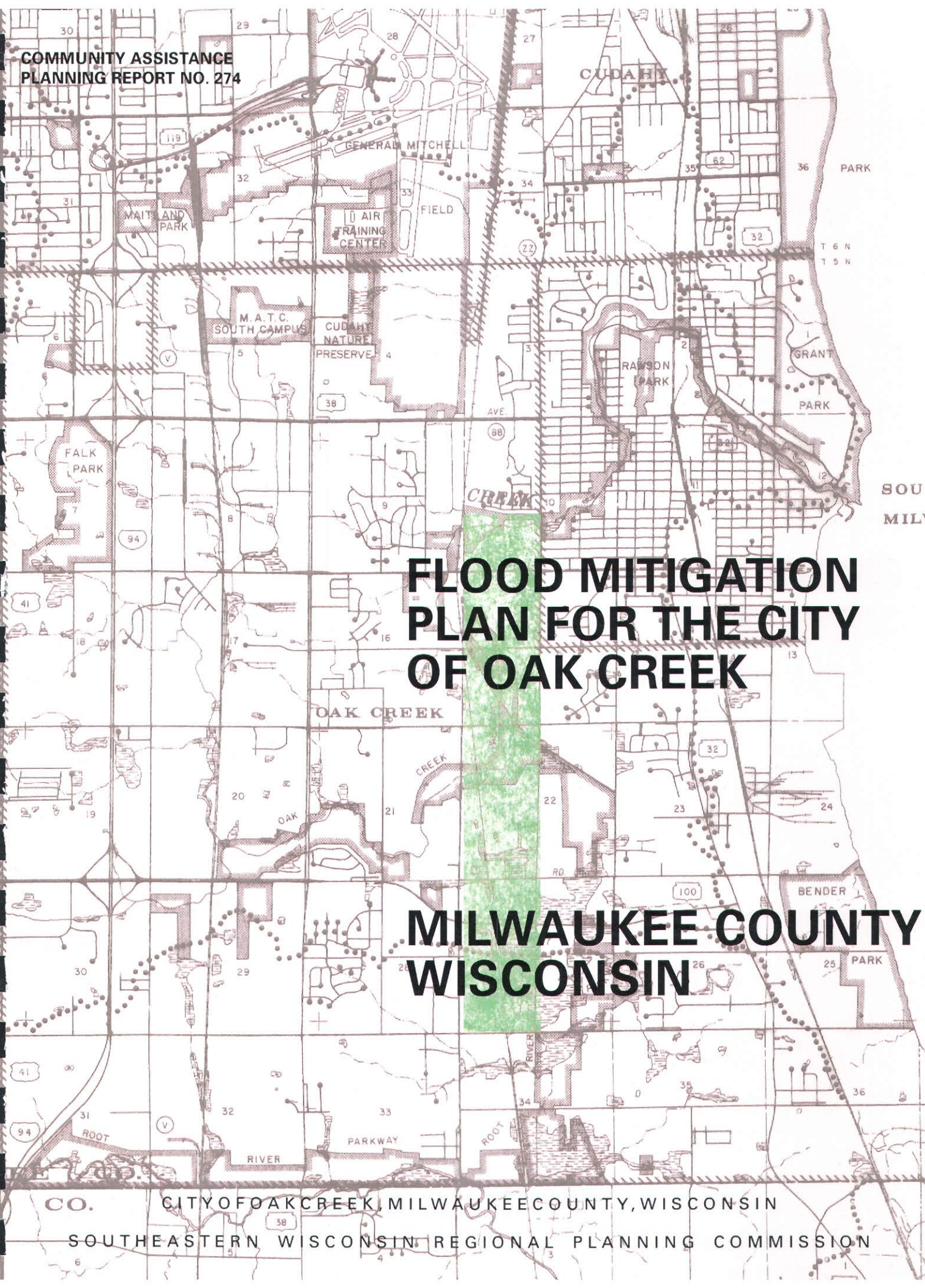
COMMUNITY ASSISTANCE
PLANNING REPORT NO. 274



FLOOD MITIGATION PLAN FOR THE CITY OF OAK CREEK

MILWAUKEE COUNTY WISCONSIN

CITY OF OAK CREEK, MILWAUKEE COUNTY, WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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COMMUNITY ASSISTANCE PLANNING REPORT
NUMBER 274

FLOOD MITIGATION PLAN FOR THE CITY OF OAK CREEK MILWAUKEE COUNTY, WISCONSIN

Prepared by the

City of Oak Creek
and the
Southeastern Wisconsin Regional Planning Commission
In Cooperation with the
Wisconsin Department of Military Affairs, Division of Emergency Management

April 2004

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Outside Region $20.00

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF MAPS

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Chapter I

INTRODUCTION AND BACKGROUND

On February 16, 2001, the City of Oak Creek requested the assistance of the Southeastern Wisconsin Regional Planning Commission (SEWRPC) in the preparation of a flood mitigation plan for the City. In addition to setting forth updated flood mitigation recommendations for the City and for the three watersheds contained therein, the plan is designed to set forth current information regarding the status of flooding problems and planning for their mitigation, as well as plan implementation efforts, including public involvement activities undertaken as a part of flood mitigation planning, within and for the City and the watershed. The plan was prepared by City Department of Community Development staff and Regional Planning Commission staff and was coordinated with the related activities of other concerned units and agencies of government. In preparing the plan, the City involved the Departments of Administration and Public Works as needed. In addition, the Milwaukee County Sheriff's Department, Division of Emergency Management, was contacted and has been involved in ongoing cooperative flood mitigation planning. Additionally, the development of detailed system plans as described herein involved the coordination and cooperation of many agencies and units of government, including, but not limited to, adjacent and other concerned local units of government, the Milwaukee Metropolitan Sewerage District, and the Wisconsin Department of Natural Resources.

The preparation of this plan is an important step in minimizing flood damages in the City and is a condition of the City's receiving grant funding administered by the Wisconsin Department of Military Affairs, Division of Emergency Management, under the Hazard Mitigation Grant Program in conjunction with the flooding that occurred in the City in 2000.

STUDY AREA

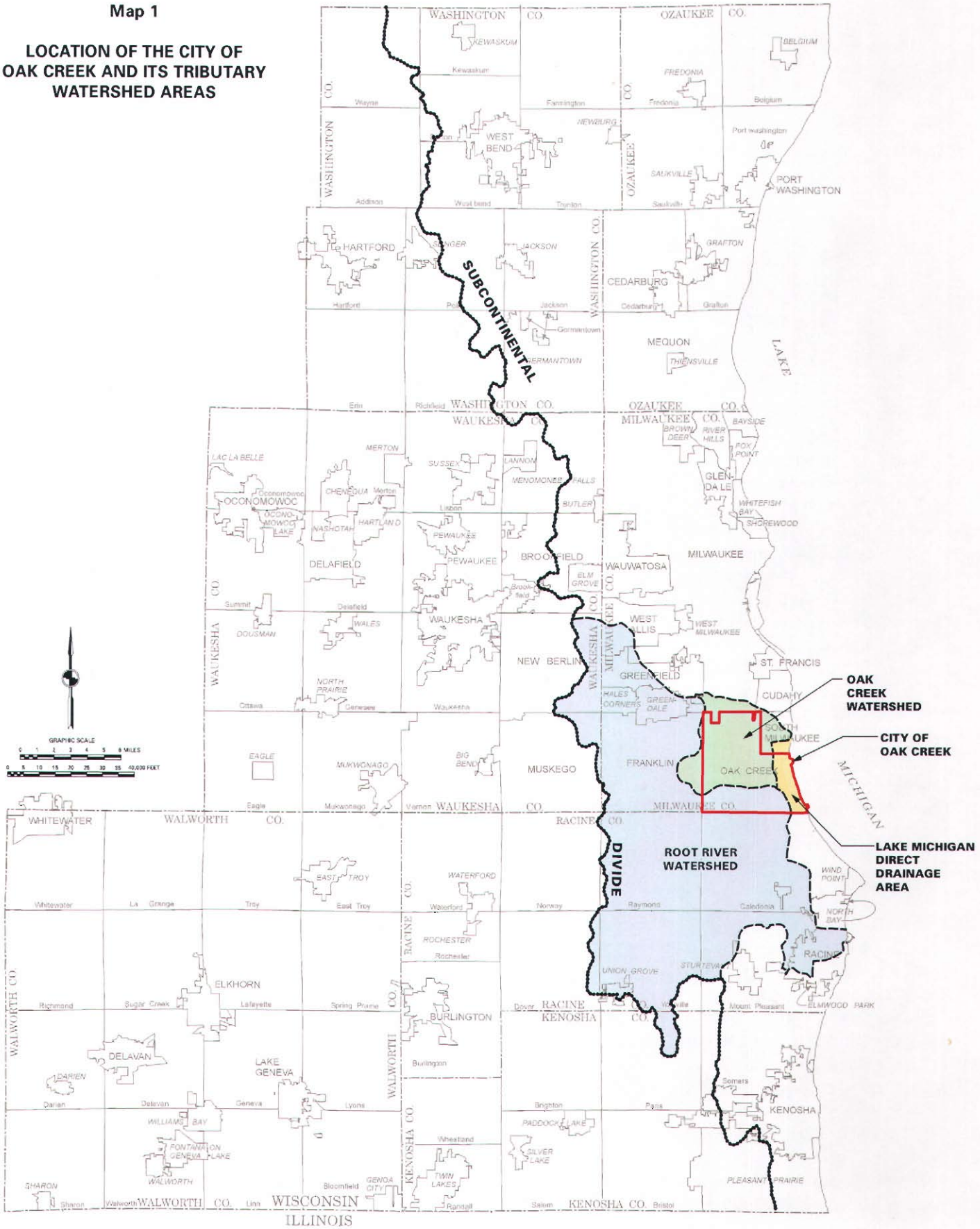
The study area encompassed by the plan includes 1) a primary study area coterminous with the corporate boundaries of the City of Oak Creek which includes portions of three watersheds—the Oak Creek, Root River, and Lake Michigan Direct Drainage Area watersheds—that lie within the City and 2) a secondary study area encompassing those portions of the Oak Creek and Root River watersheds that lie outside the City (see Map 1). The latter portion of the overall study area was considered because of the importance of considering floodland management planning on a watershed basis. The primary study area encompasses a total of about 28.4 square miles, or about 12 percent of the overall study area. The secondary study area encompasses a total of about 201.32 square miles, or the remaining 88 percent of the overall study area.

NEED FOR THE PLAN

Floodwaters can directly damage buildings and other structures in numerous ways. The most common types of damage include hydrostatic pressure leading to the collapse of building foundations, basement slab heaving, and

Map 1

LOCATION OF THE CITY OF OAK CREEK AND ITS TRIBUTARY WATERSHED AREAS



Source: SEWRPC.

loss of mortar; erosion of foundations and soil; heaving of sidewalks and slabs; saturation of insulation; wood rot; deterioration of masonry and concrete, including soluble salt damage and freezing and thawing damage; damage to metal structural components, including fasteners, exposed metals, and embedded iron; damage to interior finishes, including drywall, plaster, wood floors and trim, interior paint, wallpaper, and floor coverings; exterior paint problems; and damage to utilities, appliances, equipment, merchandise, and personal belongings. In addition to personal losses arising from such damage, businesses damaged by floodwater can suffer economic losses arising from being forced to suspend operations as a result of the flooding and its aftermath. In addition to direct flood damages, indirect damages, such as the cost of temporary evacuation or relocation and lost wages, as well as intangible damages, such as psychological stress and health hazards, can occur.

A number of major flooding events, including many that have caused extensive damage, have been recorded within the primary and secondary planning areas since their settlement by Europeans in the 19th century. In addition to floods in 1917, 1940, 1960, 1972, and 1973, these events have included the following:

- The event of August 6, 1986, when 6.84 inches of rain fell in 24 hours at General Mitchell International Airport, located immediately north of the City of Oak Creek. The most intense precipitation from the storm occurred within a band oriented from the northwest to southeast across Milwaukee County. The rainfall recorded at the airport was a single-day record for that reporting station and had a recurrence interval of about 300 years, with the most intense portion of the storm having a recurrence interval in excess of 500 years. That event resulted in the largest peak discharge recorded at the U.S. Geological Survey stream gage on Oak Creek in 39 years of operation.

- The event of June 20-21, 1997, when a 26-hour storm involving a period of moderate rainfall followed by intense thunderstorms centered in northern Milwaukee County resulted in at least four inches of rain across the County, with much of the County receiving about six inches of rain. More than seven inches of rain was recorded in the City of Wauwatosa, and more than nine inches of rain was recorded in the Village of Brown Deer. A total of 5.25 inches was reported at General Mitchell International Airport in the southern end of the County. Widespread flooding was reported in the City of Oak Creek, although not as severe as in the northern portion of the County.

- The event of July 2, 1997, a "follow-up" storm to the June 20-21, 1997, storm event, involved as much as four inches of rain, but resulted in little additional property damage.

- The event of August 6, 1998, which produced in excess of 11 inches of rain in the City of Brookfield in Waukesha County, and up to six inches of rain in the Wauwatosa area and in northwestern Milwaukee County. Less than one inch of rain was reported at General Mitchell International Airport for that event, although about 3.7 inches of rain was recorded at that location the previous day.

- The event of July 2, 2000, in which up to seven inches of rain fell over eastern Waukesha and southern Milwaukee Counties. That rain, coupled with high winds, including one tornado, resulted in significant flooding and wind-related damage in the City of Oak Creek.

The recent flooding events demonstrate the continuing need for a comprehensive and cooperative strategy for mitigating existing flooding problems and for preventing future flooding in the City of Oak Creek. In the absence of adequate planning, the City may be expected to continue to experience repetitive flooding problems. A systematic plan to address existing flooding problems and avoid the creation of new problems is therefore critical to the sound development of the City.

SCOPE AND PURPOSE OF PLAN

This plan is intended to set forth the most appropriate, feasible, and effective flood mitigation strategy for the City of Oak Creek. The planning process, which is also documented in this report, includes the following steps:

- Conduct of inventories and analyses of relevant basic data pertaining to the overall study area, including data on current and planned land use and related data; the surface-water system; existing applicable floodland management regulations and programs; historical flooding problems; and recent flood events and associated flooding problems.

- Identification of flood mitigation goals and objectives for the City.

- Analysis and assessment of flood problems in the City.

- Consideration of alternative flood mitigation strategies. Alternative strategies must be considered in the context of comprehensive water resource and other planning efforts, particularly recent floodland system planning efforts.

- Identification of potential funding sources for flood hazard mitigation efforts.

- Selection and description of a recommended flood mitigation plan for the City, including 1) documentation of public participation activities and coordination efforts undertaken with other concerned "stakeholders," including other units and agencies of government and concerned private-sector parties, undertaken as part of the planning process, 2) description of recommended plan implementation strategies, and 3) description of recommended plan monitoring strategies.

The Watershed as a Planning Unit

Planning for floodland- and stormwater-related problems can conceivably be carried out on the basis of a number of different geographic units, including areas defined by governmental jurisdictions, economic linkages, or watersheds. There are important reasons for utilizing the watershed as a water resources planning unit. These reasons include the following:

- Floodland management measures, flood control measures, and stormwater management facilities should form a single integrated system over a watershed. The streams and watercourses of a watershed must be capable of carrying present and future runoff loads generated by existing and probable future land use development patterns within the watershed. Therefore, flood control and stormwater management problems can best be considered on a watershed basis.

- Flood control and stormwater drainage problems are closely related to other land and water use problems. Consequently, floodland protection and water-related park and open space preservation can be best studied on a watershed basis.

- Changes in land use and transportation requirements ordinarily are not controlled by watershed factors, but nevertheless have major effects on watershed problems. Land use and transportation system patterns significantly affect the amount and spatial distribution of hydrologic loadings to be accommodated by water control facilities. In turn, the water control facilities and their effect on historical floodlands determine to a considerable extent the uses to which certain land areas can be put.

- Finally, the related physical problems of a watershed tend to create a community interest within the watershed around which floodland and stormwater management planning efforts can be organized.

For these reasons, the watershed is a logical unit for floodland management and related stormwater management planning, provided the relationships existing between the watershed and the surrounding region are recognized. Accordingly, since its inception in 1960, the regional planning program in the Southeastern Wisconsin Region has embodied a recognition of the need to consider watersheds as rational planning units if workable solutions are to be found for interrelated land and water use problems, including flood mitigation. Also accordingly, this flood

mitigation plan has included consideration of the watersheds which lie within or partially within the City of Oak Creek in addition to the City itself.

Relationship of Flood Control Planning to Stormwater Management Planning
While the focus of the current planning effort is flood mitigation within the City of Oak Creek, it is imperative to note the importance of the relationship between flood control planning and stormwater management planning.

In both flood control and stormwater management planning, the important effect of land use development on flood flows and stages and on water quality conditions must be recognized. It is important to understand the differences between flood control and stormwater management planning. Flood control planning deals with the problems presented when peak streamflows exceed stream channel capabilities and floodwaters move outward from stream channels to occupy natural floodplains, particularly such floodplains occupied by flood-damage-prone development. Sound flood control measures for any given watershed include, first and foremost, the preservation of floodlands in essentially natural, open uses and, as may be found necessary, the provision of floodwater storage capacity above and beyond that provided by the remaining open floodlands to reduce peak flood flows along the stream channels; the removal of existing flood-damage-prone buildings and the floodproofing of other existing flood-damage-prone buildings; and, as a last resort, modifications to increase the flood conveyance capacities of the streams and watercourses, including the replacement of hydraulic control structures, such as bridges, culverts, and dams.

Stormwater management planning deals with problems created by the inability of stormwater runoff to reach the major stream channels of a watershed without attendant local ponding; street, yard, and basement flooding; and surcharging of sanitary sewerage systems with attendant basement flooding. The proper preparation of stormwater management system plans requires the existence of agreed-upon flood control system plans. This is important because the flood elevations along the major stream channels will determine the configuration, sizing, and performance of the local drainage systems. In some cases, the design of a stormwater management system may require revisions in the flood control plan.

Both flood control and stormwater management system plans must consider the need for water pollution abatement measures to meet water use objectives and related water quality standards. At the watershed level, this requires the incorporation of areawide recommendations for the abatement of point sources of water pollution, such as sewage treatment plant discharges, and the reduction of nonpoint sources of water pollution.

Importantly, local stormwater management system planning must also be integrated with sanitary sewerage system planning in order to address the serious public health and safety problems caused by the surcharging of sanitary sewers during periods of excessive rainfall with attendant backup of sanitary sewage into basements of buildings, or the required bypassing of raw sanitary sewage to storm sewers, roadside swales and ditches, and natural swales and watercourses.

Other Hazards
Like other municipalities in Milwaukee County, the City of Oak Creek is vulnerable to a wide range of hazards besides flooding. Accordingly, as an integral part of their emergency management planning efforts, both the City and other municipalities in the County cooperate with Milwaukee County in analyzing such hazards and, as appropriate, planning for and responding to any disasters that may arise from those hazards.

A September 1998 hazard analysis prepared by Milwaukee County describes various types of disasters which have occurred in the County and/or which are likely to or which may otherwise happen in the County.[1] The analysis categorizes flooding among other natural hazards to which the County is vulnerable, including heat waves; droughts; thunderstorms; lightning; hail; tornadoes and downbursts; and winter storms. Although the

[1]Hazard Analysis for the County of Milwaukee, *Milwaukee County Sheriff, Division of Emergency Management, September 1998.*

threat to Wisconsin of another type of natural hazard, earthquakes, as a whole is not great, the analysis notes that ground shaking can be felt from earthquakes centered in Wisconsin or in adjacent states.

The Milwaukee County analysis also includes an examination of 1) health threats, including epidemics of contagious disease; the contamination of water and food by microorganisms; emergencies involving the spilling or unsafe release of hazardous materials into the environment; and violent crime, including child abuse and neglect; 2) technological and/or human-created hazards, including dam failures; incidents involving the spilling or unsafe release of hazardous materials; transportation accidents, including trucking, aircraft, rail, and maritime accidents, many of which may involve mass casualties and/or rescues; nuclear power plant and/or other nuclear-energy-related incidents, including both incidents which may involve the release of radioactive materials into the atmosphere from nuclear power plant accidents and incidents arising in the transportation or storage of radioactive materials; electrical power outages; and urban fires, defined as fires occurring in, around, or on a structure or a vehicle inside the limits of an incorporated village or city; and 3) national security threats, including chemical and biological warfare; nuclear attack; sabotage and terrorism; and civil disturbances, including terrorist attacks, riots, labor stoppages resulting in violence, demonstrations resulting in police intervention and arrests, and disturbances at mass spectator events or at correctional or other detention facilities. Milwaukee County developed an emergency operations program that sets forth an "all hazards" action plan for the County, including the City of Oak Creek.

The City of Oak Creek also developed an emergency operations plan[2] that compliments the County plan and also sets forth procedures and actions to deal with a range of situations and events. The plan includes information on the organization, assignment of responsibilities, and procedures for activating the City of Oak Creek emergency operations center and for directing and controlling the emergency operations during major emergency situations.

It should be noted that the hazards considered by the County and in the integrated emergency operations program, with the exception of flood hazards, are not geographic in nature. Accordingly, no mapping of the other hazard areas is needed.

[2] *City of Oak Creek,* City of Oak Creek Emergency Operation Plan, *March 2002.*

Chapter II

BASIC STUDY AREA INVENTORY AND ANALYSIS

Information on certain pertinent natural and built features and aspects of the study area is essential to sound flood mitigation planning. Accordingly, the collection and collation of definitive information regarding basic demographic characteristics, existing and planned land use, surface-water-system characteristics, environmentally sensitive areas, existing floodland management regulations and programs, historical flooding problems, and recent flood events constitute an important step in the planning process. The resulting information is essential to the planning process, since sound alternative plans cannot be formulated and evaluated without an in-depth knowledge of the relevant conditions in the study area.

POPULATION AND HOUSEHOLDS

Because of the direct relationships that exist between resident population levels and land use patterns, an inventory and analysis of the existing and anticipated 2020 resident population and household levels in the City of Oak Creek, the Oak Creek watershed, the Root River watershed, and that portion of the Lake Michigan Direct Drainage Area within the City of Oak Creek was performed as part of the preparation of this flood mitigation plan for the City. As indicated in Table 1, the resident population of the City is anticipated to increase by about 38 percent between 2000 and 2020. This significant increase reflects the fact that Oak Creek, along with the City of Franklin, contains most of the remaining developable open space in Milwaukee County. Between 2000 and 2020, the resident population of the Oak Creek watershed—which is largely contained in the City of Oak Creek—is anticipated to increase by about 21 percent; the resident population of the Root River watershed is anticipated to increase by about 11 percent; and the resident population of the City of Oak Creek portion of the Lake Michigan direct drainage area is anticipated to increase by about 85 percent.

Similarly, the rate of growth in the number of households within the City of Oak Creek between 2000 and 2020 is envisioned to be significant, with an anticipated increase of about 30 percent. Between 2000 and 2020 the number of households in the Oak Creek watershed is anticipated to increase by about 14 percent; the number of households in the Root River watershed is anticipated to increase by about 13 percent; and the number of households in the City of Oak Creek portion of the Lake Michigan direct drainage area is anticipated to increase by about 68 percent. The total number of households in the three drainage areas combined is anticipated to increase by about 13 percent.

