dwelling units	Met[a]
		Park and recreation land allocation	Major—four net acres per 1,000 added persons	Met[a]
			Other—eight net acres per 1,000 added persons	Met[a]
		Industrial land allocation	Seven net acres per 100 added employees	Met[a]
		Commercial land allocation	Major—one net acre per 100 added employees	Met[a]
			Other—two net acres per 100 added employees	Met[a]
		Governmental and Institutional land allocation	Nine net acres per 1,000 added persons	Met[a]
2	A spatial distribution of the various land uses which will result in a compatible arrangement of land uses	Neighborhood units for urban high-, medium-, and low-density residential development		Could be met[b]
		Suburban and rural residential land location		Met
		Industrial land location		Met
		Major commercial land location		Met
3	A spatial distribution of various land uses which will result in the protection and wise use of the natural resources of the Region, including its soils, inland lakes and streams, groundwater, wetlands, woodlands, prairies, and wildlife, and the protection of natural floodwater storage areas	Soils	Sewered urban development	Met[a]
			Unsewered urban development	Met[a]
			Rural development	Met[a]
		Inland lakes and streams	25 percent of shoreline of major lakes in natural state	Generally met
			50 percent of shoreline of major lakes in nonurban use	Generally met
			10 percent of shoreline of major lakes maintained for public use	Partially met
			25 percent of shoreline of minor lakes in natural state or low-intensity public use	Met
			25 percent of shoreline of perennial streams in natural state	Generally met
			50 percent of shoreline of perennial streams in nonurban use	Met
			Floodlands free from new incompatible urban development	Met
			Restrict encroachments in channels and floodways	Met
		Wetlands	Protect wetlands adjacent to streams or lakes, within special wildlife or natural areas, and wetlands of five acres or greater	Met
			Maintain open lands surrounding important wetlands	Partially met
		Woodlands	Protect 10 percent of watershed	Not met[c]
			Maintain five acres per 1,000 population	Not met[c]
		Prairies	Maintain remaining native prairies	Could be met
		Wildlife	Maintain a wholesome habitat	Met

Table 119 (continued)

Objective		Standard	Degree to Which Standard is Met
Number	Description		
Land Use Objectives (continued)			
4	A spatial distribution of the various land uses which is properly related to the supporting transportation, utility, and public facility systems in order to assure the economical provision of transportation, utility, and municipal services	Maximize use of existing transportation and utility facilities	Met[a]
		Transportation systems to provide access to urban areas	Could be met
		Sewer service residential areas	Met[a]
		Water supply to residential areas	Met[a]
		Medium- and high-density residential land serviceable by mass transit facilities	Partially met
		Minimum penetration by major transportation routes of residential neighborhood units	Could be met[b]
		Locate transportation terminal facilities near principal land uses served	Could be met[b]
		Limitations on onsite sewage disposal systems	Met
5	The preservation and provision of open space to enhance the total quality of the environment, maximize essential natural resource availability, give form and structure to urban development, and facilitate the ultimate attainment of a balanced year-round outdoor recreational program providing a full range of facilities for all age groups	Local park spatial location	Could be met[b]
		Regional park spatial location	Met[a]
		Areas of scientific, cultural scientific, and educational value	Met[a]
6	Preservation of land areas to provide for agriculture, provide a reserve or holding area for future urban and rural needs, and ensure the preservation of those rural areas which provide wildlife habitat and which are essential to shape and order urban development	Preserve prime agricultural land	Met
		Preserve all agricultural land surrounding high-value resources	Met
Park and Open Space Objectives			
1	The provision of an integrated system of public general-use outdoor recreation sites and related open space areas which will allow the resident population of the Region adequate opportunity to participate in a wide range of outdoor recreational activities	Sufficient recreation sites to meet the recreation demand of population: Regional	Met
		Multi-community	Met
		Community	Met
		Neighborhood	Met
		Recreation sites located within corridors	Met[d]
		Linear recreation corridor requirement	Met[d]
		Recreation corridor dimensions	Met[d]
		Travel distance to recreation corridors	Met[d]
		Resource-oriented recreation corridors	Met[d]
2	The preservation of sufficient high-quality open space lands for protection of the underlying and sustaining natural resource base and enhancement of the social and economic well-being and environmental quality of the Region	Preserve all remaining nonurban lands within corridors	Met
		Preserve all prime agricultural lands	Met
		Preserve agricultural lands adjoining recreational or educational sites	Partially met

Table 119 (continued)

Objective		Standard	Degree to Which Standard is Met
Number	Description		
Water Quality Management Objectives			
1	The development of land management and water quality control practices and facilities—inclusive of sanitary sewerage systems—which will effectively serve the existing regional urban development pattern and promote implementation of the regional land use plan, meeting the anticipated need for sanitary and industrial wastewater disposal and the need for stormwater runoff control generated by the existing and proposed land uses	Sanitary sewer service to medium- and high-density urban development	Met[a]
		Sanitary sewer service to low-density development	Met
		Provision of stormwater management facilities for existing and proposed urban development	Could be met
		Sanitary sewer service in poor soil areas	Met[a]
		Sanitary sewer service not provided to undeveloped primary environmental corridor lands	Met[a]
		Sanitary sewer service not provided to floodlands	Met
		Sanitary sewer service restricted in areas of soils with very severe limitations for urban development	Met[a]
		Orderly extension of sanitary sewerage facilities	Could be met
		Sizing of sewerage facility components in accordance with land use plan	Met
		Treatment and disposal of industrial wastes	Met[e]
		Priority to prime agricultural lands for land management practices	Could be met[e]
2	The development of land management and water quality control practices and facilities—inclusive of sanitary sewerage systems—so as to meet the recommended water use objectives and supporting water quality standards	Level of treatment at sewage treatment plant	Met
		Stormwater treatment and land management practices	Met[e]
		Stream fencing and feedlot runoff control	Met[e]
		Sewage treatment plant discharge to inland lakes	Met
		Interim sewage treatment plants	Not applicable
		Prohibition of sewage bypasses to storm sewers and waterways	Met
		Adequate design of sewage treatment plants	Met
		Standards for sewage treatment plants	Could be met
		No nonconforming pollutant discharge	Met[e]
		Orderly transition of rural lands to urban lands	Met[e]
3	The development of land management and water quality control practices and facilities—inclusive of sanitary sewerage systems—that are properly related to, and will enhance, the overall quality of the natural and man-made environments	Location of new and replacement sewage treatment plants outside the 100-year recurrence interval floodplain	Met
		Floodproofing existing sewage treatment plants in the 100-ear recurrence interval floodplain	No applicable
		Location of new and replacement sewage treatment and stormwater treatment facilities for compatibility with existing and proposed development	Met
		Provision of aesthetically compatible new and replacement sewage treatment plants with buffer zones between existing and proposed development	Could be met[b]
		Disposal of sewage treatment plant sludge	Met
		Proper location of pollutant storage facilities in relation to the 100-year recurrence interval floodplain	Met
		Elimination of discharges of metals, pesticides, and other toxic and hazardous substances	Could be met[e]
		Nondegradation of existing water quality	Met[e]
4	The development of land management and water quality control practices and facilities—inclusive of sanitary sewerage systems—that are economical and efficient, meeting all other objectives at the lowest possible cost	Minimize investment and operating costs of sanitary sewerage systems and stormwater control facilities and related land management practices	Could be met
		Minimize number of sanitary sewerage system and sewage treatment facilities	Met
		Maximize feasible use of pollution control facilities	Met
		Use of new and improved materials and management practices	Could be met
		Staged or incremental construction of sanitary sewerage facilities	Met
		Minimize land acquisition costs for new sewer constructions	Met

Table 119 (continued)

Objective		Standard		Degree to Which Standard is Met
Number	Description			
Water Quality Management Objectives (continued)				
4	(continued)	Minimize excessive clearwater inflows and infiltration into sanitary sewerage system		Met
		Integrated design of sanitary and storm sewer systems		Could be met
5	The development of water quality management institutions—inclusive of the government units and their responsibilities, authorities, policies, procedures, resources, and supporting revenue-raising mechanisms which are effective and locally acceptable, and which will provide a sound basis for plan implementation, including the planning, design, construction, operation, maintenance, repair and replacement of water quality control practices and facilities, inclusive of sanitary sewerage systems, stormwater management systems, and land management practices	Develop and establish system of user charges and industrial cost recovery for program support		Could be met[b]
		Maximum utilization of existing institutional structures		Met
		Water pollution control by local entities		Met
		Provide management groups with necessary resources		Could be met[b]
6	The attainment of soil and water conservation which reduces stormwater runoff, soil erosion, stream and lake sedimentation, nonpoint source pollution, and eutrophication	Soil erosion rate should not exceed T-value		Met
		Provisions to minimize loss of sediment during land disturbing activities		Met
Water Control Objectives				
1	An integrated system of drainage and flood control facilities and floodland management programs which will effectively reduce flood damage under the existing land use pattern of the watershed and promote the implementation of the watershed land use plan, meeting the anticipated runoff loadings generated by the existing and proposed land uses	New and replacement bridges and culverts	Minor streets—pass the 10-year recurrence interval flood	Could be met
			Arterial streets and highways–pass the 50-year recurrence interval flood	Could be met
			Freeways and expressways—pass the 100-year recurrence interval flood	Could be met
			Railroads—pass the 100-year recurrence interval flood	Could be met
		New or replacement bridges and culverts shall pass the 100-year recurrence interval flood without raising the peak stage more than 0.01 foot		Could be met
		Structure design shall maximize passage of ice flow and debris		Could be met
		Certain new and replacement bridges and culverts shall pass the 100-year recurrence interval flood with two feet of freeboard		Could be met
		Existing bridges and culverts to meet standards 1, 3, and 4 above		Partially met
		New and replacement bridges and culverts should not inhibit fish passage		Could be met
		Channel improvements, dikes, and floodwalls should be restricted to the absolute minimum necessary		Not applicable
		The height of dikes and floodwalls shall pass the 100-year recurrence interval flood with two feet of freeboard		Not applicable
		The construction of channel modifications, dikes, or floodwalls to change limits of regulatory floodlands		Not applicable
		Upon completion of the construction of reservoirs and diversions, regulatory floodland limits will be changed		Could be met
		All other water control facilities, such as dams or diversion channels shall meet requirements of NR 333		Could be met[f]
		All water control facilities should be compatible with existing local stormwater management plans		Met

Table 119 (continued)

Objective		Standard	Degree to Which Standard is Met
Number	Description		
Water Control Objectives (continued)			
1	(continued)	Public land acquisition to eliminate water control facilities shall encompass the entire 100-year recurrence interval floodplain	Met
		Regulatory floodways shall accommodate existing committed and planned floodplain land uses	Could be met
		Floodway stage increase limited to less than 0.01 foot	Met
		Under recommended plan and planned land sue conditions, limit peak two- through 100-year peak flows at the Wisconsin-Illinois state line to their 1990 levels	Met
		Provide compensatory floodwater storage volume	Met
		Do not modify floodplains to accommodate planned urban uses	Met
2	An integrated system of land management and water quality control facilities and point and nonpoint source pollution abatement measures adequate to ensure a quality of surface necessary to meet the established water use objectives and supporting water quality standards	Meet water quality standards	Met
		Satisfy established water quality standards which are applicable except during 1) extreme low-flow periods and 2) extreme conditions recognized in the probabilistic approach to water quality standards achievement	Met
		Flood control and stormwater management facilities designed to minimize negative impacts on fish and aquatic life and to support water quality use objectives	Met
		Minimize adverse impacts on wetlands	Met
		Maintain 1990 peak two-year flood flows in streams with potential bank erosion and bed scour problems	Generally met

[a]*This standard has been met under the recommended land use plan and regional sanitary sewerage system plan because it served as an input to the plan design process.*

[b]*This standard could be met only by local community action.*

[c]*Not met under 1990 conditions.*

[d]*This standard has been met under the recommended Regional, County, and Kenosha Urban Planning District park and open space plans because it served as an input to the plan design process.*

e This standard has been met under the recommended water quality management plan because it served as an input to the plan design process.

[f]*Some detention facilities to store and pass runoff from new development could have embankments classified as dams.*

Source: SEWRPC.

comprehensive plan for the watershed meets these objectives and standards. Accordingly, an evaluation of the comprehensive plan was made on the basis of its ability to meet the watershed development objectives and standards. The results of that evaluation are presented in summary form in Table 119.

Only a relatively small number of standards could not be met or could be only partially met under the recommended comprehensive plan for the Des Plaines River watershed, as indicated in Table 119. Adoption and implementation of the recommended watershed plan could result in substantial attainment of the adopted watershed development objectives, and thus implementation of the plan may be expected to provide a safer, more healthful, and more pleasant, as well as more orderly and efficient, environment for all life within the watershed.

CONSEQUENCES OF NOT IMPLEMENTING THE RECOMMENDED COMPREHENSIVE PLAN FOR THE DES PLAINES RIVER WATERSHED

Within the framework of the overriding goals of the Des Plaines River watershed planning program—that is, the adopted objectives and standards—it is likely that the recommended comprehensive plan approaches the optimum or best combination of measures for: 1) resolving the water resource problems such as flooding, water pollution, diminishing quality of the natural resource base, soil erosion and sedimentation, and changing land use in the Des Plaines River watershed; and 2) preventing the aggravation of existing or development of new environmental problems within the watershed. This is because preparation of the recommended comprehensive plan for the Des Plaines River watershed involved the conduct of extensive inventories; the application of state-of-the-art analytic tools; exhaustive examination of alternative subelements and careful evaluation of the technical, economic, and environmental impacts of each alternative; the preparation of a plan implementation strategy and capital and operation and maintenance expenditure schedule; and considerable deliberation by the Des Plaines River Watershed Committee, a committee comprised of knowledgeable and concerned citizens and public officials.

In the absence of a sound, comprehensive watershed plan, a multitude of incorrect decisions are likely to be made and courses of action are likely to be followed that will lead to the aggravation of existing water resource problems and the development of new problems. Because the comprehensive plan for the Des Plaines River watershed seeks to identify those courses of action most likely to result in rational and lasting solutions to the water resource problems of the watershed and the prevention of future problems, it is appropriate to identify and, where feasible, quantify the consequences of not adopting and implementing the recommendations of the comprehensive plan. The analysis of the consequences of not adopting and implementing the watershed plan has a negative aspect in that it identifies water resource problems that may be expected to occur or to be aggravated in the absence of watershed plan implementation. The analysis is positive or constructive, however, in that it is intended to support and reinforce the need for implementation of the recommended plan.

The analysis of the likely consequences of not implementing the recommended comprehensive plan for the Des Plaines River watershed is based primarily on two sources of information: 1) the data collected and the analyses conducted under the Des Plaines River watershed planning program, and 2) empirical information derived from observation of the water resource problems that already exist within the seven-county Planning Region and which have been the subject of other Commission planning activities. The likely consequences of not implementing the recommended comprehensive plan for the Des Plaines River watershed are summarized in Table 120. Within the overall framework of the four basic plan elements—the land use and park and open space plan element, the floodland and stormwater management plan element, the water quality management plan element, and the fisheries management plan element—Table 120 identifies each plan subelement and some likely consequences of failure to implement those subelements.

SUMMARY

The various plan elements recommended to be adopted as integral parts of the comprehensive plan for the Des Plaines River watershed have all been described separately in the preceding chapters of this report. This chapter presents a concise description of the overall recommended comprehensive plan for the Des Plaines River watershed as that plan was synthesized from the best alternatives considered. The comprehensive plan consists of a land use and park and open space element, a floodland and stormwater management element, a water quality management element, and a fisheries management element.

Under the comprehensive watershed plan recommended herein, future urban development within the watershed would be guided through locally exercised land use controls into a more orderly and economical land use pattern, and the intensification of existing and creation of new developmental and environmental problems would thus be avoided. The primary environmental corridors of the watershed, together with the remaining undeveloped floodlands, would be protected from incompatible urban development, thereby assuring continued enjoyment of the recreational, aesthetic, ecological, and cultural values associated with the riverine areas, while avoiding the

Table 120

PROBABLE CONSEQUENCES OF NOT IMPLEMENTING THE RECOMMENDED COMPREHENSIVE PLAN FOR THE DES PLAINES RIVER WATERSHED

Plan Element	Plan Subelement	Probable Consequences of Failure to Implement Plan Recommendations
Land Use	Overall land use	Increased cost of public utilities and services, such as sanitary sewerage, water supply, transportation, and police and fire protection Essentially all of the negative consequences discussed below, since most were inextricably related to the land use plan
	Primary environmental corridor	Loss of recreational, aesthetic, ecological, and cultural values found in essentially natural unprotected riverine lands and associated woodland, wetland, and wildlife habitat areas
	Park and open space plan	Loss of recreational, aesthetic, environmental, and cultural values in park and open space lands
	Recreational trails	Prevention of full public use and enjoyment of primary environmental corridor lands
Floodland and Stormwater Management	Floodland and stormwater management measures for watershed	Average annual flood damage risk of $161,000 or more under existing conditions Significant increases in two- through 100-year flood flows throughout the watershed and lesser increases in downstream areas in Illinois
	Bridge replacement (for transportation purposes)	Interference with operation of highway and railroad facilities during flood events
	Land Use Controls • Floodland regulations	Increased flood losses due to construction of new floodprone structures Aggravation of upstream and downstream flood problems due to loss of conveyance and storage resulting in an increase in average annual flood damages Loss of critical portions of primary environmental corridors
	• Stormwater management plans and regulations	Increases in two- through 100-year flood flows Continuation of existing stormwater management problems and creation of new problems Lack of a consistent mechanism for providing the necessary stormwater measures and controls throughout the watershed
	• Flood insurance	Large monetary losses absorbed by owners of floodprone structures and property
	• Lending institution policies	Acquisition of floodprone lands and structures by unwary buyers
	• Community utility policies	Tacit approval of urban development in floodprone lands and primary environmental corridors
	• Control of land use outside floodlands	Increased runoff to the stream system resulting in an increase in average annual flood damages
	• Emergency procedures	Damage to property and risk to property owners due to inadequate information about floods already in progress
	• Community education programs	Lack of necessary public support for plan implementation
	• Stream gaging network	Lack of critical flow data on actual flood events for use in monitoring urbanization effects and in eventually refining simulation models Lack of water quality data to assess the effectiveness of controls

Table 120 (continued)

Plan Element	Plan Subelement	Probable Consequences of Failure to Implement Plan Recommendations
Water Quality	Public sewage treatment plants	Inefficient operation Potential pollution problems
	Private sewage treatment facilities	Inefficient operation Potential pollution problem
	Industrial discharge abatement	Localized pollution problems
	Sanitary sewer service to all new urban development	Localized and instream hazards and localized objectionable aesthetic conditions
	Nonpoint source pollution control, including onsite sewage disposal system management	Continued watershedwide surface water quality degradation due to pollution of streams with sediment, nutrients, heavy metals, and other toxic substances Loss of instream habitat Impairment of agricultural drainage systems Continued contamination of surface waters and groundwater with pathogenic pollution
	Water quality monitoring program	Lack of data for use in documenting impact of watershed development on water quality
Fisheries Management	Maintenance and development of fishery	Lack of a balance fish population Lack of a recreation sport and forage fishery Loss of ecological, aesthetic, and educational values associated with a balanced fish and aquatic life community Loss of impetus for implementing additional watershed plan elements, such as the water quality and park and open space plan elements

Source: SEWRPC.

intensification of flood damage and water pollution problems. Primary environmental corridor preservation would be accomplished by public regulation and acquisition of corridor lands. In addition to recommending the preservation of the existing primary environmental corridor lands in the watershed, the plan recommends that 0.2 square mile of floodlands adjacent to the Des Plaines River in the Village of Pleasant Prairie be restored to wetland vegetation. It is recommended that secondary environmental corridors in developing areas be considered for preservation in natural, open use or incorporated in local plans as drainageways, stormwater detention or retention areas, or as local parks or recreation trails. It is also recommended that isolated natural resource areas be preserved in natural open uses insofar as practicable.

A system of 36.5 lineal miles of areawide recreation trails and 44 miles of local trails is recommended to be developed as shown on Map 83. In addition to the continued maintenance of existing State and County parks, a golf course and a community park are recommended to be developed in the Village of Pleasant Prairie; additional development is recommended at Prairie Springs Park in Pleasant Prairie; one new neighborhood park is recommended to be located in the far western portion of the City of Kenosha, five new neighborhood parks are recommended in the Village of Pleasant Prairie; one new neighborhood park is recommended within Racine County adjacent to the Village of Union Grove; and six new neighborhood parks are proposed within Kenosha County—two in the Town of Salem and four in the Town of Bristol.

The recommended plan would accommodate a year 2010 population in the watershed of about 33,500 persons and a planned employment level of about 36,700 jobs. To accommodate the increase in population and employment, an additional 8.9 square miles of land would be converted from rural to urban use from 1990 to 2010. An additional

11.8 square miles are forecast to be converted from rural to urban use from 2010 until the planned urban service areas are fully developed around 2030.

This recommended floodland and stormwater management plan, as shown on Map 84, consists of the following components:

- Floodproofing 51 structures
- Elevating four houses
- Removing 17 structures
- Providing detention storage to control the runoff from areas of planned development. The post-development two-year storm peak flow release rate would be 0.04 cfs per acre of new development and the post-development 100-year storm peak flow release rate would be 0.30 cfs per acre of new development.
- Restoring 20 percent of the potential prairie areas in the watershed (six square miles). High priority areas to be considered for prairie restoration are shown on Map 84.
- Restoring all potential wetland areas within floodlands (3.1 square miles).
- Providing a centralized detention storage basin along Unnamed Tributary No. 6 to Brighton Creek.
- Improving storm sewers in the Village of Paddock Lake along Unnamed Tributary No. 6 to Brighton Creek.
- Improved culvert capacity at a single location along Unnamed Tributary No. 1 to Hooker Lake.
- Instituting a monitoring program to assess sediment conditions along the Upper Des Plaines River.

In addition to the foregoing measures, the floodland management element of the plan includes recommended standards relative to bridge replacement to assure that major streets and highways remain operable during major flood events. Based upon the application of these standards, it was determined that, of the 176 hydraulically significant bridges and culverts in the watershed, 151, or 86 percent are hydraulically adequate. Of the remaining 25 crossings, 12 would be hydraulically adequate under recommended plan conditions, and the provision of additional hydraulic capacity would not be required if significant implementation of recommended floodland and stormwater measures occurs in the area tributary to the structures. The remaining 13 crossings would be hydraulically inadequate under existing and recommended plan conditions and should be modified or replaced in the normal course of events as the transportation system is renewed.

Also included in the floodland and stormwater management element are various supplemental measures intended to minimize the monetary losses associated with flooding, including local adoption or updating of floodland zoning regulations to include requirements for compensatory floodwater storage to offset any filling in the floodplain, the development of detailed subwatershed stormwater management plans, participation in the Federal Flood Insurance Program, continuation of desirable lending institution policies concerning the sale of riverine area properties, and community education programs.

Finally, the floodland and stormwater management element recommends maintenance of the existing stream gauge on the Des Plaines River at Russell, Illinois and establishment and maintenance of an additional gauge on the Des Plaines River between CTH K and CTH N near the outlet of the Upper Des Plaines River watershed in Kenosha County.

The recommended water quality management plan calls for the eventual abandonment of two sewage treatment plants in the Village of Pleasant Prairie and connection of those service areas to the Kenosha Water Utility facilities. The plan recommends that a sewerage system plan evaluation be made to determine the best means of providing for sewage treatment for the Bristol and Paddock Lake sewer service areas, with that plan considering local plant(s) upgrading and expansion alternatives, as well as connection to the Kenosha sewerage system. The plan recommends that three private sewage treatment plants be maintained and that the levels of treatment of those plants be formulated as part of the Wisconsin Pollutant Discharge Elimination system permitting process, and that when each of the two other private plants in the watershed require significant upgrading or modification, detailed facility planning be conducted to evaluate the alternative of connecting these two areas to the adjacent public sanitary sewer system.

The water quality management plan also calls for the implementation of agricultural and urban nonpoint source pollution control measures consistent with the regional water quality management plan, the county land and water resource management plans, and the performance standards of Chapter NR 151 of the *Wisconsin Administrative Code*. The nonpoint source pollution control recommendations are set forth in Table 114 in Chapter XIII of this report.

The fisheries management plan element recommends that subwatershed-level fishery management plans be prepared considering the recommended fish management measures set forth in Table 116 in Chapter XIV of this report. The table sets forth a tiered approach that recommends the implementation of specific larger-scale actions prior to local-level actions.

The watershed plan implementation schedule assumes a 28-year plan implementation period beginning in 2003 and extending through the year 2030. The capital cost of implementing the entire Des Plaines River watershed plan, including capital projects; park development; land rental, easements, and/or acquisitions; and certain administrative and planning costs, is estimated to potentially range from $111.9 million to $127.8 million, depending on the degree to which lands are converted to prairies and wetlands through the U.S. Department of Agriculture Conservation Reserve Program or through purchase of easements and development rights. The capital cost represents an average annual capital expenditure over the 28-year period of about $4.0 to $4.6 million. About $16.9 million, or 13 to 15 percent of the totals, and representing an average annual expenditure of about $603,000 is required to implement the park and open space element of the plan, including the acquisition of primary environmental corridor lands; from about $70.9 to $86.8 million, or from about 63 to 68 percent of the total and representing an average annual expenditure of from about $2.5 to $3.1 million, is required for implementation of the floodland and stormwater management element of the plan; about $24.1 million, or from about 19 to 22 percent of the total, and representing an average annual expenditure of about $862,000, is required for implementation of the water quality management element of the plan. The average annual operation and maintenance costs for the recommended plan components is estimated to range from $529,000 to $1,566,000, with those costs shared between the private and public sectors. The total capital investment and operation and maintenance cost required for plan implementation may be expected to approximate from $4.5 to $6.1 million on an average annual basis. About $59 million, or 46 to 53 percent of the total capital cost, would be borne by the private sector as a cost of land development. Approximately $1.0 million, or 0.8 to 0.9 percent of the total capital cost of the plan, would be borne by the private sector for structure floodproofing and elevation. About $14.0 million of the park and open space plan cost is reflected in the total cost of the County park and open space plans, the Kenosha Urban Planning District plan, and the regional bicycle and pedestrian facilities plan, and are not, therefore, considered to be additional costs in the Des Plaines River watershed plan. Thus, about $74.0 million, or from 58 to 66 percent of the total capital cost of the plan, would either be borne by the private sector, or has been included under a previously adopted plan. The costs of stormwater and fisheries management measures will be determined under the detailed subwatershed-level stormwater and fisheries management plans that are recommended to be prepared. Thus, the watershed plan costs do not include the costs of stormwater management measures to address areas of existing development, nor the fisheries management measures. Also, the plan costs do not include community and neighborhood parks or local recreational trails.

The comprehensive plan was evaluated for its ability to meet the adopted watershed development objectives and standards. The analysis indicates that the watershed plan could result in achievement of most of the standards established in support of the adopted watershed development objectives. Implementation of the plan may be expected to provide a safer, more healthful, and more pleasant, as well as more orderly and efficient, environment within the watershed.

An evaluation was also conducted of the probable consequences of not implementing the recommended comprehensive plan for the Des Plaines River watershed based on analyses carried out under the watershed planning program and on empirical evidence gathered from other portions of the Planning Region. This evaluation indicates that, in the absence of watershed plan implementation, the Des Plaines River watershed will be susceptible to aggravation of the existing water resource problems and to the development of new problems.

Chapter XVI

PLAN IMPLEMENTATION

INTRODUCTION

The recommended comprehensive plan for the Des Plaines River watershed, as described in Chapter XV of this report, provides a design for the attainment of the specific watershed development objectives formulated under the Des Plaines River watershed study. The final watershed plan consists of four major elements: 1) a land use element, including open space preservation and outdoor recreation subelements; 2) a supporting floodland and stormwater management element composed of various structural and nonstructural subelements; 3) a supporting water quality management element composed of various point and nonpoint source pollution abatement subelements; and 4) a recommended fisheries management element.[1]

While the recommended comprehensive plan for the Des Plaines River watershed is designed to attain, to the extent practicable, the agreed upon watershed development objectives, the plan is not complete in a practical sense until the steps required to implement the plan—that is, to convert the plan into action policies and programs—are specified. This chapter provides that specification and is intended as a guide for use in the implementation of the Des Plaines River watershed plan. Basically, it outlines the actions which must be taken by the various levels and agencies of government concerned if the recommended comprehensive watershed plan is to be fully carried out by the design year. Those units and agencies of government which have plan adoption and plan implementation powers applicable to the Des Plaines River watershed plan are identified; necessary or desirable formal plan adoption actions are specified; and specific implementation actions are recommended for each of the units and agencies of government with respect to the land use, floodland and stormwater management, water quality management, and fisheries management plan elements of the plan. In addition, financial and technical assistance programs available to such units and agencies of government in the implementation of the watershed plan are described.

PRINCIPLES OF PLAN IMPLEMENTATION

The plan implementation recommendations contained in this chapter are, to the maximum extent possible, based upon and related to year 2002 government programs and are predicated upon existing enabling legislation.

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[1]*The recommended land use plan element, the recommended floodland and stormwater management plan element, the recommended water quality management plan element, and the recommended fisheries management plan element, as well as the process used to arrive at these elements and the alternatives considered, are described in Chapters XI, XII, XIII, and XIV, respectively. The recommended comprehensive plan for the Des Plaines River watershed is described in Chapter XV of this report.*

Because of the possibility of unforeseen changes in economic conditions, State and Federal legislation, case law decisions, governmental organization, and tax and fiscal policies, it is not possible to declare once and for all time exactly how a process as complex as watershed plan implementation should be administered and financed. In the continuing regional planning program for Southeastern Wisconsin, it will, therefore, be necessary to periodically update not only the watershed plan elements and the data and forecasts on which these plan elements are based, but the recommendations contained herein for plan implementation. In addition to consideration of the possible changed conditions listed above, such updates should consider future changes to planned sewer service areas, the effects of those changes on hydrologic and hydraulic conditions, and the consequences for floodland and stormwater management in the watershed.

It is important to recognize that plan implementation measures must not only grow out of formally adopted plans, but must be based upon a full understanding of the findings and recommendations contained in those plans. Thus, action policies and programs must not only be preceded by formal plan adoption and, following such adoption, be consistent with the adopted plans, but must emphasize implementation of the most important and essential elements of the comprehensive watershed plan and those areas of action which will have the greatest impact on guiding and shaping development in accordance with those elements. Of particular importance in this regard are those plan implementation efforts which are most directly related to achieving the basic watershed development objectives, especially those objectives concerned with the protection of the underlying and sustaining natural resource base; flood control and flood damage abatement; and water quality control and pollution abatement.

Principal Means of Plan Implementation

There are three principal ways through which the necessary watershed plan implementation may be achieved—ways which parallel the three functions of the Regional Planning Commission: 1) inventory, or the collection, analysis, and dissemination of basic planning data on a uniform, areawide basis; 2) plan design, or the preparation of a framework of long range plans for the physical development of the Region; and 3) plan implementation, or the provision of a center for the coordination of planning and plan implementation activities. All require a receptive attitude and active planning and plan implementation programs at the local, county, State, and Federal levels of government.

A great deal can be achieved in guiding watershed development into a more desirable pattern through the simple task of collecting, analyzing, and disseminating basic planning and engineering data on a continuing, uniform, areawide basis. Experience within the Southeastern Wisconsin Region to date has shown that, if this important inventory function is properly carried out, the resulting information will be used and acted upon both by local, State, and Federal agencies of government and by private investors. A wealth of definitive information about the natural and manmade features of the watershed, the hydrology and hydraulics of the watershed, and the water related problems of the watershed—particularly flood damage and water pollution—was assembled under the Des Plaines River watershed study. The use of this information base in arriving at development decisions on a day-to-day basis by the public and private interests involved contributes substantially toward implementation of the recommended watershed plan.

With respect to plan preparation or design, it is essential that some of the watershed plan elements be carried into greater depth and detail for sound plan implementation. Specifically, the plan recommendations dealing with structural flood control and stormwater management measures and pollution abatement facilities must be carried through preliminary engineering to the final design stages. Also the preparation of detailed plans will be needed to implement the recommendations regarding stormwater and fisheries management. Further study must be given to the acquisition and development of proposed neighborhood parks and the development of urban outdoor recreation facilities. The preparation of such detailed plans will require the continuing development of close working relationships between the Commission, the Racine and Kenosha County Boards, the local units of government concerned, and certain other agencies—in particular, the Wisconsin Department of Natural Resources (WDNR).

To achieve a high degree of watershed plan implementation, it will be essential to effectively carry out the Commission's function as a center for the coordination of local, areawide, State, and Federal planning and plan implementation activities within the watershed. The community assistance program, through which the Commission, upon request, actively assists the local municipalities in the preparation of local plans and plan implementation devices, is an important factor in this function. If properly utilized, this program should help make possible the full integration of watershed and local plans, adjusting the details of the latter to the broader framework of the former.

Distinction Between the Systems Planning, Preliminary Engineering, and Final Design and Construction Phases of the Public Works Development Process

The planning process used to prepare the Des Plaines River watershed plan constituted the first, or systems planning, phase of what may be regarded as a three-phase public works development process. Preliminary engineering is the second phase in this sequential process, with final design being the third and last phase. Because effective implementation of the Des Plaines River watershed plan requires an understanding of this three phased process, that process is briefly described below. Although emphasis is placed on use of the process in preparing a comprehensive plan for the Des Plaines River watershed and in the subsequent steps needed to advance that plan toward implementation, it is important to note that the three-phased process is applicable to any regional or subregional plan containing recommendations for the development of public works for flood control, pollution abatement, water supply, sanitary sewerage, transportation, park and open space, or other public facilities and services.

Systems Planning

The systems planning phase concentrates on the precise definition of the problems to be addressed and on the development and evaluation of alternative measures for resolution of these problems on a sound areawide basis. Systems planning is intended to permit the selection, from among the alternative measures considered, of the most effective measure to resolve the identified problems in accordance with agreed upon objectives and supporting standards. In this first or systems planning phase, each alternative plan element is developed to sufficient detail to permit a sound consistent comparison of the technical practicality and economic feasibility of each alternative and a proper evaluation of its nontechnical and noneconomic characteristics.

Properly conducted, systems planning is comprehensive in three ways. First, it is comprehensive in that it takes into consideration the entire system and attendant rational planning area most likely to significantly influence the environmental and developmental problems of concern and the proper resolution of those problems. Water and water resource related problems, for example, should be approached on a watershed basis because the watershed system is the most rational planning area for such problems. Man’s use of the land and changes in such use in one portion of a watershed can markedly influence environmental problems in other areas of the watershed.

Second, properly conducted systems planning is comprehensive in that it considers not only the immediate problem but the relationship of the problem to broad land use, socioeconomic, and environmental considerations. For example, comprehensive watershed planning recognizes that the quantity and quality of the surface waters in the watershed system are determined, in part, by existing and planned land use in the watershed system and that land use is, in turn, determined by socioeconomic conditions within as well as outside the watershed. Therefore, the regional land use plan—as refined and detailed in the watershed planning process—is taken as a “given” in the preparation of the watershed plan so as to reflect regional land use, socioeconomic, and environmental conditions likely to influence the cause of, and solution to, water resource problems within the watershed.[2]

Third, the systems planning phase of the three phase public works development process is comprehensive in that a full spectrum of potential solutions to the water resource and water resource related problems are considered during the process. Because of the many measures, variations on measures, and combinations of measures that are available, it is recognized in the systems planning phase that there are an almost unlimited number of solutions to a given problem that, in effect, form a continuum of possible solutions. The key to efficient systems planning is

[2]*The recommendations of this watershed study as they relate to water quality management and floodland and stormwater management would be reflected in the next regional land use plan and in the forthcoming Kenosha and Racine County “smart growth” plans.*

not examining each of the many possible alternative measures but rather examining alternatives that define the boundaries of the continuum and that are truly representative of the full range of available measures within the continuum.