LAND USE

The existing 2000 land use pattern within the City of Oak Creek is graphically set forth on Map 2. The existing 2000 land use pattern for the three drainage areas that lie partly within the City of Oak Creek is graphically set

Table 1

POPULATION AND HOUSEHOLD LEVELS WITHIN THE CITY OF OAK CREEK AND OF SELECTED DRAINAGE AREAS: 2000 AND 2020[a]

Area	Population			Number of Households		
	Existing 2000	Planned 2020	2000-2020 Change	Existing 2000	Planned 2020	2000-2020 Change
City of Oak Creek	28,456	39,284	10,828	11,239	14,565	3,326
Watershed Areas						
Oak Creek Watershed	51,596	62,298	10,702	21,155	24,175	3,020
Root River Watershed	168,929	187,151	18,222	64,860	72,992	8,132
Lake Michigan Direct Drainage Area (City of Oak Creek portion)	1,363	2,518	1,155	529	888	359
Total for Three Drainage Areas	221,888	251,967	30,079	86,544	98,055	11,511

[a]*For the purposes of this table, municipal and drainage-area boundaries have been approximated by whole U.S. Public Land Survey one-quarter section.*

Source: SEWRPC.

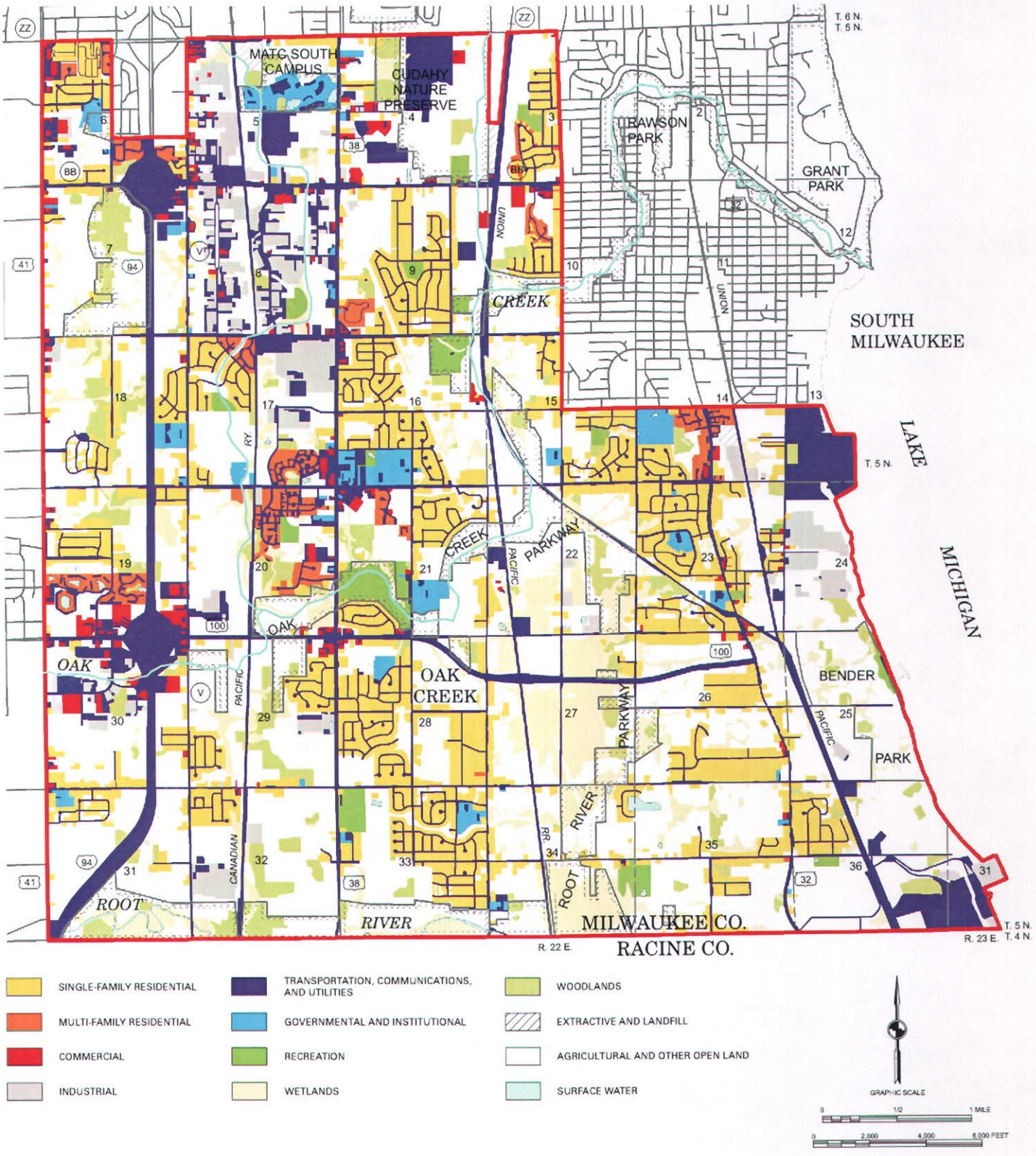
forth on Map 3. The areal extents of existing 2000 and planned 2020 land uses in 1) the City of Oak Creek and 2) each of the three drainage areas that lie partly within the City of Oak Creek are set forth, respectively, in Tables 2 through 5.

As indicated in Table 2, agricultural and other open space use, including wetlands, woodlands, and surface water, comprise the largest area within the given land use categories in the City under both 2000 and planned 2020 development conditions, encompassing about 57 percent of the total area of the City in 2000 and planned to encompass about 46 percent of the total area of the City in 2020. Lands in residential uses encompass the second-largest area within a given land use category in the City under both sets of conditions, encompassing about 18 percent of the total area of the City under actual 2000 conditions and about 23 percent of the total area of the City under planned 2020 conditions. Lands in transportation, communication, and utility uses encompass the third-largest area within a given land use category in the City under both sets of conditions, encompassing about 15 percent of the total area of the City under actual 2000 conditions and about 16 percent of the total area of the City under planned 2020 conditions. It is envisioned that about three square miles of lands currently in agricultural or open uses, encompassing about 10 percent of the total area of the City, will be converted to urban uses, mostly residential uses, by 2020.

Land use in the Oak Creek watershed follows a pattern similar to the City of Oak Creek (see Table 3). This may be expected since the majority of the watershed—about 64 percent—lies within the City. Again, agricultural and other open space use, including wetlands, woodlands, and surface water, comprise the largest area within the given land use categories in the watershed under 2000 development conditions and the second largest under planned 2020 development conditions, encompassing about 42 percent of the total area of the watershed in 2000 and planned to encompass about 30 percent of the total area of the watershed in 2020. Lands in residential uses encompass the second-largest area within a given land use category in the watershed under 2000 development conditions and the largest under planned 2020 development conditions, encompassing about 26 percent of the total area of the watershed under actual 2000 conditions and about 31 percent of the total area of the watershed under planned 2020 conditions. Lands in transportation, communication, and utility uses encompass the third-largest area within a given land use category in the watershed under both sets of conditions, encompassing about 20 percent of the total area of the watershed under actual 2000 conditions and about 22 percent of the total area of the watershed under planned 2020 conditions. It is envisioned that about 3.5 square miles of lands currently in agricultural or open uses, encompassing about 12 percent of the total area of the watershed, will be converted to urban uses, about 40 percent of which will be residential uses, by 2020.

Map 2

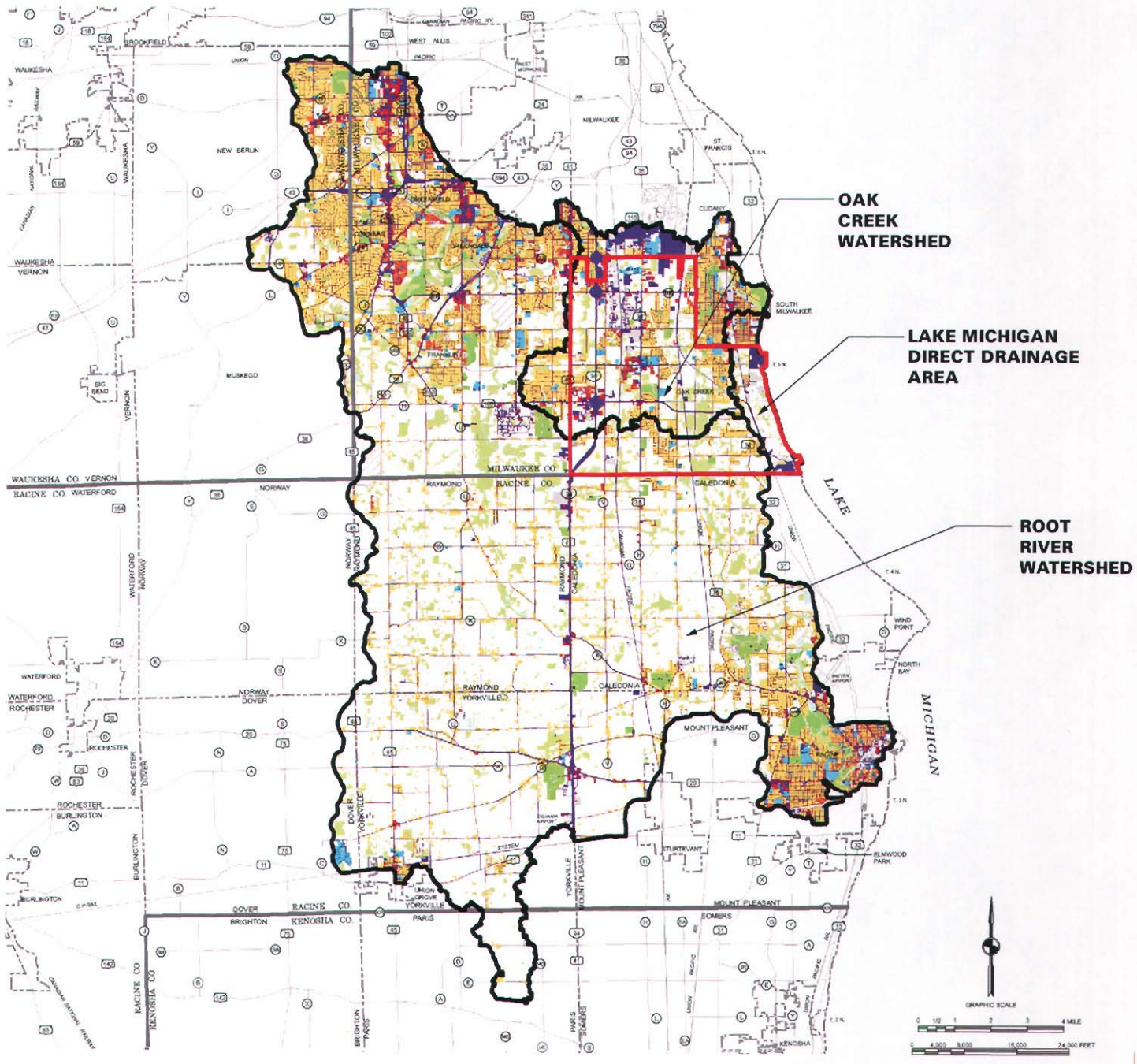
EXISTING LAND USE IN THE CITY OF OAK CREEK: 2000



Source: SEWRPC.

Map 3

EXISTING LAND USE IN THE CITY OF OAK CREEK AND ITS TRIBUTARY WATERSHEDS: 2000



Source: SEWRPC.

Table 2

LAND USE IN THE CITY OF OAK CREEK BY ACREAGES: 2000 AND 2020[a]

Land Use Category	Existing 2000	Planned 2020	2000-2020 Change
Residential			
Suburban-Density (0.2-0.6 dwelling unit per net residential acre)	0	0	0
Urban Low-Density (0.7-2.2 dwelling units per net residential acre)	1,482	1,732	250
Urban Medium-Density (2.3-6.9 dwelling units per net residential acre)	1,526	2,088	562
Urban High-Density (7.0-17.9 dwelling units per net residential acre)	303	353	50
Residential Subtotal	3,311	4,173	862
Commercial	425	517	92
Industrial	771	1,270	499
Transportation, Communication, and Utilities[b]	2,680	2,970	290
Governmental and Institutional	383	405	22
Recreational	298	474	176
Agricultural	4,754	3,579	-1,175
Open Lands[c]	3,395	2,629	-766
Wetlands	1,423	1,423	0
Woodlands	829	829	0
Surface Water	57	57	0
Total	18,326	18,326	0

[a]*For the purposes of this table, municipal and watershed boundaries have been approximated by whole U.S. Public Land Survey one-quarter section.*

[b]*Off-street parking included with associated land use.*

[c]*Includes extractive lands, landfills, and other open lands.*

Source: SEWRPC.

Agricultural lands comprise the largest area within a given land use category in the Root River watershed as a whole (see Table 4). Agricultural lands there encompass about 50 percent of the area involved under both actual 2000 and planned 2020 conditions. Lands in residential use, which encompass about 17 percent of the total watershed under actual 2000 and about 19 percent of the total watershed under planned 2020 conditions, comprise the second-largest portion of the area within a given land use category. Lands in transportation, communication, and utility uses encompass the third-largest area within a given land use category in the watershed under both sets of conditions, encompassing about 9 percent of the total area of the watershed under both actual 2000 and planned 2020 conditions. About six square miles of the watershed portion now in agricultural or open uses, or about 3 percent of the total area, are envisioned to be converted to urban uses by 2020.

In the City of Oak Creek portion of the Lake Michigan Direct Drainage Area, lands in open use, excluding wetlands and woodlands, comprise the largest area within a given land use category under both actual 2000 and planned 2020 conditions, encompassing about 47 percent of the total area of the watershed in 2000 and planned to encompass about 36 percent of the watershed in 2020 (see Table 5). Lands in transportation, communication, and utility uses comprise the second-largest area within a given land use category in the watershed under both sets of conditions, encompassing about 22 percent of the watershed under actual 2000 conditions and about 24 percent under planned 2020 conditions. Lands in residential uses encompass the third-largest area within a given land use category in the watershed under planned 2020 conditions and the fourth-largest area under actual 2000 conditions, encompassing about 7 percent of the total area of the watershed in 2000 and planned to encompass about 13 percent of the watershed in 2020. About 0.7 square mile of the watershed now in agricultural or open uses, or about 22 percent of the total area of the watershed, are envisioned to be converted to urban uses by 2020.

Table 3

LAND USE IN THE OAK CREEK WATERSHED BY ACREAGES: 2000 AND 2020[a]

Land Use Category	Existing 2000	Planned 2020	2000-2020 Change
Residential			
Suburban-Density (0.2-0.6 dwelling unit per net residential acre)	0	0	0
Urban Low-Density (0.7-2.2 dwelling units per net residential acre)	1,459	1,659	200
Urban Medium-Density (2.3-6.9 dwelling units per net residential acre)	2,272	2,972	700
Urban High-Density (7.0-17.9 dwelling units per net residential acre)	1,033	1,083	50
Residential Subtotal	4,764	5,714	950
Commercial	644	742	98
Industrial	536	1,317	781
Transportation, Communication, and Utilities[b]	3,637	4,003	366
Governmental and Institutional	655	685	30
Recreational	571	608	37
Agricultural	3,138	1,778	-1,360
Open Lands[c]	2,880	1,978	-902
Wetlands	935	935	0
Woodlands	764	764	0
Surface Water	30	30	0
Total	18,554	18,554	0

[a]*For the purposes of this table, municipal and watershed boundaries have been approximated by whole U.S. Public Land Survey one-quarter section.*

[b]*Off-street parking included with associated land use.*

[c]*Includes extractive lands, landfills, and other open lands.*

Source: SEWRPC.

SURFACE-WATER SYSTEM

The City of Oak Creek lies entirely east of a major subcontinental divide that roughly bisects the Southeastern Wisconsin Region. The entire City is therefore tributary to the Great Lakes-St. Lawrence River drainage system. Except for that portion of the City that lies within the Lake Michigan direct drainage area, all drainage in the City ultimately enters Lake Michigan through either the mouth of Oak Creek in the City of South Milwaukee or the mouth of the Root River in the City of Racine.

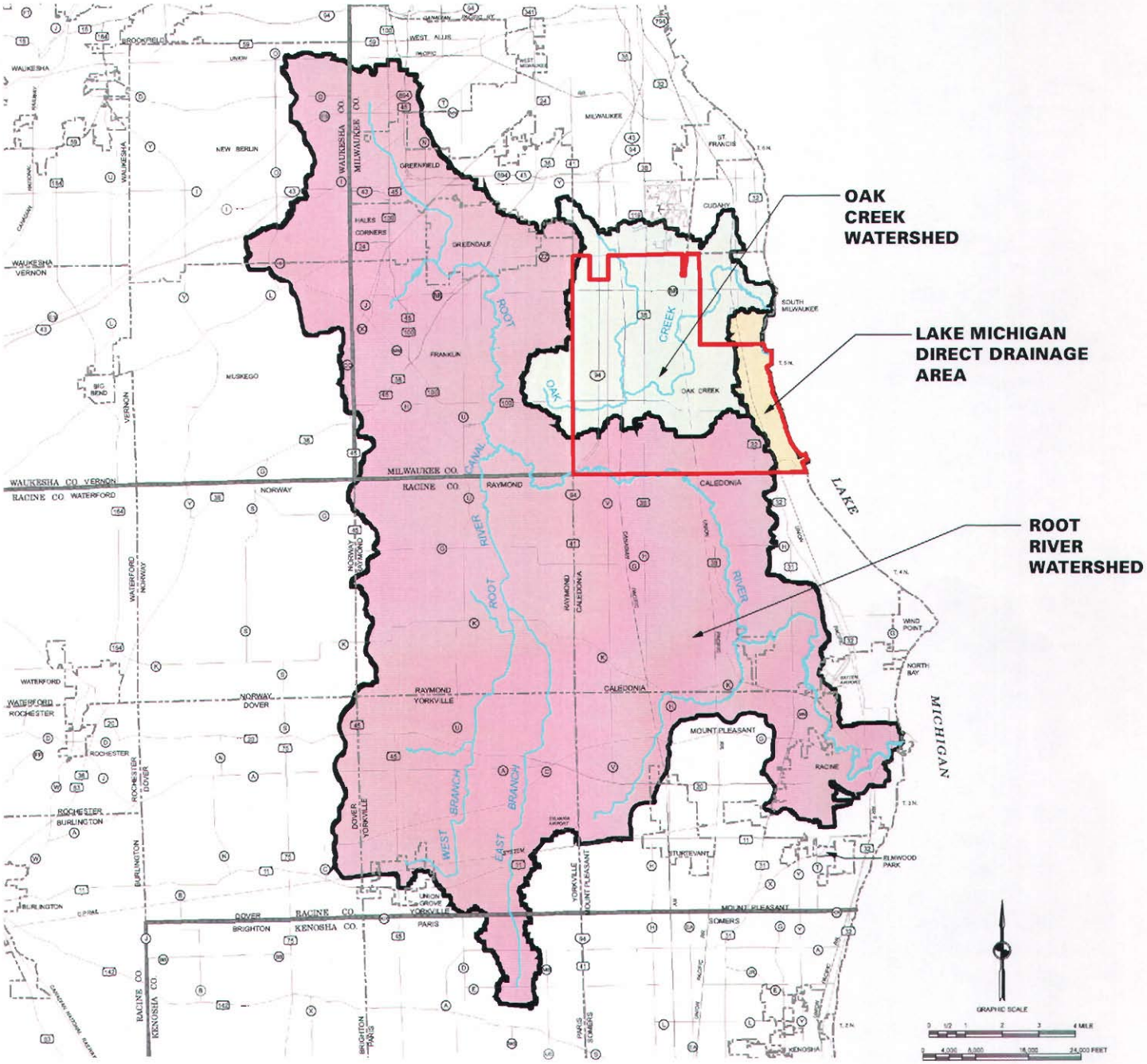
Map 4 illustrates significant streams within the boundaries of the three drainage areas that lie partly within the City of Oak Creek. Details of the flood hazard areas associated with these surface waters within the City are presented in Chapter IV.

ENVIRONMENTALLY SENSITIVE AREAS AND OPEN SPACE PRESERVATION

Many of the natural resource base elements of the City of Oak Creek occur in linear concentrations on the landscape. One of the most important tasks completed under the regional planning program for Southeastern Wisconsin has been the identification and delineation of these linear areas, or corridors. The most important elements of the natural resource base and closely related features, including wetlands, woodlands, prairies, wildlife habitat, major lakes and streams and associated shorelands and floodlands, and historic, scenic, and

Map 4

THE SURFACE WATER SYSTEM OF THE CITY OF OAK CREEK AND ITS TRIBUTARY WATERSHED AREAS



CITY OF OAK CREEK

Source: SEWRPC.

Table 4

LAND USE IN THE ROOT RIVER WATERSHED BY ACREAGES: 2000 AND 2020[a]

Land Use Category	Existing 2000	Planned 2020	2000-2020 Change
Residential			
Suburban-Density (0.2-0.6 dwelling unit per net residential acre)	42	66	24
Urban Low-Density (0.7-2.2 dwelling units per net residential acre)	11,957	12,357	400
Urban Medium-Density (2.3-6.9 dwelling units per net residential acre)	8,163	10,133	1,970
Urban High-Density (7.0-17.9 dwelling units per net residential acre)	1,824	1,966	142
Residential Subtotal	21,986	24,522	2,536
Commercial	1,813	1,899	86
Industrial	1,221	1,625	404
Transportation, Communication, and Utilities[b]	10,653	11,258	605
Governmental and Institutional	1,870	1,933	63
Recreational	3,202	3,302	100
Agricultural	64,030	61,754	-2,276
Open Lands[c]	8,534	7,016	-1,518
Wetlands	6,783	6,783	0
Woodlands	4,827	4,827	0
Surface Water	1,000	1,000	0
Total	125,919	125,919	0

[a]*For the purposes of this table, municipal and watershed boundaries have been approximated by whole U.S. Public Land Survey one-quarter section.*

[b]*Off-street parking included with associated land use.*

[c]*Includes extractive lands, landfills, and other open lands.*

Source: SEWRPC.

recreational sites, when combined, result in an essentially linear pattern referred to by the Regional Planning Commission as environmental corridors. Primary environmental corridors include a wide variety of important natural resource and related elements and are, by definition, at least 400 acres in area, two miles long, and 200 feet wide. Secondary environmental corridors generally connect with the primary environmental corridors and are at least 100 acres in area and one mile in length. In addition, smaller concentrations of natural resource base elements that are separated physically from the environmental corridors by intensive urban or agricultural land uses have also been identified. These areas, which are at least five acres in area each, are referred to as isolated natural resource areas.

In any consideration of environmental corridors and important natural features, it is important to note that the preservation of such features can assist in the attenuation of flood flows. The drainage of wetlands, which are included in the corridors and natural resource areas, may destroy natural filtration and floodwater storage areas. In addition, the intrusion of intensive urban land uses into such areas may result in the creation of serious and costly problems, such as failing foundations for pavements and structures, wet basements, excessive operation of sump pumps, excessive clear-water infiltration into sanitary sewerage systems, and poor drainage. Similarly, destruction of ground cover may result in soil erosion, stream siltation, more rapid runoff, and increased flooding, as well as the destruction of wildlife habitat.

Table 5

LAND USE IN THE CITY OF OAK CREEK PORTION OF THE LAKE MICHIGAN DIRECT DRAINAGE AREA BY ACREAGES: 2000 AND 2020[a]

Land Use Category	Existing 2000	Planned 2020	2000-2020 Change
Residential			
Suburban-Density (0.2-0.6 dwelling unit per net residential acre)	0	0	0
Urban Low-Density (0.7-2.2 dwelling units per net residential acre)	11	14	3
Urban Medium-Density (2.3-6.9 dwelling units per net residential acre)	122	227	105
Urban High-Density (7.0-17.9 dwelling units per net residential acre)	0	0	0
Residential Subtotal	133	241	108
Commercial	11	15	4
Industrial	58	165	107
Transportation, Communication, and Utilities[b]	417	461	44
Governmental and Institutional	8	12	4
Recreational	28	178	150
Agricultural	201	0	-201
Open Lands[c]	911	695	-216
Wetlands	76	76	0
Woodlands	75	75	0
Surface Water	0	0	0
Total	1,918	1,918	0

[a]*For the purposes of this table, municipal and watershed boundaries have been approximated by whole U.S. Public Land Survey one-quarter section.*

[b]*Off-street parking included with associated land use.*

[c]*Includes extractive lands, landfills, and other open lands.*

Source: SEWRPC.

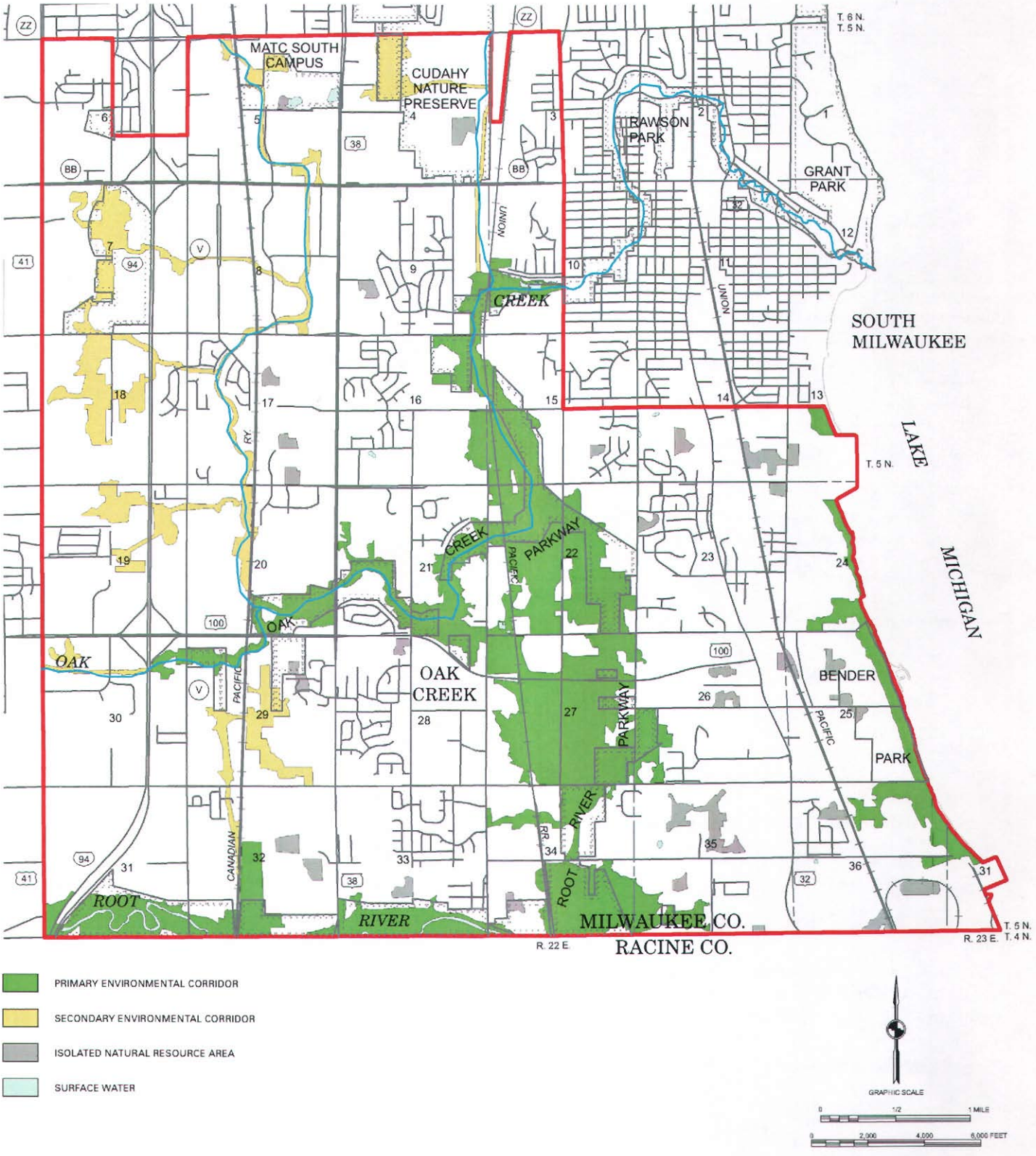
Although the effects of any one of these environmental changes may not in and of itself be overwhelming, the combined effects must eventually lead to a serious deterioration of the underlying and sustaining natural resource base and of the overall quality of the environment for life. The need to maintain the integrity of the remaining environmental corridors and isolated natural resource areas in the City of Oak Creek should thus be apparent. The location and extent of the environmental corridors and isolated natural resource areas in the City is shown on Map 5.

In addition to environmental corridors and isolated natural resource areas, SEWRPC has also developed an inventory of natural area sites and critical species habitats.[1] Natural area sites are tracts of land or water containing plant and animal communities representative of the pre-European settlement landscape. Critical species habitats are tracts of land or water which support endangered, threatened, or rare plant or animal species. Within the City of Oak Creek, eight natural area sites, six critical plant habitat sites, one critical bird species habitat site, and one critical herptile species habitat site have been identified. These sites are located within the identified environmental corridors and isolated natural resource areas.

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

Map 5

ENVIRONMENTALLY SIGNIFICANT LANDS IN THE CITY OF OAK CREEK



Source: SEWRPC.

The City of Oak Creek has taken an active role in preserving the environmental corridors, isolated natural resource areas, natural areas, and critical species habitats within the City through both its park and open space planning program[2] and recently adopted comprehensive plan.[3] The comprehensive plan has incorporated and expanded upon the recommendations of the City's park and open space plan. Under full implementation of the agricultural, natural, and cultural resources plan element of the City's comprehensive plan, the important natural resource features in the City would be protected and preserved for resource preservation and other open space purposes. As shown on Map 6, these lands are located within three planned land use categories: 1) active recreation; 2) resource protection area; and 3) limited development area. Active recreation use includes existing and planned regional, community, and neighborhood park sites that include active recreational features such as playgrounds, baseball diamonds, and golf courses. Resource protection areas and limited development areas include other lands with sensitive environmental features or significant development limitations, as well as lands already in public ownership. Resource protection areas are to be protected through a combination of public acquisition and regulation. Limited development areas are to be protected through a combination of regulation and appropriate site development planning. These latter two land use categories include identified floodplains, primary and secondary environmental corridors, isolated natural resource areas, natural area sites, and critical species habitat.

In addition to the City's park and open space and comprehensive plans, Milwaukee County has also adopted a park and open space plan.[4] The City's plans have incorporated features of the County's plan, including the recommendation for the County to continue to acquire primary environmental corridor lands, as well certain floodlands that have been used for agricultural purposes, as part of the County's system of parkways. This includes the Oak Creek and Root River parkways in the City of Oak Creek.

Finally, the Milwaukee Metropolitan Sewerage District (MMSD) has recently adopted a "Conservation Plan" that identifies land parcels that are recommended to be protected for multiple purposes, including flood reduction potential and stormwater management benefits, as well as wildlife habitat, water quality, and recreational benefits.[5] That plan identified 165 sites, including 42 high-priority sites, for protection through public acquisition or conservation easements, throughout the Menomonee River, Root River, and Oak Creek watersheds. There are eight high priority sites identified in the City of Oak Creek. Most of these sites are included in the Resource Protection and Limited Development Areas described above. Thus, the MMSD program presents another potential source of funding for resource preservation in the City. SEWRPC has recently completed a greenway connection plan for the MMSD that identifies additional lands for acquisition that would connect those sites identified in the Conservation Plan.[6]

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[2]*City of Oak Creek,* 1998 Park and Open Space Plan for Oak Creek, *December 16, 1997.*

[3]*Vandewalle & Associates,* 2020 Vision—A Comprehensive Plan for the City of Oak Creek, *Volume 1,* Inventory & Analysis Report, *April 14, 1999; Volume II,* Community Visioning Results, *August 25, 1999; and Volume III,* Plan Recommendations, *April 1, 2002.*

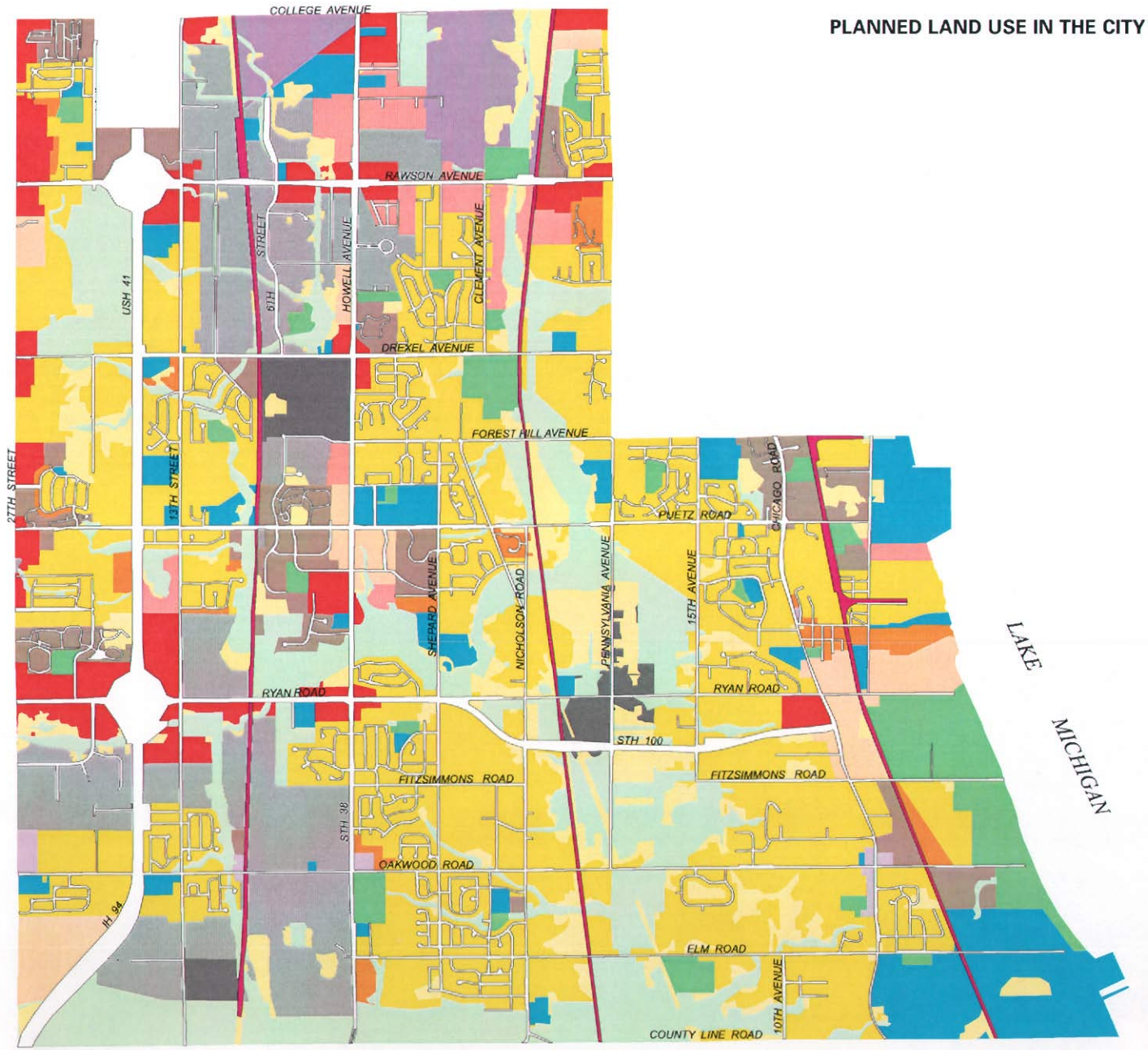
[4]*SEWRPC Community Assistance Planning Report No. 132,* A Park and Open Space Plan for Milwaukee County, *November 1991.*

[5]*The Conservation Fund; Applied Ecological Service, Inc.; Heart Lake Conservation Associates; Velasco & Associates; K. Singh & Associates,* Conservation Plan, Technical Report Submitted to Milwaukee Metropolitan Sewerage District, *October 31, 2001.*

[6]*SEWRPC Memorandum Report No. 152,* A Greenway Connection Plan for the Milwaukee Metropolitan Sewerage District, *December 2002.*

Map 6

PLANNED LAND USE IN THE CITY OF OAK CREEK



- SINGLE FAMILY RESIDENTIAL
- TWO FAMILY/TOWNHOUSE RESIDENTIAL
- MIXED RESIDENTIAL
- PLANNED OFFICE
- NEIGHBORHOOD BUSINESS
- PLANNED BUSINESS
- PLANNED INDUSTRIAL
- GENERAL INDUSTRIAL
- PLANNED MIXED USE
- INSTITUTIONAL
- AIR TRANSPORTATION
- ACTIVE RECREATION
- RESOURCE PROTECTION AREA
- LIMITED DEVELOPMENT AREA
- ROAD
- RAILROAD

NOTE: Shapes on map represent general recommendations for future land use at "build-out" of the city. Actual boundaries between different land use types and associated zoning districts may vary somewhat from representations on this map.

GRAPHIC SCALE
0 1/2 1 MILE

Adopted: April 1, 2002

Source: Vandewalle & Associates.

Vandewalle & Associates
Madison & Milwaukee, Wisconsin
Planning - Creating - Rebuilding

FLOODLAND MANAGEMENT AND RELATED REGULATIONS AND PROGRAMS

Floodland management regulations and programs perform critical roles toward assuring that flood mitigation efforts are properly implemented. The City of Oak Creek currently has several pertinent regulations in the form of City zoning regulations.

Floodplain Zoning Ordinance

The City has enacted a floodplain zoning ordinance which is intended to preserve floodwater conveyance and storage capacity of floodplain areas and to prevent the location of new flood-damage-prone development in flood hazard areas. The stated purpose of the ordinance is to "1) Protect life, health, and property. 2) minimize expenditures of public monies for costly flood control projects. 3) Minimize rescue and relief efforts, generally undertaken at the expense of the general public. 4) Minimize business interruptions. 5) Minimize damage to public facilities on the floodplains such as water mains, sewer lines, streets and bridges. 6) Minimize the occurrence of future flood blight areas on floodplains. 7) Eliminate the victimization of unwary land and home buyers." Under the ordinance, designated floodland areas within the City are divided into three overlay districts, 1) a Floodway District (FW), 2) a Flood Fringe District (FF), and 3) a General Floodplain District (GFP). The ordinance defines a "floodway" as "the channel of a stream and those portions of the floodplain adjoining the channel that are required to carry and discharge the flood waters or flood flows of any river or stream associated with the regional flood." The ordinance defines the "flood fringe" as "that portion of the floodplain between the regional flood limits and the floodway area." The ordinance defines the "general floodplain" as "the land which has been or may be hereafter covered by flood water during the regional flood and encompasses both the Floodway and Flood Fringe Districts." The general floodplain category applies to floodplains for which detailed hydrologic and hydraulic analyses have not been conducted, or where no floodway has been determined.

The ordinance defines the 100-year recurrence interval flood, or "regional flood," as "the flood determined to be representative of large floods known to have generally occurred in Wisconsin and which may be expected to occur on a particular stream because of like physical characteristics," and which in any given year has a 1 percent chance of occurring or being exceeded. Within the three districts, all uses not listed as permitted uses are generally prohibited.

The ordinance generally prohibits any development within designated areas in cases where any such development would either be vulnerable to significant damage from flooding or cause a flood stage increase equal to or greater than 0.1 foot. Under the ordinance, developments in designated flood fringe areas may not materially affect the storage capacity of the floodplains. In designated floodway areas, open space uses having a low flood damage potential and which do not obstruct flood flows, such as agricultural, park, recreational, conservation, and other open space uses; parking lots, yards, and other auxiliary land uses; utility facility uses, including uses involving dams, transmission lines, pipelines, and municipal water supply and sanitary sewerage systems; other water-related uses; and bridges, are generally permitted. In designated flood fringe areas, certain uses, including residential, commercial, manufacturing and industrial, utilities, sewage system uses, are permitted under certain conditions. For the designated general floodplain areas, a determination is to be made as to whether the land is located in the floodway or flood fringe and the appropriate regulations then applied.

Stormwater Regulations

In December 2002, the City of Oak Creek adopted a new storm water runoff ordinance, the purpose of which is to "set forth storm water requirements and criteria which will prevent and control water pollution, and diminish the threats to public health, safety, welfare, and aquatic life due to runoff of storm water from development or redevelopment." This ordinance applies to land development activities that 1) increase the impervious surface area by 0.5 acre or more; 2) are likely to result in storm water runoff that exceeds the capacity of existing drainage facilities or receiving bodies of water, cause undue channel erosion, increase water pollution by scouring or transportation of particulate matter, or endanger downstream property or public safety; and 3) create an impervious surface area of less than 0.5 acre if such activities are part of a larger common plan of development or sale.

The ordinance sets forth standards for the drainage system requirements and both runoff quantity and quality control. These include applying release rates for the peak discharge of the two- and 100-year recurrence storm events, controlling the volume of runoff to maximum extent practicable, and applying best management practices to remove a minimum of 80 percent of the total suspended solids load. The ordinance encourages the preservation and use of natural topography and land cover features such as natural stream channels, floodplain, natural depressions, native soil infiltrating capacity, and natural groundwater recharge areas to meet these requirements. Exceptions to the requirements are allowed for areas covered under an approved storm water management plan, residential infill on lots five acres or less in size, areas where the impervious surface would be less than 5 percent of the total site, and recreational trails less than 10 feet in width with a five-foot pervious buffer on either side.

The Milwaukee Metropolitan Sewerage District has also adopted a comprehensive rule designed to minimize the potential to increase flood risk due to development or redevelopment in the District's service area. The rule applies to the City of Oak Creek and the communities that lie upstream of the City in the tributary watershed areas and that are located within the MMSD planning area. The rule was in effect as of January 1, 2002, and provides for community ordinances—such as that adopted by the City of Oak Creek—which require the management of the volume and peak rate of stormwater flows from new development and redevelopment in such a way that peak flows in a watershed do not increase downstream flooding problems. The rule provides for flexibility in choosing the means to comply with the rule. Options include limiting stormwater runoff from new development or redevelopment to established acceptable release rates or development of regional or multiple site approaches designed to meet the rule objective. This rule should be an important component of a strategy to minimize the creation of new or increased flooding problems.

Wetland Preservation Zoning

The City has also enacted a shoreland wetland preservation zoning ordinance that sets forth provisions for a wetland district under which shoreland wetland areas located within the City and encompassing five or more acres, as shown on the WDNR's October 28, 1987, Wisconsin Wetlands Inventory, are generally protected. Shoreland wetlands are defined as wetlands that are five acres or greater in area and that are located either 1) within 1,000 feet of the ordinary high-water mark of navigable lakes, ponds, or flowages or 2) within 300 feet of the ordinary high-water mark of navigable streams, or to the landward side of the floodplain, whichever distance is greater. The ordinance essentially seeks to protect all designated wetland areas from intensive development.

In addition to the shoreland wetland ordinance, the City's storm water runoff ordinance also includes standards relating to the discharge of runoff to wetlands. These standards are intended to protect wetlands from the damaging modifications and adverse changes in water quality and quantity associated with new development.

Wetland and Floodplain Preservation Planning

As previously discussed in this chapter, the City of Oak Creek, as part of its comprehensive planning effort, has developed specific plans for preserving wetlands and floodplains within the City.

Other Related Ordinances and Regulations Programs

Through a series of municipal ordinance provisions, the City seeks to control discharges to the municipal separate storm sewer system and to limit storage in and alteration to floodprone and important stormwater drainage areas. Because of the relationship between floodland and stormwater management, these regulations are mentioned here in summary form. The City seeks to control the contribution of pollutants to the municipal separate storm sewer system through zoning regulations that, in zoning categories other than those where outdoor storage is permitted, generally prohibit such storage; that prohibit the location of refuse disposal, refuse incineration, and sanitary landfill sites; that regulate the location of various industrial and commercial uses; that provide for the prohibition, in applicable specific cases, of conditional uses when such uses could have adverse impacts upon the environment, or be detrimental to the public health, safety, comfort, or general welfare; that prohibit most filling, the storage of materials that are buoyant, flammable, explosive, or injurious to human, animal, or plant life, and the location of new onsite soil-absorption sanitary sewerage system sites, within floodway areas; that regulate filling within floodplain areas; that regulate the storage or processing of materials that are buoyant, flammable, explosive, toxic, or hazardous, or that in times of flooding could be injurious to human, animal, or plant life,

within floodplain areas; that regulate the location of solid-waste-disposal sites or onsite soil-absorption sanitary sewerage system sites within floodplain areas; that seek to prevent and control pollution of streams through wetland preservation; and that seek to protect existing open channels, floodways, and drainageways.

Flood Hazard Area Documentation

The floodplains in the City of Oak Creek are currently delineated and mapped as documented in a Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) dated September 29, 1978. In 1990, SEWRPC completed a floodland management plan for the Milwaukee Metropolitan Sewerage District (MMSD). That plan included updated hydrologic and hydraulic analyses for the Oak Creek and Root River watersheds. That work was later further updated by SEWRPC for the Oak Creek watershed, and by the MMSD for the Crayfish Creek portion of the Root River watershed. In addition, similar analyses were conducted for minor tributaries in the Oak Creek and Root River watersheds as part of the development of a citywide stormwater management master plan. The City of Oak Creek has submitted a request to the Wisconsin Department of Natural Resources for approval to adopt these new floodplains for zoning purposes. Once such approval is received, the City will also petition FEMA to incorporate these new floodplains into the City's FIS. This work should serve to improve the FIS program in the City.

Residents of the City are eligible to participate in the National Flood Insurance Program (NFIP). The flood hazard areas within the City are described in Chapter IV.

Ongoing Floodland Management Planning

In addition to the regulations and programs noted above, the MMSD, as noted previously and as detailed in Chapter VI of this report, is currently engaged in comprehensive, detailed flood management planning efforts intended to update and implement its 1990 watercourse system plan. These work efforts by the MMSD include flood mitigation planning efforts for areas within the corporate limits of the City of Oak Creek. In undertaking the updating and implementation of its watercourse system plan, the MMSD has recognized the importance of achieving consensus from all the major stakeholders involved regarding the goals and objectives of the planning effort as well as the need to obtain a final set of acceptable and implementable solutions for current flooding problems in each of the drainage areas involved.

Accordingly, for the Oak Creek and Root River watersheds, within which most of the City of Oak Creek lies, the MMSD has formed stakeholder groups to facilitate this aspect of plan development. The stakeholder groups include representatives of the City of Oak Creek, other concerned local units of government, Milwaukee County, the WDNR, SEWRPC, and the Wisconsin Department of Transportation. Stakeholder meetings have been held throughout the MMSD's process of developing alternatives for flood management within the watersheds in order to obtain feedback regarding proposed solutions to flooding problems. Stakeholder meetings for the watersheds have been held since 1998 and continue to be held through the plan development process. A listing of stakeholder work group representatives, along with meetings held, is included in Appendix A.