Preliminary Engineering

Although systems planning requires considerable effort, it is not normally carried to the level of detail needed to permit immediate implementation of the recommended measures. In general, it is essential that the analysis of the technical, economic, environmental, and other features of the plan elements be carried into great detail and depth as the first step toward implementation of the system plan. The second phase of the three phase public works development process is referred to as preliminary engineering and is most properly carried out, subsequent to the adoption of the areawide systems plan, by the implementing units and agencies of government concerned.

The preliminary engineering phase begins where the systems planning phase ends, and the analysis is no longer comprehensive. Emphasis is now placed on function in that the preliminary engineering phase concentrates on the basic solution to the problem at hand as that problem and its solution have been identified in the systems planning phase. The preliminary engineering phase of the three-phase public works development process presumes that the optimum solution in terms of technical practicality, economic feasibility, and environmental consequences and other considerations has been identified under the previous systems planning phase. Preliminary engineering concentrates on examining variations of the recommended solution and on examining the technical, economic, environmental, and other features of those variations in depth in order to determine the best way to carry out the recommended solution.

Final Design

Upon acceptance of the findings and recommendations of the preliminary engineering phase by the governmental units and agencies affected, the third or final design phase of the public works development process is initiated. This work should also be carried out by the implementing units and agencies of government concerned. Starting with the solution to the problem at hand as set forth in the final, approved version of the preliminary engineering report, the final design phase should move toward the development of the detailed construction plans and specifications needed to completely implement the recommended solution. In the case of a public works project involving construction, the plans and specifications should provide sufficient detail to permit potential contractors to submit bids for the project and to actually construct the recommended works. Engineers responsible for carrying out the final phase should also have responsibility for securing the necessary permits and other approvals from regulatory and review agencies, for providing supervisory and inspection services during the actual construction process, and for certifying to the governmental units and agencies involved that the construction is carried out in accordance with the design provisions and specifications.

Other Considerations

For many reasons, the three phased public works development process does not always proceed in the simple three-step fashion as described above. In some situations, an iterative process is set in motion whereby a re-examination of an earlier step is required. For example during the preliminary engineering phase, a new alternative, based on additional information, may be developed that must be subjected to systems analysis.

Ever-changing Federal and State regulations and guidelines can disrupt the three-phased public works development process. This is particularly true if a significant change in those regulations and guidelines occurs subsequent to the systems planning phase and prior to or during the preliminary engineering phase, thus necessitating an iteration to the systems planning phase to reconsider measures studied during that phase or to analyze additional measures as may be necessitated by regulation and guideline changes. As a result of the passage of time between the systems planning phase and the preliminary engineering phase, significant changes may occur in the explicitly stated or implicitly expressed values and objectives of elected officials and concerned citizens. In an environment of changing values and objectives, a solution to an environmental problem that was originally accepted as optimal, based on systems planning techniques and an agreed upon set of objectives, could later, because of changing values and objectives, be rejected or encounter considerable opposition, necessitating an iteration to the systems planning phase.

The effective functioning of the three-phase public works development process is highly dependent on close cooperation among governmental units and agencies. For example, the systems level planning conducted by the Southeastern Wisconsin Regional Planning Commission must be acceptable to local governmental units and agencies in order to prompt them to undertake the necessary second or preliminary engineering phase and to make full use of the recommendations resulting from the first or systems planning phase of the public works development process.

In some special situations, the public works development process can be carried out without proceeding through the above three phases. For example, systems planning in the area of floodland management may lead to the recommendation that structure floodproofing and removal be used to resolve flood problems. In this instance, assuming adoption of the plan recommendations by the governmental units and agencies concerned, the preliminary engineering phase can be combined with the final design phase, the goal of which would be to provide a precise identification of structures requiring floodproofing and those requiring removal, and of the manner in which floodproofing and removal should be carried out.

In carrying out the three-phase process, there is a tendency to circumvent a critical step, usually the systems planning phase, in response to intense public concern and controversy over a pressing environmental or developmental problem. This approach sometimes achieves short-term gains in that it leads to prompt problem solving activity—for example, minor channel work to "solve" a flood problem—thereby satisfying the immediate public concern. Unfortunately, circumvention of key steps in the public works development process often leads to long-term losses as a result of the failure to fully identify and quantify the problem at hand and to determine the most effective solution to that problem in terms of technical practicality, economic feasibility, and environmental impact. Superimposition of man's works and activities on the natural resource base produces an urban ecosystem that is complicated in terms of its many and varied components and processes and the interrelationships between those components and processes—an ecosystem that usually defies simple solutions to the environmental and developmental problems that arise.

Review Responsibility of the Regional Planning Commission

Under the provisions of certain State and Federal regulations, applications by State and local units of government for Federal grants in partial support of the planning, land acquisition, and construction of public works facilities such as sewerage and water supply systems, parks, waste treatment facilities, and soil and water conservation projects, must be submitted to an officially designated areawide planning agency for review, comment, and recommendation before consideration by the administering agency. The comments and recommendations of the areawide planning agency must include information concerning the extent to which the proposed project is consistent with the comprehensive planning program for the region, including the Des Plaines River watershed planning program in Southeastern Wisconsin, and the extent to which such a project contributes to the fulfillment of such planning programs. The review comments and recommendations by the areawide planning agency are advisory to the local, State, and Federal agencies of government concerned and are intended to provide a basis for achieving the necessary coordination of public development programs in urbanizing regions of the United States on a voluntary, cooperative basis. If used properly, such reviews can be of material assistance in achieving implementation of the recommended Des Plaines River watershed plan.

In this respect, it should be noted that the Regional Planning Commission has formally adopted a policy statement on the review of applications submitted to the Commission for grants in aid. This policy requires that adopted plan elements, such as a comprehensive watershed plan, form the basis for review and comment of applications by the Commission. All projects that are the subject of applications are thus either certified as being in conformance with and serving to implement, not in conflict with, or in conflict with adopted regional plan elements. In considering the Regional Planning Commission's findings in this respect, it is important that local public officials and concerned citizens recognize that the failure to implement any major element of the recommended comprehensive watershed plan will proportionately reduce the capability of the watershed to provide a pleasant, safe, and healthful place in which to live and work. In addition, it is essential that the State and Federal implementing agencies recognize that the watersheds of Southeastern Wisconsin, including the Des Plaines River watershed, are located in that part of the State where the concentration of people is the largest, where the degree of natural resource base destruction has been greatest, and where existing demands on the resource base are highest.

PLAN IMPLEMENTATION ORGANIZATIONS

Although the Regional Planning Commission can promote and encourage watershed plan implementation in various ways, the completely advisory role of the Commission makes actual implementation of the recommended Des Plaines watershed plan entirely dependent upon action by local, areawide, State and Federal agencies of government. Examination of the various agencies that are available under existing enabling legislation to implement the recommended watershed plan reveals an array of departments, commissions, committees, boards, and districts at all levels of government. These agencies range from general-purpose local units of government such as counties, cities, villages, and towns to special-purpose districts, such as lake districts or drainage districts. These agencies also include State regulatory bodies, such as the Wisconsin Department of Natural Resources; and Federal agencies that provide financial and technical assistance for plan implementation, such as the U.S. Army Corps of Engineers and the U.S. Department of Agriculture, Natural Resources Conservation Service.

Because of the many and varied public agencies in existence, it becomes important to identify those agencies having the legal authority and financial capability to most effectively implement the recommended watershed plan elements. Accordingly, those agencies whose actions will have significant effect either directly or indirectly upon the successful implementation of the recommended comprehensive watershed plan and whose full cooperation in plan implementation will be essential are listed and discussed below. The agencies are, for convenience, discussed by level of government; however, the interdependence between the various levels, as well as between agencies of government, and the need for close intergovernmental cooperation, cannot be overemphasized. The creation of new agencies for watershed plan implementation should be considered only if the existing agencies fail to carry out the plan in a timely manner; and, if found necessary, new agencies should be created in such form as to effectively complement and supplement the plan implementation activities of the agencies already in existence.

Watershed Committee

Since planning at its best is a continuing function, a public body should remain on the scene to coordinate and advise on the execution of the watershed plan to undertake plan updating and renovation as necessitated by changing events. Although the Regional Planning Commission is charged with, and will perform, this continuing areawide planning function, it cannot do so properly without the active participation and support of local governmental officials and representatives of appropriate private organizations, through an appropriate advisory committee structure. It is, therefore recommended that the Des Plaines River Watershed Committee be reconstituted as a continuing advisory committee to provide a focus for the coordination of all levels of government, along with appropriate private organizations, in the implementation of the Des Plaines watershed plan. The Des Plaines River Watershed Committee would thus continue to be a creation of the Southeastern Wisconsin Regional Planning Commission, pursuant to Section 66.0309(8) of the *Wisconsin Statutes*, and would report directly to the Commission. It is recommended that all agency representatives and individuals currently serving on the Des Plaines Watershed Committee remain as members of the continuing committee and that the question of committee membership be left open so that additional members could be added to the Committee as appropriate.

Local Level Agencies

Statutory provisions exist for the creation at the County and municipal level of the following agencies having planning and plan implementation powers, including police powers and acquisition, condemnation (eminent domain), and construction (tax appropriation) powers, important to comprehensive watershed plan implementation.

County Park and Planning Agencies

County government has considerable latitude available in forming agencies to perform the park and outdoor recreation and zoning and planning functions within the County. Counties may organize park commissions or park and planning commissions pursuant to Section 27.02 and 59.69(2), respectively of the *Wisconsin Statutes.*

Instead of organizing such commissions, counties may elect to utilize committees of the County Board to perform the park and outdoor recreation and zoning and planning functions. The powers are, however, essentially the same no matter how an individual County chooses to organize these functions. If, however, a County elects to establish a county park or county park and planning commission, these commissions have the obligation to prepare a county park system plan and a county street and highway system plan. There is no similar mandate for plan preparation when a County elects to handle these functions with committees of the County Board.

In Kenosha County, responsibility for park and parkway acquisition, development, operation, and maintenance rests with the Highway and Parks Committee of the County Board. Staff services are provided by the Division of Golf/Parks and Recreation that is overseen by the Department of Public Works which reports to the abovereferenced County Board Committee. The planning, zoning, plat review, and onsite sewage disposal regulatory functions are the responsibility of the Land Use Committee of the County Board. Staff services in this area are provided by the Divisions of County Development, Planning and Conservation, and Code Administration within the Department of Planning and Development, which reports to the referenced County Board Committee.

In Racine County, responsibility for the acquisition, development, operation, and maintenance of parks and parkways is assigned to the Public Works, Parks and Facilities Committee of the County Board. Staff services with respect to park and parkway matters are provided by the Public Works Department, which reports to the referenced County Board Committee. Planning, zoning, subdivision plat review, and onsite sewage disposal regulatory functions are the responsibility of the Economic Development and Land Use Planning Committee of the County Board. Staff services in this area are provided by the Planning and Code Administration Divisions. Zoning and sanitation activities are staffed by the Code Administration Division, within the Planning and Development Department, which reports to the referenced County Board Committee.

County Public Works and Highway Committees

County highway committees of the County Board are required in every County of Wisconsin, pursuant to Section 83.015 of the *Wisconsin Statutes.* This requirement is met in the Des Plaines River watershed through the Kenosha County Highway and Parks Committee and the Racine County Public Works, Parks and Facilities Committee. Each such committee is responsible for laying out, constructing, and maintaining all County highways as authorized by the County Board of Supervisors. These County committees work in close cooperation with the Wisconsin Department of Transportation (WisDOT). The Racine and Kenosha County committees responsible for highway development have important responsibilities in implementation of the Des Plaines River watershed plan with respect to the construction of certain highway bridges within the watershed where it was determined that the hydraulic capacity should be upgraded when bridge replacement is programmed in the future (see Table 110).

County Land and Water Conservation Committees

County land and water conservation committees are responsible for land conservation programs within the County and are also responsible for implementing the State's soil and water resource management program. These committees report to the County Board. Sections 92.07 and 92.10 of the *Wisconsin Statutes* authorize the land and water conservation committees to have a broad range of powers and duties. These powers and duties include:

- Development and adoption of standards and specifications for management practices to control erosion, sedimentation, and nonpoint sources of water pollution;
- Distribution and allocation of available Federal and State cost-sharing funds relating to soil and water conservation;
- Conduct of research and educational information programs relating to soil and water conservation;
- Conduct of programs designed to prevent flood damage, drainage, irrigation, groundwater, and surface water problems;
- Provision of financial, technical, and other assistance to landowners;

- Acquisition of land and other interests and property, machinery, equipment, and supplies required to carry out various land conservation programs;
- Construction, improvement, operation, and maintenance of structures needed for land conservation, flood prevention, and nonpoint source pollution control; and
- Preparation of a long-range natural resource conservation plan for the County, including an erosion control plan and program.

As a committee of the County board, all of its activities are closely supervised by the County Board and subject to the fiscal resources made available by the County Board. Pursuant to this law, both Racine and Kenosha Counties have created Land Conservation Committees to perform these various functions. Through these Committees, both counties will have important implementation responsibilities not only for land and water conservation, but also for floodland management measures in the Des Plaines River watershed.

Municipal Planning Agencies

Municipal planning agencies include city, village, and town plan commissions and town zoning committees created pursuant to Sections 62.23(1), 61.35, and 60.61(4) of the *Wisconsin Statutes*. Such agencies are important to watershed plan implementation at the local level. All 12 local units of government within the watershed have established plan commissions, or zoning committees.

Municipal Utility and Sanitary Districts

Municipal utility districts may be created by cities, villages, and towns pursuant to Section 66.0827 of the *Wisconsin Statutes.* Town sanitary districts may be created pursuant to Section 60.71 and 60.72 of the *Wisconsin Statutes.* Such special districts are authorized to plan, design, construct, operate, and maintain various public utility systems, including sanitary sewerage, water supply, and stormwater drainage systems. At the present time, there exist within the Des Plaines River watershed all or portions of the following districts: the Town of Bristol Utility District Nos. 1, 3, and 4; the Village of Pleasant Prairie Utility District D; the Village of Pleasant Prairie Sanitary District No. 73-1; and the Town of Salem Utility District Nos. 1 and 2. The boundaries of these districts within the Des Plaines River watershed are shown on Map 9.

In addition, the City of Kenosha has formed the Kenosha Water Utility under the provisions of Section 66.067 of the *Wisconsin Statutes* to own and operate the City's water treatment and major conveyance and storage facilities and the City's sewage treatment and other major sewer system facilities. The Kenosha Water Utility is operated as an enterprise fund under the Municipal Code.

Areawide Agencies

Statutory provision exist for the creation of the following areawide agencies having both general and specific planning and plan implementation powers potentially applicable to the implementation of the Des Plaines River watershed plan.

Metropolitan Sewerage Districts

Section 200.05 of the *Wisconsin Statutes* enables the creation of metropolitan sewerage districts outside of Milwaukee County. Such districts may be created by the Wisconsin Department of Natural Resources upon a request by resolution of the governing body of any municipality sought to be served by such a district. The WDNR is required to hold a public hearing on the proposal to create a district and, in order for the WDNR to order the creation of a district, must make certain findings. Cities and villages owning or operating sewage collection and disposal systems may object to being included in such a district in which case the WDNR must honor such objection. No such metropolitan districts have been created to date to serve any portion of the Des Plaines River watershed. In addition to being capable of properly carrying out projects relating to the conveyance and treatment of sanitary sewage, metropolitan sewerage districts may build stormwater drainage and flood control facilities.

County Drainage Boards and Districts

Farm Drainage Districts

Chapter 88 of the *Wisconsin Statutes* authorizes landowners to petition the circuit court to establish a drainage district under the control of the County Drainage Board. Such districts are intended to provide for the execution of specific areawide drainage improvements. A drainage district may lie within more than one municipality and in more than one County. The cost of any drainage improvements are assessed against the lands which are specifically benefited. The Dutch Gap Canal Drainage District in Kenosha County is wholly contained within the Des Plaines River watershed. Very small portions of the Norway-Dover-Yorkville-Raymond Farm Drainage District and the Hoods Creek Farm Drainage District are located within the watershed in Racine County. The boundaries of the existing drainage districts are shown on Map 4 of this report.

Stormwater Drainage District

The portion of the watershed in the Town of Mt. Pleasant is included in the Town of Mt. Pleasant Stormwater Drainage Utility District. The District is responsible for stormwater drainage in both urban and rural areas. The portion of the District located in the Des Plaines River watershed is not taxed for utility district purposes.

Lake Districts and Associations

Lake districts are special purpose units of government that are established to maintain, protect, and improve the quality of a lake and its watershed for the benefit of the lake, fish and wildlife habitat, and the surrounding community. The boundaries of the district include the riparian property owners but can extend to off-lake property that affects the watershed or that benefits from the lake. Chapter 33 of the *Wisconsin Statutes* enables lake districts to carry out the following roles and responsibilities:

- Land acquisition for the benefit of the watershed;
- Collection of fees in the form of a tax from affected citizens and the authority to borrow money;
- Development and preparation of surveys or studies, management of aquatic weeds, control of soil erosion, dredging, operating dams, and monitoring water quality; and
- If delegated to do so by a County, City, or Village, adopting and regulating boating activities, aircraft, and travel on ice-bound lakes.

There are three lake districts in the Des Plaines River watershed: the George Lake Protection and Rehabilitation District, the Hooker Lake Protection and Rehabilitation District, and the Paddock Lake Protection and Rehabilitation District. The districts will be key organizations in carrying out the water quality and fisheries management recommendations of the Des Plaines River watershed plan.

In addition to lake districts, lake associations can also be of help in plan implementation. Lake associations can carry out many of the same roles and functions of a lake district, but some key differences exist. Lake associations are not considered special purpose units of government, and as such do not have taxing authority, and cannot develop and oversee lake use regulations compared to a lake district. However, they are beneficial with regards to water quality improvement projects and some of the activities they can undertake include the following:

- Operate dams;
- Contract for aquatic plant removal or buy and operate an aquatic plant harvester;
- Apply for and receive certain lake planning and protection grants;
- Collect data on water quality, lake development, and lake use conflicts; and
- Purchase sensitive areas such as wetlands.

The Lake Shangri-La Management Association is the only lake association in the Des Plaines River watershed. The Association will have a role in implementing plan recommendations related to water quality.

Flood Control Boards

Under Chapter 87 of the *Wisconsin Statutes* the WDNR is empowered to 1) order the straightening, widening, altering or deepening of, or the removal of obstructions from, watercourses and 2) to order the construction or removal of "ditches, canals, levees, dikes, dams, sluices, revetments, reservoirs, holding basins, floodways, pumping stations, sewers and siphons, and any other (pertinent) works" necessary to provide flood relief.

Chapter 87 provides that a group of property owners, consisting of at least 25 individuals living in a single, common drainage area, may petition the WDNR to order the construction of facilities to abate flooding "by the waters of any designated stream, lake or pond or any tributaries thereof." The WDNR may request that the governor appoint a flood control board to effect the necessary flood control measures. All activities of such boards are subject to review by, and approval of, the WDNR.

Cooperative Contract Commissions

Section 66.0301(2) of the *Wisconsin Statutes* provides that municipalities[3] may contract with each other to form cooperative service commissions for the joint provision of any services or joint exercise of any powers that each municipality may be authorized to exercise separately. Such commissions have been given bonding powers for the purposes of acquiring, developing, and equipping land, building, and facilities for areawide projects. Economies can often be effected through the provision of governmental services and facilities on a cooperative, areawide basis. Moreover, the nature of certain developmental and environmental problems often requires that solutions be approached on an areawide basis. Such an approach may be efficiently and economically provided through the use of a cooperative contract commission.

Intergovernmental cooperation under such cooperative contract commission may range from the sharing of expensive public works equipment to the construction, operation, and maintenance of major public works facilities on an areawide basis. A cooperative contract commission may be created for the purpose of watershed plan implementation and may be utilized in lieu of any of the aforementioned areawide organizations for such implementation.

Regional Planning Commission

Although not a plan implementation agency as such, one other areawide agency warrants comment: the Regional Planning Commission. As already noted, the Commission has no statutory plan implementation powers. In its role, however, as a coordinating agency for planning and development activities within the Southeastern Wisconsin Region, the Commission may play an important role in plan implementation through community planning assistance services and through the review of Federal and State grant-in-aid applications, using adopted plan elements as a basis for this review. In addition, the Commission provides a basis for the creation and continued functioning of the Des Plaines River Watershed Committee, which should remain as an important continuing public planning organization in the watershed.

State Level Agencies

The following State agencies have either general or specific planning authority and hold certain plan implementation powers important to the adoption and implementation of the Des Plaines River watershed plan.

Wisconsin Department of Natural Resources

The WDNR has broad authority and responsibility in the areas of park development, natural resources protection, water quality control, and water regulation. The WDNR has the obligation to prepare a comprehensive Statewide plan for outdoor recreation; and to develop long range, Statewide conservation and water resource plans. In addition, it has the authority to designate such sites as necessary to protect, develop, and regulate the use of State

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[3]*The term municipality under this section of the statutes is defined to include the State, any agency thereof, cities, villages, towns, counties, school districts, and regional planning commissions.*

parks, forests, fish, game, lakes, streams, certain plant life, and other outdoor resources; and to acquire conservation and scenic easements.

Designation of State Project Areas
In its role of designating sites to protect the natural resources of the State, the WDNR can play an important part in implementing and funding the prairie and wetland restoration and stream rehabilitation components of the recommended Des Plaines River watershed plan. The prairie and wetland restorations may be accomplished as a whole, or in part, through creation of a State Project Area within which the WDNR could acquire, develop, and manage properties. Section 23.09(2)(d) of the *Wisconsin Statues* lists purposes for which the State may acquire lands through purchase, lease, or gift. The listed purposes that may be applicable to the recommended prairie and wetland restorations include:

- State recreation areas,
- Streambank protection,
- Habitat areas and fisheries, and
- State wildlife areas.

As noted in Chapter XV of this report, regarding the high-priority prairie restoration areas shown on Map 84 and characterized in Table 118, 1) four of the six areas are located near known natural areas and their restoration would enhance or complement those natural areas, 2) one of the areas is located within the grassland reserve sites that are recommended to be established near the Bong State Recreation Area under the SEWRPC regional natural areas plan, and 3) restoration of two of the areas would enhance habitat and natural character along a major stream corridor.

Chapter NR 1 of the *Wisconsin Administrative Code*, establishes priorities for WDNR acquisition of lands. The categories that are applicable to the recommended prairie and wetland restoration, in descending priority, are:

- Water-based resources,
- Lands to accommodate broad, natural resources-based outdoor recreation and state recreational trails. (Portions of the recommended recreation areas contain segments of the recommended areawide Des Plaines River recreational trail.)
- Land within 40 miles of Wisconsin's 12 largest cities. (The Cities of Kenosha and Racine are both among the 12 largest and are less than 40 miles from the restoration areas.)

A proposed State Project Area is evaluated by the WDNR through preparation of a feasibility study, following which the Project Area may be approved or rejected by the Natural Resources Board and the Governor.

Certification of Areawide Water Quality Management Plans
The secretary of the WDNR has, pursuant to Federal planning guidelines, the responsibility of certifying to the U.S. Environmental Protection Agency (EPA) areawide plans for water quality management. Without such certification and subsequent acceptance by the EPA, local units of government within the watershed would lose their eligibility for Federal grants-in-aid for the construction of sewerage facilities.

Water Pollution Control Function
As already noted in Chapter IX of this report, the responsibility for water pollution control in Wisconsin is centered in the Wisconsin Department of Natural Resources. The basic authority and accompanying responsibilities relating to the water pollution control function of the WDNR are set forth in Chapter 144 of the *Wisconsin Statutes.* Under this chapter, the WDNR is given broad authority to do the following:

- Prepare water use objectives and supporting water quality standards;
- Issue general and specific order relating to water pollution abatement;
- Review and approve all plans and specifications for components of sanitary sewerage systems;
- Conduct research and demonstration projects on sewerage and waste treatment matters;
- Operate an examining program for the certification of sewage treatment plant operators;
- Order the installation of centralized sanitary sewerage systems;
- Review and approve the creation of joint sewerage systems and metropolitan sewerage districts; and
- Administer a financial assistance program for the construction of pollution prevention and abatement facilities.

In addition, under Chapter 147 of the *Wisconsin Statutes*, the WDNR is given broad authority to establish and carry out a pollutant discharge elimination program in accordance with the policy guidelines set forth by the U.S. Congress under the Federal Water Pollution Control Act Amendments of 1972 and 1987. This legislation establishes a waste discharge permit system and provides that no permit may be issued by the WDNR for any discharge from a point source of pollution which is in conflict with any areawide waste water treatment and water quality management plan approved by the WDNR. Also under this legislation, the WDNR is given rule-making authority to establish effluent limitations, water quality-related limitations, performance standards related to classes or categories of pollution, and toxic and pretreatment effluent standards. All permits issued by the WDNR must include the conditions that waste discharges must meet, as applicable, and all effluent limitations, performance standards, effluent prohibitions, and pretreatment standards and any other limitations which must be met to comply with the established water use objectives and supporting water quality standards as developed under areawide waste treatment management planning programs. As appropriate, the permits may require periodic water quality monitoring to determine compliance, and may include a timetable for appropriate action on the part of the owner or operator of any point waste discharge. This legislation and accompanying procedures is the primary enforcement tool of the Wisconsin Department of Natural Resources in achieving the established water use objectives and supporting water quality standards.

Standards for Floodplain and Shoreland Zoning
The WDNR also has the obligation to establish standards for floodplain and shoreland zoning and the authority to adopt, in the absence of satisfactory local action, shoreland and floodplain zoning ordinances. The WDNR also has authority to regulate the following: water diversions, shoreland grading, dredging, encroachments, and deposits in navigable waters; the construction of neighboring ponds, lagoons, waterways, stream improvements, and pierhead and bulkhead lines; the construction, maintenance, and abandonment of dams; and water levels of navigable lakes and streams and lake and stream improvements, including the removal of certain lakebed materials. Finally, the WDNR has the authority to require abatement of water pollution; to administer State financial aid programs for water resource protection; to assign priority for Federal aid application for sewerage facilities; to review and approve water supply and sewerage systems; and to license well drillers and issue permits for high-capacity wells. With such broad authority for the protection of the natural resources of the State and Region, the WDNR will be extremely important to the implementation of nearly all of the major elements of the Des Plaines River watershed plan.

Wisconsin Department of Transportation
The Wisconsin Department of Transportation (WisDOT) is broadly empowered to provide the State with an integrated transportation system. The WisDOT is responsible for administering all State and Federal aid and highway and airport improvements; for planning, designing, constructing, and maintaining all State highways; and for planning, laying out, revising, constructing, reconstructing, and maintaining the national interstate and defense highway system, the Federal aid primary system, the Federal aid secondary system, the forest highway system, and the airport aid system, all subject to Federal regulation and control. The WisDOT is also responsible for reviewing and approving changes in county trunk highway systems. As such, the WisDOT along with the

respective highway committees of the County Boards of Supervisors, can contribute to full implementation of the Des Plaines River watershed plan with respect to the construction and reconstruction of certain bridges and highway facilities within the watershed.

Wisconsin Department of Agriculture, Trade and Consumer Protection

Under the Wisconsin Soil and Water Conservation Law, State-level soil and water conservation responsibilities have been placed under Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) authority. Within that Department, the law created a seven-member advisory Land and Water Conservation Board. The Land and Water Conservation Board reviews and comments on rules relating to soil and water conservation, administers the State's Farmland Preservation Program, reviews all County erosion control plans and the annual County and long-range County land and water conservation plans, and generally advises the Secretary of DATCP and the University of Wisconsin on matters relating to soil and water conservation. The DATCP rules require the preparation of county land and water conservation plans and provide for partial funding of such county plans administration and implementation. As such, the Department and its Land and Water Conservation Board will have plan implementation responsibilities relative to the Des Plaines River watershed plan.

University of Wisconsin-Extension

A University of Wisconsin-Extension office is located within each County. Although the Extension has no statutory plan implementation powers, the Extension can aid communities in solving environmental problems by providing educational and informational programs to the general public, and by offering advice to local decision-makers and community leaders. The Extension carries out these responsibilities by conducting meetings, tours, and consultations, and by providing newsletters, bulletins, and research information.

Federal-Level Agencies

The following Federal agencies administer aid and assistance programs that may be applicable to implementation of the recommended Des Plaines River watershed plan. Funding from such programs may be used for land acquisition and construction of specific facilities.

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency administers water quality management planning grants and sanitary sewerage facility construction grants. The latter can be particularly important to implementation of the water quality management element of the Des Plaines River watershed plan. In addition, this agency is responsible for the ultimate achievement and enforcement of water quality standards for all interstate waters, should the States not adequately enforce such standards. In this respect, the EPA has delegated authority over the National Pollutant Discharge Elimination Systems (NPDES) permit issuance process whereby the WDNR issues discharge permits under both State and Federal authorities. Under guidelines promulgated by the EPA, areawide water quality management and sanitary sewerage facilities plans must be prepared as prerequisites to the receipt of Federal capital grants in support of sewerage works construction. As a designated areawide water quality management planning agency under Section 208 of the Federal Water Pollution Control act, the Regional Planning Commission is engaged in a continuing areawide water quality management planning program for Southeastern Wisconsin under an ongoing cooperative program with the Wisconsin Department of Natural Resources.

U.S. Geological Survey

The U.S. Geological Survey (USGS) conducts continuing programs on water resource appraisal and monitoring. The programs of the U.S. Geological Survey are important to the implementation of the continuous streamflow gaging program recommended in the Des Plaines River watershed plan.

U.S. Department of Agriculture, Farm Services Agency

The U.S. Department of Agriculture (USDA), Farm Services Agency (FSA) administers the Farm Security and Rural Investment Act of 2002 (also known as the 2002 Farm Bill). This program provides grants to rural landowners in partial support of carrying out approved land and water conservation practices. Grants from this program could be used for implementation of recommended water quality elements of the Des Plaines River watershed plan.

U.S. Department of Agriculture, Natural Resources Conservation Service
This agency administers resource conservation and development projects and watershed projects under Federal Public Law 566 and provides technical and financial assistance to landowners through the County land conservation committees. Such assistance may include the planning and construction of measures for land treatment, agricultural water management, and flood prevention and for public fish, wildlife, and recreational development. This agency also conducts detailed soil surveys and provides interpretations as a guide to utilizing soil survey data in local planning and development. Certain programs administered by this agency, including those providing partial funding for land conservation practices, can contribute to implementation of the land management and treatment measures recommended under the water quality management element of the Des Plaines River watershed plan. The current Natural Resources Conservation Service staff have been actively providing technical assistance and promotion of land conservation programs and practices in the Des Plaines River watershed and have played an important role in achieving a relatively high level of farm conservation practices planning and implementation in the watershed.

Federal Emergency Management Agency
The Federal Emergency Management Agency (FEMA) serves as the primary Federal agency responsible for emergency matters, including emergencies relating to flooding. Among its activities are the provision of technical assistance programs to State and local governments to reduce or eliminate flood risks, the administration of programs to assist individuals and businesses in obtaining insurance protection against floods, and the publication of Flood Insurance Rate Maps (FIRM) that delineate flood hazard areas. In order for residents to be eligible for the purchase of flood insurance, local communities must ensure that their floodland zoning regulations meet the minimum standards set forth in rules published by the Federal Emergency Management Agency. This agency can assist with implementation of the watershed plan through review and approval of the revised floodplain boundary maps that were developed under the plan and through issuing new FIRMs which incorporate the revised floodplain boundaries in each community in the watershed.

U.S. Army Corps of Engineers
The U.S. Army Corps of Engineers (USCOE) can conduct planning studies and construct flood control facilities as authorized by the U.S. Congress. There are two programs which could be used by the Corps to undertake plan implementation activities in the Des Plaines River watershed. Under Section 205 of the Federal Flood Control Act of 1948, as amended, the Corps is authorized under its small continuing authorities program to contribute to the design and construction phases of certain flood control projects, provided the maximum cost to the Corps is $7 million or less. Projects to be included under this program are authorized by the Chief of Engineers. A second program the general investigation program, requires explicit congressional authorization and appropriation. This type of project would be done in several phases, including a three-stage feasibility study followed by a construction phase. Both the feasibility study and the construction phase require explicit congressional approval, and implementation of projects under the program can require more than a decade to accomplish. There is no statutory limit to the funding which can be made available under this program. However, both of the programs require that the projects be demonstrated to be economically feasible and environmentally sound.

A general investigation program for the Upper Des Plaines River watershed in Wisconsin and Illinois is underway. In 1999, the USCOE completed a Phase 1 feasibility study for the main stem of the Upper Des Plaines River in Illinois. Following issuance of that study, a coalition of local communities and organizations formed an advisory committee to develop a scope of work that would expand upon the Phase 1 study to include consideration of flooding problems along tributaries to the Des Plaines River along with an environmental restoration component. That scope of work was issued in 2001.[4] The congressional representatives from the Wisconsin and Illinois districts in the Upper Des Plaines River watershed sponsored the inclusion of funding for the Phase 2 feasibility study in the 1999 Federal Water Resources Development Act. The funding authorization specifically stated that the feasibility study should make maximum use of existing information, such as this watershed study. A Feasibility Cost Share Agreement was executed by the USCOE and its partners-Kenosha

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[4]*The Carmen Group,* Upper Des Plaines River and Tributaries Phase 2 Study Sponsors and Stakeholders Alliance Recommendations and Guidance for Feasibility Study, Including the Scope of Work, *January 29, 2001.*

County; Cook County, Illinois; the Lake County, Illinois Stormwater Management Commission; and the Illinois Department of Natural Resources. Under that agreement, Kenosha County was credited with an in-kind local cost-share contribution of $555,000, almost entirely based on work completed under this comprehensive plan for the Wisconsin portion of the watershed. The Kenosha County and Commission staffs have been active in the Phase 2 Feasibility Study development process, serving on the Project Delivery Team and the Environmental Restoration, Hydrology and Hydraulics, Transportation, and Plan Formulation Subcommittees. The WDNR also serves on the Environmental Restoration Subcommittee. As of June 2003, the Phase 2 Feasibility Study was still in its early stages; however, because of the advanced stage of planning in Wisconsin under this watershed study, the possibility of considering implementation of Wisconsin projects in the broad context of the overall Phase 2 study, but prior to completion of that study was being explored.

The Corps of Engineers also administers a regulatory program relating to the discharge of dredge and fill materials into the waters of the United States and adjacent wetlands. This program is administered pursuant to Section 404 of the Federal Water Pollution Control Act as amended in 1972. The administration of this program supports the recommendations of the land use, park and open space, floodland management, and water quality management elements of the Des Plaines River watershed plan, regarding preserving wetlands.

OVERALL COORDINATION OF THE PLAN ADOPTION AND IMPLEMENTATION PROCESS

It is recommended that Kenosha and Racine Counties each designate an existing staff member to oversee the overall coordination of adoption and implementation of the plan. Logically, the designated staff position would be in the County Planning and Development Departments and would report to the Directors of those Departments. The staff coordinators could be those staff involved in implementation of the County land and water conservation plans which have several program elements which are common to the comprehensive watershed plan. Those designated coordinators, under the direction of the Department Directors, would use this plan to identify recommended projects and activities and would work closely with the local, State, and Federal governments and agencies responsible for implementing those projects and activities. The coordinators would develop detailed schedules for plan implementation, would be responsible for contacting the units of government and agencies essential to implementation of the various components of the plan, and would track the progress of plan implementation. Such contacts would involve notifying those units of government and agencies of their specific roles in plan implementation and assisting them in pursuing the technical and financial resources needed to implement the plan. In that respect the County coordinators 1) would either directly apply for grant funding, or direct local governments to appropriate sources of grant funds and 2) would provide information to local and County departments to assist them in budgeting for projects essential to plan implementation.