The MMSD has also held community workshops within the watersheds to obtain community input regarding possible solutions to flooding problems in the context of what kind of community resource area residents—not just flood victims, but all residents involved—desire regarding their watercourse as a community resource. The MMSD has also held a number of special technical meetings with technical representatives from concerned communities located wholly or partly within the watershed, as well as representatives from the WDNR, SEWRPC, and Milwaukee County.

In addition to other meetings with representatives of the local communities involved and other agencies, the City has participated in a series of meetings related to floodland and stormwater management with the Southeastern Municipal Executives (SEME). These meetings, facilitated by SEWRPC and SEME, have focused on identifying common goals and intergovernmental efficiencies to produce a more effective set of solutions to flooding problems.

Throughout this public involvement process, potential solutions have been developed with input from major stakeholders. Various solutions and scenarios have been presented and feedback has been sought regarding their acceptability. The process has also considered and, as appropriate, incorporated the objectives of concerned local agencies and the authority and policy decisions made by the MMSD.

In addition to the floodplain management planning by the MMSD, the City of Oak Creek recently completed a comprehensive stormwater management master plan.[7] The development of that plan was guided by a Stormwater Management Committee (SMC) made up of City officials and staff, private developers, and local citizens. In addition, representatives of the WDNR, SEWRPC, MMSD, and Milwaukee County were invited to attend meetings as ad hoc members of the committee. Regular meetings of the SMC were held between 1995 and 2001 to review the ongoing findings and to provide direction to the planning process. As part of the planning process, a public information meeting was held on October 28, 1995, to receive comments from residents regarding specific stormwater drainage and flooding problems. Additional public information meetings were held on October 18, 25, and 26, 2000 and on November 28, 2001.

With regard to other public informational and educational efforts applicable to flood mitigation in the City of Oak Creek, the Milwaukee County Sheriff's Department, Division of Emergency Management, has had prepared and distributes a booklet, *The Dry Facts: Protecting Your Home From Flood-Related Damage* (see Appendix B). This booklet sets forth a variety of potential self-help measures and other information useful to Milwaukee County homeowners with regard to mitigating or preventing flood damage to residences and personal property inside residences. The booklet also provides basic information about flood warnings, as well as NFIP and various Federal and State aid programs that become available to flood victims upon the issuance of a Presidential declaration for the affected area. In addition to the booklet, a corresponding videotape is available through the Milwaukee County Federated Library System. The Milwaukee County Sheriff's Department, Division of Emergency Management, also makes the videotape available upon telephone request.

HISTORICAL FLOODING PROBLEMS

As noted in Chapter I of this report, a number of major flooding events, including several that caused significant damage, have been recorded in the area now encompassed by the City of Oak Creek and the watershed areas that lie partly within its boundaries, from the time that area was settled by Europeans in the 19th century. The earliest major flood event of record within the Oak Creek area for which information is available is that of June 1917. That flood resulted from a total 24-hour rainfall of 5.8 inches as recorded at the U.S. Weather Bureau station at Milwaukee, then located about 6.5 miles north of Oak Creek. Accounts indicate extensive damage had occurred to the mill dam on the Oak Creek main stem in the City of South Milwaukee, as well as to a portion of the adjacent Mill Street. Farmers reported extensive damage to newly planted crops. Another major flood event occurred in June 1940 that apparently approached but did not equal the severity of the June 1917 flood. This flood resulted in a number of basements flooded on the west side of the South Milwaukee. Hundreds of acres of truck gardens and field crops in the City of Oak Creek were inundated, with damages estimated in the thousands of dollars.

In late March and early April 1960, serious flooding occurred throughout southeastern Wisconsin as the result of a snowmelt-rainfall event. Streams throughout the area overflowed their banks and caused flooding along a number of roads, with one report of nearly all roads in the City of Oak Creek being inundated and impassible with the exception of STH 32. Flood damage to buildings was reported in both the Cities of South Milwaukee and Oak Creek.

A September 1972 flood event caused by a relatively large quantity of rainfall occurring under high antecedent moisture conditions resulted in widespread flooding in the Oak Creek area. Again, numerous streets were reported flooded, including Nicholson Road, E. Ryan Road, and E. Forest Hill Avenue in the City of Oak Creek. As with

[7] *R.A. Smith & Associates, Inc., and Hey & Associates, Inc.,* City of Oak Creek, WI Stormwater Management Master Plan, *December 10, 2001.*

the other flood events, most building damage occurred in the more heavily developed City of South Milwaukee. Farmers did report problems with flooding of fields. Because of the damages resulting from this flood, the U.S. Small Business Administration declared Milwaukee County a disaster area, and therefore, eligible for federal assistance.

An April 1973 major flood event resulted from moderate rainfall volumes occurring over the entire area under very wet antecedent moisture conditions. Although the event caused flood problems throughout much of southeastern Wisconsin, relatively few damages were reported in the Oak Creek area. The most prevalent problem was again flooding of streets, including E. Puetz Road and E. Ryan Road in the City of Oak Creek.

An August 1986 storm event centered in a one- to four-mile-wide band extending northwesterly from the City of Oak Creek through General Mitchell International Airport to the northern portion of the City of Wauwatosa near Lawrence J. Timmerman Airport resulted in a storm total rainfall of 6.84 inches in 24 hours, the single-day record at the airport's recording station. The 24-hour total had an estimated recurrence interval of about 300 years, with the most intense portion of the storm having a recurrence interval in excess of 500 years. That event produced a peak discharge of 1,160 cubic feet per second (cfs) as recorded at the U.S. Geological Survey stream gage on Oak Creek in the City of South Milwaukee. That remains the largest peak recorded at that location in 39 years of operation. Even though as much as seven inches of rain was reported at the Oak Creek City Hall, rainfall totals across the City were highly variable, with the heaviest rain occurring in the north and central portion. Rainfall totals in the southwest portion of the City were about two inches, while only 0.5-inch of rain was reported at the South Milwaukee wastewater treatment plan located to the east along Lake Michigan. As a result, overall riverine flooding in the Oak Creek area was not as severe as would be expected. Also, channel modifications that had been carried out along the Oak Creek channel in South Milwaukee in the mid-1970s helped to prevent serious flooding of buildings in that community. Much more severe flooding occurred in the Kinnickinnic River watershed located to the north of Oak Creek in the City of Milwaukee. As a result of this event, a Presidential Disaster Declaration was issued for Milwaukee County. The City of Oak Creek received about $9,500 under the Federal Public Assistance Program.

DESCRIPTION OF RECENT FLOOD EVENTS

As also noted in Chapter I of this report, major flooding occurred in 1997 and 2000 within the City of Oak Creek and the drainage areas that lie partly within its boundaries. These flood events, which are significant with regard to the current flood mitigation planning effort for the City, include the following:

- The event of June 20-21, 1997, when a 26-hour storm involving a period of moderate rainfall followed by intense thunderstorms centered in northern Milwaukee County resulted in at least four inches of rain across the County, with more than seven inches of rain recorded in the City of Wauwatosa, and more than nine inches of rain recorded in the Village of Brown Deer. Rainfall over the City of Oak Creek and its tributary drainage area was in the four to five inch range. Significant overbank flooding and flooding of roadways occurred within the Oak Creek area. The peak flood flow of 1,110 cfs recorded at the continuous-recording stream gage on Oak Creek in the City of South Milwaukee was the second largest to that date, nearly equaling the flow from the August 1986 event.

  Estimated flood damages during the June 1997 event were $78.0 million in Milwaukee County, prompting a Presidential Disaster Declaration to be made. Assistance received by the City of Oak Creek through the FEMA and State Public Assistance program administered by the Wisconsin Department of Military Affairs, Division of Emergency Management, associated with this event totaled about $2,300.

- The event of July 2, 1997, a "follow-up" storm to the June 20-21, 1997, storm event, involved as much as four inches of rain, but resulted in little additional property damage.

- The event of August 6, 1998, in which over six inches of rain in portions of the City of Wauwatosa and northwestern Milwaukee County and eastern Waukesha County resulted in significant property damage in that area. Rainfall totals in southern Milwaukee County were much lower—generally less than one inch—with no significant flooding problems reported. A moderately heavy rain did fall across southern Milwaukee County on the previous day, with a total of 3.65 inches being recorded at General Mitchell International Airport. Although streams in the area were reported swollen due to that event, no significant flooding problems were reported.

- The event of July 2, 2000, in which as much as seven inches of rain fell over eastern Waukesha and southern Milwaukee Counties. Most of this rain fell in about a six hour period in the late-afternoon and evening hours. Within the City of Oak Creek, rainfall amounts were in the four to six inch range. This storm was also associated with high straight-line winds and produced one tornado that touched down near the Franklin/Oak Creek corporate line at S. 27th Street and W. Ryan Road. The tornado continued east from that location, traveling across the southern end of Oak Creek before finally exiting the City into Racine County near Chicago Road (STH 32). The tornado dissipated shortly after entering Racine County. In addition to damage from the tornado, severe flooding also occurred in the City due to the heavy rains. The peak flood flow of 1,120 cfs recorded at the Oak Creek gage in South Milwaukee was the second largest to date. More significant was the 1,360 cfs recorded at the USGS crest stage gage located on Oak Creek at Nicholson Road in the City of Oak Creek. That is the largest discharge recorded at that gage since it was installed in 1958 and has a recurrence interval in excess of 100 years.

  As a result of flooding and wind-related damage, a Presidential Disaster Declaration was made for Milwaukee County. Estimated flood damages from this event were $6.8 million in Milwaukee County. Property damage in the City of Oak Creek amounted to about $850,000. Assistance received by the City through the FEMA and State Hazard Mitigation and Public Assistance programs administered by the Wisconsin Department of Military Affairs, Division of Emergency Management, associated with this event totaled about $112,000 under the FEMA Hazard Mitigation Grant Program and about $211,000 under the FEMA Public Assistance program. The Hazard Mitigation funds were used to purchase one repetitive loss property in the City.

Chapter III

FLOOD MITIGATION GOALS AND OBJECTIVES

Planning may be defined as a rational process for formulating and meeting goals and objectives. Consequently, the formulation of goals and objectives is an essential task that must be undertaken before plans can be prepared. This chapter sets forth flood mitigation goals and objectives for use in the design and evaluation of alternative flood mitigation plans for the City of Oak Creek and the three watersheds that each lie partly within its boundaries, and in the selection of a recommended plan from among those alternatives.

In formulating and setting forth goals and objectives, their differing natures and purposes must be kept in mind. Goals are general guidelines that explain what a community desires to achieve. Based upon the selected goals, a community can then develop the specific objectives needed to attain the goals. Objectives define strategies for meeting the selected goals and are more specific than goals.

In the selection of goals and objectives and their application to the preparation, testing, and evaluation of plan alternatives, several basic considerations must be recognized. First, it must be recognized that any proposals for flood mitigation must constitute integral parts of a total system. It is not possible from an application of the goals and objectives alone to assure such system integration, since the goals and objectives cannot be used to determine the effect of any given individual proposed facility, or other proposal, on the system as a whole, nor on the environment within which the system must operate. Such determination requires the use of quantitative planning and engineering techniques developed for those purposes. Second, it must be recognized that it is unlikely that any one plan proposal will fully meet all applicable goals and objectives; the extent to which each applicable goal and/or objective is met, exceeded, or violated must serve as the measure of the ability of each alternative plan proposal to achieve the applicable goal(s) and/or objective(s). Third, it must be recognized that there may be cases where certain goals and/or objectives may conflict, and that such conflicts may require resolution through compromise, such compromise being an essential aspect of any planning or design effort. Finally, it should be recognized that goals and objectives may, in some cases, be specific to a particular watershed or subwatershed area. Accordingly, certain citywide goals and objectives may be refined as detailed floodland and stormwater management plans are prepared for each specific subarea of the City and its related watershed or subwatershed(s).

RELATIONSHIP OF FLOOD MITIGATION GOALS AND OBJECTIVES TO COMMUNITY DEVELOPMENT AND PARK AND OPEN SPACE OBJECTIVES

As described in Chapter II, the City of Oak Creek has prepared and adopted a park and open space plan[1] and a citywide comprehensive plan[2] to guide the City in preserving and developing recreational and other open space uses throughout the City. In addition, similar park and open space plans have been prepared by Milwaukee County and by several other municipalities with lands within the tributary watersheds. As park and open space planning and floodland management planning are carried out in the City of Oak Creek in the related watersheds, integration and coordination of the goals and objectives has taken place. In addition, land use planning goals and objectives are integrated and coordinated with floodland management planning. This is accomplished at the watershed level by developing comprehensive watershed plans that include floodland management, land use, park and open space, and water quality planning in one integrated planning program. These watershed plans form a potential framework for subwatershed-level planning programs. As an example, the comprehensive watershed planning objectives, principles, and standards for the comprehensive plan for the Oak Creek watershed[3] includes nine specific objectives and supporting standards related to land use and park and open space use, as well as objectives and standards relating to flood control. A copy of the objectives, principles, and standards used for development of the comprehensive plan for the Oak Creek watershed is included in Appendix C of this report. Similarly, the City of Oak Creek park and open space and comprehensive plans contain plan elements regarding wetland and floodland preservation as described in Chapter II of this report.

FLOOD MITIGATION GOAL AND OBJECTIVES FOR THE CITY OF OAK CREEK

In response to continuing flooding problems experienced within the greater Milwaukee area, including the significant flooding experienced in 1997 and 1998, and the resulting new demands for comprehensive flood prevention measures that will produce both immediate and long-term results, the Milwaukee Metropolitan Sewerage District (MMSD), as noted in Chapter II of this report, has undertaken comprehensive, detailed flood management planning efforts intended to update and implement its 1990 watercourse system plan. These efforts include significant flood mitigation planning efforts within the Oak Creek and Root River watersheds and within the City of Oak Creek. The City, as noted in Chapter II, is among the "stakeholders" whose input has been sought by the MMSD as an integral part of its effort to develop and prepare an updated watercourse system management plan for the Oak Creek and Root River watersheds. This planning effort, in addition to the stormwater management master plan discussed below, constitutes the current citywide flood mitigation planning program within the City.

The watercourse system management plans for the Oak Creek and Root River watersheds, prepared for the MMSD by the private consulting firm Camp Dresser & McKee Inc., were completed in August 2000. The plans evaluate hydrologic and hydraulic conditions in the primary floodwater and stormwater conveyance systems within the MMSD's sewer service area within each watershed. That area includes the entire Oak Creek watershed and the North Branch of Root River and Crayfish Creek subwatersheds of the Root River watershed. The stated goal of the plans is "to develop environmentally responsible, cost effective flood management recommendations" based upon the following "fundamental objectives":

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[1] *City of Oak Creek,* 1998 Park and Open Space Plan, *December 1997.*

[2] *Vandewalle & Associates,* 2020 Vision—A Comprehensive Plan for the City of Oak Creek, *Volume I,* Inventory & Analysis Report, *April 14, 1999; Volume II,* Community Visioning Results, *August 25, 1999;* and *Volume III,* Plan Recommendations, *April 1, 2002.*

[3] *SEWRPC Planning Report No. 36,* A Comprehensive Plan for the Oak Creek Watershed, *August 1986.*

- The utilization and development of watercourse models that are consistent with Southeastern Wisconsin Regional Planning Commission (SEWRPC) methodology and that anticipate future planning efforts. The methodology applied in the MMSD's watercourse planning process will incorporate previous SEWRPC data and will provide SEWRPC with updated models for future analyses.

- The identification of problems and design solutions for the 1 percent recurrence interval flood level (the 100-year event). This is the standard level of protection from flooding demanded by the public.

- The utilization of a watershed-based approach. Analyses will identify problems and propose potential solutions throughout the entire watershed.

- The utilization of future land use conditions to identify problems and develop solutions. "Baseline" conditions for evaluating watercourses will be 2020 land use conditions without consideration of detention associated with new development.

- A focus on environmentally sensitive and aesthetically acceptable engineering solutions. Whenever possible, solutions will be chosen that enhance environmental resources while avoiding solutions that are excessively "hard" or structural.

- The integration of local stormwater runoff control features. If practical, stormwater management goals and anticipated projects will be incorporated into any recommended solutions.

- The incorporation of current regulatory requirements. Solutions must be consistent with current State and Federal floodplain and wetland regulations.

- The identification of costs and benefits of solutions. A key component of the watercourse system management plan will be the identification and estimation of costs associated with potential flood damages. These costs represent the economic benefit of solving flood problems. Provided in the plan will be an analysis of the cost-effectiveness of proposed solutions as weighed against the costs of potential flood damages.

- The obtaining of community input to develop acceptable solutions. Meetings have been held with representatives of the City of Oak Creek and other concerned local communities to aid in the identification of watercourse problems and to get local input regarding potential solutions.

CITY OF OAK CREEK STORMWATER MANAGEMENT MASTER PLAN

In an effort to address ongoing flooding and drainage problems within the City of Oak Creek, a stormwater management master plan was developed.[4] That plan, completed in 2001, was prepared by the private engineering firms of R. A. Smith & Associates, Inc. and Hey & Associates, Inc. under the direction of a Stormwater Management Committee (SMC) consisting of City of Oak Creek officials and staff, as well as private development and citizen members. Representatives of the Wisconsin Department of Natural Resources, SEWRPC, Milwaukee County, and the MMSD also served as ad hoc members to the Committee. Recognizing the previous flood control planning efforts by SEWRPC and the ongoing efforts of the MMSD in regards to the main watercourses in the Oak Creek and Root River watersheds, this plan focused on addressing problems associated with minor tributaries that were not addressed by those agencies.

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[4] *R.A. Smith & Associates, Inc., and Hey & Associates, Inc.,* City of Oak Creek, WI Stormwater Management Master Plan, *December 10, 2001*

In carrying out the development of the master plan, the SMC and its consultants set as a goal the preparation of a plan that is to "protect, maintain, and enhance the public health, safety, and general welfare by developing a plan to control the adverse impacts of increased stormwater runoff associated with existing and planned land use, and to recommend solutions to drainage problems. Proper management of stormwater runoff will minimize damage to public and private property, prevent inconvenience to local residents, protect water quality of surface and groundwater, maintain and enhance fish and wildlife habitat, protect public open space, and maintain the quality of life in the community. To achieve that goal, the following objectives were established:

- Develop a major and minor stormwater drainage system that will convey stormwater in a manner that reduces the public's exposure to drainage related inconveniences and protects public and private property from runoff related damages.
- Develop a stormwater management system that prevents any adverse impacts of increases in flood elevations; where possible, reduces the floodplain to pre-developed conditions; and protects and preserves floodplain storage.
- Develop a stormwater management system that evaluates stormwater storage versus stormwater conveyance.
- Develop a stormwater management system which will abate nonpoint source water pollution, help achieve recommended water use objectives and supporting water quality standards for local streams, protect the quality of Lake Michigan as a drinking water source for the City, and protect local groundwater resources.
- Establish a comprehensive hydrologic, hydraulic, existing and proposed land use, and cartographic data base using the best available and most appropriate technology to manage the stormwater, flood and water quality data needs of the program.
- Develop a stormwater management system that controls runoff within a greenway system and maintains or enhances terrestrial, riparian, and aquatic biological communities including plants, fish, and wildlife.
- Develop a stormwater management system that is equitable and fair and effectively meets all of the other stated objectives while considering all benefits and costs.
- Develop a stormwater management system that requires minimum maintenance and has maintenance requirements that can be implemented by available organizations or units of government.
- Develop a stormwater management system that can be implemented under existing federal, state, regional, and local regulations, and adopted management plans.
- Establish a consistent, equitable and dedicated source of revenue in order to maintain the stormwater management program in the City of Oak Creek.
- Development of an integrated stormwater management and flood control system, which effectively serves existing and future land use.

RELEVANT GOALS AND OBJECTIVES OF OTHER PLANNING EFFORTS

The aforementioned goal and objectives of the MMSD-led watercourse system management planning effort and the City's stormwater management master plan must be treated in the context of relevant historical planning efforts undertaken by SEWRPC. Each of the plans involved sets forth a series of goals that are relevant to the current flood mitigation planning effort for the City.

SEWRPC Watershed Plans

As part of its continuing planning program for the seven-county Southeastern Wisconsin Region, SEWRPC has prepared and adopted comprehensive plans for the Oak Creek[5] and Root River[6] watersheds that lie partly within the City of Oak Creek. The two plans each set forth a series of detailed water control facility development objectives, as well as related land use and park and open space objectives. In both plans, the Commission defines an "objective" as "a goal or end toward the attainment of which plans and policies are directed." Each objective, or goal, is 1) supported by a stated fundamental, primary, or generally accepted planning principle that supports the objective and asserts its inherent validity and 2) accompanied by a set of quantifiable planning standards that can be used to evaluate the relative or absolute ability of alternative plan designs to meet the stated development objective. The principles and standards serve to facilitate quantitative application of the objectives during plan design, testing, and evaluation.

An objective common to both watershed plans envisions "[a]n 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" within the watershed. As noted above, an example of the comprehensive watershed planning objectives and supporting principles and standards is included in Appendix C.

Plans Prepared for MMSD

In 1990, SEWRPC prepared a comprehensive stormwater drainage and flood control system plan for the MMSD. In preparing this plan, SEWRPC formulated and used a series of objectives, principle, and standards similar to those used in preparing its watershed plans. In the system plan prepared for the MMSD, the following water control facility development objectives, or goals, were set forth: 1) the development of 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 within the District boundaries and promote the implementation of the adopted land use plans for the watersheds in the District, meeting the anticipated runoff loadings generated by the existing and proposed land uses, and 2) the development of an integrated system of flood control and stormwater management facilities designed to minimize the negative impacts on fish and other aquatic life and to support the water use objectives set forth in the regional water quality management plan.

The proposed 1990 system plan for the MMSD reflected recommendations set forth in a 1986 stormwater drainage and flood control policy plan identifying the streams and other watercourses for which it was recommended that the District assume responsibility for flood control. The policy plan, also prepared for the MMSD by SEWRPC, was adopted by the District, by Milwaukee County, and by the Cities of Franklin, Greenfield, Milwaukee, Oak Creek, Wauwatosa, and West Allis and the Villages of Brown Deer, River Hills, and Shorewood. The 1990 system plan prepared by SEWRPC served as the major basis for the District's own 2000 watercourse system plan.

Stormwater Management Plan for the Crayfish Creek Subwatershed

At the request of the City of Oak Creek, SEWRPC prepared and completed a stormwater management plan for the Crayfish Creek subwatershed,[7] which is part of the Root River watershed and which lies mainly within the City of Oak Creek, with a small portion lying in the Town of Caledonia in Racine County. The plan, which was completed in 1988, identifies measures that would, if implemented, serve to alleviate and prevent the further

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[5]*SEWRPC Planning Report No. 36,* op. cit.

[6]*SEWRPC Planning Report No. 9, A Comprehensive Plan for the Root River Watershed, July 1966.*

[7]*SEWRPC Memorandum Report No. 35,* A Stormwater Management Plan for the Crayfish Creek Subwatershed, City of Oak Creek, Milwaukee County, Wisconsin, *June 1988.*

exacerbation of existing flooding and drainage related problems within this drainage area. In preparing that plan, five stormwater management objectives were formulated to guide the design, test, and evaluation of alternative stormwater management plans. These objectives included the development of a stormwater management system that 1) reduces the exposure of people to drainage-related inconvenience and to health and safety hazards, and that reduces the exposure of real and personal property through inadequate stormwater drainage and inundation; 2) will effectively serve existing and proposed future land uses; 3) will minimize soil erosion, sedimentation, and attendant water pollution; 4) will be flexible and readily adaptable to changing needs; and 5) will efficiently and effectively meet all of the other stated objectives at the lowest practicable cost. Relevant components of this plan were incorporated into the 1990 MMSD stormwater drainage and flood control system plan described above.

Chapter IV

ANALYSIS OF FLOOD PROBLEMS

In order to evaluate various potential flood mitigation alternatives for the City of Oak Creek and select the most effective and feasible flood mitigation strategies, the existing flooding problems in the City must first be analyzed. Accordingly, this chapter summarizes the extent and severity of the flooding problems within the City of Oak Creek and the potential for those problems to increase in the future, and sets forth recent analyses of such problems as developed under detailed floodland and stormwater management plans that have been prepared for the City.

ANALYSIS DATA AND PROCEDURES

The most recent analyses of flooding problems incorporates basic data developed by the SEWRPC and adopted by the Milwaukee Metropolitan Sewerage District (MMSD) for use in their system-level Phase 1 watercourse management plans[1] and to the extent practicable, subsequent plan implementation programs and projects. These analyses represent a refinement of earlier system planning programs.[2] Additional analyses for minor tributary areas not covered under the SEWRPC/MMSD studies were carried out as part of the City of Oak stormwater management planning effort.[3] Plan implementation has included more-detailed project planning and implementation of the recommended flood mitigation measures set forth in the system-level management plans and stormwater management master plan. Details regarding the alternative and recommended flood mitigation plans, which have been developed to address all of the flooding problem areas in the City, are provided in Chapter VI and Appendices D and E. However, this section describes the pertinent basic analysis data and procedures used in the development and evaluation of alternative flood mitigation measures.

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[1] *Milwaukee Metropolitan Sewerage District,* Oak Creek Phase 1 Watercourse Management Plan, *August 2000; and Milwaukee Metropolitan Sewerage District,* Root River Phase 1 Watercourse Management Plan, *August 2000.*

[2] *SEWRPC Planning Report No. 9,* A Comprehensive Plan for the Root River Watershed, July 1966; *SEWRPC Planning Report No. 36,* A Comprehensive Plan for the Oak Creek Watershed, *August 1986; SEWRPC Memorandum Report No. 35,* A Stormwater Management Plan for the Crayfish Creek Subwatershed, City of Oak Creek, Milwaukee County, Wisconsin, *June 1988*; *and SEWRPC Community Assistance Planning Report No. 152,* A Stormwater Drainage and Flood Control System Plan for the Milwaukee Metropolitan Sewerage District, *December 1990.*

[3] *R.A. Smith & Associates, Inc., and Hey & Associates, Inc.,* City of Oak Creek, WI, Stormwater Management Master Plan, *December 10, 2001*

As part of the Phase 1 watercourse management plan and stormwater management master plan, all structures within the identified 100-year recurrence interval floodplain within the City of Oak Creek were mapped using available large-scale topographic mapping and, in some cases, field data where available. An example of that mapping is shown in Appendix F. This structure identification has been refined as subsequent detailed planning and preliminary design steps are carried out.

Similarly, the approximate depths of flooding, generalized estimates of property values, and potential flood damages were developed for all floodprone structures in the City as part of the system-level management plan. Information regarding approximate depths of flooding was also developed for the minor tributaries under the stormwater management master plan. The property values used at the system planning level were typically based upon generalized values of $140,000 for single- and two-family residential buildings, $250,000 for multi-family residential buildings, and $200,000 to $1.0 million for institutional, commercial, and industrial buildings, except in certain instances where assessment data was readily available. Systems-level alternative and recommended plans were then developed using the flood depth and damage data so developed. As more-detailed project planning and design is carried out, these data are being refined by field survey and by obtaining assessed and market property values. As part of this step in the flood mitigation program, the recommended plans developed at the systems-level are being refined and detailed as this process is ongoing under the Milwaukee Metropolitan Sewerage District flood mitigation program and the City's stormwater management planning program. All of the basic data noted above as applied to the City of Oak Creek, is incorporated into the following section of this report and its supporting appendices.

CITY OF OAK CREEK FLOODING PROBLEM AND ONGOING FLOOD MITIGATION ACTIONS

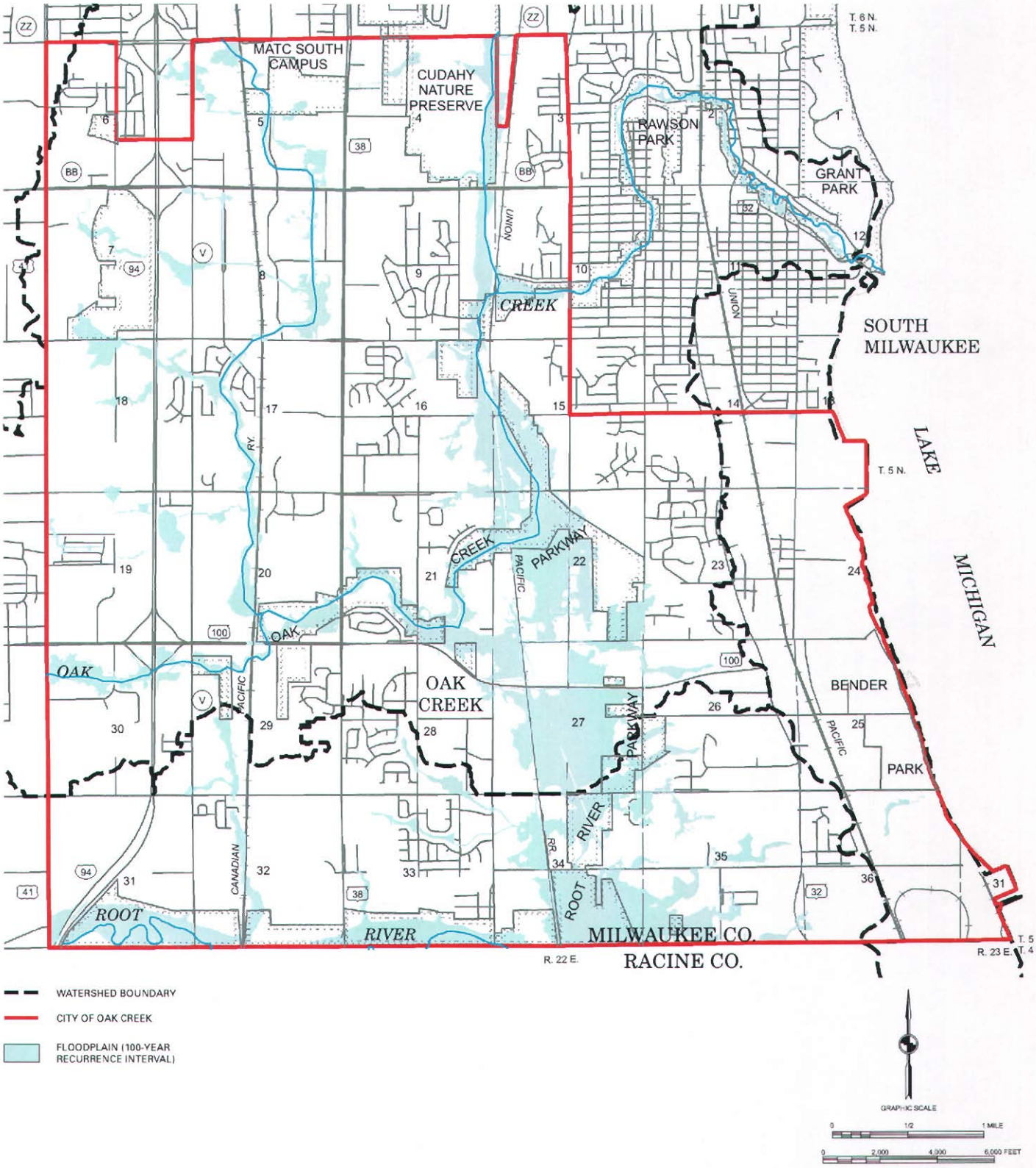
The floodplain areas, as well as the watershed boundaries, within the City of Oak Creek are shown on Map 7. The floodplain areas are generally located along the major stream system throughout the City. The floodplains have been delineated for a total of about 39.8 miles of stream within the City. The source of the hydrologic and hydraulic data for each stream reach is shown on Map 8. All of the floodplain areas have been mapped on large-scale topographic mapping prepared at a scale of one inch equals 100 feet with a contour interval of two feet. Flood flows and stages are currently readily available for all 39.8 miles of the total stream reaches involved. Under the Milwaukee County Automated Mapping and Land Information System (MCAMLIS) program, updated large-scale digital topographic base maps and large-scale digital cadastral overlays have been prepared for the entire City of Oak Creek. A program has been initiated to develop a digital flood hazard area overlay for the MCAMLIS maps. That program will be completed for the City of Oak Creek in 2004.

Currently there are 19 structures identified as being located within the 100-year recurrence interval flood hazard areas of the City of Oak Creek when considering planned land use conditions in the watershed. The locations of these structures are shown on Map 9. The type of structures identified includes three residential structures, 14 industrial and commercial structures, and two other structures. These structures were identified and documented in the aforenoted Milwaukee Metropolitan Sewerage District August 2000 watercourse management plan and the City's stormwater management master plan, as amended based on subsequent field surveys carried out under the MMSD's and the City's more-detailed planning efforts. In addition to the 19 structures noted above, there are two additional residential structures identified on Map 9. The flood hazard associated with these two structures was eliminated as a result of measures initially recommended under the City's stormwater management master plan and implemented by the City in 2002. There currently are no structures that are considered as repetitive-loss properties by the Federal Emergency Management Agency (FEMA). One repetitive-loss structure was purchased and removed by the City following the July 2000 flood event using funds provided under the Hazard Mitigation Grant Program.

Detailed flood hazard data are available for each of the structures identified. Appendix G contains selected information on each structure, including the type of structure, depth of flooding, and assessed and market values. Estimated flood damages are also included. As can be seen by review of Appendix G, the total value of the 19

Map 7

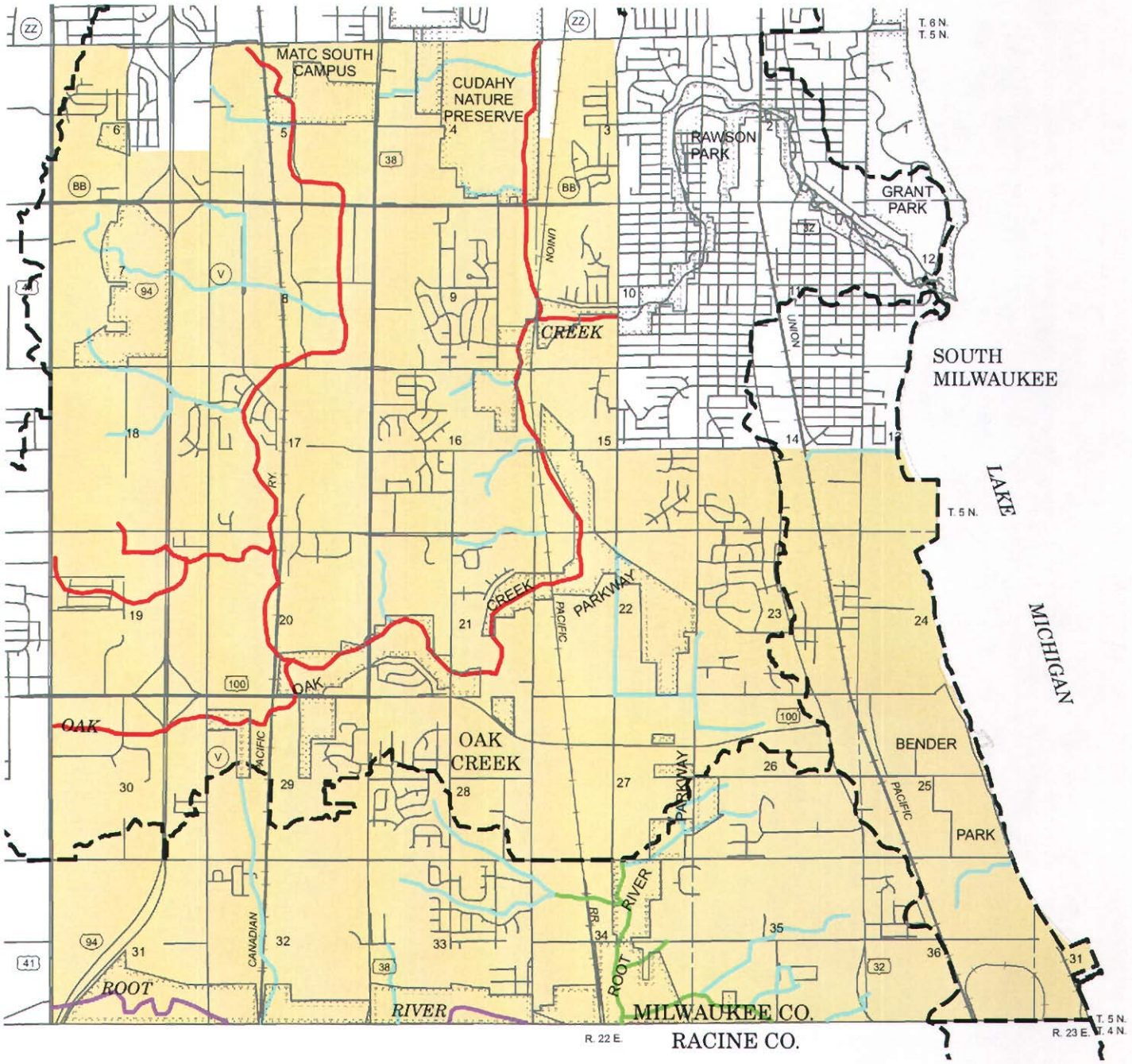
MAPPED FLOODPLAINS IN THE CITY OF OAK CREEK



Source: SEWRPC.

Map 8

SOURCES OF FLOOD HAZARD DATA FOR STREAM REACHES WITHIN THE CITY OF OAK CREEK: 2003



WATERSHED BOUNDARY

CITY OF OAK CREEK

SOURCE OF FLOOD HAZARD DATA

STREAM REACHES FOR WHICH FLOOD FLOWS AND STAGES WERE DEVELOPED UNDER THE OAK CREEK WATERSHED STUDY AND UPDATED UNDER THE MMSD WATER COURSE SYSTEM PLAN -- 16.2 MILES

STREAM REACHES FOR WHICH FLOOD FLOWS AND STAGES WERE DEVELOPED UNDER THE CITY OF OAK CREEK STORMWATER MANAGEMENT MASTER PLAN -- 17.4 MILES

STREAM REACHES FOR WHICH FLOOD FLOWS AND STAGES WERE DEVELOPED UNDER THE ROOT RIVER WATERSHED STUDY AND UPDATED UNDER SEWRPC CAPR. 152, A STORMWATER DRAINAGE AND FLOOD CONTROL SYSTEM PLAN FOR THE MILWAUKEE METROPOLITAN SEWERAGE DISTRICT -- 2.5 MILES

STREAM REACHES FOR WHICH FLOOD FLOWS AND STAGES WERE DEVELOPED AS SET FORTH IN SEWRPC MR. 35, A STORMWATER MANAGEMENT PLAN FOR THE CRAYFISH CREEK SUBWATERSHED, CITY OF OAK CREEK, MILWAUKEE COUNTY, WISCONSIN AND UPDATED UNDER SEWRPC OPEN FILE WRSP 260 -- 3.7 MILES

GRAPHIC SCALE

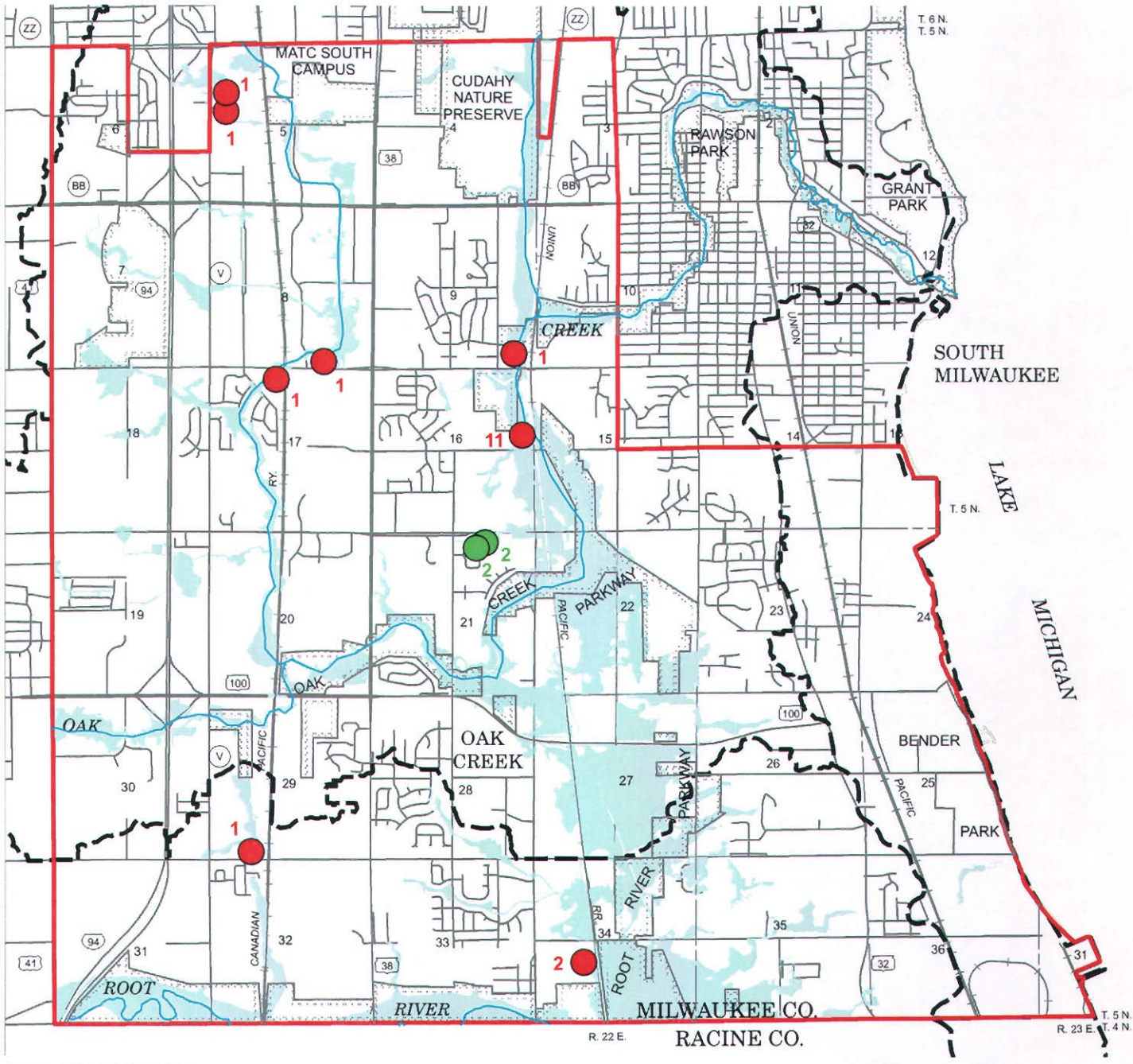
0 1/2 1 MILE

0 2,000 4,000 8,000 FEET

Source: SEWRPC.

Map 9

FLOOD-RELATED PROBLEM AREAS IN THE CITY OF OAK CREEK



Source: Milwaukee Metropolitan Sewerage District, City of Oak Creek, and SEWRPC.

structures that are identified as being subject to flooding is about $1.7 million. Damages expected during a 100-year flood event are estimated to be about $259,000 and annual average damages are estimated to be about $37,000.

In addition to the structures that lie within the floodplain, there are other areas within the City that experience flooding and stormwater drainage problems. These areas have been identified in the City's stormwater management master plan. A map of these problem areas and a general description of the problem are included in Appendix H. The problems generally include frequent street flooding and inadequate drainage conditions, causing flooding of yards and cropland. One area of particular concern was along W. Ryan Road (STH 100) at a railroad underpass located between S. Howell Avenue and S. 13th Street. This section of a major arterial street experienced frequent closures due to flooding caused by high local inflows and high water levels on Oak Creek, to which this area drains. In a cooperative effort between the MMSD, the City of Oak Creek, and the Wisconsin Department of Transportation, this problem was alleviated through the construction in 2000 of a stormwater pumping station and backwater prevention measures.

CITY OF OAK CREEK FLOODING-RELATED COMMUNITY IMPACTS DESCRIPTION

Map 10 shows the locations of selected types of critical community facilities, including fire and police stations, hospitals, and community administration facilities within the City. None of these facilities is located within the flood hazard areas. However, because of the need for access to and from these facilities, this flood mitigation plan includes their locations and shows their relationship to the flood hazard areas.