It is envisioned that the County coordinators will be guided by the Watershed Advisory Committee and will receive assistance from the Regional Planning Commission staff as may be necessary. Adequate coordination of plan implementation will require a greater effort on the part of the Kenosha County Coordinator than it would of the Racine County coordinator, given the relative amounts of each County in the watershed.

One option for implementation of the prairie and wetland restoration recommendations would be through creation of a State Project Area encompassing the restoration areas. The Wisconsin Department of Natural Resources could acquire, develop, and manage properties within that area. The process of Project Area designation is outlined above in the report section that generally describes the plan implementation role of the WDNR. If such a designation were obtained, the WDNR would be the lead agency responsible for implementation of the prairie and wetland restoration recommendations. It is recommended that the County coordinators work with the WDNR to consider and, if found viable, attain Project Area designation.

PLAN ADOPTION AND INTEGRATION

Upon adoption of the Des Plaines River watershed plan by formal resolution of the Southeastern Wisconsin Regional Planning Commission, in accordance with Section 66.0309(10) of the *Wisconsin Statutes*, the

Commission will transmit a certified copy of the resolution adopting the watershed plan, together with the plan itself, to all local legislative bodies within the Des Plaines River watershed and to all of the existing Federal, State, areawide, and local units and agencies of government that have potential plan implementation functions. Adoption, endorsement, or formal acknowledgment of the comprehensive watershed plan by the local legislative bodies and the existing local, areawide, State, and Federal level agencies concerned is highly desirable to assure a common understanding among the several governmental levels and to enable their staffs to program the necessary implementation work. This acceptance or acknowledgment is, in some cases, required by the *Wisconsin Statutes* before certain planning actions can proceed; such a requirement holding in the case of city and village plan commissions created pursuant to Section 62.23 and 61.35 of the *Wisconsin Statutes*. In addition, formal plan adoption may also be required for State and Federal financial aid eligibility.[5] A model resolution for adoption of the comprehensive plan for the Des Plaines River watershed is included in Appendix O. Adoption of the recommended Des Plaines River watershed plan by any unit or agency of government pertains only to the statutory duties and functions of the adopting agencies and such adoption does not and cannot in any way preempt or commit action by another unit or agency of government acting within its own area of functional and geographic jurisdiction.

Upon adoption or endorsement of the Des Plaines River watershed plan by a unit or agency of government, it is recommended that the policymaking body of the unit or agency direct its staff to review in detail the plan elements of the comprehensive watershed plan. Once such review is completed, the staff can propose to the policy making body for its consideration and approval the steps necessary to fully integrate the watershed plan elements into the plans and programs of the unit or agency of government. A summary of the plan elements to be implemented by various governmental units, agencies, and private organizations is set forth in Table 121.

Local-Level Agencies

1. It is recommended that the Kenosha County Board of Supervisors formally adopt the Des Plaines River watershed plan by resolution, pursuant to Section 66.0309(12)(a) of the *Wisconsin Statutes*, after a report and recommendation by the County Highway and Parks Committee, the County Land Use Committee, and the County Land Conservation Committee.

2. It is recommended that the Racine County Board of Supervisors formally adopt the Des Plaines River watershed plan by resolution, pursuant to Section 66.0309(12)(a) of the Wisconsin Statutes, after a report and recommendation by the County Public Works, Parks and Facilities Committee; the County Economic Development and Land Use Planning Committee; and the County Land Conservation Committee.

3. It is recommended that the Plan Commissions of the City of Kenosha, the Villages of Paddock Lake, Pleasant Prairie, and Union Grove, and the Towns of Brighton, Bristol, Dover, Mt. Pleasant, Paris, Salem, Somers, and Yorkville adopt the Des Plaines River watershed plan as it affects them by resolution, pursuant to Section 62.23(3)(b) of the Wisconsin Statutes, and certify such adoption to their respective governing bodies, and that upon such certification the governing bodies also adopt the recommended plan.

4. It is recommended that the governing boards and commissions of the Town of Bristol Utility District No. 1, The Village of Pleasant Prairie Utility District D, the Village of Pleasant Prairie Sanitary District No. 73-1, and the Town of Salem Utility Districts No. 1 and 2, and the Kenosha Water Utility adopt the Des Plaines River watershed plan as it affects them by resolution, pursuant to Section 66.0309(12)(a) of the Wisconsin Statutes.

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[5]*Plan adoption would not be required to receive funds through ongoing USDA or other land conservation programs, since those programs are not directly related to planning activities, such as the Des Plaines River watershed comprehensive plan. However, the plan implementation activities will focus on funding sources for the implementation actions, including land management practices. Thus, additional funding opportunities may become available during plan implementation.*

Table 121

SUMMARY OF MAJOR DES PLAINES RIVER WATERSHED PLAN ELEMENTS AND PRIMARY IMPLEMENTING GOVERNMENTAL UNITS AND AGENCIES

Action or Project	Kenosha County	Racine County	Racine County Drainage Board	City of Kenosha	Village of Paddock Lake	Village of Pleasant Prairie	Village of Union Grove	Town of Brighton	Town of Bristol	Town of Dover	Town of Mount Pleasant	Town of Paris	Town of Salem	Town of Somers
Plan Adoption or Endorsement	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Designation of County Implementation Coordinator	✓	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Land Use Element General Zoning Ordinance Review and Revision	✓	✓	- -	✓	✓	✓	✓	- -[a]	- -[a]	- -[b]	- -[c]	- -[a]	- -[a]	- -[a]
Park and Open Space Element														
Primary Environmental Corridor Land Acquisition	✓	- -	- -	- -	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -
Areawide Recreational Trail Land Acquisition, Design, Construction, and Maintenance	✓	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Develop Brightondale Connector	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Local Recreational Trail Land Acquisition, Design, Construction, and Maintenance	- -	- -	- -	✓	✓	✓	- -	✓	✓	- -	- -	✓	✓	✓
18-Hole Golf Course Development	✓	- -	- -	- -	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -
Community and/or Neighborhood Park Development	- -	- -	- -	✓	- -	✓	✓	- -	✓	- -	- -	- -	✓	- -
Floodland Management Element														
Adopt Revised or New 100-Year Floodplain Boundaries	✓	✓	- -	✓	✓	✓	✓	- -	- -	- -	- -	- -	- -	- -
Stormwater Ordinance Revision or Adoption	✓	✓	- -	✓	✓	✓	✓	- -	✓	✓	✓	- -	✓	✓
Explore WDNR State Project Area Designation for Recommended Prairie and Wetland Restoration Areas and Implement Restoration Program	✓	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Purchase and Demolish or Move Buildings in the 100-Year Floodplain	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Field Surveys and Engineering Assistance to Implement Floodproofing of Buildings	- -	- -	- -	- -	✓	✓	- -	✓	✓	- -	✓	- -	✓	✓
Preliminary Engineering Design of Stormwater Management Improvements Along Unnamed Tributary No. 6 to Brighton Creek	- -	- -	- -	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -
Install Replacement Culverts Under 83rd Street Along Unnamed Tributary No 1 to Hooker Lake	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	✓	- -
Over Time, Construct New and Replacement Bridges Per Recommended Standards	✓	✓	- -	- -	✓	✓	- -	- -	✓	- -	- -	- -	✓	- -
Initial Upper Des Plaines River Channel Clearing[d]	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	✓	- -	- -
Watershedwide Channel Maintenance Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Implement Stream Rehabilitation Plan	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	✓	- -	- -
Utilize Watershed Study in Conducting Upper Des Plaines River Phase 2 Feasibility Study	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Consider Implementing Wisconsin Flood Control/Ecosystem Restoration Projects Prior to Completion of Phase 2 Study	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Maintain Stream Gage at Russell, Illinois, and Install New Gage on Upper Des Plaines River	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Fishery Development Element Subwatershed-Level Fishery Management Plans	✓ Lead agency	✓	- -	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water Quality Management Element														
Prepare Sewerage System Facility Plan for the Village of Paddock Lake/Town of Bristol Area	✓	- -	- -	✓	✓	- -	- -	- -	✓ Lead agency	- -	- -	- -	- -	- -
Abandon Sewer Utility District D and Sanitary District No. 73-1 Plants and connect to City of Kenosha System	- -	- -	- -	✓	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -
Monitor Hickory Haven and Rainbow Lake Manor Private Sewage Treatment Plants and Initiate Facility Planning When Upgrades are Needed	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Continue Implementation of Onsite Sewage Disposal Program	✓	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Nonpoint Source Pollution Abatement[e]	✓	✓	- -	✓	✓	✓	✓	- -	- -	- -	✓	- -	- -	- -
Compliance with Construction Site Stormwater Discharge Permit Requirements of Chapter NR 216	✓	✓	- -	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Compliance with Municipal Stormwater Discharge Permit Requirements of Chapter NR 216[f]	✓	✓	- -	✓	- -	✓	- -	- -	- -	- -	✓	- -	- -	✓
Stormwater Management Plan Development[g,h]	- -	- -	- -	✓ Lead agency	✓ Lead agency	✓ Lead agency	✓ Lead agency	- -	✓	✓	✓ Lead agency	✓	✓	✓
Education Element	✓	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 121 (continued)

Action or Project	Town of Yorkville	Wisconsin Department of Natural Resources	Wisconsin Department of Transportation	Wisconsin Department of Agriculture, Trade and Consumer Protection	University of Wisconsin–Extension Service	U.S. Environmental Protection Agency	U.S. Geological Survey	U.S. Natural Resources Conservation Service	U.S. Farm Service Agency	Federal Emergency Management Agency	U.S. Army Corps of Engineers	Kenosha/ Racine Land Trust	Private Developers
Plan Adoption or Endorsement	✓	✓	✓	✓	✓	✓	✓	✓	✓	- -	✓	- -	- -
Designation of County Implementation Coordinator	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Land Use Element													
General Zoning Ordinance Review and Revision	- -[b]	- -	- -	- -	- -	- -		- -	- -	- -	- -	- -	- -
Park and Open Space Element													
Primary Environmental Corridor Land Acquisition	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	✓	- -
Areawide Recreational Trail Land Acquisition, Design, Construction, and Maintenance	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Develop Brightondale Connector	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Local Recreational Trail Land Acquisition, Design, Construction, and Maintenance	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
18-Hole Golf Course Development	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Community and/or Neighborhood Park Development	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Floodland Management Element													
Adopt Revised or New 100-Year Floodplain Boundaries	- -	✓	- -	- -	- -	- -	- -	- -	- -	✓	- -	- -	- -
Stormwater Ordinance Revision or Adoption	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Explore WDNR State Project Area Designation for Recommended Prairie and Wetland Restoration Areas and Implement Restoration Program	- -	✓ Lead agency	- -	- -	- -	- -	- -	✓	✓	- -	- -	✓	- -
Purchase and Demolish or Move Buildings in the 100-Year Floodplain	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Field Surveys and Engineering Assistance to Implement Floodproofing of Buildings	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Preliminary Engineering Design of Stormwater Management Improvements Along Unnamed Tributary No. 6 to Brighton Creek	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Install Replacement Culverts Under 83rd Street Along Unnamed Tributary No 1 to Hooker Lake	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Over Time, Construct New and Replacement Bridges Per Recommended Standards	- -	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Initial Upper Des Plaines River Channel Clearing[d]	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Watershedwide Channel Maintenance Program	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Implement Stream Rehabilitation Plan	- -	✓ Lead agency	- -	- -	- -	- -	- -	✓	- -	- -	- -	- -	- -
Utilize Watershed Study in Conducting Upper Des Plaines River Phase 2 Feasibility Study	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	✓	- -	- -
Consider Implementing Wisconsin Flood Control/Ecosystem Restoration Projects Prior to Completion of Phase 2 Study	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	✓	- -	- -
Maintain Stream Gage at Russell, Illinois, and Install New Gage on Upper Des Plaines River	- -	✓	- -	- -	- -	- -	✓	- -	- -	- -	- -	- -	- -
Fishery Development Element													
Subwatershed-Level Fishery Management Plans	✓	✓ Lead agency	- -	- -	- -	- -	- -	✓	- -	- -	- -	- -	- -
Abandon Sewer Utility District D and Sanitary District No. 73-1 Plants and connect to City of Kenosha System	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Water Quality Management Element													
Prepare Sewerage System Facility Plan for the Village of Paddock Lake/Town of Bristol Area	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Monitor Hickory Haven and Rainbow Lake Manor Private Sewage Treatment Plants and Initiate Facility Planning When Upgrades are Needed	- -	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Continue Implementation of Onsite Sewage Disposal Program	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Table 121 (continued)

Action or Project	Town of Yorkville	Wisconsin Department of Natural Resources	Wisconsin Department of Transportation	Wisconsin Department of Agriculture, Trade and Consumer Protection	University of Wisconsin–Extension Service	U.S. Environmental Protection Agency	U.S. Geological Survey	U.S. Natural Resources Conservation Service	U.S. Farm Service Agency	Federal Emergency Management Agency	U.S. Army Corps of Engineers	Kenosha/ Racine Land Trust	Private Developers
Nonpoint Source Pollution Abatement[e]	- -	✓	- -	✓	✓	- -	- -	✓	✓	- -	- -	- -	- -
Compliance with Construction Site Stormwater Discharge Permit Requirements of Chapter NR 216	✓	✓	✓	✓	- -	✓	- -	- -	- -	- -	- -	- -	✓
Compliance with Municipal Stormwater Discharge Permit Requirements of Chapter NR 216[f]	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Stormwater Management Plan Development[g,h]	✓	✓	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Education Element	- -	✓	- -	✓	✓	- -	- -	✓	- -	- -	- -	✓	- -

[a]*The towns in Kenosha County have formally adopted County zoning.*

[b]*Towns in Racine County which have formally adopted County zoning.*

[c]*The Town of Mt. Pleasant has its own zoning ordinance and issues related permits. Rezonings are subject to County approval.*

[d]*This project may require a permit from the WDNR under Chapter 30 of the Wisconsin Statutes.*

[e]*For a comprehensive list of nonpoint source and water quality improvement recommendations and related actions, refer to Table 114 of this report.*

[f]*The indicated Counties and municipalities have been preliminarily designated as candidates for municipal stormwater discharge permits. In some cases, such as the Counties, the permit will generally only apply to County-owned facilities including highway systems. Some currently designated communities may be able to obtain exemption from designation by providing additional data to support such an exemption.*

[g]*For a comprehensive description of key elements of a stormwater management plan, refer to Appendix L.*

[h]*Detailed local stormwater management plans would also address water quantity issues, refining the recommended two- and 100-year storm post-development release rates.*

Source: SEWRPC.

5. It is recommended that the governing boards of the George Lake Protection and Rehabilitation District, the Hooker Lake Protection and Rehabilitation District, and the Paddock Lake Protection and Rehabilitation District adopt the Des Plaines River watershed plan as it affects them by resolution, pursuant to Section 66.0309(12)(a) of the *Wisconsin Statutes*

Areawide Agencies

1. It is recommended that the Kenosha[6] and Racine County Drainage Boards formally acknowledge the Des Plaines River watershed plan by resolution, pursuant to Section 66.0309(12)(a) of the *Wisconsin Statutes.*

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[6]*As of June 2003, Kenosha County did not have an active Drainage Board.*

State-Level Agencies

1. It is recommended that the Wisconsin Department of Natural Resources endorse the comprehensive Des Plaines River watershed plan as an amendment to the previously endorsed regional water quality management plan, certify the plan as an amendment to the regional water quality management plan to the U.S. EPA, and direct the staff of the WDNR to integrate the recommended watershed plan elements into its broad range of agency responsibilities, as well as to assist in coordinating plan implementation activities between the publication date and the year 2030. In particular, it is recommended that the WDNR Board, through its staff, coordinate the recommended Des Plaines River watershed plan with those activities relating to water regulation and control; floodland, shoreland, and wetland zoning; and water quality management planning and water pollution abatement activities.

2. It is recommended that the Wisconsin Department of Transportation endorse the Des Plaines River watershed plan and direct the department staff to give due consideration to the plan in the exercise of its various responsibilities governing the construction and reconstruction of highway and attendant drainage facilities in the watershed.

3. It is recommended that the Wisconsin Department of Agriculture, Trade and Consumer Protection, upon recommendation of the Land Conservation Board, endorse the Des Plaines River watershed plan and direct the department staff to give due consideration to the plan in the exercise of its various responsibilities governing farmland preservation and soil and water conservation.

Federal-Level Agencies

1. It is recommended that the U.S. Environmental Protection Agency formally accept and endorse the Des Plaines River watershed plan as an amendment to the regional water quality management plan upon certification as such by the State of Wisconsin.

2. It is recommended that the U.S. Geological Survey endorse the Des Plaines River watershed plan, continue its cooperative stream gaging program within the watershed, and work with Kenosha County and the Regional Planning Commission to establish a new continuous recording streamflow and sediment sampling gage on the main stem of the Des Plaines River near its confluence with Brighton Creek.

3. It is recommended that the U.S. Department of Agriculture, Farm Services Agency, formally acknowledge the Des Plaines River watershed plan and utilize the plan recommendations in its administration of the Federal agricultural and conservation program.

4. It is recommended that the U.S. Department of Agriculture, Natural Resources Conservation Service formally acknowledge the Des Plaines River watershed plan and utilize the plan recommendations in the administration of its various technical assistance programs relating to soil and water conservation.

5. It is recommended that the Federal Emergency Management Agency formally acknowledge the Des Plaines River watershed plan and use the floodland data contained in the plan for updating and expanding its series of Federal flood insurance studies and flood insurance rate maps.[7]

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[7]*In 1998, the Village of Pleasant Prairie adopted a floodplain zoning ordinance, incorporating the 100-year recurrence interval flood profiles and the corresponding floodplain and floodway boundary delineations that were developed within the Village under the Des Plaines River watershed study. The flood profiles and the corresponding floodplain zoning maps were approved by the Wisconsin Department of Natural Resources prior to adoption and were submitted to FEMA, along with supporting documentation, in October 1999. As of June 2003, FEMA approval had not yet been granted, but the hydrologic and hydraulic model review had been completed and preliminary FIRM preparation had begun. In 1998, the WDNR also approved the 100-year flood flows developed throughout the watershed under this study.*

6. It is recommended that the U.S. Army Corps of Engineers formally acknowledge the Des Plaines River watershed plan. It is further recommended that, under the ongoing Upper Des Plaines River and Tributaries, Wisconsin and Illinois Phase 2 Feasibility Study process, the USCOE integrate the recommendations of the Des Plaines River watershed study as an element of the study and continue to work with local, State, and regional units and agencies of government in any requests for assistance in the review, design, and construction/implementation phases of the floodland management, ecosystem restoration, and recreational components of the recommended Des Plaines River watershed plan. It is also recommended that the USCOE use the land use and environmental corridor elements of the plan in carrying out its regulatory program relative to the placement of fill and the conduct of other activities in wetlands.

SUBSEQUENT ADJUSTMENT OF THE PLAN

No plan can be permanent in all of its aspects or precise in all of its elements. The very definition and characteristics of areawide planning suggest that an areawide plan, such as a comprehensive watershed plan, to be viable and of use to local, State, and Federal units and agencies of government, be continually adjusted through formal amendments, extensions, additions, and refinements to reflect changing conditions. The Wisconsin Legislature clearly foresaw this when it gave to regional planning commissions the power to ". . . amend, extend, or add to the master plan or carry any part or subject matter into greater detail . . . " in Section 66.0309(9) of the *Wisconsin Statutes*.

Amendments, extensions, and additions to the Des Plaines River watershed plan will be forthcoming not only from the work of the Commission under various continuing regional planning programs but also from State agencies as they adjust and refine statewide plans and from Federal agencies as national policies are established or modified, as new programs are created, or as existing programs are expanded or curtailed. Adjustments must also come from local planning programs which, of necessity, must be prepared in greater detail and result in greater refinement of the watershed plan. This is particularly true of the land use element of the watershed plan. Areawide adjustments may come from subsequent regional or State planning programs, which may include additional comprehensive or special purpose planning efforts, such as the preparation of regional sanitary sewerage service plans, regional water supply plans, and regional or county park and open space plans. Updating of the hydrologic and hydraulic analyses which form the basis for the floodland and stormwater management recommendations of this plan and for the delineation of floodlands for local zoning purposes may be necessary as the land use element is refined and revised under future planning programs.

All of these adjustments and refinements will require the utmost cooperation by the local, areawide, State, and Federal agencies of government, as well as coordination by the Southeastern Wisconsin Regional Planning Commission, which has been empowered under Section 66.0309(8) of the *Wisconsin Statutes* to act as a coordinating agency for programs and activities of the local units of government. To achieve this coordination between local, State, and Federal programs most effectively and efficiently and, therefore, to assure the timely adjustments of the watershed plan, it is recommended that all of the State, areawide, and local agencies having various plan and plan implementation powers advise and transmit all subsequent planning studies, plan proposals and amendments, and plan implementation devices to the Southeastern Wisconsin Regional Planning Commission for consideration as to integration into, and adjustment of, the watershed plan. Of particular importance in this respect will be the continuing role of the Des Plaines River Watershed Committee in intergovernmental coordination.

LAND USE PLAN ELEMENT IMPLEMENTATION

The implementation of the land use plan element—including the overall land use, open space preservation, and outdoor recreation components—of the comprehensive Des Plaines River watershed plan is of central importance to the realization of the overall watershed plan. This element, moreover, requires the most intricate implementation actions and utmost cooperation between the local units of government and the areawide, State, and Federal agencies concerned if the watershed development objectives are to be fully achieved. This is true not only because the land use plan elements are closely interrelated in nature and support and complement one another, but because they are closely related to the floodland management and water quality management elements of the plan.

If, for example, urban residential, commercial, and industrial growth is properly located within the watershed and is not allowed to further preempt the natural floodland areas, a great deal will be achieved with respect to flood damage mitigation. Similarly, the maintenance and preservation of primary environmental corridors for natural resource protection and conservancy purposes will, in turn, assure the preservation of many of the best park sites remaining within the watershed. Although all of the plan implementation recommendations are closely interrelated, this section has been divided for convenience in presentation and use into the following major subject areas: overall land use plan element, open space preservation plan element, and outdoor recreation plan element. A schedule of capital and land acquisition costs for this plan element is set forth in Table 122.

Overall Land Use Plan Element

Implementation of the overall land use plan element can best be accomplished through the adoption of the Des Plaines River watershed plan and the implementation of that plan through local, State, and Federal land use and land use-related regulations. The following methods are suggested for use in this respect.

Zoning Ordinances

Of all the land use plan implementation devices, the most readily available, most important, and most versatile are zoning ordinances, including zoning district regulations and zoning district delineations. Within incorporated municipalities in the Des Plaines River watershed, zoning is the responsibility of the City of Kenosha and the Villages of Paddock Lake, Pleasant Prairie, and Union Grove. Within the unincorporated portions of the watershed, zoning is generally the responsibility of each County in cooperation with the respective towns.[8] It is recommended that each of the local governments with zoning responsibility review and, as necessary, revise their existing zoning ordinances and zoning district maps so as to seek to implement the land use plan element of the Des Plaines River watershed plan. The following suggestions are made to all zoning agencies within the watershed to assist them in this task.

Urban Residential and Related Urban Areas

Not all of the areas shown as devoted to urban residential and other urban uses in the recommended watershed land use plan should be initially placed in urban land use districts. Only existing and platted but not yet fully developed residential areas and those areas that have immediate development potential which can be economically served by municipal utilities and facilities, and in particular sanitary sewerage and water supply facilities, should be placed in exclusive residential districts related to the development densities indicated on the recommended watershed land use plan. The balance of the proposed future urban residential land use areas should remain in exclusive agricultural districts so as to act as a holding zone for future development. Such holding districts should be rezoned into the appropriate residential zoning district or supporting land use district, such as business or industrial districts, only when the community can economically and efficiently accommodate the proposed development.[9]

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[8] *The Town of Mt. Pleasant has its own zoning ordinance and issues related permits. Rezonings are subject to County approval.*

[9] *This general approach to rezoning for urban uses has long been recommended by the Regional Planning Commission. The approach enables communities to stage development over time—based upon such factors as the availability of public facilities and services—within the framework of a long-range plan. It should be noted that this approach may not be allowed after January 1, 2010, owing to changes in the comprehensive planning law enacted in 1999. Under the new comprehensive planning law, beginning on January 1, 2010, local government actions and programs which affect land use, including zoning, must be consistent with the comprehensive plan.*

Table 122

SCHEDULE OF LAND ACQUISITION AND DEVELOPMENT COSTS OF THE PARK AND OPEN SPACE PLAN ELEMENT OF THE RECOMMENDED PLAN FOR THE DES PLAINES RIVER WATERSHED: 2003-2030[a,b]

		Primary Environmental Corridors			Areawide Recreational Trails					
		Land Acquisition			Kenosha County			Racine County		
Calendar Year	Project Year	Kenosha County	Village of Pleasant Prairie	Total	Land Acquisition	Development	Total	Land Acquisition	Development	Total
2003	1	$ 95,850	$ 91,650	$ 187,500	$ 25,000	$ 84,000	$ 109,000	$ 3,000	$ 17,000	$ 20,000
2004	2	95,850	91,650	187,500	25,000	84,000	109,000	3,000	17,000	20,000
2005	3	95,850	91,650	187,500	25,000	84,000	109,000	3,000	17,000	20,000
2006	4	95,850	91,650	187,500	25,000	84,000	109,000	3,000	17,000	20,000
2007	5	95,850	91,650	187,500	25,000	84,000	109,000	3,000	17,000	20,000
2008	6	95,850	91,650	187,500	25,000	84,000	109,000	3,000	17,000	20,000
2009	7	95,850	91,650	187,500	25,000	84,000	109,000	3,000	17,000	20,000
2010	8	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2011	9	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2012	10	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2013	11	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2014	12	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2015	13	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2016	14	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2017	15	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2018	16	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2019	17	95,850	91,650	187,500	24,000	84,000	108,000	3,000	17,000	20,000
2020	18	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2021	19	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2022	20	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2023	21	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2024	22	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2025	23	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2026	24	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2027	25	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2028	26	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2029	27	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
2030	28	95,850	91,650	187,500	24,000	83,000	107,000	3,000	17,000	20,000
Total		$2,683,800	$2,566,200	$5,250,000	$679,000	$2,341,000	$3,020,000	$84,000	$476,000	$560,000
Annual Average		$ 95,850	$ 91,650	$ 187,500	$ 24,250	$ 83,600	$ 107,860	$ 3,000	$ 17,000	$ 20,000

		Areawide Recreational Trails (continued)								
		Village of Pleasant Prairie			Wisconsin Department of Transportation			Wisconsin Department of Natural Resources		
Calendar Year	Project Year	Land Acquisition	Development	Total	Land Acquisition	Development	Total	Land Acquisition	Development	Total
2003	1	$ 9,000	$ 25,000	$ 34,000	$0	$ 10,000	$ 10,000	$0	$ 3,000	$ 3,000
2004	2	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2005	3	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2006	4	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2007	5	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2008	6	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2009	7	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2010	8	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2011	9	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2012	10	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2013	11	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2014	12	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2015	13	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2016	14	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2017	15	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2018	16	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2019	17	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2020	18	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2021	19	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2022	20	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2023	21	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2024	22	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2025	23	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2026	24	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2027	25	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2028	26	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2029	27	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
2030	28	9,000	25,000	34,000	0	10,000	10,000	0	3,000	3,000
Total		$252,000	$700,000	$952,000	$0	$280,000	$280,000	$0	$84,000	$84,000
Annual Average		$ 9,000	$ 25,000	$ 34,000	$0	$ 10,000	$ 10,000	$0	$ 3,000	$ 3,000

Table 122 (continued)

		Areawide Recreational Trails Total			Major Parks Developmen t	Golf Course: Kenosha County, Village of Pleasant Prairie, and Private Developers			Parks and Opens Space Total		
Calendar Year	Project Year	Land Acquisition	Development	Total	Village of Pleasant Prairie	Land Acquisition	Development	Total	Land Acquisition	Development	Total
2003	1	$ 37,000	$ 139,000	$ 176,000	$190,000	$ 33,000	$ 189,000	$ 222,000	$ 257,500	$ 518,000	$ 775,500
2004	2	37,000	139,000	176,000	330,000	33,000	189,000	222,000	257,500	658,000	915,500
2005	3	37,000	139,000	176,000	--	33,000	189,000	222,000	257,500	328,000	585,500
2006	4	37,000	139,000	176,000	--	33,000	189,000	222,000	257,500	328,000	585,500
2007	5	37,000	139,000	176,000	--	33,000	189,000	222,000	257,500	328,000	585,500
2008	6	37,000	139,000	176,000	--	33,000	189,000	222,000	257,500	328,000	585,500
2009	7	37,000	139,000	176,000	--	33,000	189,000	222,000	257,500	328,000	585,500
2010	8	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2011	9	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2012	10	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2013	11	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2014	12	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2015	13	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2016	14	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2017	15	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2018	16	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2019	17	36,000	139,000	175,000	--	33,000	189,000	222,000	256,500	328,000	584,500
2020	18	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2021	19	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2022	20	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2023	21	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2024	22	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2025	23	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2026	24	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2027	25	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2028	26	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2029	27	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
2030	28	36,000	138,000	174,000	--	33,000	189,000	222,000	256,500	327,000	583,500
Total		$1,015,000	$3,881,000	$4,896,000	$520,000	$924,000	$5,292,000	$6,216,000	$7,189,000	$9,693,000	$16,882,000
Annual Average		$ 36,300	$ 138,600	$ 174,900	$ 18,600	$ 33,000	$ 189,000	$ 222,000	$ 256,800	$ 346,200	$ 602,900

[a] *Costs represent 2002 conditions.* 2002 Engineering News-Record *Construction Cost Index = 7,710.*

[b] *It is recommended that Federal, State, or private grant funds be obtained to cover as much as possible of the County and municipal costs.*

Source: SEWRPC.

Environmental Corridors and Isolated Natural Resource Areas

The environmental corridors and isolated natural resource areas shown on the recommended watershed land use plan should remain or be placed into one of several zoning districts as dictated by consideration of the character of the specific resource values to be protected within the corridor and the attainment of the outdoor recreation, open space preservation, and resource base conservation objectives of the watershed plan. All lakes, rivers, streams, wetlands, and undeveloped floodlands should be placed in lowland conservancy or floodplain protection districts. Upland portions of the environmental corridors and isolated natural resource areas should be placed in protective upland conservancy districts or in park and recreation districts which accommodate compatible recreational facilities in accordance with the watershed plan. Upland conservancy districts may accommodate rural density residential development (no more than one dwelling unit per five acres) in upland areas not covered by steep slopes—with development plans subject to careful review to ensure that site design and construction activities minimize disturbance of natural features.

As certain lands are converted to wetlands and prairies, according to the recommendations of the plan, the limits of environmental corridors may be expanded and the restored areas generally should be placed in conservancy districts.

Agricultural, Rural Residential, and Other Open Land
In general, areas identified on the recommended watershed land use plan map as "agricultural, rural residential, and open land" should remain or be placed in rural zoning districts. The application of specific rural zoning districts should be in accordance with county and local plans.

Areas shown as prime agricultural land in county-adopted farmland preservation plans should remain in an exclusive agricultural zoning districts which essentially permits only agricultural uses and which establishes a minimum parcel size of at least 35 acres.

Other (nonprime) agricultural areas should be retained in exclusive agricultural districts as defined above or in general agricultural districts with smaller minimum parcel sizes as may be appropriate for smaller agricultural operations, such as hobby farms or other specialty farms. Such nonprime agricultural lands may also be placed into a rural residential zoning district which limits residential development to a maximum of one dwelling unit per five acres, consistent with the maintenance of rural character, as provided for in county and local land use plans.

Other Zoning Considerations: Conservation Subdivisions
As noted above, the zoning for upland environmental corridors and isolated natural resource areas (excluding areas of steep slope) and for nonprime agricultural land could accommodate rural residential development at a density of no more than one dwelling unit per five acres. Where such rural residential development is anticipated, the use of conservation subdivision designs should be considered. In such designs, dwellings are clustered on relatively small lots surrounded by large open space lands, achieving the desired overall density. The site design preserves significant natural resources and other open space to the greatest extent possible.

Conservation subdivision designs offer many benefits in comparison to conventional designs where rural residential development is to be accommodated. Well designed conservation subdivisions can minimize the visual impact of the permitted residential development, maintain scenic views, preserve significant natural features and open space, help to maintain natural drainage systems, and maintain the rural character of the landscape. Conservation subdivision designs may also decrease the total amount of impervious surface attendant to development.

The single most important design consideration in conservation subdivisions is that the proposed development should be designed around the natural resource base. Existing natural features and features which contribute to the rural landscape should be carefully identified, delineated, and set aside as open space prior to any attempt to design street and lot layouts. Conservation subdivision design principles and guidelines are described in detail in SEWRPC Planning Guide No. 7, *Rural Cluster Development Guide*.

Floodland Regulations
Floodland regulations should be reviewed and updated as necessary in order to ensure the substantial maintenance in open uses of all undeveloped floodways and floodplains as delineated under the watershed study. Either a basic floodland use district or an overlay floodland use district approach may be taken, depending upon local preference. In those cases where urban development already exists in the floodplain and where the watershed plan recommends structural measures for abatement of flood damages, including structure floodproofing, elevation, or removal, the provision of detention storage, and the improvement of local storm sewers, it will be necessary to identify for selected stream reaches floodway districts so as to permit the placement of such existing urban development into floodplain fringe overlay districts, thereby avoiding rendering such uses nonconforming and at the same time ensuring that appropriate regulations are in place attendant to any future development.

Sanitary Sewer Extension Review
The Wisconsin Department of Natural Resources must review and approve all locally proposed extensions of public sanitary sewers, while the Wisconsin Department of Commerce has similar oversight responsibilities for private sewers. It is recommended that these agencies review all such extensions against the basic land use recommendations contained in the Des Plaines River watershed plan, ensuring that the development proposed to be served by extended sanitary sewers is compatible with the plan recommendations. Sanitary sewer extensions should not be approved in those instances where, for example, they are intended to serve urban development that might be located within primary environmental corridors.

Wetland Regulation
It is recommended that the WDNR and the USCOE, in the administration of their various wetland regulatory programs, take into account the land use development, park and open space preservation and protection, and floodland management recommendations contained in the Des Plaines River watershed plan. The plan recommends the preservation and protection of existing wetlands and the creation or restoration of wetlands on lands that are not currently designated as wetlands. It is accordingly recommended that the State and Federal agencies concerned recognize the comprehensive nature of the Des Plaines River watershed plan, making agency decisions on wetland regulation in a manner consistent with that plan. It is also recommended that concerned counties, villages, and the City of Kenosha—all of which are mandated by State law to enact protective wetland zoning attendant to all wetlands five acres or more in size within shoreland areas—ensure that their local zoning regulations continue to protect wetlands in a manner consistent with the recommended plan.

Open Space Preservation Plan Element
Implementation of the foregoing recommendations relating to zoning and other regulatory measures for the protection of environmentally sensitive and agricultural lands will substantially contribute to implementation of the open space preservation plan element. In addition to the aforenoted regulatory actions, however, the plan recommends additional public-interest acquisition to permanently protect selected primary environmental corridors. Upon full implementation of the plan, a total of 8.4 square miles would be held in public-interest ownership. This includes 5.1 square miles located east of IH 94, in the Kenosha Urban Planning District and 3.3 square miles outside of the Kenosha Urban Planning District. Under the plan, the primary responsibility for additional corridor acquisition would rest with Kenosha County and the Village of Pleasant Prairie, with the expectation that they would gradually acquire selected corridor segments in the years ahead.