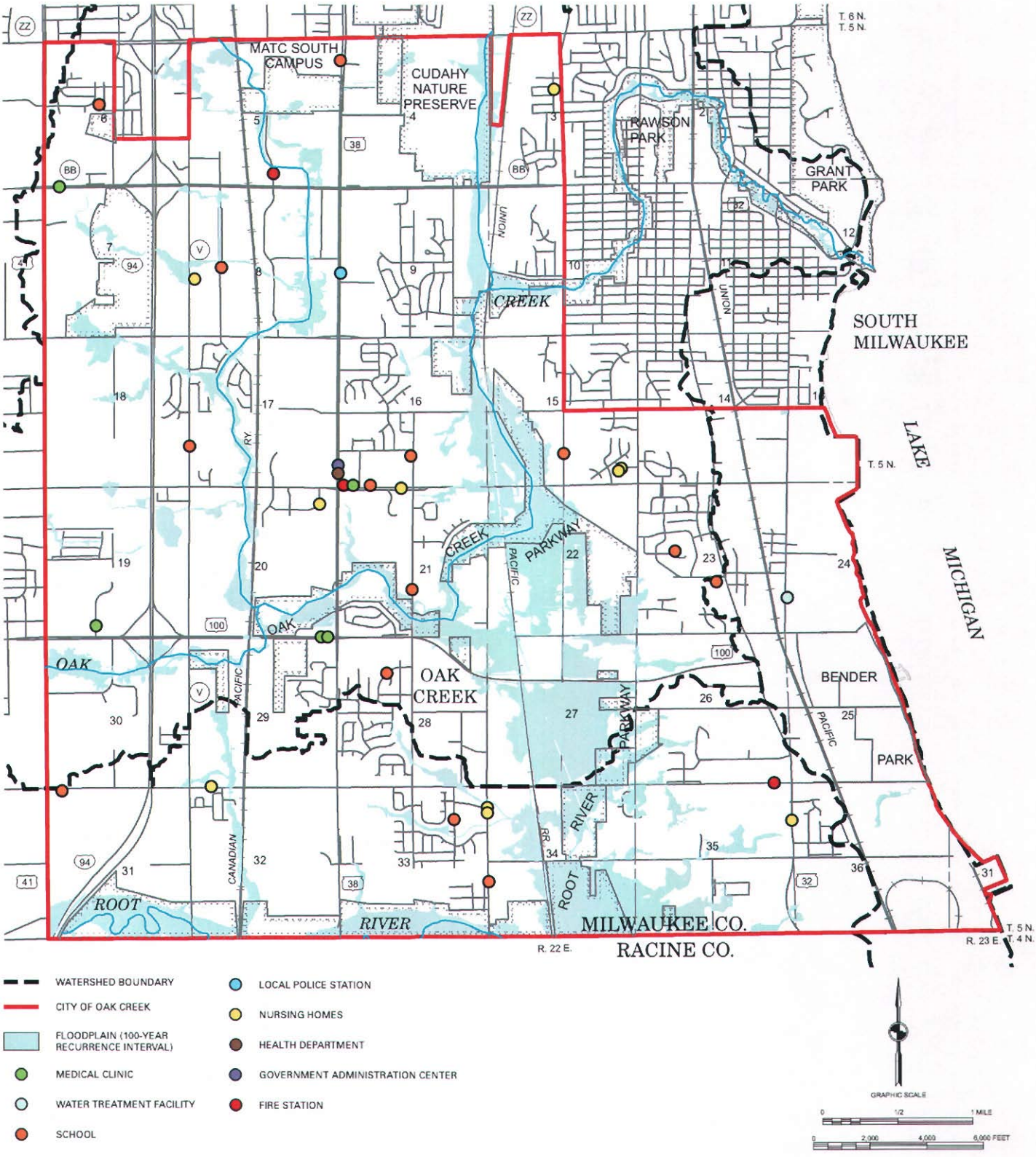
A review of the extent and severity of flooding conditions in the City of Oak Creek indicates that there is a significant community impact primarily as a result of damages caused by flooding of buildings, impaired stormwater drainage, and disruption of the transportation system. However, the flooding impacts on the community infrastructure and the need to prepare for major evacuations and other major emergency actions are not considered a significant concern given the nature and the severity of the overland flooding problems. In the event such actions would be needed in isolated areas, the Milwaukee County and City of Oak Creek emergency operations planning program does have provisions for carrying out major evacuations and/or other emergency actions if they would be needed. However, significant flood-related impacts on the community economy and businesses are of an infrequent and short-term nature. The only impacts on City operations that are relatively frequent involve posting and closure of selected roadway locations where floodwaters frequently overtop structures and cause short-term roadway flooding.

POTENTIAL FUTURE CHANGES IN FLOODPLAIN BOUNDARIES AND PROBLEMS

As described in Chapter II of this report, the City of Oak Creek is expected to experience a significant amount of urban development. As part of its current watercourse system planning effort with regard to the Oak Creek and Root River watersheds, the MMSD has obtained and analyzed data on existing 1995 and anticipated future 2020 flood flows and flood stages within those watersheds, including those portions of the Oak Creek watershed and Crayfish Creek subwatershed located within the City of Oak Creek. The 2020 flood flows were based on projected land cover conditions and were made using conservative assumptions that no detention would be put in place with the new development. Under those assumptions, the 100-year peak flows along the Oak Creek main stem in the City of Oak Creek are projected to increase by between 11 and 43 percent, along the North Branch of Oak Creek, by between 19 and 52 percent, along the Mitchell Field Drainage Ditch by between 19 and 50 percent, and along Crayfish Creek and the Caledonia Branch by between seven and 13 percent. In addition to the effect of land use change, the MMSD also evaluated the effect of floodplain storage on flood discharge within the Oak Creek watershed. The Phase 1 watercourse system plan for that watershed notes that a significant amount of natural floodwater storage exists, particularly in the southeast portion of the watershed. The study found that removal of that storage would result in increases in excess of 100 percent along the Oak Creek main stem for a 100-year flood event, demonstrating the importance of maintaining the existing floodland.

Map 10

LOCATION OF CRITICAL COMMUNITY FACILITIES IN RELATION TO FLOODPLAINS IN THE CITY OF OAK CREEK



Source: City of Oak Creek and SEWRPC.

Also as described in Chapter II of this report, the City of Oak Creek currently has in place land use controls and planning programs to preserve nearly all of the remaining environmentally sensitive areas, including wetlands and floodplains, in the City. This will help to prevent the potential increase in flood discharge due to loss of existing natural floodwater storage. Furthermore, the City has adopted a stormwater management ordinance that requires sound stormwater management practices and will limit increases in future stormwater runoff volume and peak rates of flow. Thus, the increases in discharge due to future development and redevelopment as noted in the MMSD watercourse system plan may not be completely realized. The City is, however, working to adopt new floodplain zoning maps that reflect the potential future land use condition floodplain assuming no runoff controls, in keeping with the Wisconsin Administrative Code in that regard.[4] As of mid-2003, the City had submitted the proposed floodplain information for review and approval by the Wisconsin Department of Natural Resources. Once such approval is obtained, the City will make a similar submittal to the Federal Emergency Management Agency (FEMA) for revision of the City's Federal flood insurance study.

In addition to the above, the City of Oak Creek's current floodplain zoning regulations are designed to prevent the location of new flood-damage-prone development in flood hazard areas, as well as to discourage any floodway or floodplain encroachment that would cause significant increases in existing flood stages.

Based upon the above, it can be concluded that the extent and severity of the flooding problem within the City will not become significantly more severe in the future. However, this conclusion is based upon the assumption of, and highlights the importance of, carrying out and implementing current floodplain and related ordinances and existing and ongoing stormwater management plans and regulations.

[4]Wisconsin Administrative Code *Chapter NR 116.07(3)(b)7 requires that in rapidly urbanizing watersheds, the municipality shall require that computations for regional flood flow discharges reflect increased runoff from all projected future development. Furthermore, current Wisconsin Department of Natural Resources policy does not allow for consideration of potential future stormwater runoff controls in the discharge calculations. Only those controls that have already been constructed may be considered.*

Chapter V

FLOOD HAZARD MITIGATION FUNDING SOURCES

Financing of the construction, operation, and maintenance of floodland and stormwater management facilities may be accomplished through the establishment of a stormwater utility; tax-incremental-financing (TIF) districts; local property taxes; reserve funds; general obligation bonds; private-developer contributions, including fees paid to be applied toward construction of regional stormwater management facilities in lieu of providing onsite facilities; State grants or loans; and certain Federal and State programs.

There are thus several options available to the City of Oak Creek and the Milwaukee Metropolitan Sewerage District (MMSD) for the financing of a flood mitigation program. The identification of potential funding sources, including sources other than solely local-level sources, is an integral part of the implementation of a successful mitigation plan. The following description of funding sources includes those that appear to be potentially applicable for the City of Oak Creek and the MMSD as of the year 2003. However, funding programs and opportunities are constantly changing. Accordingly, staff members from the City departments, MMSD, and other agencies concerned have become and will continue to become familiar with the potential funding sources and programs that may be utilized as such sources and programs become available. It is intended that this list facilitate the implementation of the flood mitigation activities recommended under the flood mitigation plan for the MMSD and City set forth in this report. Some of the programs described in this chapter may not be available under all envisioned conditions in the City or to its residents and/or property owners for a variety of reasons, including, for example, eligibility requirements or lack of funds at a given time in Federal and/or State budgets. Nonetheless, the list of sources and programs set forth in this chapter should provide a starting point for identifying possible funding sources for implementing the flood mitigation plan recommended in this report.

It should be noted that the MMSD is the lead agency in carrying out flood mitigation measures for Milwaukee County, including the City of Oak Creek. The MMSD has budgeted considerable funds to plan, design, and carry out flood mitigation programs. Based upon the MMSD; City; Wisconsin Department of Military Affairs, Division of Emergency Management; and the Federal Emergency Management Agency (FEMA) current and planned budgets and programs, funding for this flood mitigation plan implementation is largely in place, or will be in place, as implementation is carried out.

FEDERAL EMERGENCY MANAGEMENT AGENCY PROGRAMS

The Federal Emergency Management Agency funds several programs that in the State of Wisconsin are administered through the Wisconsin Department of Military Affairs, Division of Emergency Management. 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 various projects designed to reduce or eliminate future disaster costs. Such projects can include the floodproofing or acquisition and relocation of floodprone properties, the elevation of structures in compliance with National Flood Insurance Program (NFIP) standards, and other flood control measures, including structural projects where identified as cost-effective. 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. 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 used on private property for eligible projects. The HMGP gives priority to properties identified by FEMA as repetitive-loss properties.

The City of Oak Creek has already obtained funds under this program for structure purchase and removal. Funding is available through this program only in set amounts.

Flood Mitigation Assistance Program
The Flood Mitigation Assistance (FMA) program can potentially provide up to 75 percent of the costs attendant to the acquisition, relocation, elevation, or dry floodproofing of structures insured under the NFIP. In addition to participating in the NFIP, eligible program applicants must meet cost-benefit criteria established by FEMA. Eligible projects must also be included as part of the grantee's flood mitigation plan. The City of Oak Creek is eligible to apply for flood mitigation funding under the FMA program, but under recent indications, it appears that the amount of funding available under this program has been relatively small.

Pre-Disaster Mitigation Program
The Pre-Disaster Mitigation (PDM) Program can provide up to 75 percent of the costs attendant to various hazard mitigation activities carried out by local and state governments and Indian Tribal governments. Such projects should be shown to be cost-effective and serve to complement a comprehensive mitigation program aimed at reducing injuries, loss of life, and damage or destruction of property. Funds may also be used for preparation of hazard mitigation plans. Under the PDM Program, the applicant is responsible for the remaining 25 percent of the project cost, which may be in the form of cash or acceptable in-kind services. Other Federal funding sources may not be used to make up this 25 percent. To be eligible, applicants must be participating in the National Flood Insurance Program (NFIP) if they have been identified through that program as having a Special Flood Hazard Area. They must also not be suspended or on probation from that program. The City of Oak Creek currently participates in the NFIP.

As of November 1, 2003, applicants must have an approved local mitigation plan to be eligible for PDM funding of hazard mitigation projects. However, funding will continue to be made available for the preparation of such mitigation plans. Also, after November 1, 2004, all States must have an approved Standard State mitigation plan in order to receive PDM funds for state and local mitigation projects.

Public Assistance Program
FEMA's 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. In making repairs to the infrastructure, cost-effective mitigation activities may be included. 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.

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT COMMUNITY DEVELOPMENT BLOCK GRANT PROGRAM

Community Development Block Grant (CDBG) programs, funded by the U.S. Department of Housing and Urban Development, are administered by the Wisconsin Departments of Administration and Commerce.

The Community Development Block Grant Emergency Assistance Program is a special program designed by the Wisconsin Department of Administration, Division of Housing & Intergovernmental Relations to assist local units of government in times of emergency. The program is funded with a $2.0 million portion from the Division's annual CDBG allocation, the program provides funds to address housing needs which occur as a direct result of natural or man-made disasters. A local unit of government that has recently experienced a natural or man-made disaster may apply for assistance in addressing housing problems caused by the disaster. Generally, cities, towns, counties, and villages with populations less than 50,000 and all counties, except Milwaukee, Waukesha, and Dane, are eligible to apply. Eligible activities dependent upon the nature of the disaster may include: repair of damage to the dwelling unit, acquisition and demolition of dwellings unable to be repaired, and costs for new housing units to replace those lost in the disaster.

The Small Cities Community Development Block Grant Emergency Program is designed to assist economically distressed smaller communities in the repair or replacement of public facilities that were damaged or destroyed by a natural disaster or a sudden and catastrophic event. The program is administered by the Wisconsin Department of Commerce. Local units of government with populations less than 50,000 and counties, other than Milwaukee, Waukesha, and Dane, are eligible. Eligible activities include demolition and debris removal and disaster-related work on utilities and streets, fire stations and emergency vehicles, and community/senior centers and shelters. The maximum grant amount is $500,000, with a match of one-third of the Community Development Block Grant 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. The SBA may also provide loans for relocation out of special flood hazard areas when such relocations are required by local officials. While the 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 special flood hazard areas when the community is participating in a buyout program. 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. Up to 20 percent of the disaster loan can be used for mitigation measures.

U.S. ARMY CORPS OF ENGINEERS

The Corps of Engineers programs are potential sources of funding for implementing the floodland management recommendations of this plan. In order to be eligible for funding, the plan components must meet specific Corps economic feasibility and other criteria. The programs which may be applicable include the following:

- Section 22—Water resources planning assistance—50 percent Federal, 50 percent local cost share
- Section 205—Small flood control projects—Maximum $5 million per project. 75 percent Federal, 25 percent local cost share
- Section 208—Clearing debris and sediment from channels for flood prevention—Maximum $500,000 per project. 75 percent Federal, 25 percent local cost share

- Section 14—Emergency streambank and shoreline protection—Maximum $500,000 per project. 75 percent Federal, 25 percent local cost share

WISCONSIN DEPARTMENT OF NATURAL RESOURCES PROGRAMS

The Wisconsin Department of Natural Resources (WDNR) operates programs that may serve as potential funding sources for the City's flood mitigation efforts. These programs are described below.

Urban Green Space Program
The WDNR's Urban Green Space (UGS) 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 the program is to provide natural open space within or near urban areas and protect scenic or ecological features. The City of Oak Creek is eligible to apply for grants under the UGS program.

Urban Rivers Grants Program
The WDNR's Urban Rivers Grants Program (URGP) provides 50 percent matching grants to municipalities to acquire land or rights to land on or adjacent to rivers that flow through urban areas, in order to preserve or restore urban rivers or riverfronts for the purposes of economic revitalization and encouragement of outdoor recreational activities. The City of Oak Creek is eligible to apply for grants under the URGP.

Municipal Flood Control Grants Program
The WDNR Municipal Flood Control Grants Program as initiated in 2001 under Section 281.665 of the *Wisconsin Statutes*. The program provides 75 percent matching grants with a maximum set at 20 percent of the funding available to all cities, villages, towns, and metropolitan sewerage districts concerned with municipal flood control management. Assistance is provided in two ways: 1) Local Assistance Grants that support municipal flood control administrative activities, and 2) Acquisition and Development Grants to acquire and remove floodplain structures, elevate floodplain structures, restore riparian areas, acquire land and easements for flood storage, construct flood control structures, and fund flood mapping projects.

Stormwater Management Program
The Wisconsin Department of Natural Resources, as of November 2000, administers a Targeted Runoff Management (TRM) grant program provided for under Section 281.65(4c) of the *Wisconsin Statutes*. Grants provided under this program may be used for projects to control nonpoint source pollution from areas of existing urban development and may be available to partially support dual-purpose (quality and quantity) detention ponds or other stormwater management facilities. The TRM program, which involves a competitive grant-seeking process, is currently subject to potential revision and expansion. In addition to funds available from the WDNR, the cost of certain recommended components of the stormwater drainage system may be shared between the City of Oak Creek and the Wisconsin Department of Transportation.

LOCAL FUNDING

As previously noted, there are a number of City- and MMSD-based options for funding flood mitigation programs. City staff and elected officials annually review the flood mitigation programs and allocate local funding sources as part of the budget process. The MMSD has established a capital improvements program which provides funding over a multi-year period to carry out all of the projects identified in the MMSD system plan update needed to address the overland structure flooding problem in the City of Oak Creek. The City of Oak Creek has participated to provide local cost-sharing for structure acquisition and removal of project components. The MMSD is the lead agency in the plan implementation phase and will incorporate local community funding as identified in its flood control policy and will maximize the use of State and Federal program funds to the extent possible.

GRANT AWARD ELIGIBILITY, ACQUISITION, AND ADMINISTRATION AND PROGRAM IDENTIFICATION

The eligibility and local contribution requirements associated with each of the aforementioned programs vary from program to program. The City of Oak Creek and MMSD are the lead agencies responsible for identifying potential flood mitigation funding sources and for acquiring and administering grant awards attendant to ongoing mitigation efforts in floodplain areas. The City and the MMSD are familiar with eligibility and grant local contribution requirements and have been successful in carrying out flood mitigation programs of the types identified in Chapter VI. Thus, continued eligibility and local contribution availability is expected.

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Chapter VI

FLOOD MITIGATION PLAN

This chapter sets forth a description of the flood mitigation plan for the City of Oak Creek, the public participation activities and coordination efforts with other agencies undertaken in the preparation of the plan, strategies for plan implementation and for plan monitoring. Information pertaining to alternative flood mitigation measures that were considered in the formulation of this plan is set forth in Appendices D and E.

PLAN DESCRIPTION

The flood mitigation plan for the City of Oak Creek consists of five elements: an environmentally sensitive lands preservation element, a stormwater management element, a floodland management element, a public information and education element, and a secondary plan element. Each element of the plan is an important component of the City's overall strategy for reducing flood risk and flood damage. As detailed in this chapter, as well as in certain portions of previous chapters of this report, major portions of the overall plan are already being implemented in the form of existing and ongoing activities being carried out by the City and the Milwaukee Metropolitan Sewerage District (MMSD) that contribute toward realizing the City's flood mitigation goals and objectives.

Environmentally Sensitive Lands Preservation Element

Floodland management regulations and programs perform critical roles toward assuring that flood mitigation efforts are properly implemented. As detailed in Chapter II of this report, the City currently has several pertinent floodland management regulations and programs in place, most notably in the form of City zoning regulations and other ordinances and environmentally sensitive area and open space preservation policies. In addition, nearly all of the environmentally sensitive lands in the City are currently being protected by Milwaukee County and the City under their park and open space and comprehensive planning programs.

Floodland Zoning and Wetland Preservation Zoning

City floodland management regulations include the City's floodland district zoning ordinance and shoreland-wetland zoning ordinance. The floodland zoning ordinance is intended to preserve the floodwater conveyance and storage capacity of floodplain areas within the City and to prevent the location of new flood-damage-prone development in flood hazard areas. The City shoreland-wetland zoning ordinance generally seeks to maintain the stormwater and floodwater storage capacity of wetlands in the City and to prohibit certain land uses detrimental to wetland areas. Details regarding each of these ordinances are set forth in Chapter II of this report. Implementation of these ordinances on an ongoing basis is an integral part of the City's flood mitigation strategy, with the ordinances being reviewed from time to time to ensure their continued effectiveness.

Environmentally Sensitive Area and Open Space Preservation Actions

As noted in Chapter II of this report, the preservation of environmental corridors and important natural features can assist in the prevention of increased flood flows and associated problems. These areas often include the most

significant floodplains and wetlands within a given area. In addition, the intrusion of intensive urban land uses into environmentally sensitive areas may result in the creation of serious and costly problems, such as failing foundations for pavements and structures, wet basements, excessive operation of sump pumps, excessive clear-water infiltration into sanitary sewerage systems, and poor drainage. Destruction of ground cover may result in soil erosion, stream siltation, more rapid runoff, and increased flooding.

The City and Milwaukee County have taken an active role in preserving the environmental corridors and isolated natural resource areas in the City as part of their park and open space and comprehensive planning programs. Currently, nearly all of the important natural resources in the City are protected and preserved for resource preservation and other open space purposes, as detailed in Chapter II of this report. The actions already taken and planned to be taken by the City and Milwaukee County with regard to preserving and protecting environmentally sensitive areas and open space areas thus constitute an integral part of the City's flood mitigation efforts.

Stormwater Management Element

Because of the interrelationship between stormwater management and floodland management, stormwater management actions are an important element of the flood mitigation plan. This element of the plan includes stormwater ordinances and related regulations and the development of a citywide stormwater management design guidelines, and specific stormwater management actions developed through detailed subwatershed-level stormwater management planning.

Stormwater-Related City Regulations

The City, through its recently adopted stormwater runoff ordinance, seeks to control the adverse impacts of stormwater runoff by mitigating the adverse impacts of new land use development and redevelopment on the quantity and quality of such runoff. The specific provisions involved are noted in Chapter II of this report. As in the case of the floodplain and wetland preservation zoning provisions noted above, implementation of these ordinances on an ongoing basis is an integral part of the City's flood mitigation strategy.

Stormwater Management Design Guidelines for the City of Oak Creek

The City, through its stormwater runoff ordinance, has adopted stormwater management guidelines which are applied to new development or redevelopment within the City, with the exceptions cited in Chapter II, to control potential increases in stormwater runoff amounts. These guidelines are supplemental to, and are intended to, be superceded in areas where detailed stormwater management planning has developed more site-specific runoff control strategies. The guidelines generally require the application of allowable release rates for the two- and 100-year recurrence interval storm events, and encourage the use of infiltration practices to limit runoff volume where practicable. The required detention storage associated with the guidelines should help to mitigate current and future flooding problems within and downstream of the City.

Stormwater Management Master Plan for the City of Oak Creek

As previously described in this report, the City of Oak Creek engaged the private engineering firms of R.A. Smith & Associates, Inc. and Hey & Associates, Inc. to prepare a stormwater management master plan for the City. The resulting plan, completed in 2001, is intended to provide the City with a design for a communitywide, effective stormwater management system that will adequately serve existing and design year 2020 land use development conditions in the City. The plan includes elements for the abatement of stormwater drainage and stormwater quality problems, as well as flooding problems in the City. The plan focused on a total of 32 tributary streams and their contributing drainage areas, not including the major watercourses for which the Milwaukee Metropolitan Sewerage District (MMSD) has assumed responsibility. Thus, this plan, combined with the MMSD system planning described in the following section, sets forth the means to address nearly all of the flooding problems within the City.

The stormwater management master plan involved a synthesis of corrective measures selected from among the alternatives considered, as summarized in Appendix I of this report. The selection of the corrective measures to be included in the plan was based upon finding the most cost-effective combination of implementable measures that protect property values, prevent flood damage, and protect water quality and aquatic ecology. The plan is

summarized in Appendix J of this report. Measures aimed at resolving stormwater drainage and flooding problems in the 32 minor tributary areas covered under the plan have an estimated capital cost of about $5.9 million and attendant annual operation and maintenance costs of about $49,000.

Implementation of this plan element should provide the City with a stormwater management system able to accommodate the peak rates of runoff from a 10-year recurrence interval rainfall event under planned year 2020 development conditions without disruptive roadway flooding, and from a 100-year rainfall event under similar development conditions without costly property flooding.

Floodland Management Element

In addition to other elements of the flood mitigation plan for the City of Oak Creek, actions specifically pertaining to floodland management are included and have been partially implemented with further implementation ongoing. These elements, which have been and are being prepared as part of the current effort of the MMSD to update its 1990 watercourse management plan, along with certain additional floodland management elements set forth in the City's stormwater management master plan, constitute the floodland management element of the plan. The alternatives considered by the MMSD, the City of Oak Creek, and concerned stakeholders for each watershed or subwatershed partly or totally located within the City of Oak Creek are summarized in Appendices D and E of this report. These alternative measures included storage, conveyance, levees and floodwalls, floodproofing, and acquisition. Additional detail regarding the plan for each watershed is available in the referenced planning reports prepared for the MMSD and the City of Oak Creek.

Plan for the Oak Creek Watershed

Components of the floodland management measures for the Oak Creek watershed and their estimated costs are summarized in Table 6. The locations of those components are shown on Map 11.

The MMSD is currently in the advanced planning stage of its watercourse system plan for the Oak Creek watershed. As identified in Appendix D, those alternative measures calling for structure acquisition and floodproofing were selected for further development under the current MMSD planning effort. Under Phase 1 of that plan, a total of 32 structures were initially identified as being subject to flood damages along the main watercourses of the Oak Creek watershed.[1] Of those, 24 were located in the City of Oak Creek. Those structures were initially identified based upon comparison of estimated flood stage to the ground elevations shown on the Milwaukee County topographic mapping. As part of its advanced planning phase, the MMSD conducted field-surveys to provide a more definitive identification of those structures that are subject to flooding. As a result of those surveys, the total number of buildings along those watercourses under MMSD jurisdiction was reduced to 14, as listed in Appendix G. Eleven of those structures are associated with one property, a vacant garden center located along E. Forest Hill Avenue. The current plan calls for the buyout of the one single-family residence and floodproofing of the remaining 13 buildings.

In addition to the structure flooding identified under the MMSD planning effort, four structures located along minor tributary streams were also identified under the City's stormwater management master plan as being subject to flooding from a 100-year recurrence interval event. Two commercial structures are located along Tributary N2 to the North Branch of Oak Creek. The stormwater management master plan calls for these structures to be protected through the construction of two regional detention basins. One is to be located within the southeast quadrant of the IH 94/College Avenue (CTH ZZ) interchange, while the other would be located on private land immediately south of the first, outside of the interchange. These two basins would have a combined

[1] *The actual number presented in the Phase 1 report was 22 structures. One of those is a vacant garden center consisting of 11 actual buildings on one property. Under this flood mitigation plan, this property has been quantified as 11 separate structures. Thus, the number from the MMSD Phase 1 plan has been adjusted for consistency with this report.*

Table 6

COMPONENTS AND COSTS OF FLOODLAND MANAGEMENT PLAN FOR THE OAK CREEK WATERSHED

Stream	Plan Components	Estimated Capital Cost	Estimated Benefits
Oak Creek Main Stem and North Branch of Oak Creek	1. Acquire one residential property, floodproof 12 commercial buildings and one apartment building	$ 550,000	$250,000
	2. Construct stormwater pumping station at railroad underpass along W. Ryan Road	1,050,000	--[a]
	3. Remove one steel sheet pile drop structure on Oak Creek main stem upstream of W. Ryan Road, and two steel sheet pile drop structures along S. 6th Street north of W. Rawson Avenue. Also remove associated concrete rubble and slabs, regrade channel, and revegetate adjacent streambanks	317,000	--[a]
	Subtotal – Oak Creek Main Stem	$1,917,000	$250,000
Tributary N2	1. Construct two stormwater detention basins with total volume of 45 acre-feet at IH-94/W. College Avenue interchange	$1,105,000	$ 5,000
	Subtotal – Tributary N2	$1,105,000	$ 5,000
Tributary O19A	1. Remove existing driveway culvert, install new culvert under abandoned interurban railway to allow overflow to the east, install two new culverts under Puetz Road to allow drainage of overflow route	$ 304,000	--[b]
	Subtotal – Tributary O19A	$ 304,000	--[b]
--	Total – Watershed	$3,326,000	$255,000

[a] *No cost or benefit given, as no flood damages are associated with this element.*

[b] *No cost or benefit given. This element has already been implemented.*

Source: Milwaukee Metropolitan Sewerage District, City of Oak Creek, and SEWRPC.

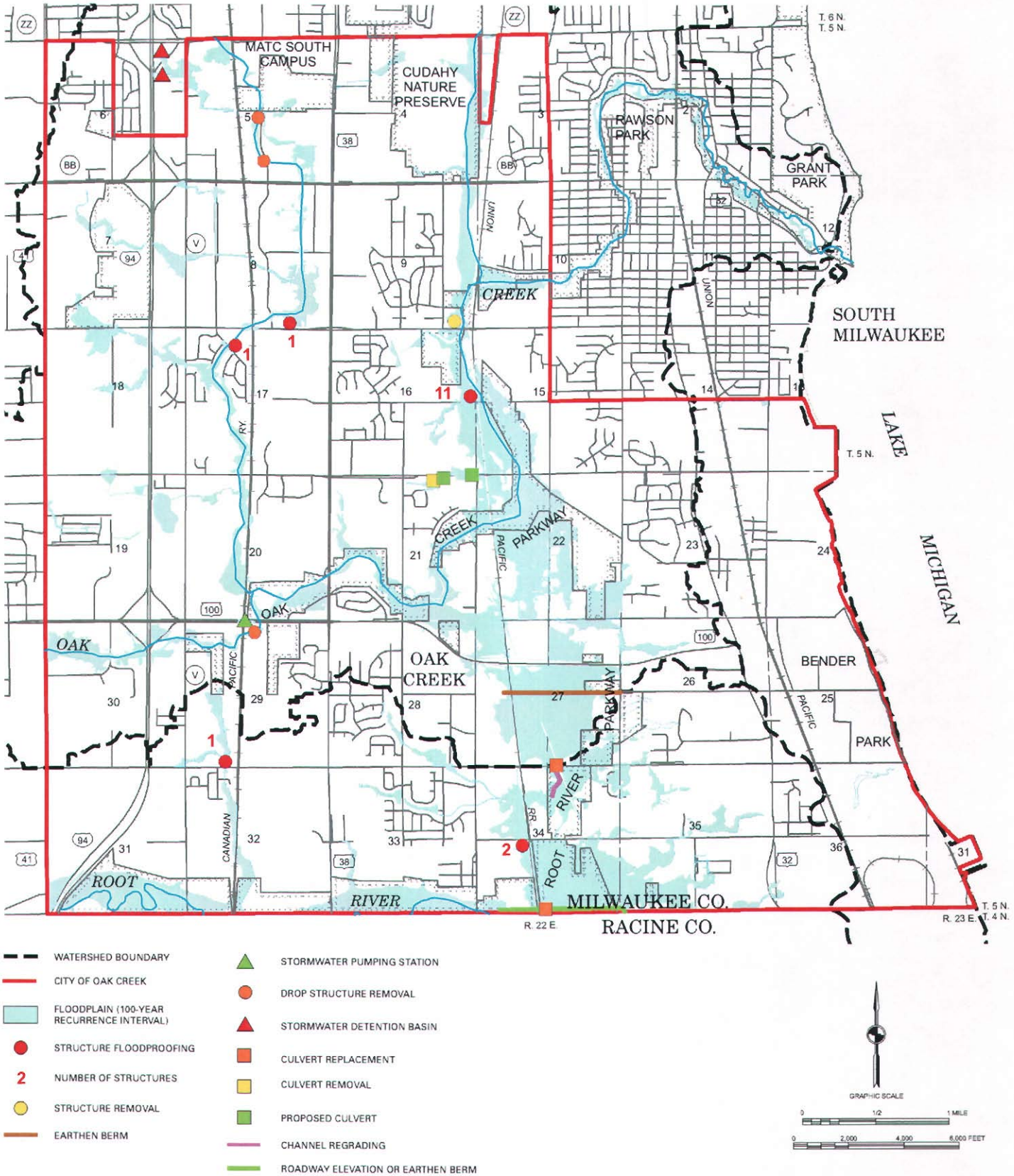
area of about 11 acres and would provide about 45 acre-feet of storage. Both basins would be designed to prevent overtopping of the adjacent roadways during a 10-year storm event and to minimize roadway flood depths under a 100-year storm event.

The remaining two structures identified in the City's stormwater management master plan include two single-family residences located along Tributary O19A to the Oak Creek main stem. The stormwater management master plan called for resolution of the flooding problem through a combination of culvert removal and installation of three new culverts in order to allow diversion of runoff along the south side of E. Puetz Road. These measures were completed by the City in 2002. As a result, the two residential structures are no longer considered subject to flooding for floods up to and including the 100-year event.

In addition to the structure buyout and floodproofing noted above the MMSD Phase 1 watercourse plan included recommendations related to resolving the frequent and serious flooding problem at a railroad underpass in the 700 block of W. Ryan Road (STH 100), as well as improving riverine drainage capacity and aquatic habitat through removal of existing drop structures along the Oak Creek main stem and the North Branch of Oak Creek. As noted in Chapter IV, flooding of Ryan Road at the railroad underpass was addressed through the construction in 2000 of a stormwater pumping station at that location.

Map 11

FLOOD CONTROL PLAN FOR THE CITY OF OAK CREEK



Source: Milwaukee Metropolitan Sewerage District, City of Oak Creek, and SEWRPC.

In addressing the issue of drop structure removal, the MMSD is working with the U.S. Army Corps of Engineers to develop a plan and schedule for their removal. In April 2001, the Corps issued a public notice regarding an Aquatic Ecosystem Restoration Project[2] for the Oak Creek watershed in the City of Oak Creek. That project calls for removal of one steel sheet pile drop structure on the Oak Creek main stem upstream of W. Ryan Road and two steel sheet pile drop structures along the North Branch of Oak Creek adjacent to S. 6th Street, upstream of W. Rawson Avenue. A fourth drop structure located on the Oak Creek main stem at Pennsylvania Avenue was removed in 2001 as part of the replacement of that roadway bridge. The Corps' plan includes notching or cutting off the existing steel sheet piling at the channel surface, removal of concrete rubble/slabs along the channel banks near the drop structures, properly grading the channel, and planting vegetation along the channel banks to control erosion.

The estimated capital cost of floodland management plan for the Oak Creek watershed is about $3.3 million. Annual operation and maintenance costs are estimated at about $43,400.

Plan for Root River Watershed

Within the Root River watershed, MMSD jurisdiction for carrying out flood abatement measures is limited to the Crayfish Creek subwatershed. Under Phase 1 of the MMSD watercourse system plan for the Root River watershed, no structures were identified within that subwatershed as being subject to flood damages. As such, there was no recommendation by the MMSD to carry out floodland management measures in that area. Previous planning efforts by SEWRPC identified measures for reducing the flooding impacts caused by poor drainage conditions along Crayfish Creek and the Caledonia Branch of Crayfish Creek. Those measures were included in the 1990 MMSD watercourse system plan. Although no recommendation was made under the Phase 1 update of the 1990 system plan, an updated estimate of the cost of the SEWRPC-developed plan was included. At the request of the City of Oak Creek, the MMSD has agreed to consider further the implementation of flood control measures in this drainage basin as part of its ongoing advanced planning for the Root River watershed. Components of the preliminary flood control measures, along with their attendant costs, are summarized in Table 7 and identified on Map 11. Those measures call for: 1) replacement of the existing E. Oakwood Road culvert; 2) regrading the Crayfish Creek channel downstream of Oakwood Road; 3) construction of about 3,500 feet of earthen berm west of 15th Avenue extended at Fitzsimmons Road extended; 4) elevation of 2,500 feet of E. County Line Road or construction of a parallel earthen berm; 5) replacement of the existing Crayfish Creek culvert under E. County Line Road; 6) installation of backwater gates at the E. County Line Road replacement culverts; 7) installation of bulkheads on the existing culverts that convey Crayfish Creek under the Union Pacific Railroad track south of E. County Line Road, and 7) construction of about 2,800 feet of new channel along the east side of the Union Pacific Railroad tracks to convey Crayfish Creek to a new outlet at the Root River near Seven Mile Road.

As noted in Appendix G, two accessory farm buildings have been identified under this flood mitigation plan as being subject to flooding from Crayfish Creek. No specific flood control measures have been identified for these structures. Protection of these buildings could be provided through floodproofing. Such measures would be carried out at the discretion and responsibility of the property owner.

One additional structure, a single-family residence, has been identified as being subject to flooding along Tributary R2 to the Root River. This structure was not identified under any previous planning effort, but did incur damages during the July 2002 flood event. A subsequent survey of the property showed it to have a basement level entrance that is about 1.1 feet below the estimated 100-year flood elevation for this tributary. No specific flood mitigation plan has been developed for this property. Stormwater management measures consisting of onsite detention storage basins are being planned for two new developments located west of S. 13th Street, upstream

[2] *U.S. Army Engineer District, Detroit, Corps of Engineers,* Environmental Assessment, Section 206, Aquatic Ecosystem Restoration Project, Oak Creek, City of Oak Creek, Milwaukee County, Wisconsin, *April 2001.*

Table 7

COMPONENTS AND COSTS OF FLOODLAND MANAGEMENT PLAN FOR THE ROOT RIVER WATERSHED

Stream	Plan Components	Estimated Capital Cost	Estimated Benefits
Crayfish Creek	1a. Replace existing E. Oakwood Road culvert with a 48-inch corrugated metal pipe culvert b. Regrade Crayfish Creek channel in vicinity of E. Oakwood Road c. Reconstruct 2,500 feet of E. County Line Road or construct an equivalent length of earthen berm adjacent to roadway d. Replace existing E. County Line Road culvert with four 72-inch corrugated metal pipe culverts with backwater gates e. Install bulkheads on existing culverts conveying Crayfish Creek under Union Pacific Railroad f. Construct 2,810 feet of new open channel south from E. County Line Road, along east side of Union Pacific Railroad, to the Root River at a point about 850 feet north of Seven Mile Road g. Make refinements to the inlet and outlet of an existing retention pond along the route of the new open channel h. Construct 3,500 feet of earthen berm west of 15th Avenue and parallel to and 50 feet south of E. Fitzsimmons Road extended	$4,900,000	--[a]
	2. Floodproof two farm buildings	10,000	$5,100
	Subtotal – Crayfish Creek	$4,910,000	$5,100
Tributary R2	1. Floodproof one residential structure	$ 10,000	$1,640
	Subtotal – Tributary R2	$ 10,000	$1,640
--	Total – Watershed	$4,920,000	$6,740

[a]*No cost or benefit given, as no flood damages are associated with this element. Benefit will be in the form of improved drainage and reduction in nuisance flooding.*

Source: Milwaukee Metropolitan Sewerage District, City of Oak Creek, and SEWRPC.

from this property. These basins may serve to reduce the risk of flooding at this location. Should future evaluation of those detention basins show a continued risk of flooding at this structure, protection should be provided through floodproofing measures that would be the responsibility of the owner.

As noted in Chapter IV and in Appendix G, no structural flooding problems have been identified along the Root River main stem in the City of Oak Creek. As such, no flood mitigation measures are proposed for the City of Oak Creek portion of that stream. There are, however, flood mitigation measures that have been recommended by the MMSD for the Root River upstream of the City, as well as by SEWRPC for the Root River Canal in Racine County. Recommended measures as identified in the MMSD watercourse system plan and in the SEWRPC Root River watershed comprehensive plan are summarized in Table 8. These measures are not expected to have a significant impact on flooding along the Oak Creek portion of the Root River main stem.

The estimated capital cost of floodland management measures for the City of Oak Creek portion of the Root River watershed is about $4.9 million. Annual operation and maintenance costs are estimated at about $3,400.

Table 8

RECOMMENDED FLOODLAND MANAGEMENT PLAN ELEMENTS FOR THE ROOT RIVER WATERSHED UPSTREAM FROM THE CITY OF OAK CREEK

Stream	Plan Components
North Branch of the Root River and Hale Creek	1. Modify National Avenue bridge to eliminate overtopping 2. Construct pumping station along storm sewer upstream of Hale Creek 3. Acquisition of six residential structures
East Branch of the Root River	1. Acquisition of five residential structures and eight mobile homes
Whitnall Park Creek	1. Floodproof seven commercial structures
Northwest Branch of Whitnall Park Creek	1. Acquisition of seven residential structures 2. Floodproof two condominium buildings
North Branch of Whitnall Park Creek	1. Enclose existing roadside drainage ditch upstream of W. Grange Avenue 2. Construct 2.7 acre-foot detention basin downstream of W. Grange Avenue 3. Floodplain lowering downstream of proposed detention basin to the confluence with the Northwest Branch of Whitnall Park Creek 4. Stabilization of an existing head-cut in the channel upstream of the confluence with the Northwest Branch of Whitnall Park Creek 5. Acquisition of five residential structures
Root River Canal (including east and west branches)	1. Channel debrushing and maintenance along 19.4 miles of canal in Racine County
Root River Main Stem	1. Construct 660-acre multi-purpose—flood control, water quality enhancement, low-flow augmentation, and recreational use—reservoir at the confluence of the North Branch of the Root River and the Root River Canal in the City of Franklin

Source: Milwaukee Metropolitan Sewerage District and SEWRPC.

Plan for Lake Michigan Direct Drainage Area

There are no identified flooding problems identified in the City of Oak Creek portion of the Lake Michigan Direct Drainage area. As such, no specific flood mitigation measures have been developed for this area.

Auxiliary Flood Mitigation Plan Components

In addition to the foregoing subwatershed-specific plan components, several auxiliary plan components have been developed under the MMSD's current planning effort for the Oak Creek and Root River watersheds. These auxiliary components include 1) the implementation of watershedwide stormwater management regulations to control increases in stormwater runoff resulting from new-development storage and significant redevelopment; 2) the preservation of existing natural storage found in wetlands, floodplains, and low-lying and internally drained areas; and 3) the integration of ongoing and subsequent planning efforts into a comprehensive plan for the watershed.

Public Information and Education Element

Public information, education, and participation constitute an integral aspect of the City's flood mitigation and related efforts. The City intends to continue to engage in continuing informational and educational efforts oriented toward resolving the flooding and related stormwater drainage and sanitary sewer backup problems in the City. This plan element will be carried out through the following three subelement activities: 1) the continuation of ongoing public involvement activity of the City actions on citywide flood problem resolution; 2) public education activities; and 3) public information programming and coordination associated with detailed floodland management plans.

City Continual Activity on Citywide Flood Problem Resolution

The first subelement involves the continuation of the City activity on flood problem resolution. The City Council, working through the City Departments of Public Works and Community Development, has taken up the role of overseeing a program for researching problems, identifying needs, and presenting policy recommendations that would provide continued direction regarding resolving flooding problems. This process was initiated by the City in 1995 and by the City and the MMSD in 1998 when public informational meetings were held to obtain citizen comments on stormwater drainage and flooding issues. Through its meetings and other efforts, the City intends to involve the public in carrying out its mission. The City Departments of Public Works and Community Development staffs, will prepare and distribute annual updated reports setting forth the current status of flooding and related problems in the City and of efforts to address those problems, as well as related policy recommendations. These reports will be prepared with the active and sustained input of the general public and will be prepared in consultation with members of the staffs of the WDNR, MMSD, and SEWRPC.

Public Education Activities

The second subelement involves preparation and distribution of educational and self-help materials and the provision by City staff of educational programs. Under this subelement of the flood mitigation plan, the City staff would periodically obtain or prepare and make available and/or distribute various public informational and educational materials, including materials oriented toward local homeowners and designed to help them consider and potentially undertake actions to mitigate damage caused by stormwater flooding and sanitary sewer backups in the City. With the proper knowledge, citizens could minimize some of their own problems and prevent damage caused by stormwater and sanitary sewer backups. The subjects of the envisioned City educational efforts could include the citywide stormwater management plan; proper filling and grading, including landscaping and diversion of downspout water; the ramifications of clear-water introduction into the sanitary sewer system; and methods of reducing flood damage to individual residences, including backflow valves, backup sump pumps, emergency standby generators, and hung sewers.

Educational materials produced or obtained as a part of this effort could include a self-help guide for local property owners. The guide would set forth potential causes of basement flooding, potential preventive measures that may be taken by homeowners, and information regarding potential actions that homeowners might take after flood damage occurs to a residence. Other, available related materials will be distributed as part of the City's informational and educational efforts. These informational and educational activities are integral to the City's efforts toward resolving the flooding and related stormwater drainage and sanitary sewer backup problems in the City.

Public Participation Activities and Coordination with Other Agencies and Units of Government

The third subelement involves direct public participation and coordination with other agencies and units of government during subwatershed-area detailed stormwater and floodland management plan development. As previously noted, the City has participated and continues to participate in the MMSD's current effort to implement its watercourse system management plans for the Oak Creek and Root River watersheds as one of the stakeholders involved in those efforts. The first-phase watercourse management plans represent the results of a concerted planning effort involving the MMSD, SEWRPC, the WDNR, local-level public stakeholders, including the Milwaukee County Board of Supervisors, Milwaukee County Department of Parks, Recreation and Culture, and the City of Oak Creek and other municipalities having lands within those watersheds, and certain concerned private parties such as the Friends of the Root River. The planning effort included a public involvement component focusing on stakeholder information and education. The stakeholder information and feedback process provided the opportunity for all major flooding related issues of concern to the stakeholders to be addressed in the watercourse system management plan. It also served as a forum to gauge public acceptance of various solutions proposed by local officials. Formal stakeholder meetings, open to all participants, were held to address flooding problems within the entire watershed, while other, more informal meetings and technical workshops, were held by the MMSD and the private consulting firm Camp Dresser & McKee Inc. with representatives of local communities, neighborhood organizations, SEWRPC, Milwaukee County agencies, and local business and industry groups. Joint agency meetings were also held. Potential solutions were developed interactively with the major stakeholders as various alternative solutions were presented and feedback was sought regarding their accepta-

bility. The recommendations for the watershed made under the MMSD effort were thus developed through a series of meetings between the MMSD and the major stakeholders in the watershed. The development process included a number of meetings held between 1998 and 1999. The result of this process was a general consensus regarding the direction the MMSD should take to address major watercourse problems in the watershed. The City of Oak Creek will continue its participation as a stakeholder in the MMSD's continuing planning efforts.

Secondary Plan Element

In addition to the above measures, several secondary measures are included as an element of the City of Oak Creek flood mitigation plan. These secondary measures are described below.

National Flood Insurance Program and Floodplain and Floodplain Map Updating Efforts

The City of Oak Creek has been designated by FEMA as having flood hazard areas and has taken the steps needed to make its residents eligible to participate in the National Flood Insurance Program (NFIP). A FEMA Flood Insurance Study (FIS) has been completed and subsequently refined by FEMA for the City. The City will continue to participate in the NFIP. The City will also work with FEMA to revise, as necessary, local flood insurance studies to reflect new flood hazard data. These efforts will support and guide owners of property in floodprone areas within the City to purchase flood insurance in order to provide some financial relief for losses sustained in floods that may occur before the implementation of any identified flood control measures.

As applicable information regarding floodplains, hydrologic and hydraulic data, flood flows and stages, water-surface elevations, structure damages resulting from flooding, and related matters becomes available through recent, current, and future planning, mapping, and related efforts, the City intends to amend its floodplain zoning ordinances to reflect the 100-year recurrence interval water-surface profiles developed under the work efforts concerned. At the time of any such amendment, the City will submit its proposed floodplain revisions and additions to the WDNR, requesting revision of the applicable flood insurance rate maps by the FEMA Federal Insurance Administration. As noted in Chapter IV, the City has submitted such updated floodplain data to the WDNR for review and approval.

Lending Institution and Real-Estate-Agent Policies

It is expected that lending institutions will continue their practice of determining the floodprone status of properties before mortgage transactions and that the principal sources of flood hazard information be the most recent available studies for the watersheds and subwatersheds located partly or wholly within the City. It is further expected that real-estate brokers and salespersons continue to inform potential purchasers of property of any flood hazard that may exist at the site being traded in accord with rules of the Wisconsin Department of Regulation and Licensing, Bureau of Direct Licensing and Real Estate.

Community Utility Policies and Emergency Programs

The City intends to work with other related governmental units and agencies to continue its policies for the design, construction, operation, and maintenance of public utilities and facilities, such as water supply and sewerage facilities, drainageways, and streets and highways, in a manner fully consistent with the land use and floodland regulation measures set forth or noted in this plan. The City of Oak Creek and the Milwaukee County Sheriff's Department will continue to implement existing emergency procedures and develop appropriate new emergency procedures as needed to provide residents of the City with timely information about floods in progress and to help them in taking appropriate action.