Outdoor Recreation Plan Element
In addition to maintaining the three major parks in the watershed, Brighton Dale Park, Bristol Woods Park, and Prairie Springs Park, it is recommended that the Kenosha County Highway and Parks Committee, the City of Kenosha Public Works Committee, and the Village of Pleasant Prairie assume responsibility for developing an approximately 36.5-mile-long recreational trail corridor adjacent to the Des Plaines River, extending north from the Wisconsin-Illinois State line to the Bong Recreational Area in the upper reaches of the Brighton Creek subwatershed, as well as along the Kilbourn Road Ditch to CTH K. It is also recommended that Kenosha County and the Village of Pleasant Prairie work together to formulate an approach for the development of an 18 hole golf course on approximately 160 acres in the southwestern portion of the Village. As noted in Chapter XV, the actual development may take the form of a public-private partnership.

It is recommended that the Village of Pleasant Prairie acquire and develop one community park in the south-central portion of the Village. It is recommended that the Town of Bristol continue to maintain the existing community park in the west-central portion of the Town.

It is further recommended that the City of Kenosha, the Villages of Paddock Lake and Pleasant Prairie, and the Town of Yorkville continue to maintain the five existing neighborhood parks in the watershed. Over time, as the need for parks becomes evident, it is recommended that the acquisition and development of 13 new neighborhood parks be accomplished by the City of Kenosha (one park), the Village of Pleasant Prairie (five parks), the Village of Union Grove (one park), the Town of Bristol (four parks), and the Town of Salem (two parks).

FLOODLAND AND STORMWATER MANAGEMENT PLAN ELEMENT IMPLEMENTATION

The major floodland and stormwater management recommendations of this watershed plan are 1) structure floodproofing, elevation, and removal; 2) the continuation and institution of sound floodland zoning regulations and practices throughout the watershed; 3) the preservation in open space uses of primary environmental corridor lands; 4) the conversion of certain lands in the floodplain from agricultural uses to wetlands; 5) the conversion of certain lands from agricultural uses to prairies; 6) the development of stormwater management plans and regulations, including a recommendation that communities adopt release rates that will result in uniform, watershedwide controls on runoff from new development; 7) stream rehabilitation along the main stem of the Upper Des Plaines River; and 8) miscellaneous structural and nonstructural measures. A schedule of capital and land acquisition costs for this plan element is set forth in Table 123.

Structure Floodproofing, Elevation, and Removal

The recommended plan calls for floodproofing, elevation, or removal of buildings to be undertaken at various locations throughout the watershed, as set forth on Map 84. The buildings to be floodproofed, elevated or removed in each civil division are set forth in Table 124. Floodproofing is recommended at three houses along Unnamed Tributary No. 6 to Brighton Creek in the Village of Paddock Lake; four houses and two commercial buildings along the Des Plaines River or Lake Russo, three houses along Jerome Creek, nine agricultural buildings along the Des Plaines River, all in the Village of Pleasant Prairie; two recreational buildings along Francis Lake in the Town of Brighton; one house along Unnamed Tributary No. 1 to the Salem Branch of Brighton Creek, 10 houses near George Lake and the Dutch Gap Canal, three agricultural buildings and one commercial building along the Des Plaines River and two agricultural buildings along the Dutch Gap Canal, all in the Town of Bristol; two houses along the Kilbourn Road Ditch in the Town of Mt. Pleasant; seven houses along Hooker Lake or the Salem Branch of Brighton Creek in the Town of Salem; and two houses along the Kilbourn Road Ditch in the Town of Somers.

Elevation is recommended for four houses along the Des Plaines River in the Village of Pleasant Prairie.

Structure floodproofing and/or elevation would be undertaken, and paid for, by the property owners directly affected. It is recommended, however, that the Villages of Paddock Lake and Pleasant Prairie and the Towns of Brighton, Bristol, Mt. Pleasant, Salem, and Somers make available, at no cost to the property owners concerned, the professional services of qualified engineers which would be required to prepare plans for floodproofing and elevation of the individual buildings. In addition, it is recommended that the two Villages and the Towns review their local building ordinances to ensure that appropriate regulations dealing with structure floodproofing and elevation are included.

Removal is recommended for two houses along Unnamed Tributary No. 6 to Brighton Creek in the Village of Paddock Lake, one house and two agricultural buildings along the Des Plaines River in the Village of Pleasant Prairie, and 12 mobile homes along the Kilbourn Road Ditch in the Town of Somers. It is recommended that the properties be acquired and the structures moved or demolished by Kenosha County, and that the acquired land be kept in open space use.

It is recommended that the County coordinators for plan implementation explore, on behalf of the property owners directly affected and the Counties, any available State and/or Federal aids for floodproofing, elevation, or removal.[10]

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[10]*The availability of State and Federal funds for structure floodproofing, elevation, and removal in the Village of Paddock Lake is likely to be limited because the Village does not participate in the Federal flood insurance program. It is recommended that the Village consider initiating such participation and establishing floodplain zoning regulations. The hydrologic and hydraulic analyses developed under this watershed study for the purpose of delineating the 100-year recurrence interval floodplain and floodway limits could be submitted to the Wisconsin Department of Natural Resources and the Federal Emergency Management Agency for approval and preparation of Flood Insurance Rate Maps and a Flood Insurance Study report.*

Table 123

SCHEDULE OF CAPITAL, LAND RENTAL/EASEMENT, AND OPERATION AND MAINTENANCE COSTS OF THE FLOODLAND AND STORMWATER MANAGEMENT PLAN ELEMENT OF THE RECOMMENDED PLAN FOR THE DES PLAINES RIVER WATERSHED: 2003-2030[a]

Calendar Year	Project Year	Structure Floodproofing, and Elevation – Private Owners – Capital	Structure Removal – Kenosha County	Detention Storage for New Development – Private Developers – Capital	Detention Storage for New Development – Private Developers – Operation and Maintenance	Detention Storage for New Development – Private Developers – Total	Prairie Restoration – Capital[c]	Prairie Restoration – Land Rental/Easement Options – USDA-NRCS – Enrollment in Conservation Reserve Program	Prairie Restoration – Land Rental/Easement Options – Kenosha/Racine Land Trust, Kenosha and Racine Counties, and WDNR[b] – Purchase of Conservation Easements	Prairie Restoration – Operation and Maintenance – Kenosha/ Racine Land Trust, Kenosha and Racine Counties, and WDNR[b] – Lower Limit	Prairie Restoration – Operation and Maintenance – Upper Limit	Prairie Restoration Subtotal – Lower Limit	Prairie Restoration Subtotal – Upper Limit
2003	1	$199,800	$ 205,200	$ 1,333,000	$ 380,000	$ 1,713,000	$ 527,000	$ 15,000	$ 616,000	$ 1,000	$ 48,000	$ 543,000	$ 1,191,000
2004	2	199,800	205,200	1,333,000	380,000	1,713,000	527,000	30,000	616,000	1,000	96,000	558,000	1,239,000
2005	3	199,800	205,200	1,333,000	380,000	1,713,000	527,000	45,000	615,000	2,000	144,000	574,000	1,286,000
2006	4	199,800	205,200	1,333,000	380,000	1,713,000	527,000	60,000	615,000	3,000	191,000	590,000	1,333,000
2007	5	199,800	205,200	1,332,000	380,000	1,712,000	527,000	75,000	615,000	3,000	239,000	605,000	1,381,000
2008	6	0	0	1,332,000	380,000	1,712,000	527,000	90,000	615,000	4,000	287,000	621,000	1,429,000
2009	7	0	0	1,332,000	380,000	1,712,000	527,000	105,000	615,000	5,000	335,000	637,000	1,477,000
2010	8	0	0	1,332,000	380,000	1,712,000	526,000	120,000	615,000	5,000	383,000	651,000	1,524,000
2011	9	0	0	1,332,000	380,000	1,712,000	526,000	135,000	615,000	6,000	431,000	667,000	1,572,000
2012	10	0	0	1,332,000	380,000	1,712,000	526,000	150,000	615,000	7,000	479,000	683,000	1,620,000
2013	11	0	0	1,332,000	380,000	1,712,000	526,000	165,000	615,000	7,000	526,000	698,000	1,667,000
2014	12	0	0	1,332,000	380,000	1,712,000	526,000	180,000	615,000	8,000	574,000	714,000	1,715,000
2015	13	0	0	1,332,000	380,000	1,712,000	526,000	195,000	615,000	9,000	622,000	730,000	1,763,000
2016	14	0	0	1,332,000	380,000	1,712,000	526,000	211,000	615,000	10,000	670,000	747,000	1,811,000
2017	15	0	0	1,332,000	380,000	1,712,000	526,000	226,000	615,000	10,000	718,000	762,000	1,859,000
2018	16	0	0	1,332,000	380,000	1,712,000	526,000	241,000	615,000	11,000	766,000	778,000	1,907,000
2019	17	0	0	1,332,000	380,000	1,712,000	526,000	256,000	615,000	12,000	814,000	794,000	1,955,000
2020	18	0	0	1,332,000	380,000	1,712,000	526,000	271,000	615,000	12,000	861,000	809,000	2,002,000
2021	19	0	0	1,332,000	380,000	1,712,000	526,000	286,000	615,000	13,000	909,000	825,000	2,050,000
2022	20	0	0	1,332,000	380,000	1,712,000	526,000	301,000	615,000	14,000	957,000	841,000	2,098,000
2023	21	0	0	1,332,000	380,000	1,712,000	526,000	316,000	615,000	14,000	1,005,000	856,000	2,146,000
2024	22	0	0	1,332,000	380,000	1,712,000	526,000	331,000	615,000	15,000	1,053,000	872,000	2,194,000
2025	23	0	0	1,332,000	380,000	1,712,000	526,000	346,000	615,000	16,000	1,101,000	888,000	2,242,000
2026	24	0	0	1,332,000	380,000	1,712,000	526,000	361,000	615,000	16,000	1,149,000	903,000	2,290,000
2027	25	0	0	1,332,000	380,000	1,712,000	526,000	376,000	615,000	17,000	1,196,000	919,000	2,337,000
2028	26	0	0	1,332,000	380,000	1,712,000	526,000	391,000	615,000	18,000	1,244,000	935,000	2,385,000
2029	27	0	0	1,332,000	380,000	1,712,000	526,000	406,000	615,000	18,000	1,292,000	950,000	2,433,000
2030	28	0	0	1,332,000	380,000	1,712,000	526,000	421,000	615,000	19,000	1,340,000	966,000	2,481,000
Total		$999,000	$1,026,000	$37,300,000	$10,640,000	$47,940,000	$14,735,000	$6,105,000	$17,222,000	$276,000	$19,430,000	$21,116,000	$51,387,000
Average Annual		$ 35,700	$ 36,600	$ 1,332,100	$ 380,000	$ 1,712,100	$ 526,300	$ 218,000	$ 615,000	$ 9,900	$ 693,900	$ 754,100	$ 1,835,300

Calendar Year	Project Year	Wetland Restoration – Capital[d]	Wetland Restoration – Land Rental/Easement Options – USDA-NRCS – Enrollment in Conservation Reserve Program	Wetland Restoration – Land Rental/Easement Options – Kenosha/Racine Land Trust, Kenosha and Racine Counties, and WDNR[b] – Purchase of Conservation Easements	Wetland Restoration – Operation and Maintenance – Kenosha/ Racine Land Trust, Kenosha and Racine Counties, and WDNR[b] – Lower Limit	Wetland Restoration – Operation and Maintenance – Upper Limit	Wetland Restoration Subtotal – Lower Limit	Wetland Restoration Subtotal – Upper Limit	Centralized Detention Storage and Storm Sewer Improvements Along Unnamed Tributary No. 6 to Brighton Creek[e] – Village of Paddock Lake – Capital	Village of Paddock Lake – Operation and Maintenance	Village of Paddock Lake – Total	Culvert Replacement Along Unnamed Tributary No. 1 to Hooker Lake – Town of Salem – Capital	Town of Salem – Operation and Maintenance	Town of Salem – Total
2003	1	$ 232,000	$ 8,000	$ 283,000	$ 1,000	$ 25,000	$ 241,000	$ 540,000	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
2004	2	232,000	16,000	283,000	1,000	49,000	249,000	564,000	471,500	- -	471,500	110,000	100	110,100
2005	3	232,000	23,000	283,000	1,000	74,000	256,000	589,000	471,500	6,000	477,500	0	100	100
2006	4	232,000	31,000	283,000	1,000	99,000	264,000	614,000	0	6,000	6,000	0	100	100
2007	5	232,000	39,000	282,000	2,000	123,000	273,000	637,000	0	6,000	6,000	0	100	100
2008	6	232,000	47,000	282,000	2,000	148,000	281,000	662,000	0	6,000	6,000	0	100	100
2009	7	233,000	54,000	282,000	3,000	173,000	290,000	688,000	0	6,000	6,000	0	100	100
2010	8	233,000	62,000	282,000	3,000	197,000	298,000	712,000	0	6,000	6,000	0	100	100
2011	9	233,000	70,000	282,000	3,000	222,000	306,000	737,000	0	6,000	6,000	0	100	100
2012	10	233,000	78,000	282,000	4,000	247,000	315,000	762,000	0	6,000	6,000	0	100	100
2013	11	233,000	85,000	282,000	4,000	271,000	322,000	786,000	0	6,000	6,000	0	100	100
2014	12	233,000	93,000	282,000	4,000	296,000	330,000	811,000	0	6,000	6,000	0	100	100
2015	13	233,000	101,000	282,000	5,000	321,000	339,000	836,000	0	6,000	6,000	0	100	100
2016	14	233,000	109,000	282,000	5,000	346,000	347,000	861,000	0	6,000	6,000	0	100	100
2017	15	233,000	116,000	282,000	5,000	370,000	354,000	885,000	0	6,000	6,000	0	100	100
2018	16	233,000	124,000	282,000	6,000	395,000	363,000	910,000	0	6,000	6,000	0	100	100
2019	17	233,000	132,000	282,000	6,000	420,000	371,000	935,000	0	6,000	6,000	0	100	100
2020	18	233,000	140,000	282,000	6,000	444,000	379,000	959,000	0	6,000	6,000	0	100	100
2021	19	233,000	147,000	282,000	7,000	469,000	387,000	984,000	0	6,000	6,000	0	100	100
2022	20	233,000	155,000	282,000	7,000	494,000	395,000	1,009,000	0	6,000	6,000	0	100	100
2023	21	233,000	163,000	282,000	8,000	518,000	404,000	1,033,000	0	6,000	6,000	0	100	100
2024	22	233,000	171,000	282,000	8,000	543,000	412,000	1,058,000	0	6,000	6,000	0	100	100
2025	23	233,000	178,000	282,000	8,000	568,000	419,000	1,083,000	0	6,000	6,000	0	100	100
2026	24	233,000	186,000	282,000	9,000	592,000	428,000	1,107,000	0	6,000	6,000	0	100	100
2027	25	233,000	194,000	282,000	9,000	617,000	436,000	1,132,000	0	6,000	6,000	0	100	100
2028	26	233,000	202,000	282,000	9,000	642,000	444,000	1,157,000	0	6,000	6,000	0	100	100
2029	27	233,000	209,000	282,000	10,000	666,000	452,000	1,181,000	0	6,000	6,000	0	100	100
2030	28	233,000	217,000	282,000	10,000	691,000	460,000	1,206,000	0	6,000	6,000	0	100	100
Total		$6,518,000	$3,150,000	$7,900,000	$147,000	$10,020,000	$9,815,000	$24,438,000	$943,000	$156,000	$1,099,000	$110,000	$2,700	$112,700
Average Annual		$ 232,800	$ 112,500	$ 282,100	$ 5,300	$ 357,900	$ 350,500	$ 872,800	$ 33,700	$ 5,600	$ 39,300	$ 3,900	$ 100	$ 4,000

Table 123 (continued)

Calendar Year	Project Year	Upper Des Plaines River Sediment Monitoring: Wisconsin Department of Natural Resources: Capital	Operation and Maintenance	Total	U.S. Geological Survey: Capital	Operation and Maintenance	Total	Total Cost: Capital	Operation and Maintenance	Total
2003	1	$ 0	- -	$ 0	$ 0	$ 0	$ 0	$ 0	- -	- -
2004	2	32,500[f]	$ 6000[g]	38,500	7,500[h]	6,000[g]	13,500	40,000	$ 12,000[g]	$ 52,000
2005	3	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2006	4	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2007	5	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2008	6	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2009	7	0	13,000	13,000[i]	0	6,000	6,000	0	19,000	19,000[i]
2010	8	0	13,000	13,000	0	6,000	6,000	0	19,000	19,000
2011	9	0	13,000	13,000	0	6,000	6,000	0	19,000	19,000
2012	10	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2013	11	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2014	12	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2015	13	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2016	14	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2017	15	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2018	16	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2019	17	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2020	18	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2021	19	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2022	20	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2023	21	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2024	22	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2025	23	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2026	24	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2027	25	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2028	26	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2029	27	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
2030	28	0	6,000	6,000	0	6,000	6,000	0	12,000	12,000
Total		$32,500	$183,000	$215,500	$7,500	$162,000	$169,500	$40,000	$345,000	$385,000
Annual Average		$ 1,200	$ 6,500	$ 7,700	$ 300	$ 5,800	$ 6,100	$ 1,400	$ 12,300	$ 13,800

Calendar Year	Project Year	Floodland and Stormwater Management Total: Capital	Land Rental/Easement Options: Enrollment in Conservation Reserve Program	Purchase of Conservation Easements	Operation and Maintenance: Lower Limit	Upper Limit	Total: Lower Limit	Upper Limit
2003	1	$ 2,497,000	$ 23,000	$ 899,000	$ 382,000	$ 453,000	$ 2,902,000	$ 3,849,000
2004	2	3,118,500	46,000	899,000	394,100	537,100	3,558,600	4,554,600
2005	3	2,968,500	68,000	898,000	401,100	616,100	3,437,600	4,482,600
2006	4	2,497,000	91,000	898,000	402,100	688,100	2,990,100	4,083,100
2007	5	2,496,000	114,000	897,000	403,100	760,100	3,013,100	4,153,100
2008	6	2,091,000	137,000	897,000	404,100	833,100	2,632,100	3,821,100
2009	7	2,092,000	159,000	897,000	413,100	913,100	2,664,100	3,902,100
2010	8	2,091,000	182,000	897,000	413,100	985,100	2,686,100	3,973,100
2011	9	2,091,000	205,000	897,000	414,100	1,058,100	2,710,100	4,046,100
2012	10	2,091,000	228,000	897,000	409,100	1,124,100	2,728,100	4,112,100
2013	11	2,091,000	250,000	897,000	409,100	1,195,100	2,750,100	4,183,100
2014	12	2,091,000	273,000	897,000	410,100	1,268,100	2,774,100	4,256,100
2015	13	2,091,000	296,000	897,000	412,100	1,341,100	2,799,100	4,329,100
2016	14	2,091,000	320,000	897,000	413,100	1,414,100	2,824,100	4,402,100
2017	15	2,091,000	342,000	897,000	413,100	1,486,100	2,846,100	4,474,100
2018	16	2,091,000	365,000	897,000	415,100	1,559,100	2,871,100	4,547,100
2019	17	2,091,000	388,000	897,000	416,100	1,632,100	2,895,100	4,620,100
2020	18	2,091,000	411,000	897,000	416,100	1,703,100	2,918,100	4,691,100
2021	19	2,091,000	433,000	897,000	418,100	1,776,100	2,942,100	4,764,100
2022	20	2,091,000	456,000	897,000	419,100	1,849,100	2,966,100	4,837,100
2023	21	2,091,000	479,000	897,000	420,100	1,921,100	2,990,100	4,909,100
2024	22	2,091,000	502,000	897,000	421,100	1,994,100	3,014,100	4,982,100
2025	23	2,091,000	524,000	897,000	422,100	2,067,100	3,037,100	5,055,100
2026	24	2,091,000	547,000	897,000	423,100	2,139,100	3,061,100	5,127,100
2027	25	2,091,000	570,000	897,000	424,100	2,211,100	3,085,100	5,199,100
2028	26	2,091,000	593,000	897,000	425,100	2,284,100	3,109,100	5,272,100
2029	27	2,091,000	615,000	897,000	426,100	2,356,100	3,132,100	5,344,100
2030	28	2,091,000	638,000	897,000	427,100	2,429,100	3,156,100	5,417,100
Total		$61,671,000	$9,255,000	$25,122,000	$11,566,700	$40,593,700	$82,492,700	$127,386,700
Annual Average		$ 2,202,500	$ 330,500	$ 897,200	$ 413,100	$ 1,449,800	$ 2,946,200	$ 4,549,500

[a] *Costs represent 2002 conditions. 2002 Engineering News-Record Construction Cost Index = 7,710.*

[b] *It is anticipated that obtaining easements on, or purchase of, these lands along with operation and maintenance would be a cooperative effort involving the organizations listed and utilizing grant funds. The restoration may be accomplished as a whole, or in part, through creation of a State Project Area, within which the WDNR could acquire, develop, and manage properties.*

[c] *Cost to establish prairies.*

[d] *Cost to establish wetlands.*

[e] *Cost of floodproofing assigned to private owners. Cost of removal assigned to Kenosha County.*

[f] *Cost to install continuous recording water quality and streamflow gage and for initial Upper Des Plaines River stream channel field surveys and establishment of horizontal and vertical control.*

[g] *Annual cost to maintain streamflow gage.*

[h] *50 percent of cost to install continuous recording water quality and stream flow gage.*

[i] *Beginning of three-year monitoring period following assumed implementation of significant measures to reduce sediment loads to the Des Plaines River.*

Source: SEWRPC.

Table 124

SUMMARY BY CIVIL DIVISION OF BUILDINGS RECOMMENDED TO BE FLOODPROOFED, ELEVATED, OR REMOVED

Civil Division	Number of Buildings[a]		
	Floodproofed	Elevated	Removed
Village of Paddock Lake.................	3 (R)	- -	2 (R)
Village of Pleasant Prairie.............	9 (A) 2 (C) 7 (R)	4 (R)	2 (A) 1 (R)
Town of Brighton	2 (Rec)	- -	- -
Town of Bristol	5 (A) 1 (C) 11 (R)	- -	- -
Town of Mt. Pleasant	2 (R)	- -	- -
Town of Salem	7 (R)	- -	- -
Town of Somers............................	2 (R)	- -	12 (R)
Totals	14 (A) 3 (C) 32 (R) 2 (Rec)	4 (R)	2 (A) 15 (R)

[a](A) denotes uninhabited agricultural structure, (C) denotes commercial structure, (R) denotes residential structure, and (Rec) denotes recreational structure.

Source: SEWRPC.

Floodland Regulations and Flood Insurance

As described in Chapter XV of this report, it is recommended that the Counties, the City of Kenosha, and the villages in the watershed revise and or develop floodland zoning regulations and continue, or begin, participation in the National Flood Insurance Program. The responsible local units of government should submit ordinance revisions to the WDNR and floodplain map revisions to both the WDNR and the Federal Emergency Management Agency. Following review of the information provided by the communities, FEMA should revise Flood Insurance Rate Maps to reflect the floodplain delineations developed under this watershed study. The County coordinators should assist the communities in encouraging that individual property owners purchase flood insurance and in considering whether to apply for reduced flood insurance premiums through participation in the FEMA Community Rating System (CRS) Program.[11] Following implementation of the steps set forth above, each community should coordinate with the Regional Planning Commission to assure that floodplain information is kept current. Such coordination would involve a two-way flow of information from the communities to the Commission and vice versa. The Counties and communities should keep the Commission apprised of new or modified bridges and culverts and of land altering activities that would directly affect the boundaries of the 100-year recurrence interval floodplain and the Commission should notify communities of updated analyses or mapping that would affect floodplain boundaries.

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[11]*The watershed plan could serve as a comprehensive floodplain management plan for which communities can obtain CRS credit.*

Preservation of Environmental Corridors
The recommendations relating to the preservation of environmental corridor lands relate to both the land use-open space preservation plan element and the floodland and stormwater management element. The implementation recommendations for this component were set forth in the previous section on implementation of the land use plan element.

Prairie and Wetland Restoration
It is recommended that the County implementation coordinators actively explore opportunities to attain WDNR State Project Area designation for the recommended prairie and wetland restoration areas. If such designation is achieved, the WDNR should assume the lead role in obtaining, developing, and managing the restoration areas and work with the County implementation coordinators, the U.S. Natural Resources Conservation Service, the Kenosha-Racine Land Trust, local communities, and local landowners to determine the best land acquisition/ easement approach for properties that are considered for wetland and prairie restoration.

Stormwater Management Plans and Regulations
It is recommended that the City of Kenosha; the Villages of Paddock Lake, Pleasant Prairie, and Union Grove; the more-urbanized Towns of Bristol, Dover, Mt. Pleasant, Salem, Somers, and Yorkville coordinate with each other to develop stormwater management plans for the approximate areas shown on Map 86. Those communities, along with Kenosha and Racine Counties, should adopt ordinance requirements that reflect the recommended release rates for runoff from new development within the Des Plaines River watershed. Those release rates are 0.3 cfs per acre for a 100-year storm and 0.04 cfs per acre for a two-year storm. The hydrologic and hydraulic analyses for evaluating pre- and post-development runoff characteristics should utilize the regional rainfall duration-frequency and temporal storm distribution information set forth in SEWRPC Technical Report No. 40 and summarized in Appendix D of this report.[12] In the interim period between adoption of the watershed study and adoption of stormwater ordinance requirements requiring attainment of the recommended release rates, it is recommended that each community and county apply a policy calling for new development to meet the release rate requirements.

As recommended in Chapter XV, the ordinances should be consistent with, or more stringent than, the nonpoint source pollution control standards set forth in Chapter NR 151, Runoff Management, of the *Wisconsin Administrative Code,*[13] including control of construction site erosion. In order to meet the intent of the recommended release rates, while avoiding placing burdensome requirements on small developments, small redevelopments, and small modifications or additions to existing developments, it is suggested that the local ordinances provide an exemption for developments that would create new impervious area less than a certain threshold.

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[12]*SEWRPC Technical Report No. 40,* Rainfall Frequency in the Southeastern Wisconsin Region, *prepared by Eric Loucks, Ph.D., P.E, Camp, Dresser & McKee, Inc.; Charles Rodgers, Ph.D. and Kenneth Potter, Professor of Civil and Environmental Engineering, both of the University of Wisconsin-Madison; and Michael G. Hahn, P.E., P.H. of the Regional Planning Commission staff; April 2000.*

[13]*Chapter NR 152 of the* Wisconsin Administrative Code*, "Model Ordinances for Construction Site Erosion Control and Storm Water Management," can serve as a guide for development of the water quality control sections of the ordinance. That model is consistent with the requirements of Chapter NR 151. The model can be revised to suit each community's needs and to incorporate water quantity controls. An additional model ordinance that could be consulted in developing local ordinances is "September 2002 Model Post-Construction Storm Water Management Ordinance for Communities Served by the Milwaukee Metropolitan Sewerage District," in progress. That model ordinance incorporates elements of the Chapter NR 152 model with a release rate approach similar to that recommended for the Des Plaines River watershed. Another ordinance that incorporates a release rate approach is "Lake County Watershed Development Ordinance," latest amendment August 14, 2001.*

Stream Rehabilitation Along Main Stem of the Upper Des Plaines River
The recommended plan calls for: 1) implementation of urban and rural sediment source control measures; 2) an initial channel clearing and maintenance program for beaver dams, dead falls, and other debris; 3) natural stream rehabilitation, including selected culvert lowering, stream flow and water quality monitoring, and field survey of baseline and subsequent channel cross-sections; and 4) possible use of mechanical sediment removal following evaluation of the effectiveness of the natural processes rehabilitation. It is recommended that the Wisconsin Department of Natural Resources be the lead agency in implementing this component of the plan, and that the Department coordinate the stream rehabilitation with the recommended prairie and wetland restoration projects, assuming State Project Area status is obtained for those restoration projects.

Sediment Source Control
As described in Chapter XV, there has been substantial achievement of the goal for reducing the sediment through agricultural land management, including the development of farm conservation plans and resource management systems. Thus, it is recommended that the local agricultural landowners, with assistance from the U.S. Natural Resources Conservation Service and Kenosha and Racine Counties, continue to implement and maintain programs that will achieve reduction in soil loss.

Initial Channel Clearing and Maintenance
It is recommended that the Kenosha County implementation coordinator work with agricultural landowners, the Kenosha County Departments of Planning and Development and Public Works, and the Town of Paris to coordinate and, if needed, seek outside funding and/or other assistance to carry out the initial channel clearing project and subsequent channel maintenance program.

Monitoring and Stream Cross-Section Survey Component of the Stream Rehabilitation Program
It is recommended that the WDNR 1) initiate the monitoring program, including establishment of a new continuous recording streamflow and sediment monitoring gage in cooperation with the U.S. Geological Survey and 2) collect baseline and annual stream cross section survey data.

Natural Stream Rehabilitation and Possible Future Reevaluation of the Need for Mechanical Sediment Removal
It is recommended that the WDNR work with the Kenosha County implementation coordinator, the agricultural landowners, the Kenosha County Departments of Planning and Development and Public Works, and the Town of Paris to coordinate and, if needed, seek funding and/or other assistance to carry out the culvert lowering and/or replacement needed to enhance the natural stream rehabilitation. It is also recommended that the Department work with this consortium to assess the potential viability and, if found viable, to carry out a series of stream channel interventions which would enhance the natural stream channel restoration process. Such interventions, as described in Chapter XV, would potentially include placement of structures to confine the base flow in selected reaches.

Finally, it is recommended that the Wisconsin Department of Natural Resources coordinate with the U.S. Geological Survey, and others in evaluating the effectiveness of the natural and enhanced stream rehabilitation program over an approximately three-year period and, if needed, reevaluate the need for mechanical sediment removal.

If a need for mechanical sediment removal is identified at that time, it is recommended that the County implementation coordinator investigate the necessary measures to reconstitute the Kenosha County Drainage Board, and that a reconstituted Board undertake the mechanical sediment removal, using funds obtained through assessment of Drainage District residents.

Miscellaneous Structural Measures

Centralized Detention and Storm Sewer Improvements along Unnamed Tributary No. 6 to Brighton Creek

The Village of Paddock Lake should pursue implementation of these recommendations. The initial step in the project would be to carry out preliminary and design engineering to refine and detail the recommendations set forth herein.

Increased Culvert Capacity at 83rd Street along Unnamed Tributary No. 1 to Hooker Lake

The Town of Salem should pursue implementation of this recommendation. The work should be directed by the Town engineer.

Bridge Construction or Replacement

It is recommended that the Wisconsin Department of Transportation and County, City, Village, and Town Departments of Public Works constructing or financing new bridges or replacing existing bridges over the streams in the watershed design and construct such bridges in accordance with the water control facility objectives set forth in Appendix C. The bridges and culverts that were identified as having inadequate hydraulic capacity according to the standards set forth in Appendix C are listed in Table 110.

Miscellaneous Nonstructural Measures

Channel Maintenance

It is recommended that the regular program of stream channel maintenance described in Chapter XV be primarily implemented by the Public Works Departments of the City of Kenosha, the Villages of Paddock Lake, Pleasant Prairie, and Union Grove, and the Towns of Brighton, Bristol, Dover, Paris, Salem, Somers, and Yorkville; the Racine County Drainage Board; and the Town of Mt. Pleasant Stormwater Drainage District. If the Kenosha County Drainage Board were reconstituted, it could assume channel maintenance responsibilities within the boundaries of legally-constituted drainage districts.

Emergency Programs

The County implementation coordinators should work with each community in the watershed to ensure that the most current floodplain map information is available to the community and its residents.

Community Education Programs

The County implementation coordinators should keep the public informed regarding plan implementation through the newsletters and web sites listed in Chapter XV.

Streamflow Gaging

It is recommended that the Illinois Department of Transportation continue to fund half of the operating cost of the continuous streamflow gage on the Des Plaines River at Russell, Illinois as a cooperator with the U.S. Geological Survey, that Kenosha County work with the USGS to install a continuous streamflow gage on the Des Plaines River near its confluence with Brighton Creek, and that the County serve as a cooperator with the USGS, contributing half of the annual costs of operation and maintenance of the gage.

WATER QUALITY MANAGEMENT PLAN ELEMENT

The major water quality management recommendations of the Des Plaines River watershed plan relate to the abatement of point and nonpoint sources of pollution and the conduct of a water quality monitoring program. The recommended actions discussed under this plan element are summarized in Table 121. A schedule of capital and land acquisition costs for this plan element is set forth in Table 125.

Public Sewage Treatment Plants and Associated Sewer Service Areas

It is recommended that the Village of Pleasant Prairie abandon the sewage treatment facilities associated with Sewer Utility District D and Sanitary District No. 73-1. It is recommended that the Kenosha Water Utility

Table 125

SCHEDULE OF CAPITAL, OPERATION AND MAINTENANCE, AND ADMINISTRATIVE AND PLANNING COSTS OF THE WATER QUALITY MANAGEMENT PLAN ELEMENT OF THE RECOMMENDED PLAN FOR THE DES PLAINES RIVER WATERSHED: 2003-2030[a,b]

Calendar Year	Project Year	Private Sector (facilities to serve new urban development): Capital[c]	Operation and Maintenance[c]	Subtotal Capital and Operation and Maintenance[c]	Kenosha County: Costs to Be Borne by County, USDA-NRCS, Municipalities, Lake Districts, and UW-Extension: Administrative and Planning Costs[d]	Racine County: Costs to Be Borne by County, USDA-NRCS, Municipalities, Lake Districts, and UW-Extension: Administrative and Planning Costs[d]	Subtotal Administrative and Planning Costs[d]	Water Quality Management Element Total
2003	1	$ 781,000	$ 8,000	$ 789,000	$ 113,600	$ 8,600	$ 122,200[e]	$ 911,200
2004	2	781,000	16,000	797,000	113,600	8,600	122,200[e]	919,200
2005	3	781,000	24,000	805,000	72,700	5,500	78,200	883,200
2006	4	781,000	32,000	813,000	72,700	5,500	78,200	891,200
2007	5	781,000	40,000	821,000	72,700	5,500	78,200	899,200
2008	6	781,000	48,000	829,000	72,700	5,500	78,200	907,200
2009	7	781,000	56,000	837,000	72,700	5,500	78,200	915,200
2010	8	781,000	64,000	845,000	72,700	5,500	78,200	923,200
2011	9	781,000	72,000	853,000	72,700	5,500	78,200	931,200
2012	10	781,000	80,000	861,000	72,700	5,500	78,200	939,200
2013	11	781,000	88,000	869,000	72,700	5,500	78,200	947,200
2014	12	781,000	96,000	877,000	72,700	5,500	78,200	955,200
2015	13	781,000	104,000	885,000	72,700	5,500	78,200	963,200
2016	14	781,000	112,000	893,000	72,700	5,500	78,200	971,200
2017	15	781,000	120,000	901,000	72,700	5,500	78,200	979,200
2018	16	781,000	128,000	909,000	72,700	5,500	78,200	987,200
2019	17	781,000	136,000	917,000	72,700	5,500	78,200	995,200
2020	18	781,000	144,000	925,000	72,700	5,500	78,200	1,003,200
2021	19	781,000	152,000	933,000	72,700	5,500	78,200	1,011,200
2022	20	781,000	160,000	941,000	72,700	5,500	78,200	1,019,200
2023	21	781,000	168,000	949,000	72,700	5,500	78,200	1,027,200
2024	22	781,000	176,000	957,000	72,700	5,500	78,200	1,035,200
2025	23	781,000	184,000	965,000	72,700	5,500	78,200	1,043,200
2026	24	781,000	192,000	973,000	72,700	5,500	78,200	1,051,200
2027	25	781,000	200,000	981,000	72,700	5,500	78,200	1,059,200
2028	26	781,000	208,000	989,000	72,700	5,500	78,200	1,067,200
2029	27	781,000	216,000	997,000	72,700	5,500	78,200	1,075,200
2030	28	781,000	224,000	1,005,000	72,700	5,500	78,200	1,083,200
Total		$21,868,000	$3,248,000	$25,116,000	$2,117,400	$160,200	$2,277,600	$27,393,600
Annual Average		$ 81,000	$ 116,000	$ 897,000	$ 75,600	$ 5,700	$ 81,300	$ 978,300

[a]*The costs of measures to control nonpoint source pollution from areas of existing development, and refinements to the costs for control of runoff from new development, will be addressed under the recommended detailed stormwater management plans. The controls on runoff from existing and new development are mandated under Chapter NR 151 of the* Wisconsin Administrative Code*, and they would be designed to be consistent with the requirements of Chapter NR 151.*

[b]*The costs of controls on runoff from agricultural lands would be determined under the recommended detailed farm plans.*

[c]*Assumed that the new development provided with nonpoint source controls is evenly distributed over the 28-year planning period. Costs represent 2002 conditions.* Engineering News-Record *Construction Cost Index = 7,710.*

[d]*The base cost in each year was determined from costs in the County Land and Water Resource Management Plans which cover the period from 2001-2004. Those costs were adjusted to year 2002 and apportioned based on the land area of the Des Plaines River watershed in each County. Those administrative costs that could appropriately be applied in the remaining years of the Des Plaines River watershed study planning period were identified and assigned from 2005 through 2030. In cases where the local shares of these costs are not already budgeted for, it is anticipated that grants would be obtained to provide the necessary funding.*

[e]*Includes the costs for developing county-wide ordinances for 1) construction site erosion control, 2) stormwater management from urban development, and 3) establishment of riparian buffers on agricultural lands.*

Source: SEWRPC.

treatment plant serve the areas currently served by those two treatment facilities. It is further recommended that a sewerage system plan evaluation be made to determine the best means of providing for sewage treatment for the Bristol and Paddock Lake sewer service areas, with that plan considering local plant(s) upgrading and expansion alternatives, as well as connection to the Kenosha sewerage system. Such a study could be done as part of the Town of Bristol facility planning program in consultation with Kenosha County, the Village of Paddock Lake, the City of Kenosha, SEWRPC, and the Wisconsin Department of Natural Resources.

Private Sewage Treatment Facilities
For one private sewage treatment plant in Kenosha County—serving the Rainbow Lake Manor Mobile Home Park—and one such facility in Racine County—serving the Hickory Haven Mobile Home Park—it is recommended that consideration be given to connection of the private sewage systems with the nearest public sewerage system when the private plants require significant upgrading in the future. It is recommended that the Wisconsin Department of Natural Resources, under its Wisconsin Pollution Discharge Elimination System (WPDES) and compliance maintenance programs, monitor the status of those two private plants and require that appropriate consideration be given to plant abandonment alternatives as part of the facility planning process when upgrades become necessary.

Operation and Regulation of Public and Private Sewage Treatment Facilities
The operators of public and private plants should continue to implement plant-specific sewerage system facility plans and to control discharges as stipulated in their Wisconsin Pollutant Discharge Elimination System permits issued by the WDNR.

Control of Pollution from Nonpoint Sources
The abatement of nonpoint source abatement measures can best be achieved through implementation of the Land and Water Resource Management Plan (LWRMP) programs for Kenosha and Racine Counties, and participation in the USDA Natural Resources Conservation Service and Farm Services Agency agricultural assistance programs and the WDNR targeted runoff management and urban nonpoint source and stormwater programs. The County implementation coordinators should develop an overall strategy to implement the necessary controls and to involve each of these agencies along with the general public.

Individual landowners are eligible to receive cost-share and technical assistance for nonpoint source pollution abatement measures through the County LWRMP program. This program utilizes funding from DATCP and has provisions for cost-sharing of between 50 and 70 percent of the cost of certain nonpoint source projects provided that the project area is located within an unincorporated region of the County. Practices that are eligible for cost sharing utilizing State funding are presented in Table 126. The NRCS and FSA have several programs designed to help landowners reduce agricultural nonpoint source pollution. These programs typically share 50 to 100 percent of the cost of installation of a best management practice, depending on the type of program. Specific details on USDA Natural Resources Conservation Service and FSA programs are presented in Tables 127 and 128.

Municipalities are eligible for nonpoint source pollution abatement program funding through the WDNR targeted runoff management grant program and the urban nonpoint source and stormwater grant program. Under these programs, projects are evaluated through a competitive process, with a maximum State cost-share rate of up to 70 percent of eligible urban and rural projects. It is recommended that individual landowners and municipalities take advantage of these programs to help reduce the effects of nonpoint source pollution. It is also recommended that the nonpoint source pollution abatement plan be coordinated with local, detailed stormwater management plans for urban and urbanizing subwatersheds.

Subject to the recommendations set forth in each County's land and water resource management plan,[14] it is recommended that the communities within the watershed use a judicious blend of education and regulation to encourage citizens to apply low-cost measures, such as, for urban areas, control of litter and pet waste; proper application of chemical and organic fertilizers and pesticides to lawns and shrubbery, and for rural areas, minimum soil conservation practices. Critical areas of upland, shoreland, and stream bank erosion should be protected in both urban and rural areas.

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[14]*SEWRPC Community Assistance Planning Report, No. 255,* A Land and Water Resource Management Plan for Kenosha County: 2000-2004, *September 2000; and SEWRPC Community Assistance Planning Report, No. 259,* A Land and Water Resource Management Plan for Racine County: 2000-2004, *September 2000.*

Table 126

AGRICULTURAL CONSERVATION PRACTICES ELIGIBLE FOR COST-SHARE FUNDING[a]

Conservation Practice	Description
Manure Storage Systems	Manure storage facility and related practices that environmentally and safely store manure
Manure Storage System Closure	Permanently disabling and sealing a leaking or improperly sited manure storage system
Barnyard Runoff Control Systems	Practices used to contain, divert, retard, or control the runoff from concentrated areas of livestock
Access Roads and Cattle Crossings	Road or path to confine or direct livestock or farm equipment
Animal Trails and Walkways	Travel land to facilitate movement of livestock
Contour Farming	Farming along the established grades with the topography
Critical Area Stabilization	Planting vegetation along steep slopes to stabilize soil and prevent erosion
Cover and Green Manure Crops	Close growing vegetation planted after the primary crop to provide cover on the soil surface during the nongrowing season to retard soil erosion
Diversions	A structure used to divert surface runoff to an area where it can be discharged without causing excessive soil erosion
Field Windbreaks	A strip of trees planted adjacent to a cropped field to reduce the impacts of wind erosion
Filter Strips	A strip of grassed vegetation planted to capture sediment and other contaminants
Grade Stabilization Structures	A structure which stabilizes the grade in a channel and helps to prevent gully erosion
Heavy Use Area Protection	Installation of material to control runoff and erosion in areas subject to concentrated or frequent livestock activity. Can be vegetative, or concrete, stone, or geotextile material
Lake Sediment Treatment	Chemical, physical, or biological treatment of polluted lake sediments
Livestock Fencing	Fencing to prevent livestock from accessing erodible areas or to prevent human access from manure storage structures
Livestock Watering Facilities	A means of supplying water to livestock using either a tank, trough, pipe, well, or other means
Milking Center Waste Control Systems	A containment system used to control the discharge of milkhouse waste
Nutrient and Pesticide Management	Controlling the amount and location of applied plant nutrients and pesticides used in crop production
Prescribed Grazing	A grazing system which divides pastures into multiple cells each of which is grazed intensively and then protected from grazing
Relocating or Abandoning Animal Feeding Operations	Disabling or moving a feedlot that is on an environmentally sensitive site
Residue Management	Maintaining vegetative residue to resist soil erosion
Riparian Buffers	An area in which vegetation is enhanced or established to control sedimentation and discharge of nutrients into surface and groundwater resources
Roofs	A structure that shields an animal lot or manure storage structure from precipitation
Roof Runoff Systems	Facilities designed to collect, divert, and dispose of runoff from roofs
Sediment Basins	Permanent basins designed to capture soil and manure sediment and other debris
Shoreline Habitat Restoration for Developed Areas	Establishment of a shoreline buffer zone of diverse native vegetation that extends inland from the ordinary high water mark
Sinkhole Treatment	Modifying a sinkhole or the adjacent area to reduce erosion, prevent expansion of the hole, and reduce water pollution

Table 126 (continued)

Conservation Practice	Description
Streambank and Shoreline Protection	Use of vegetation or structures to protect streambanks, lakes, and other shorelines from the effects of scour and erosion
Strip-Cropping	Growing alternating crops adjacent to one another in small strips, so that legumes or grasses are planted next to traditional row crops or fallow land
Subsurface Drains	A conduit installed below the surface to collect drainage and convey it to a suitable outlet
Terrace Systems	System of ridges and channels installed on the contour designed to shorten the slope length and reduce the impacts of erosion
Underground Outlets	A conduit installed below the surface to collect drainage and convey it to a suitable outlet
Waste Transfer Systems	The components used to convey manure and milking center wastes to storage structures, loading or treatment areas
Wastewater Treatment Strips	An area of herbaceous vegetation used to remove pollutants from animal lot runoff or wastewater
Water and Sediment Control Basins	An earthen embankment installed across a slope or minor channel to collect water and trap sediment
Waterway Systems	A grassed watercourse that is graded and shaped and is designed to help prevent rill and gully erosion
Well Decommissioning	Permanently disabling and sealing a well to prevent groundwater contamination
Wetland Development or Restoration	The construction of berms or the destruction of tile lines to create conditions suitable for wetland vegetation

[a]*According to Chapter ATCP 50 and Chapter NR 154 of the* Wisconsin Administrative Code*.*

Source: Wisconsin Departrment of Agriculture, Trade, and Consumer Protection; Wisconsin Department of Natural Resource;, and SEWRPC.

The University of Wisconsin-Extension and the land conservation staffs of each County should assist in educating the public about litter and pet waste control and fertilizer and pesticide application. The County implementation coordinators should work with the NRCS and land conservation staffs of each County to provide technical assistance to communities in implementing the specific nonpoint source pollution control measures recommended under this watershed plan. In addition, it is recommended that municipal public works departments examine the manner in which they conduct current practices such as street sweeping, lawn maintenance, and application of deicing materials, to promote control of nonpoint source pollution. Each community in the watershed should ensure that its local ordinances address the control of accidental spills, the disconnection of building floor drains from surface water drainage systems, and the development of spill prevention and control plans.

The Counties should continue to implement their onsite sewage disposal programs, including consideration of recent changes to Chapter Comm 83 of the *Wisconsin Administrative Code*.

Continuing Water Quality Monitoring Program

It is recommended that the WDNR, in cooperation with the Regional Planning Commission and the major units of government in the Des Plaines River watershed, develop and implement a continuing water quality monitoring program. Such a program would demonstrate and document the changes in surface water quality attendant to implementation of the Des Plaines River watershed plan and would help detect, locate, and control future sources of pollution. It is also recommended that the George, Hooker, and Paddock Lake Protection and Rehabilitation Districts and the Lake Shangri-La Management Association continue to collect water quality data under the WDNR Self-Help Lake Monitoring Program.

Table 127

CHARACTERISTICS OF USDA FINANCIAL ASSISTANCE PROGRAMS

Program	Contract Length	Sign-Up Period	Cost-Share	Rental or Tillage Payments	Practices Suitable for Program	Amount of Land
Conservation Reserve Program (CRP)	10 or 15 years	Continuous or once a year	50 percent	A specified dollar amount per acre based upon soil type	Permanent pasture, buffer strips, grassed waterways, windbreaks, trees	Small sensitive areas along stream corridors to large tracts of land
Environmental Quality Incentive Program (EQIP)	Five to 10 years	Twice a year	Up to 75 percent	$18.50 per acre for three years	Livestock waste management, erosion and sediment control, habitat improvement, groundwater protection	Designed for the whole farm, not just small areas of the farm
Wildlife Habitat Incentives Program (WHIP)	10 years	Continuous	Up to 75 percent	- -	Instream structures for fish habitat, prairie restoration, wildlife travel lanes, wetland scrapes	Site- and species-specific; small to large areas
Wetland Reserve Program (WRP)	10 years, or 30-year and permanent easements	Continuous	Up to 100 percent	Variable; up to $1,000 per acre of assessed value if placed into a permanent easement (one time payment)	Wetland restoration	Variable

Source: U.S. Department of Agriculture Natural Resources Conservation Service and SEWRPC.

FISHERIES MANAGEMENT PLAN ELEMENT

It is recommended that the County implementation coordinators work with the WDNR to secure funding for the recommended subwatershed-level fishery management plans and that the coordinators work with the municipalities that will be developing detailed stormwater management plans to accomplish fisheries management planning in conjunction with stormwater management planning.

FINANCIAL AND TECHNICAL ASSISTANCE

Following adoption of the recommended land use, park and open space, floodland management, water quality management and fisheries management plan elements of the comprehensive plan for the Des Plaines River watershed, it is important for the units of government within the watershed to effectively utilize all available sources of financial and technical assistance for the timely execution of the recommended plan. In addition to using current tax revenue sources, such as property taxes, fees, fines, public utility earnings, highway aids, and State-shared taxes, the local units of government can make use of such revenue sources as borrowing, special taxes and assessments, establishment of stormwater utilities, State and Federal grants, and gifts.

Table 128

CONSERVATION PRACTICES AND AVAILABLE USDA PROGRAMS

Conservation Practice	CRP	EQIP	WRP	WHIP
Vegetative Buffers or Riparian Buffers	X	X	- -	- -
Grassed Waterways	X	- -	- -	- -
Contour Grass Strips	X	- -	- -	- -
Permanent Pasture	X	X	- -	- -
Conservation Tillage	X	X	- -	- -
Conservation Cropping	- -	X	- -	- -
Contour Farming	- -	X	- -	- -
Cover Crops	- -	X	- -	- -
Diversions	- -	X	- -	- -
Fish Habitat Improvement	- -	X	- -	X
Windbreaks	X	X	- -	- -
Nutrient Management	- -	X	- -	- -
Pest Management	- -	X	- -	- -
Wetland Restoration	- -	X	X	- -
Stream Fencing	- -	X	- -	- -
Manure Management	- -	X	- -	- -
Upland Habitat	- -	X	X	X
Wetland Habitat	- -	X	X	X
Wildlife Ponds	X	X	X	- -

Source: U.S. Department of Agriculture Natural Resources Conservation Service and SEWRPC.

Various types of technical assistance useful in plan implementation are also available from County, State, and Federal agencies. The type of assistance available includes possible State and Federal cost-share funding for floodland management and nonpoint source pollution control projects; technical advice on land and water management practices provided by the NRCS staff and County land conservation staff; and educational, advisory, and review services offered by the University of Wisconsin-Extension Service and the Regional Planning Commission.

Borrowing

Local units of government are normally authorized to borrow so as to effectuate their powers and discharge their duties. Chapter 67 of the *Wisconsin Statutes* generally empowers counties, cities, villages, and towns to borrow money and to issue municipal obligations not to exceed five percent of the equalized assessed valuation of their taxable property, with certain exceptions, including school bonds and revenue bonds. Such borrowing powers which are related directly to implementation of the comprehensive Des Plaines River watershed plan include the following:

1. Counties may issue bonds for County park and related open space land acquisition and development.

2. Cities and Villages may borrow and issue bonds for the construction of water supply and distribution systems and the construction of sewage treatment plants, and for park and related open space land acquisition and development.

Special Taxes and Assessments

Counties and cities have special assessment powers for park and parkway acquisition and improvements under Sections 27.065 and 27.10(4), respectively, of the *Wisconsin Statutes.* Counties are empowered under Section 27.06 of the *Wisconsin Statutes* to levy a mill tax to be collected and placed into a separate fund and to be paid out only upon order of the County Park Commission for the purchase of land and other Commission expenses. Farm drainage boards, town sanitary districts, metropolitan sewerage districts, cities, and villages also have taxing and special assessment powers under Sections 88.35, 33.32 (5), 200.13(1), 66.0827(2), and 62.18(16) of the *Wisconsin Statutes.*

Grant and Loan Programs

The identification of potential funding sources, including sources other than solely local-level sources, is an integral part of the implementation of a successful plan. The following description of funding sources includes those that appear to be potentially applicable as of the year 2003. Funding programs and opportunities are constantly changing. Accordingly, the involved local staffs need to continue to track the availability and status of potential funding sources and programs. It is intended that this list facilitate the implementation of the recommended activities set forth in this watershed management plan. Some of the programs described herein may not be available under all envisioned conditions for a variety of reasons, including local eligibility requirements or lack of funds at a given time in Federal and/or State budgets. Nonetheless, the list of sources and programs should provide a starting point for identifying possible funding sources for implementing the watershed plan recommendations.

There are numerous grant and loan programs offered through both public and private sources for many aspects of plan implementation. Table P-1 in Appendix P summarizes many of the major grant and assistance programs that are available to municipalities and individuals under the areas of floodland mitigation, wildlife and fish habitat, water quality, land acquisition for park and open spaces, and other areas such as education and sustainable development that have the potential to indirectly affect the quality of the water resources of the watershed. Appendix Q lists contacts for details about grant programs.

Floodland Management Funding Sources

There are several agencies and funding sources available to the County, the Villages and the Towns for financing a local floodland management program. Those agencies and their programs are described below.

Federal Emergency Management Agency Programs

The Federal Emergency Management Agency funds the Pre-Disaster Mitigation, Hazard Mitigation Grant, Flood Mitigation Assistance (FMA), and Public Assistance Programs. In the State of Wisconsin the programs are administered through the Wisconsin Department of Military Affairs, Division of Emergency Management. According to the requirements of the Federal Disaster Assistance Act of 2000, in order for a community to receive funding under the Hazard Mitigation Grant, Pre-Disaster Mitigation, or Flood Mitigation Assistance Programs, it must have an approved All Natural Hazards Mitigation Plan in place by November 2004. The Community Rating System is a FEMA program directed towards improving management of floodlands. These programs are described below.

HAZARD MITIGATION GRANT PROGRAM

The Hazard Mitigation Grant Program (HMGP) can provide up to 75 percent of the costs attendant to the floodproofing or acquisition and relocation of flood-prone properties, or to the elevation of structures in compliance with National Flood Insurance Program (NFIP) standards. Under the HMGP, the balance of the costs is shared by the State of Wisconsin (12.5 percent) and the grantee (12.5 percent). Communities in Wisconsin can apply through the State for HMGP funds only after a Presidential disaster declaration is issued for an area in the State. The total amount of funds provided equals 20 percent of the total monetary damages resulting from the disaster.[15] HMGP funds must be applied for within 60 days of the declaration. The State, as HMGP grantee, is responsible for identifying and prioritizing projects. Eligible projects must be included as part of the grantee’s flood mitigation plan and must meet cost-benefit criteria established by FEMA. Although State and local units of government are eligible applicants, HMGP funds can be provided to individuals for eligible projects. The HMGP gives priority to properties identified by FEMA as repetitive-loss properties.

[15] *That percentage is subject to periodic change by Congress.*

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation Program (PDMP) can provide up to 75 percent of the costs for the following types of flood hazard mitigation undertaken by states and municipalities:

- Acquisition and relocation of flood-prone structures,
- Floodproofing,
- Minor structural projects, and
- Flood control projects such as ring levees and floodwalls to protect critical facilities.

This program does not require a Presidential disaster declaration, thus it encourages proactive mitigation activities to avoid damages in identified flood hazard areas.

Flood Mitigation Assistance Program

The Flood Mitigation Assistance program can potentially provide up to 75 percent of the costs attendant to the acquisition, relocation, elevation, or floodproofing of structures insured under the NFIP. The balance of the cost is expected to be met by local funds. In addition to participating in the NFIP, eligible program applicants must meet cost-benefit criteria established by FEMA. There are two types of grants available for projects: planning grants and project grants. In order to be eligible for a project grant, communities must have a flood mitigation plan.

Public Assistance Program

The Public Assistance Program can provide some limited assistance with respect to structure elevation and relocation. For example, if entire portions of a community were to be relocated outside of a floodplain, this program can assist in rebuilding the necessary infrastructure in the new location. Funding under this program is provided for repair of infrastructure damaged during a flood that results in a Presidential disaster declaration. If a community determines that a badly damaged facility is not to be repaired, the estimated damage amount may be used to fund hazard mitigation measures.

Community Rating System

Discounts may be obtained on Federal flood insurance premiums depending on community activities relative to public information, mapping and regulations, flood damage reduction, and flood preparedness.

U.S. Army Corps of Engineers Programs

The following Corps of Engineers programs are potential sources of funding for implementing the floodland management recommendations of this plan, subject to projects meeting Corps economic feasibility criteria.

Water Resources Development and Flood Control Acts

These two congressional acts contain several individual programs that can be used for flood mitigation projects. Some of the programs involved include the following: Small Flood Control Projects Program; Snagging and Clearing for Flood Control Program; and the Emergency Bank Protection Program. Projects that could be potentially funded include small flood control practices, clearing channels of debris and snags, bank protection measures from flood induced conditions, emergency streambank and shoreline protection, and water resources planning assistance. Federal cost-share assistance is available for 50 to 75 percent of the cost of implementation depending on the project, requiring a 25 to 50 percent local match.

Flood Hazard Mitigation and Riverine Ecosystem Restoration Program

This program was recently created, and it provided funding opportunities for the first time in 2001. This program can provide up to 50 percent cost-sharing for floodland management studies and up to 65 percent for project implementation. The program was specifically designed to look at alternative floodland mitigation measures that are designed to help restore a riverine ecosystem. Eligible projects can include relocation of threatened structures, conservation or restoration of wetlands and natural floodwater storage areas, and planning activities to determine future responses to flood situations.

U.S. Department of Agriculture

Traditionally, the U.S. Department of Agriculture through the NRCS has been known for agricultural, soil conservation, and wildlife habitat programs. However, the USDA also has three programs designed to help mitigate flooding problems. These programs are described below.

Watershed Protection and Flood Prevention Program

This program is designed for smaller watersheds which do not exceed 250,000 acres in size. The program provides for cost-share funding for large-scale projects that are designed to prevent flooding and protect the watershed. Projects implemented by State and local units of government are typically eligible for Federal funding typically ranging from about $3.5 to $5.0 million; in addition, technical assistance is also provided. Eligible projects could include wetland restoration, flood prevention, water supply, erosion and sediment control, water quality, and fish and wildlife habitat enhancement.

Emergency Watershed Protection Program

This program was designed to help mitigate cropland flooding by removing farmland from production in areas that are in floodplains and have a history of repeated flooding. The landowner retains most of the property rights associated with ownership, however, the USDA has the authority to restore the floodplain to its original function and value. Individual landowners must have a sponsor such as a local unit of government and are eligible for one of three types of payments for land taken out of production. Those options include payment based on a geographic rate, payment based on an assessment from crop productivity, and payment based on a sale price suggested by the landowner. Landowners are eligible to receive up to 75 percent of the cost of the appraised value of the land in Federal cost-share assistance, with the remaining 25 percent, expected to be matched by the landowners local sponsor.

Emergency Conservation Program

This program is designed to help agricultural producers restore land conditions to post-flooding or post-disaster conditions. Individual landowners are eligible for up to 64 percent Federal cost-share funding for projects such as regrading and shaping farm fields, removing and redistributing to uplands eroded soil that has been deposited in downslope areas, clearing debris, and restoring conservation practices. This funding is available only when there has been a declared disaster such as a flood event.

U.S. Department of Housing and Urban Development

Community Development Block Grant Program

Under this program, funds to address long-term needs as well as emergency response activities are provided following a Presidential disaster declaration. Eligible projects can receive from 75 to 100 percent Federal cost-share assistance, with the remainder expected to come from local funds.

U.S. Small Business Administration Programs

The U.S. Small Business Administration (SBA) provides disaster loans to homeowners and businesses to repair or replace property damaged in a declared disaster. SBA loans are granted only for uninsured losses. Loans may be used to meet required building codes, such as the NFIP requirements. SBA may also provide loans for involuntary relocations out of special flood hazard areas when such relocations are required by local officials. While SBA's enabling legislation generally prohibits the agency from making disaster loans for voluntary relocations, there are exceptions that can be made, including relocations of homeowners, renters, and business owners out of a special flood hazard area. These loans would be limited to the amount necessary to repair or replace the damage at the disaster site. SBA loans may also be used to refinance existing mortgages.

Wisconsin Department of Natural Resources
Chapter NR 199, "Municipal Flood Control Grants," of the Wisconsin Administrative Code became effective on November 1, 2001. NR 199 establishes a grant program to mitigate flood damage and to prevent future damage. The specifics of this program are detailed below.

MUNICIPAL FLOOD CONTROL GRANTS
Under Chapter NR 199, municipalities, including cities, towns, and villages, as well as metropolitan sewerage districts are eligible for cost-sharing grants from the State for projects such as acquisition and removal of structures; floodproofing and elevation of structures; riparian restoration projects; acquisition of vacant land, or purchase of easements, to provide additional flood storage or to facilitate natural or more efficient flood flows; construction of facilities for the collection, detention, retention, storage, and transmission of stormwater and groundwater for flood control and riparian restoration projects; and preparation of flood mapping projects. Municipalities and metropolitan sewerage districts are eligible for up to 70 percent State cost-share funding for eligible projects, and would have to provide at least a 30 percent local match. Applications are due on July 15 of each calendar year.

Wildlife and Fish Habitat Funding Sources
There are several recommendations that would improve fish and wildlife habitat within the plan. In order to successfully implement these recommendations, obtaining funding sources from various programs is essential. Many agencies have programs designed for enhancing wildlife and fish habitat that provide both funding and technical assistance. These agencies and their programs are described below.

U.S. Fish and Wildlife Service
The U.S. Fish and Wildlife Service (FWS) funds several programs for wildlife and fish habitat improvement. These programs are described below.

WILDLIFE CONSERVATION AND APPRECIATION PROGRAM
The Wildlife Conservation and Appreciation program was designed 1) to identify specific fish and wildlife habitat concern areas and ways to protect and conserve wildlife species and their habitats, and 2) to help facilitate a greater appreciation and enjoyment of the public for fish and wildlife through nonconsumptive uses. State fish and wildlife agencies and private organizations and individuals through those agencies are eligible for cost-share funding for eligible practices. The program is competitive, as the funding is somewhat limited. Total funding available for this program has been approximately $768,000 annually.

PARTNERS FOR FISH AND WILDLIFE HABITAT RESTORATION PROGRAM
This program was developed to help assist individual landowners with habitat restoration by providing cost-share and technical assistance. Landowners are eligible for assistance on projects such as restoration of degraded wetlands, prairie restoration, and stream and riparian restoration. Individuals must sign a 10 year contract with the FWS to receive a maximum amount of $25,000 in Federal cost-share funds. In addition to funding, technical assistance is also provided.

PARTNERSHIP FOR WILDLIFE
The Partnership for Wildlife program is administered by the FWS but also receives funds from the National Fish and Wildlife Foundation (NFWF) and other sources to help fund this program. The FWS contributes $768,000 nationwide annually to this program, which is expected to be matched by State and private sources. State and local agencies, private nonprofit organizations, and individuals are eligible to receive funding for approved projects. This program is specifically designed to help restore habitat and protect nongame fish and wildlife species.

North American Wetlands Conservation Fund[16]

This program was designed to help conserve wetlands that are critical to migratory waterfowl. State and public agencies are eligible to apply for funding for projects that include land acquisition for the protection of wetlands that migratory birds and other animals are dependent upon, wetland restoration, and habitat restoration. Eligible projects can receive up to 50 percent Federal cost-share assistance.

Landowner Incentive Program

This program is intended to provide technical or financial assistance for private landowners to protect and restore habitat to benefit Federally-listed, proposed, candidate, or other at-risk species. Program applications are submitted by State and Tribal governments and Territorial agencies.

U.S. Department of Agriculture, Natural Resources Conservation Service

The Federal government, through the U.S. Department of Agriculture NRCS offers programs which are directed at restoring wildlife habitat and reclaiming wetlands that have been in agricultural use. There are three programs available to the agricultural producer and landowner that can help to offset the cost of implementing wildlife habitat restoration practices, and one program that is available to State and local units of government. The USDA's programs for use in wildlife protection are described below.

Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program is directed towards protecting habitat for specific targeted species of wildlife. This program applies to upland, lowland, and aquatic species of wildlife. For example, a producer could establish a continuous travel lane for wildlife along a fence row, which would also function to reduce soil erosion. Additionally, if a producer or owner had property that was not in production due to wetness problems, a wetland scrape or wildlife pond could be established. This program would also be suitable for restoration of fish habitat in the Des Plaines River watershed. The USDA will cost-share up to 75 percent of the installation practices for approved structures. The length of the contract is 10 years. It is the land owner's responsibility to maintain the structures over the life of the contract.

Wetland Reserve Program

The Wetland Reserve Program is a program that is well suited to marginal cropland in the floodplain areas of the Des Plaines River. This program is targeted towards lands that historically were wetlands, have since been cultivated or drained for agricultural production, and, thus, are classified by the NRCS as farmed wetlands or prior converted croplands. This program would be a viable option for landowners that have farmland that is subject to routine flooding over the years, or is consistently wet. However, the land must be restorable to its original wetland condition. Under this program, the landowner retains full privileges for the use and enjoyment of the property, and the land remains in his private ownership. No crop production on the land is permitted over the term of the easement; however, haying, grazing, and timber harvesting may be allowed, depending on the requirements of the wetland reserve plan of operation agreed to by the owner and the NRCS. Currently, the following three options are available to landowners participating in the WRP:

- The first option is a 10-year agreement under which the landowner is eligible to receive Federal funds covering up to 75 percent of the restoration cost. No easements would be placed on the property, however, the landowner would be responsible for maintaining the restored wetland.

- The second option involves a 30-year easement. Under this option the landowner receives a one-time payment equal to 75 percent of the assessment for the land taken out of production. The maximum assessed value of the land under this program is $1,000 per acre. The USDA also pays for the full restoration cost and associated titling fees.

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[16] *In Wisconsin, the WDNR Bureau of Wildlife Management assists with this program, and private organizations such as Ducks Unlimited and the Kenosha/Racine Land Trust may also be candidates to implement projects funded under this program.*

- The final WRP option involves the establishment of a permanent easement. In this situation, the landowner receives 100 percent of the assessment, up to a maximum of $1,000 per acre, and the USDA also pays for the full restoration cost and associated titling fees.

Once the cropland has reverted back to a wetland, there should be an associated tax decrease on the property. This would be especially true for the 30-year and permanent easements.

Watershed Protection and Flood Prevention Program
This program was described in the previous section under Floodland Mitigation Funding Sources. The program is funded through the USDA and has the potential to fund a wide variety of watershed-based projects including wildlife and fish habitat restoration.

U.S. Army Corps of Engineers
The U.S. Army Corps of Engineers has one program designed to restore habitat. The Aquatic Ecosystem Restoration Program is part of the Water Resources Development Act. This program is described below.

Aquatic Ecosystem Restoration Program
This program allows for State and local levels of government to restore degraded aquatic systems so that they are returned to a more natural condition. Eligible projects can receive up to 65 percent Federal cost-share assistance, with a maximum Federal cost-share amount of $5,000,000. However, grant recipients are responsible for maintenance after the project is completed.

U.S. Environmental Protection Agency
The EPA Five Star Restoration Program could be used in restoration of habitat for wildlife. This program is further described below.

Five-Star Restoration Program
The Five-Star Restoration program was designed to bring public and private organizations together to support community based restoration projects. The EPA has a total funding level of approximately $500,000 annually for this program of which individual projects could be eligible to receive up to $20,000 in Federal funding. In addition, technical assistance is also provided. Potential projects must have at least five contributing partners and must be part of a larger watershed and have community support. Eligible projects include wetland and riparian restoration.

Wisconsin Department of Natural Resources
The Department of Natural Resources administers the Stewardship Incentives Program for the protection of forestry resources. This program is funded utilizing USDA, Forest Service funding. The details of this program are described below.

Stewardship Incentives Program
The Stewardship Incentives Program is designed to help individual landowners maintain private tracts of woodland for several purposes. Individual landowners are eligible to receive up to 65 percent Federal cost-share assistance with a maximum of $5,000 for individual projects. Potential projects could include reforestation, forest improvement, tree planting, development of a forest management plan, and wildlife and fisheries habitat improvement such as travel corridors, nest boxes, and stream habitat enhancements.

National Audubon Society, Upper Mississippi River Campaign
The National Audubon Society has begun a recent campaign that focuses on the Upper Mississippi River Basin. The Stewardship program is a highly competitive program with limited funding available, but could potentially provide some financial assistance for implementing plan recommendations. The details of the program are further described below.

Stewardship Program
The Stewardship program is designed for local communities and nonprofit organizations to apply for some financial assistance for projects that will improve the overall water quality and wildlife habitat of the Upper Mississippi River and its tributaries. Eligible projects could include wetland restorations, educational endeavors, and establishing wildlife travel areas in riparian corridors. The maximum amount of funding available for a given project is $5,000.

National Fish and Wildlife Foundation
The National Fish and Wildlife Foundation offers the following program designed to improve fish and wildlife habitat.

Challenge Grant Program
The Challenge Grant program is made available to units of government, educational institutions, and nonprofit organizations for the enhancement of wildlife habitat. Projects most likely to receive funding would be those that focused on restoring and protecting habitat on private lands, conservation educational programs, and programs that work to develop sustainable communities through conservation. The program provides 50 percent cost-share assistance for eligible projects, provided that the remaining match comes from non-Federal sources. The average funding level for a project is between $25,000 and $75,000.

Water Quality Funding Sources
There are several sources of funding that can potentially be used for carrying out the water quality management recommendations of this plan. The principal agencies that offer funding programs to enhance water quality include the Wisconsin Department of Natural Resources; the Wisconsin Department of Agriculture, Trade and Consumer Protection; the U.S. Department of Agriculture; and the U.S. Environmental Protection Agency. The major funding programs available for plan implementation are described below.

Wisconsin Department of Agriculture, Trade and Consumer Protection
The Wisconsin Department of Agriculture, Trade and Consumer Protection is one of the State's primary funding agencies for agricultural nonpoint source pollution guidance and funding. There are two forms of DATCP funding that can be utilized in implementing the recommendations of the Des Plaines River watershed plan. They are: 1) the land and water resource management program and 2) the farmland preservation program. There is cost-share funding available to landowners for agricultural best management practices through the land and water resource management plan program, and there is a tax incentive associated with the farmland preservation program. These programs are further described below.

Land and Water Resource Management Program
In 1997, Wisconsin Act 27 was passed and Chapter 92 of the *Wisconsin Statutes* was revised. This change in Wisconsin State Law initiated a redesign of the State's nonpoint source pollution abatement program. As a result of this redesign, Chapter ATCP 50 of the *Wisconsin Administrative Code* requires each county in Wisconsin to develop a land and water resource management plan to address both rural and urban nonpoint source problems. Upon development of these plans, counties become eligible to receive cost-share funding for land conservation practices, as well as funding for staff. In September of 2000, both Racine and Kenosha Counties completed their land and water resource management plans,[17] and as a result, have access to cost-share funding for rural best management practices. Chapter NR 153, " Targeted Runoff Management Grant Program," of the *Wisconsin Administrative Code* establishes administrative procedures for that program. Chapter NR 154, "Best Management Practices, Technical Standards and Cost-Share Conditions," sets forth cost-share conditions for eligible agricultural best management practices. Chapter NR 155, "Urban Nonpoint Source Water Pollution Abatement and Stormwater Management Grant Program" establishes administrative procedures for that program which are specifically designed to address urban nonpoint source abatement issues. The maximum amount of funding available to landowners and local units of government is 70 percent of the cost of the project. Although in the case

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[17]*SEWRPC Community Assistance Planning Report, No. 255, op. cit.; and SEWRPC Community Assistance Planning Report, No. 259, op. cit.*

of proven financial hardship for individual landowners, up to 90 percent of the cost of an approved project can be funded. A comprehensive list of agricultural best management practices eligible for cost-share funding is presented in Table 126.

Farmland Preservation Program

The farmland preservation program has been available to farmers since the early 1970s. At present, the program is set up to be a property tax incentive for agricultural landowners who have adopted, and who follow, a farm management plan to reduce farm erosion to the "tolerable" soil loss rate referred to as the "T-value." This plan is developed between the landowner, producer, and the county conservationist. This program is not directly related to any Federal programs and must have a separate farm plan on file with the county. The tolerable soil loss rates are established by the Federal government for individual soil types. In the Des Plaines River watershed, the typical T factor is between three and five tons of soil loss per acre per year. If the landowner decides to leave the program, he must wait a period of 10 years before he can rezone the property out of agriculture, or he will have to repay the tax incentives he received over the years. The increasing urban growth taking place in portions of Kenosha and Racine Counties has created pressure to rezone and develop agricultural land, making it difficult to achieve high levels of participation in the program.

Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources administers eight grant programs that may serve as potential funding sources for water quality improvement efforts. These programs include Lake Protection grants, Lake Planning grants, Stewardship grants, Urban Rivers grants, Targeted Runoff Management grants, Urban Nonpoint Source and Storm Water grants, River Protection grants, and the Stewardship Incentives Program. These programs are further described below.

Lake Protection Grant Program

The Lake Protection Grant program was designed to assist local governments, lake districts and associations, and other nonprofit organizations in improving and protecting water quality in lakes. The funding that is available is a 75 percent State cost-share, with a 25 percent local match. Cost-share funding for any one project cannot exceed $200,000. The types of projects that are eligible for cost-share assistance include land acquisition for easement establishment, wetland restoration, and various lake improvement projects such as those involving pollution prevention and control, diagnostic feasibility studies, and lake restoration.

Lake Planning Grant Program

The Lake Planning Grant program was designed to assist local governments, lake districts and associations, and nonprofit organizations with funding for activities that are involved with planning aspects of lake management. Organizations are eligible to receive up to 75 percent State cost-share funding with a maximum of $10,000 for individual projects. For each lake receiving funding under this program, there is a maximum funding level of $100,000 for different projects. The types of projects that are eligible for funding include developing a lake management plan, compiling and interpreting water quality data for waterbodies, describing adjacent land use, reviewing jurisdictional boundaries and evaluating ordinances that relate to zoning, and gathering and analyzing information from lake property owners and lake users.

Stewardship Grant Program

The administrative rules for the State of Wisconsin Stewardship Grant Program are set forth in Chapters NR 50 and 51 of the *Wisconsin Administrative Code.* The WDNR's Urban Green Space (UGS) program which is a component of the Stewardship Grant Program provides 50 percent matching grants to cities, villages, towns, counties, public inland lake protection and rehabilitation districts, and qualified nonprofit conservation organizations for the acquisition of land. Funding for streambank protection projects may also be available through the Stewardship program.

Urban Rivers Grants Program

The WDNR's Urban Rivers Grants Program (URGP) provides 50 percent matching grants to municipalities to acquire lands, or rights to land, on or adjacent to rivers that flow through urban areas. This program is intended to preserve or restore urban rivers or riverfronts for the purposes of economic revitalization and the encouragement of outdoor recreational activities.

Targeted Runoff Management Grant Program

The Targeted Runoff Management Grant program (see Chapter NR 153 of the *Wisconsin Administrative Code*) has had limited funds in the past; however, it is expected that this will become a more viable source for funding as priority watershed projects close and those funds and a portion of those funds are redirected towards this program. Local units of government and lake districts and associations are eligible to receive up to 70 percent of State cost-share dollars provided that there is a 30 percent local match. Rural projects have a maximum cap of $30,000 and urban projects have a maximum cap of $150,000. Potential projects could include installing practices that ensure compliance with the State nonpoint source performance standards as set forth in Chapter NR 151, improving threatened or impaired waters as designated under Section 303(d) of the Federal Clean Water Act, protecting outstanding water resources, complying with a notice of discharge from animal feeding operations, and addressing water quality concerns for a waterbody of national or statewide importance such as the Upper Mississippi River.

Urban Nonpoint Source Water Pollution Abatement and Storm Water Management Grant Program

This program, which is set forth in Chapter NR 155 of the *Wisconsin Administrative Code,* assists municipalities in designated urban areas[18] with designing and implementing urban nonpoint source best management practices. The program will fund eligible technical assistance and planning costs to a maximum of 70 percent and includes projects such as ordinance development and enforcement, educational activities, and planning and design activities. In addition, construction costs of best management practices are also eligible for up to 50 percent cost-share. Eligible projects could include detention basins, streambank stabilization, and shoreline stabilization. There is no maximum project limit for this grant program.

River Protection Grant Program

Recently, the WDNR developed a new program, which is set forth in Chapter NR 195 of the *Wisconsin Administrative Code* to fund activities related to the protection of rivers. The River Protection Grant program was designed to financially assist local governments and nonprofit conservation organizations to protect river ecosystems. Eligible projects can receive up to 75 percent State cost-share, provided that there is a 25 percent local match. Potential projects are varied and could include activities designed to develop partnerships, educational endeavors, developing a river management plan, land acquisition, ordinance revision and development, and installation of practices to control nonpoint source pollution.

Stewardship Incentives Program

The Stewardship Incentives Program is designed to help individual landowners maintain private tracts of woodland. Individual landowners are eligible to receive up to 65 percent Federal cost-share assistance with a maximum of $5,000 for individual projects. Potential projects could include riparian buffer establishment and wind break and hedgerow establishment.

U.S. Department of Agriculture

The USDA funds several programs designed to help improve water quality. There are five programs that could potentially be used to help implement water quality recommendations set forth in this plan. Those programs include Water and Waste Disposal Systems for Rural Communities, the Water Quality Special Research Grants Program, the Watershed Protection and Flood Prevention Program, the Conservation Reserve Program, and the Environmental Quality Incentives Program. These programs are described below.

Water and Waste Disposal Systems for Rural Communities

The USDA provides assistance to rural communities and local levels of government by providing a funding program designed to help ensure that safe water supplies are provided to communities and that waste disposal systems in those communities are maintained properly. Eligible candidates for funding include municipalities,

[18] *Defined as an area having population density of greater than 1,000 people per square mile.*

counties, local units of government, and nonprofit corporations. Federal funding is provided both in the form of grants and loans. Grants and loans range in size from a few thousand dollars to over a million dollars. Eligible projects include the installation, expansion, or repair of rural water supply facilities and rural waste disposal facilities.

Watershed Protection and Flood Prevention Program

This program was described in the previous section under Floodland Mitigation Funding Sources. The program is funded through the USDA and has the potential to fund a wide variety of watershed based projects including watershed protection activities and erosion and sediment removal.

The Conservation Reserve Program

The Conservation Reserve Program was enacted to protect lands which are sensitive to erosion and to take land along riparian corridors out of agricultural production and place the land into long-term vegetative cover for a period of 10 to 15 years. Land is eligible for inclusion under the program if it has been in agricultural production for at least two of the preceding five years and the applicant has owned the property for at least one full year. Some of the practices that are eligible for CRP funding include riparian buffer strips, permanent pasture, windbreaks, grassed waterways, and contour grass strips. The USDA pays an annual rental rate for the land taken out of production for these practices, based upon soil type. Additionally, it will also cost-share 50 percent of the expenses for the establishment of these conservation practices.

At present, there are two types of CRP enrollments: general CRP and continuous CRP. The general CRP enrollment is geared for larger tracts of land, and is a competitive process. Landowners have a six-week window, once a year, to apply for a set amount of funding. Continuous CRP is not competitive, and is targeted towards smaller, more sensitive tracts of land, such as riparian lands, or lands susceptible to ephemeral or gully erosion. Additionally, landowners can apply for this type of CRP throughout the year.

Conservation Reserve Enhancement Program

The Conservation Reserve Enhancement Program (CREP) is an outgrowth of the CRP that is designed to protect water quality and improve wildlife habitat through the establishment of filter strips, riparian buffers, grassed waterways, and, in designated grassland project areas, the establishment of permanent introduced or native grasses. The program also involves the development and restoration of wetlands. Funding for the program may come through the USDA Farm Service Agency; the Wisconsin Department of Agriculture, Trade and Consumer Protection; and private conservation organizations. Eligibility and contract requirements are similar to those for the CRP; however, the CREP is targeted at areas where it has been determined that the benefits of program implementation are most needed. In the Des Plaines River watershed, the Towns of Dover, Mt. Pleasant, and Yorkville are all designated as riparian project areas. There are no designated grassland project areas in the watershed.

Environmental Quality Incentive Program

Federal cost-sharing funds available under this program have primarily been targeted towards areas of the State outside the Des Plaines River watershed. However, there is some funding available that can be directed towards whole farm planning and conservation management within the watershed. This program is highly competitive, so the more conservation practices a producer incorporates on his farm, the more likely he will be eligible for funding. EQIP focuses on several areas, including animal waste management; soil erosion and sediment control, which encompasses nutrient management and conservation tillage; habitat improvement; and groundwater protection.

If a farm is eligible for EQIP funding, the USDA will cost-share up to 75 percent of the cost for installation of conservation practices, and will also pay $18.50 per acre for conservation tillage. These tillage payments occur for a maximum of three years during the length of the contract, which is typically five years, but can be extended to 10 years.

U.S. Environmental Protection Agency
The U.S. Environmental Protection Agency has three programs that could potentially be used to fund water quality related plan recommendations. These programs include the Watershed Assistance Grants program, the Watershed Initiative Grants Program, the Pesticide Environmental Stewardship Grants program, and the Water Pollution Control State and Interstate Program (106 Grants). These programs are further described below.

WATERSHED ASSISTANCE GRANTS PROGRAM
The Watershed Assistance Grants program provides funds to help organize and develop watershed and river partnerships and organizations. USEPA funding is made available through River Network to local units of government and nonprofit conservation organizations. Grant applications must be made directly to River Network. There is approximately $365,000 available nationwide for partnership development. Grants are made in two categories: those that are less than $4,000 and those that are between $4,000 and $30,000.

WATERSHED INITIATIVE GRANTS PROGRAM
The Watershed Initiative Grants Program is intended to promote community-based programs to protect water resources. The program is directed toward implementing projects that have been identified through watershed assessments and/or plans. The first grants are to be awarded in Federal fiscal year 2003.[19]

PESTICIDE ENVIRONMENTAL STEWARDSHIP GRANTS PROGRAM
The Pesticide Environmental Stewardship Grants program is funded by the EPA with grants being distributed to partners and supporters of this program. Any organization, group, or business is eligible to become a partner provided they are committed to reducing the environmental risk from pesticide use. Partners are eligible for grants up to a maximum of $50,000. Potential projects could involve implementation of pollution control measures and plan development, which includes strategies to reduce pesticide risk.

U.S. Geological Survey
The U.S. Geological Survey has one funding program that could be used to help implement the water quality recommendations set forth in this plan. The specifics of this program are described below.

UPPER MISSISSIPPI RIVER SYSTEM LONG TERM RESOURCE MONITORING PROGRAM
This program is specifically targeted at the Upper Mississippi River and its major tributaries. State, local units of government, nonprofit organizations, and other interstate and intrastate agencies are eligible to receive funding for certain projects. Projects that could be funded include monitoring water resources, developing alternative management strategies, and information management with respect to those water resources. Projects are eligible on average for around $250,000 in Federal funding. No local cost-share is required.

U.S. Department of Transportation
The U.S. Department of Transportation (DOT) has one program that could potentially be used to help implement the water quality recommendations set forth in this report. The details of this program are described below.

TRANSPORTATION ENHANCEMENT PROGRAM
The Transportation Enhancement Program is available to State and local units of government to assist with projects designed to enhance the transportation system and mitigate some of the effects of the transportation network. Potential projects could include wetland preservation and restoration, stormwater treatment systems to help address runoff, and natural habitat restoration. Eligible projects can receive up to 80 percent in Federal cost-share assistance, requiring a 20 percent local match.

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[19]*In November 2002, the State of Illinois submitted an application for the Upper Des Plaines River watershed, including the Wisconsin portion. Information developed under this watershed study was used by the State in preparing the grant application. In evaluating applications, the USEPA gives special weight to interstate applications, such as that for the Upper Des Plaines River watershed.*

Funding Sources for Park, Recreation, and Open Space Land Acquisition

Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources administers two programs that may serve as potential funding sources for park and recreation development efforts. These programs include the Recreational Trails Program and the Land and Water Conservation Fund Grant Program. These programs are described below.

Recreational Trails Program

The WDNR funds the Recreational Trails program with funding from the U.S. Department of Transportation. The funding is made available to Federal, State, and local agencies, and select incorporated organizations for four areas involving trails. These areas include 1) rehabilitation of existing trails, 2) trail maintenance, 3) trail development, and 4) land acquisition for trail establishment. The program provides up to 80 percent Federal cost-share funding for eligible projects, providing that the remaining 20 percent be derived from non-Federal sources.

Land and Water Conservation Fund Grants Program

The WDNR administers the Land and Water Conservation Fund Grants program utilizing funding from the U.S. Department of Interior. Local units of government and State agencies can apply to the WDNR for projects involving planning for the acquisition of State and local parks, land acquisition for open space, estuaries, forests, wildlife, and natural resource areas, and supporting facilities that enhance recreational opportunities. There is approximately $40 million available annually and projects are eligible to receive up to 50 percent cost-share funding.

Stewardship Program

This program, which was previously mentioned under the "Water Quality" section, is also applicable to land acquisition. The WDNR's Urban Green Space program, which is a component of the Stewardship Grant Program, provides 50 percent matching grants to cities, villages, towns, counties, public inland lake protection and rehabilitation districts, and qualified nonprofit conservation organizations for the acquisition of land. The intent of this program is to provide natural open space within or near urban areas and protect scenic or ecological features.

U.S. Department of Transportation

The U.S. Department of Transportation has one program that could potentially be used to help implement the park and recreation recommendations set forth in this report. The details of this program are described below.

Transportation Enhancement Program

This program, which was previously mentioned under the "Water Quality" section, is available to State and local units of government to assist with projects designed to enhance the transportation system and mitigate some of the effects of the transportation network. Potential projects could include land acquisition for scenic easements, pedestrian and bike trails, and purchase of abandoned railway corridors. Eligible projects can receive up to 80 percent in Federal cost-share assistance, requiring a 20 percent local match.

Kenosha/Racine Land Trust, Inc.

The Kenosha/Racine Land Trust purchases, or obtains conservation easements for, environmentally valuable lands through member contributions, land or easement donations, and grants obtained from other sources.

Eastman Kodak

Eastman Kodak Company has one small grant program available to enhance greenway areas. The program is described below.

American Greenway Grants Program

The American Greenway Grants program is a small grant program providing only limited funds. However, these funds can be used for a wide variety of projects so long as they are used to enhance and develop greenway areas. Funding is made available to land trusts, local units of government, and nonprofit organizations for a maximum amount of $2,500. Potential projects include ecological assessments, mapping and surveying, planning activities, and other activities that help to establish greenways in communities. Projects must have matching funds from other sources and provide evidence that the project can be successfully completed.

Education, Land Use, and Other Funding Sources

There are other funding sources that are available which could potentially fund miscellaneous projects in the Des Plaines River watershed which would indirectly enhance the water resources of the watershed. The funding agencies and their programs are described below.

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency has two programs that could potentially be used to fund programs that would indirectly assist the implementation of certain plan recommendations. These programs include the Sustainable Development Challenge Grant program and the Environmental Education Grant program. These programs are described below.

SUSTAINABLE DEVELOPMENT CHALLENGE GRANT PROGRAM

This program was designed to encourage the growth and development of sustainable communities. One aspect of this program involves developing partnerships among community organizations that link environmental management with quality of life activities. This program would probably be a limited source of funding at best for plan implementation, and recently, has experienced funding shortfalls. However, State and local governments and nonprofit organizations are eligible to receive up to 80 percent of the project cost.

ENVIRONMENTAL EDUCATION GRANTS PROGRAM

The EPA offers a grant program designed to specifically address the educational aspect of environmental enhancement. Potential projects could include improving environmental education teaching skills, education on human health problems, increasing capacity for environmental programs, and educating communities through print, broadcast, or other media. State and local units of government, colleges and nonprofit organizations are eligible for three ranges of funding for eligible projects: up to $5,000; $5,000 to $25,000; and $25,000 to $100,000.

Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources has one program that may serve as a potential funding source for land management related activities. This program is described below.

LAKE CLASSIFICATION GRANT PROGRAM

Through this program, counties are eligible to apply for up to $50,000 to develop a countywide classification program for lakes.

SUMMARY

This chapter describes the various means available, and recommended specific procedures, for implementation of the recommended comprehensive Des Plaines River watershed plan. The most important recommended plan implementation actions are summarized in the following paragraphs by level of government and responsible agency or unit of government.

Local Level

Kenosha County

It is recommended that Kenosha County, through its various committees, commissions, boards, and the County Board of Supervisors, act to implement the recommended watershed plan in the following manner:

1. That the County Board of Supervisors adopt the recommended Des Plaines River watershed plan after a report and recommendation by the County Highway and Parks Committee, the County Land Use Committee, and the County Land Conservation Committee to guide future land use, park development, open space preservation, floodland and stormwater management, water quality management, and fisheries management in the watershed;

2. That the County Land Use Committee and the County Land Conservation Committee designate a staff member to serve as the County implementation coordinator for the watershed study;

3. That the County Drainage Board,[20] if the Board is reconstituted, acknowledge the comprehensive Des Plaines River watershed plan and use the plan as a frame of reference in any future activities regarding drainage;

4. That the County Land Use Committee and County Board review and revise as necessary the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance to implement the recommendations set forth in the land use and floodland management elements of the Des Plaines River watershed plan;

5. That the County Department of Planning and Development and the Land Use Committee coordinate with the Regional Planning Commission to adopt revised or new 100-year recurrence interval floodplain boundaries in unincorporated areas. Those boundaries should be used for local zoning purposes and should be submitted to the Federal Emergency Management Agency for inclusion in an updated Federal flood insurance study;

6. That the County Land Use Committee and County Board develop and adopt a stormwater management ordinance that incorporates the recommended two- and 100-year storm release rates for new development and addresses construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan. The County should work with the Towns to establish consistent construction erosion control and stormwater management ordinances in unincorporated areas of the County within the Des Plaines River watershed;

7. That the County Highway and Parks Committee acquire over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land needed along the main stem of the Des Plaines River, Brighton Creek and the Kilbourn Road Ditch for establishing regional trails as a part of a recreation corridor, and that the Committee and the County Department of Public Works design, construct, and maintain those trails;

8. That the County Highway and Parks Committee coordinate with the Wisconsin Department of Natural Resources regarding development of the Brightondale Connector, which is part of the areawide recreational trail and which is located in part in the Bong Recreational Area;

9. That the County Highway and Parks Committee coordinate with the City of Kenosha, the Village of Paddock Lake; and the Towns of Brighton, Bristol, Paris, Salem and Somers regarding a) the best location for proposed local recreation trails, b) acquisition over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing those trails, and c) the appropriate unit of government to design, construct, and maintain the trails. The acquisition should be coordinated with acquisition for portions of the trails outside the watershed as a part of a recreation corridor;

10. That the County work with both the Village of Pleasant Prairie Board and Park Commission and private interests to develop an 18-hole, 160-acre public golf course as recommended in this plan;

11. That the County implementation coordinator, working with the County Land Use Committee, the County Land Conservation Committee, the County Board, and the Racine County implementation coordinator, actively explore opportunities to attain WDNR State Project Area designation for the recommended prairie and wetland restoration areas;

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[20] *As of December 2002, Kenosha County does not have an active Drainage Board.*

12. That the County Highway and Parks Committee and the County Land Use Committee acquire over time through purchase, dedication, and gift as may be timely and appropriate, the land in primary environmental corridors that is recommended to be placed in public ownership;

13. That the County purchase and remove from the 100-year recurrence interval floodplain two houses along Unnamed Tributary No. 6 to Brighton Creek in the Village of Paddock Lake, one house and two agricultural buildings along the Des Plaines River in the Village of Pleasant Prairie, and 12 mobile homes along the Kilbourn Road Ditch in the Town of Somers. It is recommended that the designated properties, whose general locations are shown on Map 84, be acquired and moved or demolished by Kenosha County, and that the acquired land be kept in open space use.

14. That the County Highway and Parks Committee, as the highway system under its jurisdiction is maintained and reconstructed over time, construct new and replace existing bridges over the Des Plaines River watershed stream system in accordance with the recommended water control facility objectives and standards as evaluated in Table 110 in Chapter XII and in Appendix G of this report;

15. That the County Land Conservation Committee assume the lead responsibility for implementing plan recommendations regarding nonpoint source water pollution control throughout the Kenosha County portion of the watershed;

16. That the County implementation coordinator take the lead, in cooperation with the Wisconsin Department of Natural Resources, in coordinating with Racine County and the local units of government to develop subwatershed-level fishery management plans, according to the priorities set forth in Chapter XV of this report, and in assuring that those plans are coordinated, or incorporated in, the recommended detailed stormwater management plans;

17. That the Kenosha County implementation coordinator work with the landowners along the main stem, the County Departments of Planning and Development and Public Works, and the Town of Paris and, if needed, seek outside funding and/or other assistance to carry out the initial channel clearing project and subsequent channel maintenance program;

18. That the Kenosha County implementation coordinator work with the U.S. Geological Survey and the Regional Planning Commission to install a continuous recording streamflow and sediment monitoring gage in the Des Plaines River near its confluence with Brighton Creek.

19. That Kenosha County coordinate with the Town of Bristol Utility District No. 1 in preparing a sewerage system facility plan to determine the best means of providing for sewage treatment for the Bristol and Paddock Lake sewer service areas; and

20. That the County Code Administration Division continue to implement the onsite sewage disposal program, including consideration of recent changes to Chapter Comm 83 of the *Wisconsin Administrative Code*.

Racine County

It is recommended that Racine County, through its various committees, commissions, boards, and the County Board of Supervisors, act to implement the recommended watershed plan in the following manner:

1. That the County Board of Supervisors adopt the recommended Des Plaines River watershed plan after a report and recommendation by the County Public Works, Parks, and Facilities Committee; the County Economic Development and Land Use Committee; the County Land Conservation Committee; and the County Drainage Board, as a guide to future land use, park development, open space preservation, floodland and stormwater management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the County Economic Development and Land Use Committee, the County Land Conservation Committee, and the County Public Works, Parks, and Facilities Committee designate a staff member to serve as the County implementation coordinator for the watershed study;

3. That the County Drainage Board acknowledge the comprehensive Des Plaines River watershed plan and use the plan as a frame of reference in any future activities regarding drainage;

4. That the County Economic Development and Land Use Committee and the County Board review and revise as necessary the Racine County Zoning Ordinance to implement the recommendations set forth in the land use and floodland management elements of the Des Plaines River watershed plan, and cooperate with the Town of Mt. Pleasant in similarly reviewing and revising as necessary the Town Zoning Ordinance;

5. That the County Division of Planning and Development and the Economic Development and Land Use Committee coordinate with the Regional Planning Commission to adopt revised or new 100-year recurrence interval floodplain boundaries in unincorporated areas. Those boundaries should be used for local zoning purposes and should be submitted to the Federal Emergency Management Agency for inclusion in an updated Federal flood insurance study;

6. That the County Economic Development and Land Use Committee and County Board develop and adopt a stormwater management ordinance that incorporates the recommended two- and 100-year storm release rates for new development and addresses construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan. The County should work with the Towns to establish consistent construction erosion control and stormwater management ordinances in unincorporated areas of the County within the Des Plaines River watershed;

7. That the County Public Works, Parks, and Facilities Committee acquire over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the 4.3 miles of the Milwaukee Road Trail that is located in the watershed, that the acquisition be coordinated with acquisition for portions of the trail outside the watershed as a part of a recreation corridor, and that the Committee and the County Department of Public Works design, construct, and maintain the trail;

8. That the County implementation coordinator, working with the County Economic Development and Land Use Committee, the County Land Conservation Committee, the County Board, and the Kenosha County implementation coordinator, actively explore opportunities to attain WDNR State Project Area designation for the recommended prairie and wetland restoration areas;

9. That the County Public Works, Parks, and Facilities Committee, as the highway system under its jurisdiction is maintained and reconstructed over time, construct new and replace existing bridges over the Des Plaines River watershed stream system in accordance with the recommended water control facility objectives and standards as evaluated in Table 110 in Chapter XII and Appendix G of this report;

10. That the County Land Conservation Committee assume the lead responsibility for implementing plan recommendations regarding nonpoint source water pollution control throughout the Racine County portion of the watershed;

11. That the County Code Administration Division continue to implement the onsite sewage disposal program, including consideration of recent changes to Chapter Comm 83 of the *Wisconsin Administrative Code*; and

12. That the County implementation coordinator work with the Kenosha County implementation coordinator, the local units of government, and the Wisconsin Department of Natural Resources in developing subwatershed-level fishery management plans, according to the priorities set forth in Chapter XV of this report, and in assuring that those plans are coordinated, or incorporated in, the recommended detailed stormwater management plans.

City of Kenosha

It is recommended that the City of Kenosha, through its various committees, commissions, boards, and the Common Council, act to implement the recommended watershed plan in the following manner:

1. That the Common Council adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Public Works Committee, City Plan Commission, and City Park Commission, as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the City Plan Commission and the Common Council review and revise as necessary the City of Kenosha Zoning Ordinance to implement the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan. Such revision should include the adoption of a requirement to provide compensatory floodwater storage to offset any filling in the 100-year recurrence interval floodplain;

3. That the City Development Department coordinate with the Regional Planning Commission to adopt revised or new 100-year recurrence interval floodplain boundaries. Those boundaries should be used for local zoning purposes and should be submitted to the Federal Emergency Management Agency for inclusion in an updated Federal flood insurance study;

4. That the City Park Commission acquire and develop as necessary over time the recommended neighborhood park in the watershed;

5. That the City Department of Public Works and the City Council develop and adopt a stormwater management ordinance that incorporates the recommended two- and 100-year storm release rates for new development, establishment of riparian buffers in areas of new development or redevelopment, and addresses construction erosion control and post-development water quality controls as recommended under this plan;

6. That the City Department of Public Works be the lead agency in developing detailed stormwater management plans for the lower Kilbourn Road Ditch and lower Center Creek areas (Areas 3 and 5, respectively, on Map 86). The lower Kilbourn Road Ditch stormwater plan would be developed in cooperation with the Village of Pleasant Prairie and the Towns of Bristol, Paris, and Somers and the Lower Center Creek plan would be developed in cooperation with the Town of Bristol;

7. That the City work with the designated lead agency—the Village of Pleasant Prairie—in developing a detailed stormwater management plan for the Jerome Creek subwatershed (Area 1 on Map 86);

8. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the City Public Works Department;

9. That the City Public Works Committee coordinate with Kenosha County; the Village of Paddock Lake; and the Towns of Brighton, Bristol, Paris, Salem, and Somers regarding a) the best location for the proposed local recreation trail along CTH K (60th Street), b) acquisition over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the portion of the trail along the boundary between the City and the Town of Somers, and c) the appropriate unit of government to design, construct, and maintain the trail. The acquisition

should be coordinated with acquisition for portions of the trail outside the watershed as a part of a recreation corridor; and

10. That the City of Kenosha Water Utility coordinate with the Town of Bristol Utility District No. 1 in preparing a sewerage system facility plan evaluation to determine the best means of providing for sewage treatment for the Bristol and Paddock Lake sewer service areas.

Village of Paddock Lake

It is recommended that the Village of Paddock Lake through its various committees, commissions, boards, and the Village Board, act to implement the recommended watershed plan in the following manner:

1. That the Village Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Village Plan Commission, as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the Village Plan Commission and the Village Board review the local building ordinance to ensure that appropriate regulations dealing with structure floodproofing and elevation are included and provide professional engineering assistance to landowners affected by the structure floodproofing recommendations of the plan, including conducting field surveys of the low grade adjacent to the affected buildings and the floodwater entry elevations;

3. That the Village Plan Commission and Village Board review and revise as necessary the Village of Paddock Lake Zoning Ordinance to implement the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan;

4. That the Village Plan Commission coordinate with the Regional Planning Commission to adopt 100-year recurrence interval floodplain boundaries. Those boundaries should be used for local zoning purposes and should be submitted to the Federal Emergency Management Agency for inclusion in a Federal flood insurance study. The local floodplain zoning ordinance should include a requirement to provide compensatory floodwater storage to offset any filling in the 100-year recurrence interval floodplain;

5. That the Village develop and adopt a stormwater management ordinance that incorporates the recommended two- and 100-year storm release rates for new development and addresses construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan;

6. That the Village take the lead in developing a detailed stormwater management plan for the Salem Branch of Brighton Creek (Area 6 on Map 86). The stormwater plan would be developed in cooperation with the Towns of Bristol and Salem;

7. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Village Public Works Department;

8. That the Village coordinate with Kenosha County; the City of Kenosha; and the Towns of Brighton, Bristol, Paris, Salem, and Somers regarding a) the best location for the proposed local recreation trail along CTH K, b) acquisition over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the portion of the trail along the boundary between the Village and the Town, and c) the appropriate unit of government to design, construct, and maintain the trail. The acquisition should be coordinated with acquisition for portions of the trail outside the watershed as a part of a recreation corridor;

9. That the Village Board authorize the preliminary engineering design of the stormwater management system improvements recommended to be constructed along, and in the vicinity of, Unnamed Tributary No. 6 to Brighton Creek;

10. That the Village, as the street system under its jurisdiction is maintained and reconstructed over time, construct new and replace existing bridges or culverts in the Des Plaines River watershed stream system in accordance with the recommended water control facility objectives and standards as evaluated in Table 110 in Chapter XII and in Appendix G of this report; and

11. That the Village of Paddock Lake coordinate with the Town of Bristol Utility District No. 1 in preparing a sewerage system facility plan evaluation to determine the best means of providing for sewage treatment for the Bristol and Paddock Lake sewer service areas.

Village of Pleasant Prairie

It is recommended that the Village of Pleasant Prairie, through its various committees, commissions, boards, and the Village Board, act to implement the recommended watershed plan in the following manner:

1. That the Village Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Village Plan Commission, Village Park Commission, Village Sewer Utility District D, and Sanitary District No. 73-1 as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the Village Plan Commission and Village Board review and revise as necessary the Village of Pleasant Prairie General Zoning and Shoreland/Floodplain Zoning Ordinance to reflect the recommendations set forth in the land use, floodland management,[21] and water quality management elements of the Des Plaines River watershed plan;

3. That the Village develop and adopt a stormwater management ordinance that incorporates the recommended two- and 100-year storm release rates for new development and addresses construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan;

4. That the Village take the lead in developing detailed stormwater management plans for the Jerome Creek and Lower Des Plaines River subwatersheds (Areas 1 and 2, respectively, on Map 86). The Jerome Creek stormwater plan would be developed in cooperation with the City of Kenosha and the Lower Des Plaines River plan would be developed in cooperation with the Town of Bristol;

5. That the Village work with the designated lead agency—the City of Kenosha Department of Public Works—and with the Towns of Bristol, Paris, and Somers in developing a detailed stormwater management plan for the lower Kilbourn Road Ditch area (Area 3 on Map 86).

6. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Village Public Works Department;

7. That the Village Plan Commission and the Village Board review the local building ordinance to ensure that appropriate regulations dealing with structure floodproofing and elevation are included and provide professional engineering assistance to landowners affected by the structure floodproofing and elevation recommendations of the plan, including conducting field surveys of the low grade adjacent to the affected buildings and the floodwater entry elevations;

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[21]*In 1998, the Village adopted a new floodplain zoning ordinance that references the 100-year recurrence interval flood profiles and the corresponding floodway and floodplain maps developed under this watershed study.*

8. That the Village Board abandon the sewage treatment plants affiliated with Sewer Utility District D and Sanitary District No. 73-1, connecting the existing sanitary sewerage system to the City of Kenosha system;

9. That the Village Board and Village Parks Commission acquire over time through purchase, dedication, and gift as may be timely and appropriate, the land in primary environmental corridors that is recommended to be placed in public ownership;

10. That the Village Board and Village Parks Commission acquire over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the local trails recommended under this plan, that the acquisition be coordinated with acquisition for portions of connecting local trails outside the watershed, and that the Committee and the Village design, construct, and maintain the recommended regional and local trails;

11. That the Village Board and Village Park Commission acquire land for, and develop, one new community park and five new neighborhood parks as recommended in this plan;

12. That the Village Board and Village Park Commission work with Kenosha County and private interests to develop an 18-hole, 160-acre public golf course as recommended in this plan; and

13. That the Village, as the street system under its jurisdiction is maintained and reconstructed over time, construct new and replace existing bridges or culverts in the Des Plaines River watershed stream system in accordance with the recommended water control facility objectives and standards as evaluated in Table 110 in Chapter XII and in Appendix G of this report.

Village of Union Grove

It is recommended that the Village of Union Grove, through its various committees, commissions, boards, and the Village Board, act to implement the recommended watershed plan in the following manner:

1. That the Village Board act to adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Village Plan Commission as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the Village Plan Commission and Village Board review and revise as necessary the Village of Union Grove Zoning Ordinance to implement the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan, including adoption of a) the delineated 100-year recurrence interval floodplains and b) a requirement to provide compensatory floodwater storage to offset any filling in the 100-year recurrence interval floodplain;

3. That the Village Plan Commission coordinate with the Regional Planning Commission to adopt revised or new 100-year recurrence interval floodplain boundaries. Those boundaries should be used for local zoning purposes and should be submitted to the Federal Emergency Management Agency for inclusion in an updated Federal flood insurance study;

4. That the Village develop and adopt a stormwater management ordinance that incorporates the recommended two- and 100-year storm release rates for new development and addresses construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan;

5. That the Village take the lead in developing a detailed stormwater management plan for the extreme upper portion of the Des Plaines River watershed (Area 4 on Map 86). The stormwater plan would be developed in cooperation with the Towns of Dover and Yorkville;

6. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Village Public Works Department; and

7. That the Village Board and Village Park Commission acquire land for, and develop, one new neighborhood park as recommended in this plan.

Town of Brighton

It is recommended that the Town of Brighton, through its various committees, commissions, boards, and the Town Board, act to implement the recommended watershed plan in the following manner:

1. That the Town Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Town Plan Commission as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the Town Plan Commission and Town Board coordinate with Kenosha County in the review and revision of the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance to reflect the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan;

3. That the Town Plan Commission and Town Board review the local building ordinance to ensure that appropriate regulations dealing with structure floodproofing and elevation are included and provide professional engineering assistance to landowners affected by the structure floodproofing recommendations of the plan, including conducting field surveys of the low grade adjacent to the affected buildings and the floodwater entry elevations;

4. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Town Public Works Department; and

5. That the Town coordinate with Kenosha County; the City of Kenosha; the Village of Paddock Lake; and the Towns of Bristol, Paris, Salem, and Somers regarding a) the best location for the proposed local recreation trail along CTH K, b) acquisition over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the portion of the trail along the boundary between the Village of Paddock Lake, the Town of Salem, and the Town of Brighton, and c) the appropriate unit of government to design, construct, and maintain the trail. The acquisition should be coordinated with acquisition for portions of the trail outside the watershed as a part of a recreation corridor.

Town of Bristol

It is recommended that the Town of Bristol, through its various committees, commissions, boards, and the Town Board, act to implement the recommended watershed plan in the following manner:

1. That the Town Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Town Plan Commission and Town Utility District No. 1 as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the Town Plan Commission and Town Board coordinate with Kenosha County in the review and revision of the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance to reflect the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan;

3. That the Town Board revise the Town stormwater management ordinance to incorporate the recommended two- and 100-year storm release rates for new development and address construction

erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan. The County and Town should coordinate to establish consistency between construction erosion control and stormwater management ordinances;

4. That the Town work with the designated lead agency—the City of Kenosha Department of Public Works—in developing detailed stormwater management plans for the lower Kilbourn Road Ditch and lower Center Creek areas (Areas 3 and 5, respectively, on Map 86). The Lower Kilbourn Road Ditch stormwater plan would also be developed in cooperation with the Village of Pleasant Prairie and the Towns of Paris and Somers;

5. That the Town work with the designated lead agency—the Village of Paddock Lake—and with the Town of Salem in developing a detailed stormwater management plan for the Salem Branch of Brighton Creek (Area 6 on Map 86);

6. That the Town work with the designated lead agency—the Village of Pleasant Prairie—in developing a detailed stormwater management plan for the Lower Des Plaines River subwatershed (Area 2 on Map 86);

7. That the Town Plan Commission and Town Board review the local building ordinance to ensure that appropriate regulations dealing with structure floodproofing and elevation are included and provide professional engineering assistance to landowners affected by the structure floodproofing recommendations of the plan, including conducting field surveys of the low grade adjacent to the affected buildings and the floodwater entry elevations;

8. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Town Public Works Department;

9. That the Town coordinate with Kenosha County; the City of Kenosha; the Village of Paddock Lake and the Towns of Brighton, Paris, Salem, and Somers regarding a) the best location for the proposed local recreation trail along CTH K (60th Street); b) acquisition over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the portion of the trail along the boundary between the City of Kenosha, the Town of Paris, and the Town of Bristol; and c) the appropriate unit of government to design, construct, and maintain the trail. The acquisition should be coordinated with acquisition for portions of the trail outside the watershed as a part of a recreation corridor;

10. That the Town Board acquire over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the local trails recommended to be located wholly within the Town, that the acquisition be coordinated with acquisition for portions of connecting local trails outside the watershed, and that the Town design, construct, and maintain the recommended local trails;

11. That the Town Board acquire land for, and develop, four new neighborhood parks and maintain the existing community park as recommended in this plan;

12. That the Town, as the street system under its jurisdiction is maintained and reconstructed over time, construct new and replace existing bridges or culverts in the Des Plaines River watershed stream system in accordance with the recommended water control facility objectives and standards as evaluated in Table 110 in Chapter XII and in Appendix G of this report; and

13. That the Town of Bristol Utility District No. 1 coordinate with Kenosha County, the City of Kenosha Water Utility, the Village of Paddock Lake, SEWRPC, and the WDNR in preparing a sewerage

system facility plan evaluation to determine the best means of providing for sewage treatment for the Bristol and Paddock Lake sewer service areas.

Town of Dover

It is recommended that the Town of Dover, through its various committees, commissions, boards, and the Town Board, act to implement the recommended watershed plan in the following manner:

1. That the Town Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Town Plan Commission as a guide to future land use, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed.

2. That the Town Plan Commission and Town Board coordinate with Racine County in the review and revision of the Racine County Zoning Ordinance to reflect the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan;

3. That the Town Board make revisions to the Town ordinances, or adopt a separate stormwater management and construction erosion control ordinance, to incorporate the recommended two- and 100-year storm release rates for new development and address construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan. The County and Town should coordinate to establish consistency between construction erosion control and stormwater management ordinances;

4. That the Town work with the designated lead agency—the Village of Union Grove—and with the Town of Yorkville in developing a detailed stormwater management plan for the extreme upper portion of the Des Plaines River watershed (Area 4 on Map 86); and

5. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Town Public Works Department in cooperation with the County Drainage Board.

Town of Mt. Pleasant

It is recommended that the Town of Mt. Pleasant, through its various committees, commissions, boards, and the Town Board, act to implement the recommended watershed plan in the following manner:

1. That the Town Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Town Plan Commission, Town Park Commission, and Town Stormwater Drainage District No. 1 as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the Town of Mt. Pleasant Stormwater Drainage District No. 1 adopt the recommended Des Plaines River watershed plan as a guide to land use, open space preservation, floodland and stormwater management, water quality management, and fisheries management in the watershed;

3. That the Town Plan Commission and Town Board review and revise as necessary the Town Zoning Ordinance to implement the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan, including adoption of a) the delineated 100-year recurrence interval floodplains and b) a requirement to provide compensatory floodwater storage to offset any filling in the 100-year recurrence interval floodplain;

4. That the Town of Mt. Pleasant Stormwater Drainage District No. 1 adopt a stormwater management ordinance that incorporates the recommended two- and 100-year storm release rates for new

development and addresses construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan. The County and Drainage District should coordinate to establish consistency between construction erosion control and stormwater management ordinances;

5. That the Town of Mt. Pleasant Stormwater Drainage District No. 1 take the lead in developing a detailed stormwater management plan for the extreme upper portion of the Kilbourn Road Ditch subwatershed (Area 7 on Map 86). The stormwater plan would be developed in cooperation with the Town of Yorkville;

6. That a regular, cooperative program of stream channel maintenance as described in Chapter XV be implemented by the Town of Mt. Pleasant Stormwater Drainage District No. 1 in cooperation with the County Drainage Board; and

7. That the Town Plan Commission and Town Board review the local building ordinance to ensure that appropriate regulations dealing with structure floodproofing and elevation are included and provide professional engineering assistance to landowners affected by the structure floodproofing recommendations of the plan, including conducting field surveys of the low grade adjacent to the affected buildings and the floodwater entry elevations.

Town of Paris

It is recommended that the Town of Paris, through its various committees, commissions, boards, and the Town Board, act to implement the recommended watershed plan in the following manner:

1. That the Town Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Town Plan Commission as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed.

2. That the Town Plan Commission and Town Board coordinate with Kenosha County in the review and revision of the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance to reflect the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan;

3. That the Town work with the designated lead agency—the City of Kenosha Department of Public Works—and with the Village of Pleasant Prairie and the Towns of Bristol and Somers in developing a detailed stormwater management plan for the lower Kilbourn Road Ditch area (Area 3 on Map 86);

4. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Town Public Works Department; and

5. That the Town coordinate with Kenosha County; the City of Kenosha; the Village of Paddock Lake; and the Towns of Brighton, Bristol, Salem, and Somers regarding a) the best location for the proposed local recreation trail along CTH K (60th Street); b) acquisition over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the portion of the trail along the boundary between the City of Kenosha, the Town of Paris, and the Town of Bristol; and c) the appropriate unit of government to design, construct, and maintain the trail. The acquisition should be coordinated with acquisition for portions of the trail outside the watershed as a part of a recreation corridor.

Town of Salem
It is recommended that the Town of Salem, through its various committees, commissions, boards, and the Town Board, act to implement the recommended watershed plan in the following manner:

1. That the Town Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Town Plan Commission, and Town Utility Districts No. 1 and No. 2 as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed.

2. That the Town Plan Commission and Town Board coordinate with Kenosha County in the review and revision of the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance to reflect the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan;

3. That the Town make revisions to Town ordinances, or adopt a stormwater management ordinance, to incorporate the recommended two- and 100-year storm release rates for new development and address construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan. The County and the Town should coordinate to establish consistency between construction erosion control and stormwater management ordinances;

4. That the Town work with the designated lead agency—the Village of Paddock Lake—and with the Town of Bristol in developing a detailed stormwater management plan for the Salem Branch of Brighton Creek (Area 6 on Map 86);

5. That the Town Plan Commission and Town Board review the local building ordinance to ensure that appropriate regulations dealing with structure floodproofing and elevation are included and provide professional engineering assistance to landowners affected by the structure floodproofing recommendations of the plan, including conducting field surveys of the low grade adjacent to the affected buildings and the floodwater entry elevations;

6. That the Town install the two, parallel replacement culverts under 83rd Street along Unnamed Tributary No. 1 to Hooker Lake, as recommended under this plan:

7. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Town Public Works Department;

8. That the Town coordinate with Kenosha County; the City of Kenosha; the Village of Paddock Lake; and the Towns of Brighton, Bristol, Paris, and Somers regarding a) the best location for the proposed local recreation trail along CTH K, b) acquisition over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the portion of the trail along the boundary between the Town of Brighton and the Town of Salem, and c) the appropriate unit of government to design, construct, and maintain the trail. The acquisition should be coordinated with acquisition for portions of the trail outside the watershed as a part of a recreation corridor;

9. That the Town Board acquire land for, and develop, four new neighborhood parks as recommended in this plan; and

10. That the Town, as the street system under its jurisdiction is maintained and reconstructed over time, construct new and replace existing bridges or culverts in the Des Plaines River watershed stream system in accordance with the recommended water control facility objectives and standards as evaluated in Table 110 in Chapter XII and in Appendix G of this report.

Town of Somers
It is recommended that the Town of Somers, through its various committees, commissions, boards, and the Town Board, act to implement the recommended watershed plan in the following manner:

1. That the Town Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Town Plan Commission, as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the Town Plan Commission and Town Board coordinate with Kenosha County in the review and revision of the Kenosha County General Zoning and Shoreland/Floodplain Zoning Ordinance to reflect the recommendations set forth in the land use, floodland management, and water quality management elements of the Des Plaines River watershed plan;

3. That the Town make revisions to Town ordinances, or adopt a stormwater management ordinance, to incorporate the recommended two- and 100-year storm release rates for new development and address construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan. The County and the Town should coordinate to establish consistency between construction erosion control and stormwater management ordinances;

4. That the Town work with the designated lead agency—the City of Kenosha Department of Public Works—and with the Village of Pleasant Prairie and the Towns of Bristol and Paris in developing a detailed stormwater management plan for the lower Kilbourn Road Ditch area (Area 3 on Map 86);

5. That the Town Plan Commission and Town Board review the local building ordinance to ensure that appropriate regulations dealing with structure floodproofing and elevation are included and provide professional engineering assistance to landowners affected by the structure floodproofing recommendations of the plan, including conducting field surveys of the low grade adjacent to the affected buildings and the floodwater entry elevations;

6. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Town Public Works Department; and

7. That the Town coordinate with Kenosha County; the City of Kenosha; the Village of Paddock Lake; and the Towns of Brighton, Bristol, Paris, and Salem regarding a) the best location for the proposed local recreation trail along CTH K, b) acquisition over time through purchase, dedication, and gift as may be timely and appropriate, the recommended land for establishing the portion of the trail along the boundary between the City of Kenosha and the Town of Somers, and c) the appropriate unit of government to design, construct, and maintain the trail. The acquisition should be coordinated with acquisition for portions of the trail outside the watershed as a part of a recreation corridor.

Town of Yorkville
It is recommended that the Town of Yorkville, through its various committees, commissions, boards, and the Town Board, act to implement the recommended watershed plan in the following manner:

1. That the Town Board adopt the recommended Des Plaines River watershed plan after a report and recommendation by the Town Plan Commission as a guide to future land use, park development, open space preservation, floodland management, water quality management, and fisheries management in the Des Plaines River watershed;

2. That the Town Plan Commission and Town Board coordinate with Racine County in the review and revision of the Racine County Zoning Ordinance to reflect the recommendations set forth in the land

use, floodland management, and water quality management elements of the Des Plaines River watershed plan;

3. That the Town make revisions to Town ordinances, or adopt a stormwater management ordinance, to incorporate the recommended two- and 100-year storm release rates for new development and address construction erosion control, establishment of riparian buffers in areas of new development or redevelopment, and post-development water quality controls as recommended under this plan. The County and the Town should coordinate to establish consistency between construction erosion control and stormwater management ordinances;

4. That the Town work with the designated lead agency—the Village of Union Grove—and with the Town of Dover in developing a detailed stormwater management plan for the extreme upper portion of the Des Plaines River watershed (Area 4 on Map 86);

5. That the Town work with the designated lead agency—the Town of Mt. Pleasant Stormwater Drainage District No. 1—in developing a detailed stormwater management plan for the extreme upper portion of the Kilbourn Road Ditch subwatershed (Area 7 on Map 86); and

6. That a regular program of stream channel maintenance as described in Chapter XV be implemented by the Town Public Works Department.

State Level
The State-level agencies involved in implementation of the Des Plaines River watershed plan consist of the Wisconsin Departments of Natural Resources; Transportation; and Agriculture, Trade and Consumer Protection. The specific recommended actions for each of these State agencies are as follows:

Wisconsin Department of Natural Resources
It is recommended that the WDNR:

1. Endorse the comprehensive Des Plaines River watershed plan as an amendment to the previously endorsed areawide water quality management plan for the Southeastern Wisconsin Region and certify the plan as such through the Governor to the USEPA;

2. Direct its staff to integrate the watershed plan recommendations into its broad range of agency responsibilities and to assist in coordinating plan implementation over the next three decades. In particular, those Department decisions to be made with respect to floodplain zoning issues, stormwater management, fisheries management, the extension of locally proposed sanitary sewers, wetland regulation, and the regulation of industrial waste discharges should be made in a manner fully consistent with the recommended plan;

3. Cooperate with the Southeastern Wisconsin Regional Planning Commission and the local units of government in the watershed in designing and carrying out a continuing water quality monitoring program;

4. Work with the County implementation coordinators and the local units of government in developing subwatershed-level fishery management plans, according to the priorities set forth in Chapter XV of this report, and in assuring that those plans are coordinated, or incorporated in, the recommended detailed stormwater management plans;

5. Coordinate with the Town of Bristol Utility District No. 1, in preparing a sewerage system facility plan evaluation to determine the best means of providing for sewage treatment for the Bristol and Paddock Lake sewer service areas;

6. Monitor the status of the private sewage treatment plants serving the Hickory Haven Mobile Home Park and the Rainbow Lake Manor Mobile Home Park and initiate the facility planning process when upgrades to those facilities become necessary;

7. Pursue designation of the recommended wetland and prairie restoration areas as a State Project Area. If such designation is achieved, assume the lead role in obtaining, developing, and managing the restoration areas and work with the County implementation coordinators, the NRCS, the Kenosha-Racine Land Trust, local communities, and local land owners to determine the best land acquisition/easement approach for properties that are considered for wetland and prairie restoration;

8. Be the lead agency in implementing the stream rehabilitation component of the plan,[22] and coordinate the stream rehabilitation with the recommended prairie and wetland restoration projects, assuming State Project Area status is obtained for those restoration projects; and

9. Coordinate with the Kenosha County Highway and Parks Committee regarding the schedule for construction of the Brightondale Connector to the areawide recreational trail, and construct, and maintain the portion of the connector which is located in the Bong Recreational Area.

Wisconsin Department of Transportation
It is recommended that the WisDOT:

1. Endorse the recommended Des Plaines River watershed plan; and

2. Construct new and replace existing bridges over the Des Plaines River stream channel system in accordance with the recommended water control facility objectives and standards, as evaluated in Table 110 in Chapter XII and in Appendix G of this report, when the highway system under its jurisdiction is maintained and reconstructed over time.

Wisconsin Department of Agriculture, Trade and Consumer Protection
It is recommended that the DATCP:

1. Endorse the Des Plaines River watershed plan; and

2. Refer the plan to the State of Wisconsin Land and Water Conservation Board and direct that Board to utilize the plan recommendations, as appropriate, in its various responsibilities governing farmland preservation and soil and water conservation.

University of Wisconsin-Extension
It is recommended that the Extension work with the County plan implementation coordinators to implement the water quality education recommendations set forth in Table 114.

Federal Level
The Federal agencies involved or potentially involved in implementation of the Des Plaines River watershed plan include the U.S. Environmental Protection Agency; the U.S. Geological Survey; the U.S. Department of Agriculture, Farm Services Agency and the Natural Resources Conservation Service; the Federal Emergency Management Agency; and the U.S. Army Corps of Engineers. The specific recommended actions for each of these Federal agencies are as follows:

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[22]*Rehabilitation plan components include lowering and/or replacement of selected culverts, evaluation of the need for stream channel modification to enhance low flow channel development, establishment of a new continuous recording streamflow and sediment monitoring gage, collection of baseline and annual stream cross section survey data; and potentially a future reevaluation of the need for mechanical sediment removal.*

U.S. Environmental Protection Agency
It is recommended that the EPA formally accept and endorse the Des Plaines River watershed plan as an amendment to the regional water quality management plan upon certification as such by the Governor of the State of Wisconsin.

U.S. Geological Survey
It is recommended that the U.S. Geological Survey endorse the Des Plaines River watershed plan, continue to work with the Illinois Department of Transportation to maintain the existing continuous recording streamflow gage on the Des Plaines River at Russell, Illinois, and coordinate with the Regional Planning Commission and Kenosha County to install a continuous recording streamflow and sediment monitoring gage in the Des Plaines River near its confluence with Brighton Creek.

U.S. Department of Agriculture, Farm Service Agency
It is recommended that the U.S. Department of Agriculture, FSA formally acknowledge the Des Plaines River watershed plan and utilize the plan recommendations in the administration of the Federal agricultural and conservation program. The plan recommendations to restore wetlands and prairies and to control cropland erosion are especially pertinent to these programs.

U.S. Department of Agriculture, Natural Resources Conservation Service
It is recommended that the U.S. Department of Agriculture, NRCS formally acknowledge the Des Plaines River watershed plan and utilize the plan recommendations in the administration of its various technical assistance programs relating to soil and water conservation. The plan recommendations to restore wetlands and prairies and to control cropland and streambank erosion are especially pertinent to these programs. The NRCS should work with the County implementation coordinators, the WDNR, the Kenosha-Racine Land Trust, local communities, and local land owners to determine the best land acquisition/easement approach for properties that are considered for wetland and prairie restoration as recommended under this plan.

Federal Emergency Management Agency
It is recommended that the FEMA formally acknowledge the Des Plaines River watershed plan and revise Flood Insurance Rate Maps and Federal flood insurance studies to reflect the floodplain delineations developed under this watershed study.

U.S. Army Corps of Engineers
It is recommended that the USCOE formally acknowledge the Des Plaines River watershed plan; cooperate upon request with any local or State units and agencies of government for assistance in the review, design, and construction phases of the floodland management element of the recommended plan; and use the land use and environmental corridor elements of the plan in carrying out its regulatory program relative to the placement of fill in wetlands. It is also recommended that 1) the USCOE continue to utilize the information developed under this watershed study to the fullest extent practical in conducting the Upper Des Plaines River and Tributaries, Phase II, Illinois and Wisconsin Multi-Purpose Feasibility Study and that 2) the possibility of considering implementation of Wisconsin projects in the broad context of the overall Phase 2 study, but prior to completion of that study, be explored.[23]

Private Organizations
Kenosha-Racine Land Trust
It is recommended that the Land Trust:

1. Work with the County implementation coordinators, the NRCS, the WDNR, local communities, and local land owners to determine the best land acquisition/easement approach for properties that are considered for wetland and prairie restoration as recommended under this plan; and

[23]*Such implementation might be accomplished under Section 205 of the Federal Flood Control Act of 1948, as amended.*

2. Work with the Kenosha County Highway and Parks Committee and the County Land Use Committee and the Village of Pleasant Prairie to acquire over time through purchase, dedication, and gift as may be timely and appropriate, the land in primary environmental corridors that is recommended to be placed in public ownership.

Chapter XVII

SUMMARY AND CONCLUSIONS

This report presents the major findings and recommendations of the Southeastern Wisconsin Regional Planning Commission Des Plaines River watershed planning program. The report sets forth the basic concepts underlying the study and the factual findings of the extensive inventories conducted under the study. It identifies and, to the extent possible, quantifies the existing water-related developmental and environmental problems of the watershed, and sets forth forecasts of economic activity, population growth, and land use and water-related developmental and environmental problems. The report presents alternative plan elements relating to land use, parks, and open space; floodland and stormwater management; water quality management; and fisheries management. The report sets forth a recommended plan for the development of the watershed and the resolution of its existing flood damage and water pollution problems, and for the prevention of future flood damage and water pollution problems. The recommended plan is based upon regional and watershed development objectives adopted by a watershed committee. The plan contains specific recommendations for its implementation, along with analyses of ways in which to finance implementation.

STUDY ORGANIZATION AND PURPOSE

The Des Plaines River watershed study, which resulted in the preparation of this report, is the eighth comprehensive watershed planning program to be undertaken by the Regional Planning Commission. This study was undertaken within the statutory authority of the Commission and upon the specific request of Kenosha and Racine Counties. Funding for the study was provided by those counties. The study was guided from its inception by the Des Plaines River Watershed Committee, an advisory committee to the Commission composed of 19 representatives from municipal and county government, the Wisconsin Department of Natural Resources (WDNR), private interests, private citizens, conservation organizations, and county government and regional representatives from downstream reaches in the State of Illinois. The technical work was carried out by the Commission staff with the assistance of cooperating governmental agencies, including the U.S. Natural Resources Conservation Service (NRCS), the WDNR, and two private consultants engaged by the Commission, Owen Ayres & Associates, Inc., photogrammetric and control survey engineers, and Marlin P. Johnson, Associate Professor, University of Wisconsin-Waukesha Center. The NRCS assisted with field classification of streambank erosion conditions. The WDNR provided supplemental information on fish and mussel surveys and water use objectives and reviewed and approved the hydrologic analyses for the entire watershed. Owen Ayres & Associates, Inc. provided survey data on hydraulic structures. Marlin Johnson directed the 1994 fish survey and the analysis of the data from that survey.

The study was founded upon the recognition by concerned public officials that such water-related resource problems as flooding and water pollution are directly and inextricably interrelated, not only with each other, but also with problems of areawide urbanization which transcend local governmental boundaries. Solutions to such areawide problems must, therefore, be sought on a watershed basis.

The primary purpose of the Des Plaines River watershed planning program is to help abate the water resource and water resource-related problems of the watershed by developing a workable plan to guide the staged implementation of multi-purpose water resource facilities and activities and related resource conservation and management programs for the watershed. More specifically, the objectives of the planning program are to:

1. Prepare a land use plan for the Des Plaines River watershed incorporating the results of previously prepared regional, subregional, and local planning efforts and to promote the rational adjustment of land uses in this urbanizing watershed to the conveyance, storage, and waste assimilation capabilities of the water resources of the basin.
2. Prepare a plan for the management of floodlands along the waterways of the Des Plaines River watershed, including measures for the mitigation of existing and potential future flood management problems.
3. Prepare a plan which: a) considers potential stormwater management alternatives which may be expected to have significant impacts on alternative measures developed to address flood problems, b) sets forth specific guidelines to be used in addressing stormwater management problems, including the best means of treating development proposals pending completion of subsequent detailed local stormwater management plans, and c) provides a watershedwide framework for the evaluation of such local stormwater management plans.
4. Prepare a plan for the management of surface water quality for the Des Plaines River watershed, incorporating measures to abate existing pollution problems and elements intended to prevent future pollution problems. Local refinement and detailing of sanitary sewer service areas, as well as other local actions to implement the adopted regional water quality management plan, were incorporated in the watershed planning process.
5. Prepare a plan for the preservation of public open space, including measures for the preservation and enhancement of the remaining woodlands, wetlands, and fish and wildlife habitat of the watershed.
6. Prepare a plan which reduces soil erosion in the Des Plaines River watershed through the integration of stormwater management and construction erosion-control practices in urban areas, agricultural land management practices in rural areas, and streambank erosion control measures.

The problems to be addressed in the watershed study were articulated by the Watershed Committee in the prospectus for the study published in September 1991.[1] To enhance the utility and effectiveness of the watershed plan in abating problems of flooding, stormwater management, water pollution, soil erosion and sedimentation in streams, and changing land use within the watershed, the plan was developed to be amenable to cooperative adoption and joint implementation by all of the levels and agencies of government concerned.

This report can only summarize briefly the large volume of information assembled in the extensive data collection, analysis, and forecasting phases of the Des Plaines River watershed study. However, all of the basic data are on file in the Commission offices and are available to member units and agencies of government and to the general public upon request. In addition to setting forth the findings and recommendations of the watershed study, this report serves the additional purpose of indicating the types of data which are available from the Commission and which may be of value in assisting Federal, State, and local units of government and private investors in making better decisions about community development within the Region.

COORDINATION WITH FLOODLAND MANAGEMENT AND FLOOD CONTROL EFFORTS IN THE ILLINOIS PORTION OF THE WATERSHED

Heavily urbanized and rapidly urbanizing areas of the Des Plaines River watershed in the State of Illinois have experienced widespread flood damage. The Chicago District of the U.S. Army Corps of Engineers (USCOE) has

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[1]*See* Des Plaines River Watershed Planning Program Prospectus*, SEWRPC, September 1991.*

prepared a Phase 1 Feasibility Study for the main stem of the Upper Des Plaines River watershed in Illinois and is in the process of preparing a Phase 2 Feasibility Study for the Upper Des Plaines River and tributaries in Wisconsin and Illinois. The analyses performed under the Wisconsin watershed study documented herein were coordinated with the Phase 1 study results and the Wisconsin study analyses are being incorporated in the Phase 2 study. Kenosha County is a partner in the Phase 2 study process along with Cook and Lake Counties, Illinois; the Illinois Department of Natural Resources; and the USCOE.

DESCRIPTION OF THE WATERSHED

This study focuses primarily on the 133-square-mile portion of the Des Plaines River watershed area which lies within Wisconsin, while cognizant of the interrelationship between this area and the 1,977-square-mile watershed area which lies within Illinois as shown on Map 2 in Chapter I. The Des Plaines River watershed within Southeastern Wisconsin covers approximately 5 percent of the seven-county Region. The watershed ranks sixth in size of the 11 major natural watersheds located wholly or partly within the Region. As shown on Map 3 in Chapter III, the watershed lies within Kenosha and Racine Counties with about 92 percent of the total land area in Kenosha County and 8 percent in Racine County. The civil divisions that are wholly or partially contained within the watershed include the City of Kenosha; the Villages of Paddock Lake, Pleasant Prairie, and Union Grove; and the Towns of Brighton, Bristol, Dover, Mt. Pleasant, Paris, Salem, Somers, and Yorkville. Table 1 in Chapter III indicates the area of each civil division within the watershed, the percent of the watershed area within each civil division, and the percent of each civil division area within the watershed. The population in the watershed by civil division is shown in Table 3 in Chapter III.

The watershed is drained by approximately 69.1 miles of perennial streams, including the Des Plaines River and its tributaries: Jerome Creek, the Kilbourn Road Ditch, Center Creek, Brighton Creek, and the Dutch Gap Canal. Table 22 in Chapter III and Map 36 in Chapter V provide information on the stream system in the watershed.

The source of the Des Plaines River is in the southwest one-quarter of U.S. Public Land Survey Section 33, Township 3 North, Range 21 East, in the Town of Yorkville, just north of the Racine-Kenosha county line and about 0.75 mile east of the Village of Union Grove. From its source, the River flows in a generally southerly direction for approximately 12.2 miles, to about the center of Section 16, Township 1 North, Range 21 East, in the Town of Bristol; then easterly for about four miles, to its confluence with the Kilbourn Road Ditch just east of IH 94-USH 41 in the Village of Pleasant Prairie; and finally southerly for approximately 5.6 miles, to the Wisconsin-Illinois state line. The River has a perennial stream length of about 20.5 miles.

The origin of Jerome Creek is in the northeast one-quarter of Section 22, Township 1 North, Range 22 East, in the Village of Pleasant Prairie, just south of 93rd Street. The entire length of the Creek is in the Village of Pleasant Prairie. From its origin, the Creek flows about 0.7 mile in a generally northerly direction; then westerly for about 1.9 miles, crossing STH 31 and the Union Pacific Railroad line; then southwesterly for about two miles, to its confluence with the Des Plaines River one-quarter mile north of STH 165. The Creek has a perennial stream length of about 1.7 miles.

The source of Kilbourn Road Ditch is located about one-half mile east of IH 94-USH 41 in the southwest one-quarter of Section 30, Township 3 North, Range 22 East, Town of Mt. Pleasant, Racine County. From there, the stream flows southerly along IH 94-USH 41 for about 12.6 miles, to its confluence with the Des Plaines River in the southwest one-quarter of Section 7, Township 1 North, Range 22 East, in the Village of Pleasant Prairie. The entire length of the stream is classified as perennial.

Center Creek has its origin on the one-quarter section line between the northeast and northwest one-quarters of Section 15, Township 2 North, Range 21 East, Town of Paris. From its origin it flows southerly for about 5.5 miles, to STH 50; then southeasterly for about two miles, to its confluence with the Des Plaines River, just west of IH 94-USH 41 in the southeast one-quarter of Section 12, Township 1 North, Range 21 East, Town of Bristol. The Creek has a perennial stream length of about 5.6 miles.

The origin of Brighton Creek is in the northeast one-quarter of Section 14, Township 2 North, Range 20 East, Town of Brighton. From its origin, the Creek flows about six miles in a generally southerly direction, to its confluence with the Salem Branch of Brighton Creek in the southwest one-quarter of Section 6, Township 1 North, Range 21 East, Town of Bristol; then about three miles in a generally northeasterly direction, to its confluence with the Des Plaines River in the southwest one-quarter of Section 33, Township 2 North, Range 21 East. Brighton Creek has a perennial stream length of about nine miles.

The Dutch Gap Canal, which originates in the northeast one-quarter of Section 20, Township 1 North, Range 21 East, Town of Bristol, has a perennial stream length of 4.1 miles. The Canal flows in a generally southerly direction into Lake County, Illinois, where it is known as North Mill Creek and, farther downstream, as Mill Creek.

Population and Economic Activity

Forecasts indicate that based on the adopted high-growth centralized development land use alternative, the population of the Des Plaines River watershed may be expected to increase from the 1990 level of about 19,650 persons to a plan design year 2010 level of about 33,500 persons, a 70 percent increase. Employment may be expected to increase from the 1990 level of about 8,200 jobs to a plan design year 2010 level of about 36,700 jobs, a 348 percent increase. The Des Plaines River watershed is still largely in rural land uses. About 12.5 square miles, or 9.4 percent of the watershed, was devoted to urban uses in 1990. An additional 8.7 square miles of land are forecast to be converted from rural to urban use by 2010, resulting in 16 percent of the watershed in urban uses. An additional 11.8 square miles are forecast to be converted from rural to urban use from 2010 until the planned urban service areas are fully developed, resulting in 25 percent of the watershed being in urban uses. It is estimated that full development of the planned urban service area, as shown on Map 81 in Chapter XV, would not occur before the year 2030.

Environmental Corridors

The delineation of natural resource and related elements within the Region produces a pattern of narrow, elongated areas which have been termed "environmental corridors" by the Regional Planning Commission. As of 1990, primary environmental corridors in the watershed occupied 16.8 square miles, or about 13 percent of the watershed area. In contrast, primary environmental corridors occupied about 18 percent of the entire seven-county Southeastern Wisconsin Region. Secondary environmental corridors occupied an additional 6.4 square miles, or an additional 5 percent of the watershed. Isolated natural resource areas occupied about 3.0 square miles, or about 2 percent of the watershed area. The continued preservation of the primary environmental corridors in essentially natural, open uses is essential to maintaining the overall quality of the environment in the watershed.

Surface Water Hydrology and Hydraulics

The Wisconsin portion of the Des Plaines River watershed may be considered to be a composite of eight subwatersheds, as shown on Map 34 in Chapter V. Including the portion of the Dutch Gap Canal subwatershed which flows from Illinois into Wisconsin, the total area tributary to the Wisconsin portion of the watershed at the State line is 139.4 square miles, including 6.5 square miles that drain from Illinois into Wisconsin. The subwatersheds are: 1) the Upper Des Plaines River subwatershed, which encompasses 20.4 square miles, or 14.6 percent of the total watershed area and 15.3 percent of the area in Wisconsin; 2) the Lower Des Plaines River subwatershed, which encompasses 33.4 square miles, or 24.0 percent of the total watershed area and 23.6 percent of the area in Wisconsin; 3) the Brighton Creek subwatershed, which encompasses 20.7 square miles, or 14.9 percent of the total watershed area and 15.5 percent of the area in Wisconsin; 4) the Center Creek subwatershed, which encompasses 10.3 square miles, or 7.4 percent of the total watershed area and 7.8 percent of the area in Wisconsin; 5) the Dutch Gap Canal subwatershed, which encompasses 18.0 square miles, or 12.9 percent of the total watershed area and 10.2 percent of the area in Wisconsin; 6) the Jerome Creek subwatershed, which encompasses 5.9 square miles, or 4.2 percent of the total watershed area and 4.5 percent of the area in Wisconsin; 7) the Kilbourn Road Ditch subwatershed, which encompasses 23.7 square miles, or 17.0 percent of the total watershed area and 17.8 percent of the area in Wisconsin; and 8) the Salem Branch of Brighton Creek subwatershed, which encompasses 7.0 square miles, or 5.0 percent of the total watershed area and 5.3 percent of the area in Wisconsin.

It is estimated that channel modifications have been made along 39 percent of the stream reaches selected for development of flood hazard information in the Lower Des Plaines River subwatershed; 45 percent in the Brighton Creek subwatershed; 38 percent in the Center Creek subwatershed; 51 percent in the Salem Branch of Brighton Creek subwatershed; and along all of the stream reaches considered in the Upper Des Plaines River, Dutch Gap Canal, Jerome Creek, and Kilbourn Road Ditch subwatersheds.

Flood Characteristics, Damage, and Risk

Research of the available historic records indicated the occurrence of sixteen major floods in the Des Plaines River watershed since 1943. Major flood events are defined herein as those known to have caused flooding in the Wisconsin portion of the watershed with attendant disruption of normal community activities. Significant floods occurred in March of 1943, 1948, 1962, 1973, 1976, 1979, and 1986; April of 1960, 1983, and 1993; May of 1996; June of 1954 and 2000; August of 1978 and 1995; and September of 1986.

The principal types of damage experienced in the Des Plaines River watershed have been damage to croplands and to structures—primarily private residences and agricultural buildings--and to their contents as a result of direct and secondary flooding. Sections of roadways have also been damaged by the erosive action of rapidly moving floodwaters.

For the watershed as a whole, the average annual monetary damages attributable to flood damages to crops and structures may be expected to approximate \$58,000 and \$91,000, respectively, damages under 1990 land use and channel conditions; and \$70,000 and \$126,000, respectively, under planned land use and existing channel conditions. For the watershed as a whole under existing land use and channel conditions, a total of 99 structures would be subject to flood damages during a 100-year recurrence interval flood event. Under planned land use and existing channel conditions, 105 structures may be expected to be affected by flooding. The heaviest flood damage concentrations are along Unnamed Tributary No. 6 to Brighton Creek in the Village of Paddock Lake, along Kilbourn Road Ditch in the Town of Somers just downstream of CTH K, along the upper reach of Jerome Creek in the Village of Pleasant Prairie, and in an area of the Dutch Gap Canal floodplain near George Lake in the Town of Bristol.

Surface Water Quality and Pollution

The pollutant loadings analyses conducted under the watershed study indicate that point source water pollution contributions from public and private sewage treatment plants and industrial sources are relatively insignificant in the Des Plaines River watershed and that nonpoint sources account for essentially all of the total annual pollutant load to the surface waters of the Des Plaines River watershed.

Table 70 in Chapter VII of this report summarizes water quality conditions in the watershed based on water quality sampling and testing from 1964 through 2001. The following general conclusions may be drawn regarding water quality in the streams of the watershed:

- The temperature, pH, heavy metals, ammonia-nitrogen, and biocides and synthetic organic chemicals standards are estimated to have been met virtually all of the time in the Des Plaines River watershed under both dry weather and wet weather conditions.

- Levels of dissolved oxygen, phosphorus, and fecal coliform are in excess of recommended standards at least some of the time.

- Chloride concentrations in the surface waters of the Des Plaines River watershed were relatively high compared to the mean value of 7 mg/l reported from Wisconsin lakes by the WDNR, but were generally similar to those found in more rural watersheds of Southeastern Wisconsin.

- The surface waters of the Des Plaines River watershed generally do not meet the established water use objectives.

- Violations of the water quality standards for the warmwater fishery water use objective were documented in the surface waters of the Des Plaines River watershed. These violations were primarily related to low dissolved oxygen levels.

- The recreational water use objective is not met in the Des Plaines River watershed primarily because of fecal coliform bacteria and nutrient concentrations in excess of the recommended standards or guidelines.

The six major lakes in the watershed having a surface area of 50 acres or more, are Benet/Shangrila Lake, Vern Wolf Lake, George Lake, Hooker Lake, Paddock Lake, and Lake Andrea. The waters of all of the six lakes are recommended for the maintenance of a warmwater sport fishery and full recreational use, or a mesotrophic status. The data available indicate all of the lakes may be classified as in the eutrophic range, except for Paddock Lake which is a drained lake currently classified in the mesotrophic range. Thus, the eutrophic lakes are not meeting the designated warmwater sport fishery use objective.

Analysis of data collected during field inventories conducted in the watershed in 1999 indicates that about 19 miles of streambank, or 26 percent of the total considered would be expected to have a low erosion potential; about 52 miles of streambank, or 71 percent of the total considered would be expected to have a medium erosion potential, and about two miles of streambank, or 3 percent of the total considered would be expected to have a high erosion potential.

Improvement of surface water quality in the Des Plaines River watershed so as to achieve the water use objectives will require a watershedwide water quality management effort aimed at abatement of nonpoint sources of pollution and continued control of point sources.

WATERSHED DEVELOPMENT OBJECTIVES

The primary objective of the Des Plaines River watershed planning program is to assist the local, State, and Federal units and agencies of government in abating the water and water resource-related problems within the Des Plaines River basin by developing a workable plan to guide the staged implementation of multi-purpose water resource facilities and activities and related resource conservation and management programs for the watershed. The principal problems to be addressed include flood damage, water pollution, sedimentation, and changing land use as it relates to these problems.

Following determination of the present and probable future conditions within the watershed, a framework of watershed development objectives and supporting principles and standards was established to guide the design of alternative floodland and stormwater management and water quality management measures for the watershed and to provide a basis for evaluation of the relative merits of these alternatives. This framework of watershed development objectives and standards basically envisions a future watershed environment that is safe, healthful, and attractive, as well as more orderly and efficient.

The recommended water use objectives for streams in the watershed are set forth on Map 88 in Chapter XV of this report. Most of the stream miles are recommended to have a warmwater sport fish objective, but some streams are assigned either a limited forage fish or a limited aquatic life objective. The standards supporting these water use objectives are identified in Table 96 in Chapter X.

ALTERNATIVE MANAGEMENT PLANS

The comprehensive plan for the Des Plaines River watershed was prepared within the context of an existing set of adopted regional plan elements, including, importantly, the adopted regional land use plan, regional park and open space plan, and regional water quality management plan. Accordingly, the major focus of the watershed study was on the floodland and stormwater management and fisheries management plan elements. The land use and park and open space element of the watershed plan constitute a refinement of the adopted regional land use and park and open space plans. The water quality management element similarly constitutes a refinement of the adopted regional water quality management plan which recognizes recent changes to the WDNR nonpoint source pollution control program. The fisheries management plan element was not developed through comparative evaluation of alternatives; rather it calls for development of subwatershed-based management plans coordinated with the water quality plan element and with subwatershed-based stormwater management plans that are recommended under the floodland and stormwater management plan element.

In developing alternative floodland and stormwater management plans on a watershedwide basis, an emphasis was placed on nonstructural measures. In addition, case-specific structural alternatives were considered for Unnamed Tributary No. 6 to Brighton Creek and Unnamed Tributary No. 1 to Hooker Lake. Aside from the No Action Alternative, each of the watershedwide alternative plans included some degree of structure floodproofing, elevation, and removal. The five watershedwide floodland and stormwater management alternatives included:

- Structure floodproofing, elevation, and removal (FER),
- Detention storage with FER,
- Prairie restoration with FER,
- Wetland restoration with FER, and
- Stream rehabilitation with FER.

Each of these alternatives was evaluated with the assistance of water resource simulation models, assuming planned land use conditions. The effects of each alternative on the one- through 100-year flood flow regimen of the stream system was carefully evaluated. The alternative plans are described and evaluated in Chapter XII of this report, including the benefit-cost ratios attendant to each alternative.

RECOMMENDED WATERSHED PLAN

A comprehensive watershed plan was synthesized from the previously proposed regional and subregional plan elements, as these elements were refined and detailed in the watershed study, and from the alternative floodland and stormwater management and fisheries management plans prepared under the watershed study. The plan consists of a land use and park and open space element, a floodland and stormwater management element, a water quality management element, and a fisheries management element. The plan, which is recommended for adoption as a guide to the physical development of the Des Plaines River watershed, contains the following salient proposals.

Land Use and Park and Open Space Element

The recommended land use and park and open space element for the watershed was derived from the previously prepared and adopted regional land use and park and open space plans and from recent local recreational trail system plans. The recommended land use plan is shown graphically on Map 81 in Chapter XV, the recommended primary environmental corridor preservation responsibilities are shown on Map 82, and the recommended parks and recreation trial system is set forth on Map 83. This recommended plan element proposes the following measures:

1. The guidance of future land use development in the watershed through land use controls locally exercised to achieve the land use pattern shown on Map 81. That land use pattern reflects the conversion of 20.5 square miles of land from agricultural to urban uses between 1990 and 2030. Through that conversion, the watershed would change from 9 percent urban to 25 percent urban. By so guiding future development, the intensification of existing, and the creation of new, developmental and environmental problems would be avoided. As noted below, the primary environmental corridors of the watershed, together with the remaining undeveloped floodlands, would be protected from incompatible urban development, thereby assuring continued enjoyment of the recreational, aesthetic, ecological, and cultural values associated with the riverine areas, while avoiding intensification of

flood damage and water pollution problems. The new urban development would be located in areas served, or proposed to be served, by a full range of public utilities and essential urban services, particularly public sanitary sewer and water supply services.

2. Maintaining and preserving the existing primary environmental corridors, which comprise about 13 percent of the total watershed area. It is recommended that about 49 percent of the primary environmental corridors be in public or public-interest ownership, 9 percent remain in outdoor recreation use under private ownership, and 42 percent be protected through public conservancy zoning.

3. Wetland restoration on 0.2 square mile of Des Plaines River floodlands in the southwestern portion of the Village of Pleasant Prairie and the incorporation of that land into the primary environmental corridor network.

4. Continued maintenance of the Bong State Recreational Area; Kenosha County's Brighton Dale and Bristol Woods Parks; one existing community park in the Town of Bristol; and five existing neighborhood parks, four in Kenosha County and one in Racine County.

5. Continued development of Prairie Springs Park in the Village of Pleasant Prairie.

6. The development of a regulation 18-hole golf course in the Village of Pleasant Prairie. The golf course would either be developed by Kenosha County or through a public/private partnership.

7. Development of one community park in the south-central portion of the Village of Pleasant Prairie and 13 new neighborhood parks, including one in the far western portion of the City of Kenosha, five in the Village of Pleasant Prairie, one within Racine County adjacent to the Village of Union Grove, and six new parks within Kenosha County—two in the Town of Salem and four in the Town of Bristol.

8. The development of an areawide recreation trail system consisting of about 36.5 linear miles of trails, including about 27.9 miles of off-street trails and about 8.6 miles of trails within highway rights-of-way. Within Kenosha County, the recommended areawide recreation trail system includes about 32.2 linear miles of trails. Within Racine County, the system includes about 4.3 miles of trails.

9. Development of a network of 44 miles of local trails that connects to and supplements the areawide trail system.

Floodland and Stormwater Management Plan Element

The recommended floodland and stormwater management plan element for the Des Plaines River watershed consists of a carefully selected combination of structural and nonstructural measures. As a matter of policy, the Watershed Committee recommended that the plan element be based upon anticipated flood flows and stages under planned land use development conditions as reflected in the watershed land use plan. The recommended floodland and stormwater management plan element, which is shown graphically on Map 84 in Chapter XV, consists of the following components:

1. Floodproofing 51 structures, including 32 houses, three commercial buildings, two recreational buildings, and 14 uninhabited agricultural buildings.

2. Elevating four houses.

3. Removing 17 structures, including 12 mobile homes, three houses, and two uninhabited agricultural buildings.

4. Providing detention storage to control the runoff from areas of planned development. The post-development two-year storm peak flow release rate would be 0.04 cfs per acre of new development and the post-development 100-year storm peak flow release rate would be 0.30 cfs per acre of new development.

5. Restoring 20 percent of the potential prairie areas in the watershed (six square miles). High-priority areas to be considered for prairie restoration are shown on Map 84.
6. Restoring all potential wetland areas within floodlands (3.1 square miles).
7. Providing a centralized detention storage basin and improving storm sewers in the Village of Paddock Lake along Unnamed Tributary No. 6 to Brighton Creek.
8. Improving culvert capacity at a single location along Unnamed Tributary No. 1 to Hooker Lake.
9. Instream rehabilitation of the main stem of the Upper Des Plaines River.

Implementation of this floodland management plan element would result in the abatement of all flood damages in the watershed caused by flood events up to and including the 100-year recurrence interval event under planned land use conditions.

Instream Rehabilitation Along the Upper Des Plaines River

Instream rehabilitation of the main stem of the Upper Des Plaines River would be preceded by sediment source controls, as recommended under this plan. It is recommended that a prerequisite of any major stream rehabilitation would include: 1) development of farm conservation plans or resource management systems for 75 percent of the agricultural land area that is within the Upper Des Plaines River subwatershed and which contains highly erodible soils as shown on Map 85 in Chapter XV,[2] and 2) implementation of streambank stabilization measures, or committed plans for such measures to be carried out as part of the stream rehabilitation program, along 75 percent of the stream length in the Upper Des Plaines River watershed that is identified as having high or medium streambank erosion potential on Map 85. That level of control of erosion from agricultural lands and streambanks would be supplemented by more stringent local construction erosion control requirements as required under Chapter NR 151, "Runoff Management," of the Wisconsin Administrative Code. There has been substantial achievement of these goals. Thus, the initial steps in implementation of the Upper Des Plaines River stream rehabilitation could commence in the near future.

Channel Clearing for Control of Beavers, Beaver Dams, and Obstructions to Flow

An important component of any effort to rehabilitate the stream and improve agricultural drainage is to establish a program to aggressively control beavers and to remove beaver dams. The recommended plan includes such a program. It is also recommended that a regular stream channel maintenance program be undertaken throughout the major stream system of the Des Plaines River watershed. In addition to control of beaver dams, this would include the periodic removal of localized sediment deposits, heavy vegetation,[3] debris, and beaver dams[4] from streams. Such a program is necessary to avoid adverse effects on agricultural drainage systems.

Natural Rehabilitation Program

Implementation of a monitoring program to assess sediment conditions along the Upper Des Plaines River could commence upon adoption of this watershed study. The initiation of that monitoring program would be the first step in a relatively low-cost project intended to rehabilitate the Upper Des Plaines River through control of the sediment sources to the River and natural transport of deposited sediments, leading to the establishment of a more

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[2]*Map 85 indicates that approximately 26 percent of the agricultural lands with highly erodible soils have conservation plans in place and about 25 percent have resource management systems. Thus, a total of 51 percent of the highly erodible soils in the subwatershed have practices applied to reduce erosion, meaning that two-thirds of the 75 percent goal has been reached.*

[3]*Permits for removal of sediment deposits may be required from the Wisconsin Department of Natural Resources under Chapter 30 of the* Wisconsin Statues*. Chapter NR 109 of the* Wisconsin Administrative Code *sets forth rules relative to vegetation management. Also, Section 12.18-2 of the Kenosha County zoning ordinance places restrictions on the removal of vegetation within 100 feet of the ordinary high water mark of navigable streams.*

[4]*The removal of debris jams and beaver dams do not require permits if bottom sediments are not directly disturbed.*

natural stream channel and a reduction in the sediment that has accumulated within the channel. Minimal, low-cost measures would be constructed to establish riffles and promote formation of pools, to lower selected culverts to facilitate natural sediment transport, and to remove unpermitted culverts where appropriate. In addition, channel features which direct flow to enhance the formation of a low flow channel would be considered.

The Upper Des Plaines River stream channel would be monitored for three years to 1) determine whether sediment was being removed through natural processes, 2) evaluate instream sediment concentrations relative to the baseline conditions, and 3) determine whether agricultural drainage was improving due to the combination of aggressive beaver and beaver dam control policies and less obstruction of drain tile outfalls by sediment. Such monitoring would include field surveys of the baseline cross-sections, continued collection of streamflow and suspended sediment data at the stream gauge recommended to be installed on the Upper Des Plaines River near its confluence with Brighton Creek, and surveys of farmers along the Upper Des Plaines River.

If extensive mechanical sediment removal were required in the event that the initially recommended natural rehabilitation process was unsuccessful, upon application from the Town of Paris or a reconstituted County Farm Drainage Board, the Wisconsin Department of Natural Resources (WDNR) would initiate the Chapter 30 permitting process. That process would include a stream assessment, an Environmental Assessment, and determination by WDNR whether or not to issue a permit.

Auxiliary Recommendations
In addition to the foregoing measures, the plan includes recommendations relative to bridge replacement to ensure that major streets and highways remain operable during flood events, the revision or adoption of local floodland zoning regulations, the preparation of detailed stormwater management plans in subwatersheds designated on Map 86, stream channel maintenance, participation in the Federal flood insurance program, continuation of lending institution policies regarding floodprone properties, community utility policies that recognize the floodprone status of riverine areas, the development by municipalities of procedures to inform residents about the location and extent of flood hazard areas, community education through existing newsletters and web sites, the continued operation of the continuous recording streamflow gauge on the Des Plaines River at Russell, Illinois, and the installation of a new continuous recording streamflow gauge near the outlet of the Upper Des Plaines River.

Estimated Costs of the Floodland and Stormwater Management Plan Element
As set forth in Table 117 in Chapter XV, implementation of the recommended floodland and stormwater management plan element is anticipated to have a total capital cost ranging from \$70.9 to \$86.8 million and an average annual operation and maintenance cost ranging from \$413,100 to \$1,449,800. The estimated \$37.3 million cost of providing detention storage for new development, or 43 to 53 percent of the total capital cost, would be borne by the private sector as a cost of land development. It is anticipated that most of the remaining costs would be funded through grants and other outside sources.

Water Quality Management Plan Element
The adopted regional water quality management plan, as refined and detailed under the County land and water resource management plans and the watershed study, is recommended for adoption as the water quality management element of the Des Plaines River watershed plan. The plan contains recommendations for the abatement of pollution from public and private sewage treatment plants, industrial waste discharges; the control of pollution from nonpoint sources; and the development of a water quality monitoring program for the watershed.

Point Source Pollution Control Recommendations
The final recommended point source pollution control plan components are shown on Map 87 in Chapter XV. The following specific water quality recommendations are made relative to point sources of pollution:

1. That the sewage treatment plant serving Village of Pleasant Prairie Sewer Utility District D and the treatment plant serving the former Village of Pleasant Prairie Sanitary District No. 73-1 be abandoned and that their former service areas be served by the Kenosha Water Utility, which discharges treated

wastewater to Lake Michigan. Along with abandonment of those plants, this watershed plan recommends construction of the intercommunity trunk sewers needed to provide service.

2. That a sewerage system facility plan evaluation be made to determine the best means of providing for sewage treatment for the Town of Bristol and Village of Paddock Lake sewer service areas, with that plan considering local plant(s) upgrading and expansion alternatives, as well as connection to the Kenosha sewerage system. This facility plan evaluation is currently (2003) being undertaken by the Town of Bristol in cooperation with the other agencies and units of government involved.

3. That, when the Hickory Haven Mobile Home Park—located in close proximity to the planned Union Grove Sewer Service Area—and the Rainbow Lake Manor Mobile Home Park—located in close proximity to the planned Bristol service area—require significant upgrading or modification, detailed facility planning be conducted to evaluate the alternative of connecting these two areas to the adjacent public sanitary sewer systems. For the remaining three private sewage treatment plants serving the Bong Recreational Area, Brightondale County Park, and the Kenosha Beef International Company the need for upgrading and level of treatment should be formulated on a case-by-case basis during plan implementation as part of the Wisconsin Pollution Discharge Elimination System (WPDES) permitting process.

4. That the public and private sewage treatment plants in the watershed continue to implement the plant-specific sludge management plans that have been prepared for them as a part of the WPDES discharge permitting process.

5. That sewage treatment facilities and industrial wastewater discharges continue to be regulated and controlled to acceptable levels on a case-by-case basis through the operation of the WPDES process.

Nonpoint Source Pollution Control Recommendations

Table 114 in Chapter XIII of this report sets forth the agricultural and urban nonpoint source pollution control recommendations of the watershed study. Those recommendations are consistent with the goals, objectives, and actions established under the land and water resource management plans adopted by Kenosha and Racine Counties in September of 2000 and with the urban and agricultural nonpoint source pollution performance standards set forth in Chapter NR 151, "Runoff Management," of the Wisconsin Administrative Code. The urban recommendations focus primarily on practicing more effective stormwater management, reducing construction site erosion, managing onsite sewage disposal systems, and related educational land management activities. The agricultural recommendations focus on reducing nonpoint source pollution from sediment and livestock manure through a variety of governmental and individual actions and on implementing best management practices (BMPs).

Some additional control measures will be necessary in order to achieve the water use objectives for the Des Plaines River watershed. These measures include additional source controls to eliminate toxic and hazardous substances from surface waters in order to protect the development of a desired fishery.

Water Quality Monitoring Program Recommendations

It is recommended that water quality monitoring of streams in the watershed be reinstated as recommended under the Kenosha and Racine County land and water resources management plans. It is also recommended that the collection of lake water quality data be continued under the WDNR Self-Help Lake Monitoring Program, supplemented by more-detailed trophic state index (TSI) monitoring funded in part under the Chapter NR 190 Lake Management Planning Grant Program.

Estimated Costs of the Water Quality Management Plan Element

As set forth in Table 81 in Chapter XV, implementation of the recommended water quality management plan element is anticipated to have an estimated capital cost of \$21.9 million, administrative and planning costs of

$2.3 million,[5] and average annual operation and maintenance costs of about $116,000. The $21.9 million capital cost would be borne by the private sector as a cost of land development. According to information in the county land and water resource management plans, the current Kenosha County budget covers about 45 percent of the estimated annual administrative and planning costs required to implement the water quality management plan, and the current Racine County budget covers about 55 percent of those costs. The costs not currently budgeted for will be sought from outside sources and will be considered in subsequent County work planning and budgeting. Additional resources from Federal, State, and local levels of government and the private sector will be required to carry out the recommended water quality management plan.

Fisheries Management Plan Element

The fisheries management plan element makes recommendations which are aimed at maintaining and rehabilitating the warmwater sport fishery in the watershed. The recommended fisheries management plan calls for the preparation of subwatershed-based fisheries management plans, applying a four-tiered approach as set forth in Table 116 in Chapter XIV. The first tier calls for watershedwide measures consistent with the recommended water quality management plan. Each succeeding tier is more focused than the next, progressing to stream corridor and lake management measures under Tier 2, streambank and shoreline treatment measures under Tier 3, and instream and in-lake treatments under Tier 4. Under this plan element priorities for implementing fisheries management practices are assigned to certain stream reaches.

Ancillary management measures to be incorporated in the subwatershed-level plans include measures to protect threatened, endangered, and special concern species; measures to control carp; measures to enhance existing fish populations; coordination with recommended subwatershed stormwater management plans; and development and implementation of an ongoing monitoring and evaluation strategy to establish baseline conditions and to assess progress toward the rehabilitation of the stream and lake fishery within the watershed.

COST ANALYSIS

In order to assist public officials in evaluating the recommended comprehensive Des Plaines River watershed plan, a preliminary capital improvement program with attendant operation and maintenance costs was prepared which, if followed, would result in total watershed plan implementation by the year 2030.

The schedule of capital and operation and maintenance costs for the overall recommended watershed plan is set forth in Table 117 in Chapter XV. Cost assignments to implementing counties, communities, and agencies are set forth for the park and open space, floodland and stormwater management, and water quality management plan elements in Tables 122, 123, and 125, respectively, in Chapter XVI.

The plan funding schedule assumes a 28-year plan implementation period beginning in 2003 and extending through the year 2030. The capital cost of implementing the entire Des Plaines River watershed plan, including capital projects; park development; land rental, easements, and/or acquisitions; and certain administrative and planning costs, is estimated to potentially range from $111.9 million to $127.8 million, depending on the degree to which lands are converted to prairies and wetlands through the U.S. Department of Agriculture Conservation Reserve Program or through purchase of easements and development rights. The capital cost represents an average annual capital expenditure over the 28-year period of about $4.0 to $4.6 million. About $16.9 million, or 13 to 15 percent of the total, and representing an average annual expenditure of about $603,000, is required to implement the park and open space element of the plan, including the acquisition of primary environmental corridor lands; from about $70.9 to $86.8 million, or from about 63 to 68 percent of the total and representing an average annual expenditure of from about $2.5 to $3.1 million, is required for implementation of the floodland and stormwater management element of the plan; about $24.1 million, or from about 19 to 22 percent of the total, and representing an average annual expenditure of about $862,000, is required for implementation of the water

[5] *These costs do not include the planning costs associated with preparation of detailed stormwater management plans.*

quality management element of the plan.[6] The average annual operation and maintenance costs for the recommended plan components is estimated to range from $529,000 to $1,566,000, with those costs shared between the private and public sectors. The total capital investment and operation and maintenance cost required for plan implementation may be expected to approximate from $4.5 to $6.1 million on an average annual basis. About $59 million, or 46 to 53 percent of the total capital cost, would be borne by the private sector as a cost of land development. Approximately $1.0 million, or 0.8 to 0.9 percent of the total capital cost of the plan, would be borne by the private sector for structure floodproofing and elevation. About $14.0 million of the park and open space plan cost is reflected in the total cost of the County park and open space plans, the Kenosha Urban Planning District plan, and the regional bicycle and pedestrian facilities plan, and are not, therefore, considered to be additional costs in the Des Plaines River watershed plan. Thus, about $74.0 million, or from 58 to 66 percent of the total capital cost of the plan, would either be borne by the private sector, or has been included under a previously adopted plan. The remaining costs will either be covered under ongoing programs, or through funding that will be sought from outside sources. Plan implementation will be largely dependent upon funding levels being available from such outside sources.

PLAN IMPLEMENTATION

Chapter XVI of this report identifies the various plan implementation responsibilities by level and unit of government. Most of the major recommendations contained in the comprehensive Des Plaines River watershed plan can be undertaken by the existing State, county, and local units of government.

Table 121 lists the potential plan implementation organizations and the actions or projects for which they will be responsible. At the local governmental level, plan implementation entities include Kenosha and Racine Counties; the City of Kenosha; the Villages of Paddock Lake, Pleasant Prairie, and Union Grove; and the Towns of Brighton, Bristol, Dover, Mt. Pleasant, Paris, Salem, Somers, and Yorkville; and the Racine County Drainage Board. At the State level, implementation entities include the Wisconsin Departments of Natural Resources, Transportation, and Agriculture, Trade and Consumer Protection and the University of Wisconsin-Extension. At the Federal level, plan implementation entities include the U.S. Environmental Protection Agency, the U.S. Geological Survey, the U.S. Natural Resources Conservation Service, the U.S. Farm Service Agency, the Federal Emergency Management Agency, the U.S. Army Corps of Engineers. In the private sector, plan implementation entities include the Kenosha/Racine Land Trust and private developers.

It is recommended that Kenosha and Racine Counties each designate an existing staff member to oversee the overall coordination of adoption and implementation of the plan. Logically, the designated staff position would be in the County Planning and Development Departments and would report to the Directors of those Departments. The coordinators, under the direction of the Department Directors, would use this plan to identify recommended projects and activities and would work closely with the local, State, and Federal governments and agencies responsible for implementing those projects and activities. It is envisioned that the County coordinators will be guided by the Watershed Advisory Committee and will receive assistance from the Regional Planning Commission staff as may be necessary.

The coordinators would develop detailed schedules for plan implementation, would be responsible for contacting the units of government and agencies essential to implementation of the various components of the plan, and would track the progress of plan implementation. Such contacts would involve notifying those units of government and agencies of their specific roles in plan implementation and assisting them in pursuing the technical and financial resources needed to implement the plan. In that respect the County coordinators 1) would either directly apply for grant funding, or direct local governments to appropriate sources of grant funds and

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[6]*The costs of detailed stormwater and fisheries management measures will be determined under the detailed subwatershed-level stormwater and fisheries management plans that are recommended to be prepared. Thus, the watershed plan costs do not include those of stormwater management measures to address areas of existing development, nor the costs of fisheries management measures. Also, the plan costs do not include community and neighborhood parks or local recreational trails.*

2) would provide information to local and County departments to assist them in budgeting for projects essential to plan implementation.

One option for implementation of the prairie and wetland restoration recommendations would be through creation of a State Project Area encompassing the restoration areas. The Wisconsin Department of Natural Resources could acquire, develop, and manage properties within that area. The process of Project Area designation is outlined in Chapter XVI. If such a designation were obtained, the WDNR would be the lead agency responsible for implementation of the prairie and wetland restoration recommendations. It is recommended that the County coordinators work with the WDNR to consider and, if found viable, attain Project Area designation.

PUBLIC REACTION TO THE RECOMMENDED PLAN AND SUBSEQUENT ACTION OF THE DES PLAINES RIVER WATERSHED COMMITTEE

A formal public hearing was held upon completion of the preliminary plan for the watershed. The hearing was conducted on behalf of the Regional Planning Commission by the Des Plaines River Watershed Committee, with the Chairman of the Committee presiding. The purpose of the hearing was to present the preliminary findings and recommendations of the watershed study for review and consideration by public officials and interested citizens. The hearing was announced through news releases sent to The Kenosha News, Westosha Report, Racine Journal Times, and the Westine Report, which serve the watershed area; through publication of official notices in The Kenosha News, Racine Journal Times, and the Westine Report; through official notices and news releases provided to the clerk of each city, village, and town in the watershed; and through an article in the March/April 2003 "Ties to the Land" newsletter published by Kenosha County Land and Water Conservation, the Racine County Land Conservation Division, the University of Wisconsin-Extension, the U.S. Farm Service Agency Office, and the U.S. Natural Resources Conservation Service.

The hearing was held at 7:45 p.m. on March 18, 2003, at the Kenosha County Center. The hearing was preceded by an "open house" format meeting from 4:00 to 6:30 p.m. which provided an opportunity for the public to meet one-on-one, or in small groups with the County and Commission staffs to receive information, ask questions, and informally provide comment. A presentation summarizing the plan was made by the Commission staff from 7:00 to 7:45 p.m.

A transcript of the public hearing was prepared by a Registered Professional Reporter, published by the Commission, and provided to both the Des Plaines River Watershed Committee and the Regional Planning Commission for review and consideration prior to final adoption of the recommended plan. The public was given the opportunity to submit written comments on the plan through March 31, 2003.[7] The only written comments that were received came from the Kenosha/Racine Land Trust. The comments in that letter were also presented verbally at the public hearing as described below.

Public comment at the hearing was provided by the following individuals, listed in the order in which they spoke:

- Mr. Floyd Holloway of the Town of Paris,
- Mr. James Fox, Village of Union Grove Trustee and Chairperson of the Village Stormwater Committee,
- Ms. Laurie Artiomow, Vice President of the Kenosha/Racine Land Trust, Inc., and
- Mr. Lon Knoedler, Regional Vice President of Ducks Unlimited.

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[7]*See* Record of Public Comments—A Comprehensive Plan for the Des Plaines River Watershed*, SEWRPC, April 2003.*

The comments of each of those who spoke at the hearing are summarized below. The Watershed Committee considered the comments made at the public hearing and the responses set forth below and concluded that no modifications to the plan were warranted.

Mr. Floyd Holloway of the Town of Paris
Mr. Holloway's comments were directed toward Chapter XVI "Plan Implementation." His main comments related to 1) what he viewed as the large number of recommendations and implementing agencies, 2) the fact that some the recommended implementing agencies have condemnation powers which he implied could be used to implement the prairie restoration recommendations, 3) the possibility that the Kenosha County Drainage Board could be reconstituted and could assess landowners for sediment removal from the main channel of the Upper Des Plaines River, 4) the appropriateness of recommending a sewerage system facility plan for the Town of Bristol and Village of Paddock Lake sewer service areas, 5) the recommendation to adopt new or revised floodplains in unincorporated areas; and 6) his expectation that the plan would be simpler and less costly.

Mr. James Fox, Village of Union Grove Trustee and Chairperson of the Village Stormwater Committee
Mr. Fox noted the stormwater runoff problems created by new development and stated that the burden of avoiding those problems should be placed on the private developer at the time of development.

Ms. Laurie Artiomow, Vice President of the Kenosha/Racine Land Trust, Inc.
Ms. Artiomow spoke in support of the plan on behalf of the Land Trust, noting that implementation of the watershed plan 1) will help preserve the remaining critical species habitat, natural areas, and primary environmental corridors and 2) will address the need for recreational areas in the watershed. She stated that the conservation plan for the Des Plaines River watershed that was recently adopted by the Land Trust calls for restoration of natural areas, prairies, wetlands, and hydrologic functions which reduce flooding, and she noted that the watershed plan supports those goals. Ms. Artiomow remarked that the Land Trust is seeking funds to establish a staff position to help implement its conservation plan, and she offered the assistance of that individual in helping municipalities in the watershed with land negotiations, prairie and wetland restoration activities, and educational programs all consistent with the recommendations of the watershed study.

Mr. Lon Knoedler, Regional Vice President of Ducks Unlimited
Mr. Knoedler stated that Ducks Unlimited is a willing partner on wetland restoration projects through either public or private partnerships and he noted that funds for such activities are available through the recent reauthorization of the North American Wilderness Conservation Act.

Concluding Remarks
Since the public hearing was for the purpose of obtaining comment on the watershed plan from the public, the County and Commission staffs did not respond to specific public comment at the hearing. The recommendations of the watershed plan are completely consistent with Mr. Fox's comments regarding the need to require control of stormwater runoff from new development and for private developers to bear that cost. Ms. Artiomow and Mr. Knoedler provided comments in support of the plan and offered assistance in implementation of the plan.

Mr. Holloway's comments took exception with certain components of the plan. The following observations are offered in response to his remarks:

1. **Comment:** There are large numbers of recommendations and implementing agencies.

   Response: The scope of the plan as set forth by the Watershed Committee in the watershed planning prospectus was intended to be comprehensive and broad enough to address existing and potential future water-resource related problems. All of the implementing agencies, with the exception of the Kenosha County Drainage Board, currently exist and, to some degree, carry out the types of programs which are recommended. Over half of the potential implementing agencies are the local governmental bodies that stand to benefit from implementation of the plan. The remaining entities are either private, State, or Federal organizations that may be able to 1) provide funding through grants, 2) provide assistance in identifying opportunities for implementing plan recommendations, 3) provide technical assistance in designing and implementing specific plan components, and/or 4) have regulatory authority under State or Federal statutes. Thus, the number of implementing agencies is considered appropriate to the effective implementation of the plan.

2. **Comment:** Some of the recommended implementing agencies have condemnation powers which could be used to implement the prairie restoration recommendations.

   Response: The plan clearly indicates that there is no intention that condemnation powers be used to implement either the prairie or wetland restoration recommendations. Potential prairie restoration sites cover approximately 30 square miles of land within the watershed, but only 20 percent of that land area was considered possible to be restored. The prairie and wetland restorations will only be accomplished in cases where the owner is willing to be compensated a) for enrolling land in a U.S. Department of Agriculture conservation program, b) for providing a conservation easement, c) for selling land for restoration, or d) on some other agreeable basis. If it is implemented, this recommendation will offer the agricultural landowner a distinct advantage over current conditions. The landowner will not be required to do anything and can continue his current practices. However, if the landowner wishes to reduce the land in agricultural use, there would be options presented for him to be compensated for such reductions. If the landowner is not satisfied with the compensation arrangement, no agreement will be reached and there will be no change to the current situation. This seems to present only a positive potential for landowners, with no "down side."

3. **Comment:** The Kenosha County Drainage Board could be reconstituted and could assess landowners for sediment removal from the main channel of the Upper Des Plaines River.

   Response: The preferred means for rehabilitating the Upper Des Plaines River stream channel is through relatively low-cost natural processes as described in detail in Chapters XII and XV. If those stream rehabilitation means do not prove to be successful, the next option would be to mechanically remove the sediment. If that were necessary, the cost of that operation would logically be borne by landowners benefiting most directly from the project. Such a project would only be considered if the landowners agreed and sponsored it.

4. **Comment:** It is inappropriate to recommend a sewerage system facility plan for the Town of Bristol and Village of Paddock Lake sewer service areas.

   Response: Such a facility plan is directly related to the objective of maintaining and/or improving water quality within the watershed and it relates to the need to provide adequate treatment facilities to support the development envisioned under the recommended land use plan. The recommended study is currently underway, with the Town of Bristol being the lead management agency. A full range of alternatives are being considered, including maintenance, upgrading, and expansion of existing facilities.

5. **Comment:** The recommendations will result in the adoption of new or revised floodplains in unincorporated areas.

   Response: The streams for which the 100-year recurrence interval floodplain boundaries were revised, or for which new boundaries were determined, were established by the Watershed Committee when the prospectus was developed. The streams were identified based on the existence of an existing detailed or approximate floodplain, the potential for future development along and near the stream, and/or the existence of flood problems along the stream. The identification of floodplain boundaries under the watershed study is an integral component of the solution to existing flooding problems and the avoidance of future problems within the watershed. The vast majority of streams in the unincorporated areas are currently covered by floodplain zoning and mapping. The current study merely provides a more up-to-date and technically sound basis for the floodplains. In a number of cases, the floodplain boundary is actually smaller under the current study than the current regulatory floodplain, while in some cases, the floodplain is somewhat, but not significantly, larger. In any case, the current State rules require floodplain delineations and zoning in the unincorporated areas. If the floodplain delineations are not done based upon sound technical analyses, such as used in this plan, then the County must rely upon approximate delineation for zoning purposes. Such approximate delineations are typically more conservative and include larger areas of regulation.

6. **Comment:** The plan should be simpler and less costly.

   Response: The plan is intended to comprehensively address the water resource-related problems of the watershed. The problems are complex and the solutions to address those problems are commensurate with the magnitude of the problems. However, while the broad scope of the plan may give an appearance of complexity, the individual solutions are in many cases relatively simple and straightforward. For example, requiring limits on two- and 100-year release rates from new development is an uncomplicated approach that can be readily applied to avoid creating downstream flooding problems. In addition, such a recommendation meshes well with the recommendation to control the quality of runoff from new development since dual-purpose facilities may be able to meet both objectives. Likewise, adopting revised or new floodplain boundaries for zoning purposes based on analyses already conducted during the planning process is a straightforward way to avoid situations that would increase flood damages in the future.

   Regarding the cost of the plan, as noted in Chapter XV, the recommended plan would be implemented over a 28-year period, about 50 percent of the costs of the recommended plan would be borne by the private sector, an additional 12 percent of the plan costs have already been adopted under previous park and open space plans, and implementation of many of the other plan recommendations would be dependent on obtaining grant funds through the numerous sources listed in Chapter XVI. New costs to be borne by the public will be largely dependent upon the availability of outside funding sources.

CONCLUSION

The surface waters of the Des Plaines River watershed are a valuable natural resource. However, developmental and other environmental problems within the watershed have limited that value as a natural resource. Without a comprehensive approach to managing the land use and water resources within the watershed, these problems are expected to intensify. Adoption and implementation of the recommended comprehensive plan for the Des Plaines River watershed may be expected to result in the substantial achievement of the adopted watershed development objectives and supporting standards. Consequently, implementation of the plan may be expected to provide a safer, more healthful, and more pleasant, as well as more orderly and efficient, environment for all life in the watershed. Implementation of the recommended plan would abate the most serious and costly environmental problems of the watershed, including flooding and water pollution, would minimize the development of new problems of this kind, and would enhance the potential biological and recreational use of the stream system.