Stream Channel Maintenance

The City will continue to work cooperatively with the MMSD to carry out an effective stream channel maintenance program. This program would include the periodic removal of sediment deposits, heavy vegetation, and debris from all watercourses within the City, including bridge openings and culverts. Under a 1999 revision to

its watercourse policy plan,[3] the MMSD would assume responsibility for carrying out channel maintenance duties for the streams under its jurisdiction, but only under certain conditions. Specifically, the MMSD would conduct channel clearing only for those instances where the deposition of sediment or debris would materially raise the elevation of the 100-year recurrence interval flood profile as established under its watercourse system plan such that additional structures would be placed within the resulting floodplain. In no instance would the MMSD assume responsibility for the clearing of bridge and culvert openings. While the criteria used by the MMSD would address the most severe problems associated with channel obstructions, it does not address the potential for other problems that may arise, such as an increase in the incidence and severity of roadway flooding and the obstruction of storm sewer outlets. Those problems will need to be addressed by the City of Oak Creek. The City intends to work with the MMSD in identifying those instances where channel maintenance would meet the MMSD criteria. The City will also continue its own program for providing channel maintenance where the MMSD jurisdiction is not in place.

Stormwater Management Facilities Maintenance

The effectiveness of stormwater management conveyance and detention facilities can be sustained only if proper operation, repair, and maintenance procedures are carefully followed. Important maintenance procedures include the periodic repair of storm sewers, clearing of sewer obstructions, maintenance of open vegetation channel linings, clearing of debris and sediment from open channels, maintenance of detention facility inlets and outlets, maintenance of detention basin vegetative cover, and periodic removal of sediment accumulated in detention basins. Thus, these maintenance activities will be carried out on a continuing basis to maximize the effectiveness of the City's stormwater management facilities and measures and to protect the capital investment in the facilities.

PROBLEM RESOLUTION FOR REPETITIVE-LOSS STRUCTURES

As reported in Chapter IV of this report, there currently are no structures considered to be repetitive- or substantial-loss structures located in the City.

PLAN IMPLEMENTATION STRATEGIES

The recommended flood mitigation plan described in this report is designed to attain, to the maximum extent practicable, the goals and objectives set forth in Chapter III of this report. In a practical sense, however, the plan is not complete until the steps to implement it—that is, to convert the plan into action policies and programs—have been specified. Following formal adoption of the plan by the City of Oak Creek, realization of the plan will require a long-term commitment to the objectives of the plan and a high degree of coordination and cooperation among City officials and staff and various City departments and other parties, including intergovernmental task forces or other committees that may be created in the future to help address common flood mitigation issues; other concerned units and agencies of government and their respective officials and staffs; area developers and lending institutions; and concerned private citizens, in undertaking the substantial investments and series of actions needed to implement the plan. In this regard, the Milwaukee Metropolitan Sewerage District is the lead agency with regard to flood mitigation measure plan implementation for those streams for which it has assumed jurisdiction, while the City is the lead agency for other minor streams. Other units and agencies of government concerned in plan implementation include, but are not limited to, other municipalities located partly or wholly within the Oak Creek and Root River watersheds; the Milwaukee County Sheriff's Department; the WDNR; SEWRPC; the Wisconsin Department of Military Affairs, Division of Emergency Management; and FEMA. A summary of the plan elements, including estimated costs, designated management agencies, and schedules is

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[3]*A policy for MMSD stormwater drainage and flood control was initially set forth in SEWRPC Community Assistance Planning Report No. 130,* A Stormwater Drainage and Flood Control Policy Plan for the Milwaukee Metropolitan Sewerage District, *March 1986. In 1998 the Milwaukee Metropolitan Sewerage Commission formed a Watercourse Policy Advisory Group to review and revise the District's policy plan. The recommendations of that committee were adopted by the Sewerage Commission in 1999.*

included in Table 9. Information regarding implementation of those elements contained in the City's stormwater management master plan is set forth in Appendix J.

An important first step in implementation of the flood mitigation plan for the City of Oak Creek is its formal adoption by the City Plan Commission and the City Council. Upon its formal adoption by the City, the plan becomes the official guide to the making of flood mitigation and floodland management decisions for the City by City officials. Such adoption serves to signify agreement with and official support of the plan recommendations and enables City officials and staff to begin integrating the plan recommendations into the City's ongoing land use control, and public works development planning and programming.

The Milwaukee Metropolitan Sewerage District is the lead agency in carrying out flood control programs within Milwaukee County. This flood mitigation plan is largely based upon ongoing MMSD programs. That agency has adopted a plan implementation schedule for carrying out all of the MMSD projects identified in this plan. As noted earlier, plan implementation is underway with second-level planning for all projects affecting the City of Oak Creek, and with some projects actually implemented. The MMSD preliminary adopted schedule provides for implementation of the remaining projects to be completed by 2010.

The flood mitigation plan for the City of Oak Creek will also be provided to and coordinated with, as appropriate, the Milwaukee County Sheriff's Department; the Milwaukee County Department of Parks, Recreation and Culture; the MMSD; the WDNR; the Wisconsin Department of Military Affairs, Division of Emergency Management; the Wisconsin Department of Transportation; FEMA; and the U.S. Army Corps of Engineers. These units and agencies of government will be asked to coordinate and recognize, as appropriate, the recommendations set forth in this plan into their own respective activities and programs.

The City Departments of Development and Public Works will take the lead role in coordinating the implementation of the actions recommended under this plan to be taken by the parties recommended to be responsible for plan implementation and provide liaison between those parties and City agencies, officials, and staff with regard to plan implementation and its status over time.

PLAN MONITORING AND REFINING STRATEGIES

For a flood mitigation plan to be successful it must not only be implemented; it must also be monitored. Plan monitoring is best accomplished through a formal, periodic process designed to measure and assess progress in implementation, changing outside circumstances that may affect the plan and efforts to implement it, and the need for any changes to the plan and/or to how it is being implemented. In addition, the plan should be reviewed following each flood event occurrence to assess its continued viability and the need for plan revisions.

Toward ensuring successful monitoring of the flood mitigation plan for the City of Oak Creek, the City Departments of Community Development and Public Works intend to meet annually to review the plan and the status of its implementation, as well as to develop and recommend any necessary revisions to the plan. Revisions will be proposed, presented to the City Council for consideration and adoption in the form of formal amendment to the mitigation plan. This review process is recommended to be coordinated and conducted by the City Department of Community Development with input from, coordination with, and participation by the City Department of Public Works and all concerned City officials and staff, the MMSD, and, as appropriate, other units and agencies of government involved in plan implementation, and concerned private parties, including residents of the City.

The City Department of Community Development, in its review process, will periodically examine the plan and the efforts to implement it with respect to 1) whether any flood hazards affecting the City have changed, and, if so, how they have changed; 2) whether any flood mitigation goals and objectives have changed, or need to be changed; 3) the degree and extent of progress made in implementing previously identified flood mitigation actions; 4) whether the plan recommendations and their priorities should remain unchanged or need modification;

Table 9

CITY OF OAK CREEK FLOOD MITIGATION PLAN SUMMARY AND IMPLEMENTATION STRATEGIES

Plan Element and Plan Adoption	Subelement and Plan Implementation Strategies	Estimated Cost		Designated Management Agency	Implementation Status Notes	Plan Implementation Schedule
		Capital	Average Annual Operation and Maintenance			
Environmentally Sensitive Land Preservation	Continue to implement floodplain zoning and wetland preservation zoning	--[a]	--[a]	City of Oak Creek and Milwaukee County	Plan implementation largely complete	In place and ongoing
	Continue to implement environmentally sensitive land and open space preservation and acquisition policies	--[a]	--[a]	City of Oak Creek and Milwaukee County, with possible involvement by MMSD on watershed basis	Plan implementation largely underway. Some environmentally sensitive lands are under City or County ownership, with remainder protected through appropriate zoning and development controls. Additional actions are underway within watershed by MMSD	In place and ongoing
Stormwater Management	Continue implementation of stormwater-related regulation and policies	--[a]	--[a]	City of Oak Creek	Currently being implemented. New requirements in 2002 and beyond based upon MMSD rules and WDNR permit requirements	Ongoing
	Implementation of City stormwater management plans	$5.9 million	$49,000	City of Oak Creek	Implementation underway. Stormwater ordinance adopted in 2002	Ongoing
Floodland Management	Continue with second-level system plans to refine preliminary recommended plan and then implement plan					
	Oak Creek Watershed	$3.3 million[b]	$43,400[b]	MMSD, U.S. Army Corps of Engineers, and City of Oak Creek in cooperation with watershed stakeholders	Implementation underway with second-level planning underway. Installation of E. Ryan Road pump station and flood mitigation measures along Tributary O19A completed	Removal of drop structures expected in 2004 Implementation of remaining projects expected to be completed by 2010
	Root River Watershed	$4.9 million[b]	$3,400[b]	City of Oak Creek and MMSD in cooperation with watershed stakeholders	--	--
Public Information and Education	Continued citywide public involvement	--[a]	--[a]	City of Oak Creek	--	Ongoing
	Public education activities	--[a]	--[a]	City of Oak Creek	--	2004
	Public involvement and coordination with other agencies and local units of government	--[a]	--[a]	City of Oak Creek and MMSD in cooperation with other watershed stakeholders	In progress	Ongoing
Secondary Plan Element	National flood insurance program and floodplain mapping efforts	--[a]	--[a]	City of Oak Creek in conjunction with WDNR, FEMA, MMSD, and SEWRPC	Being implemented	Ongoing
	Lending institution and real-estate policies	--[a]	--[a]	City of Oak Creek, real-estate brokers, and lending institutions	Being implemented	Ongoing

Table 9 (continued)

Plan Element and Plan Adoption	Subelement and Plan Implementation Strategies	Estimated Cost		Designated Management Agency	Implementation Status Notes	Plan Implementation Schedule
		Capital	Average Annual Operation and Maintenance			
Secondary Plan Element (continued)	Community utility policies and emergency programs	--[a]	--[a]	City of Oak Creek and Milwaukee County Sheriff's Department	Being implemented	Ongoing
	Stream channel maintenance	--[a]	--[a]	City of Oak Creek and MMSD	Being implemented	Ongoing
	Stormwater and floodland management facilities maintenance	--[e]	--[e]	City of Oak Creek	Being implemented	Ongoing
Plan Adoption	--	--	--	City of Oak Creek Council upon recommendation by appropriate City committee(s)	Following draft plan review	Mid 2004
Plan Monitoring	Review, evaluate, and refine mitigation plan annually	--[a]	--[a]	City of Oak Creek Council and Departments of Community Development and Public Works	--	End 2004 and then annually with special review following each major flood event
Emergency Operations Coordination, Plan Refinement, and Post-Disaster Review	Review, evaluate, and refine plan following flood events in cooperation with emergency operations program	--[a]	--[a]	City of Oak Creek and Milwaukee County Sheriff's Department	--	Annually, with special review following each major flood event

NOTE: Where City of Oak Creek is noted as the designated management agency, it is intended to be the City Department of Community Development in cooperation with other departments, with policy review and guidance by the City Council.

[a] *No new cost involved. Costs are assigned to other ongoing City programs.*

[b] *Costs currently being refined as part of preliminary design.*

Source: City of Oak Creek, Milwaukee Metropolitan Sewerage District, and SEWRPC.

5) whether any new recommendations are needed; and 6) whether applicable funding programs and levels have changed. As an integral part of its review process, it is recommended that the City Department of Community Development submit an annual written report to the City Plan Commission and City Council setting forth the status of plan implementation efforts, detailing plan implementation actions taken over the past year, prioritizing mitigation goals and activities for the next year, and setting forth any recommended revisions to the plan. The City Department of Community Development also intends to oversee the development and maintenance of a tracking system for all future detailed flood mitigation and stormwater management plan implementation activities or new studies undertaken by and/or for the City. Such studies should be evaluated using policies established by the City Council.

The plan monitoring and refinement strategy will include a post-disaster component whereby the plan is reviewed and evaluated after any future major flood event. Based upon this review, the mitigation plan will be updated or revised as needed based upon the flood event experiences, circumstances, and consequences. In this regard, the post-disaster review effort will be coordinated with the emergency operations program administered by the City Director of Community Development and the Milwaukee County Sheriff's Department. The experiences of the emergency operations may indicate a need for refined mitigation actions which would then be incorporated into the plan. Information will also be collected from the MMSD, WDNR, and FEMA personnel. Any plan updating found to be needed shall be incorporated into the annual plan update noted above.

The City Departments of Community Development and Public Works will be responsible on a day-to-day basis for creating and implementing a flood mitigation monitoring system. This will require close cooperation and communication with the MMSD.

Reevaluation and Updating of Subwatershed-Level Recommendations

Certain components of the plan are currently being refined through second-level planning and preliminary design. In some cases, the implementation of actual projects has been completed. All of the major flood control actions are planned to be completed by 2010. The plan components, including the need for certain facilities and the location, size, and capacity of facilities, should be revised as necessary to reflect changing conditions and stormwater management needs in accord with the plan review-revision procedures set forth above.

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APPENDICES

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Appendix A

MMSD WATERCOURSE MANAGEMENT PLAN STAKEHOLDER WORK GROUP AND MEETING SCHEDULE OAK CREEK WATERSHED

STAKEHOLDER WORK GROUP

Agency/Organization	Cities
Wisconsin Department of Natural Resources	City of Cudahy
Wisconsin Department of Transportation	City of Franklin
Southeastern Wisconsin Regional Planning Commission	City of Greenfield
U.S. Army Corps of Engineers	City of Milwaukee
Milwaukee County	City of Oak Creek
Milwaukee County Department of Parks, Recreation and Culture	City of South Milwaukee

STAKEHOLDER MEETINGS HELD

May 11, 1998
November 13, 1998
January 25, 1999
March 15, 1999

MMSD WATERCOURSE MANAGEMENT PLAN STAKEHOLDER WORK GROUP AND MEETING SCHEDULE ROOT RIVER WATERSHED

STAKEHOLDER WORK GROUP

Agency/Organization	Cities	Villages
Wisconsin Department of Natural Resources	City of Milwaukee	Village of Greendale
Wisconsin Department of Transportation	City of Muskego	Village of Hales Corners
Southeastern Wisconsin Regional Planning Commission	City of New Berlin	
Milwaukee County	City of Oak Creek	
Friends of the Root River	City of West Allis	

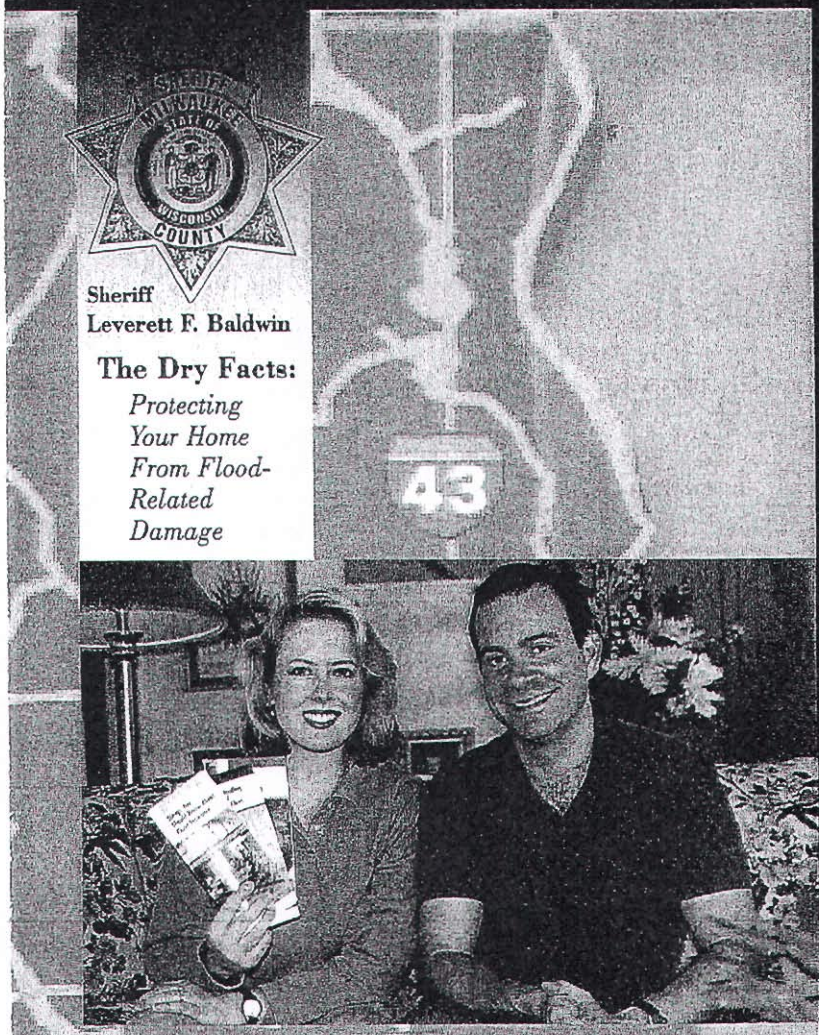
STAKEHOLDER MEETINGS HELD

May 12, 1998
December 2, 1998
April 29, 1999

Appendix B

THE DRY FACTS: PROTECTING YOUR HOME FROM FLOOD-RELATED DAMAGE

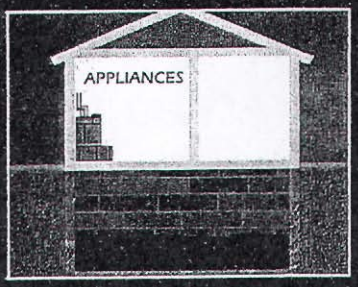
Milwaukee County Sheriff's Department
Division of Emergency Management

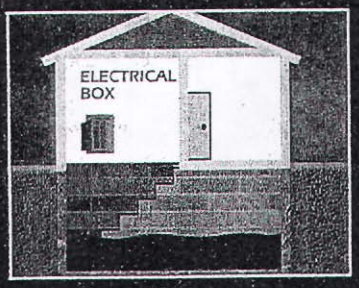


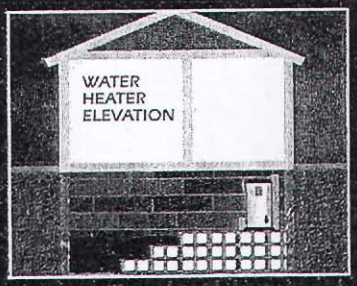
Sheriff
Leverett F. Baldwin

The Dry Facts:
Protecting Your Home From Flood-Related Damage

"Here are some simple and affordable measures you can take to protect your home and property from flood-related damage."



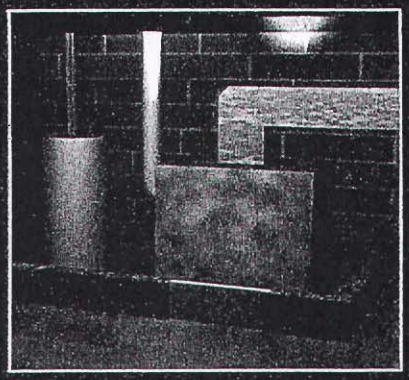




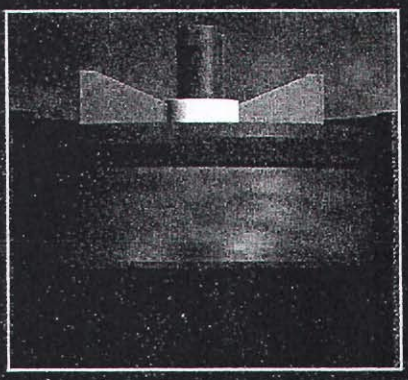
Raising or moving your appliances and electrical box can save them from flood-related damage.

FLOOD PROOFING?

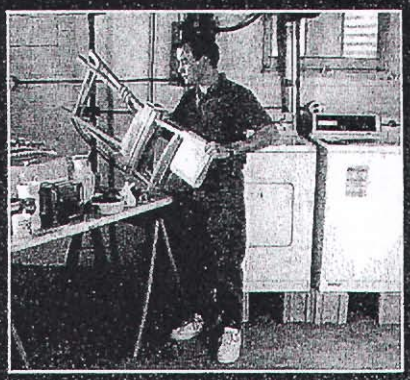
Over the last decade, flood-related damage has averaged well over three billion dollars a year! But don't give up. While we can't stop flooding, we can do a lot to reduce the cost and amount of damage it does to our homes. We call it "flood mitigation." Here are some simple and affordable measures you can take to protect your home and property from flood-related damage.



Building a flood wall around appliances that can't be moved is an effective way to protect them from encroaching flood waters.



Test plugs are used to prevent usage backup in the basement floor drain and are a quick and easy preventative solution.



Sawhorses and an old board work well to elevate small appliances and knickknacks.

BEFORE YOU DO ANYTHING

Call your building inspector. Look in the blue section of your White Pages for the building inspector in your municipality.

Things to ask...

- Are there any building code restrictions on home flood mitigation measures?
- What is my Base Flood Elevation or BFE? (Base Flood Elevation is the highest point floodwaters are expected to reach under normal circumstances in your area.)
- What "Flood Protection Level" should I use? (Flood Protection Level is the level of flooding you want your house to be able to withstand.)

DO YOUR HOMEWORK

Some of the flood proofing alterations you decide to do may require the help of a professional contractor.

Things to ask...

- Is your contractor licensed and bonded?
- Do they have proper insurance for their company and their employees?
- Do they have references? What do those references say about the contractor's work?
- Are there any complaints against your contractor registered with The Better Business Bureau?
- Will they provide everything – schedules, quotes, contracts etc. - in writing?

FLOOD MITIGATION TECHNIQUES

ELEVATE items like your washer and dryer, personal items, hazardous chemicals, food products, electrical outlets, electrical box, furnace, and water heater 1 to 2 feet above your BFE.

Things to use...

- Pressure-treated wood pallets
- Concrete blocks, bricks or masonry
- Ceiling suspension devices
- Sawhorses

INSTALL devices that will warn you of the presence of water in your basement and help remove any water present. You can find these devices at any hardware store.

Things to ask for...

- Water alarm
- Sump pump
- Battery back up sump pump

BACKFLOW REDUCTION DEVICES in your basement drains and toilets can reduce or eliminate the dreaded backflow of sewage water into your home. There are a number of backflow reduction devices out there, most of which you'll find at your hardware store.

Things to ask for...

- Backflow Valve
- Test Plug
- Pneumatic plug for basement toilet

STRUCTURAL ALTERATIONS to protect your home against flood damage will require permission from your building inspector and, in some cases, the help of a professional contractor. There are two categories of structural alteration in regards to flood mitigation: Wet Flood Proofing and Dry Flood Proofing.

Dry Flood Proofing basically means sealing your house to keep floodwaters out.

Things to do...

- Replace low-level windows with glass block.
- Protect low-level windows with aluminum or exterior plywood window shields.
- Place plastic shields over window wells.
- Sandbag around low-level windows when flood is imminent.
- Build a 1.5' above grade brick flood wall around low-level windows.

NOTE: Sandbags and flood walls should be no higher than 1.5' high. Doing so will cause a buildup of hydrostatic pressure on your basement walls and may cause them to collapse!

Wet Flood Proofing involves fortifying flood-vulnerable areas in your home. With water-resistant building materials, you significantly reduce the amount of damage caused by floodwaters.

Things to do...

- Ask your building inspector if there are any code restrictions on wet flood proofing in your area.
- Elevate items in areas to be wet flood proofed above the BFE.
- Replace building materials in these areas with water-resistant materials such as concrete, pressure-treated lumber, rigid wall insulation, epoxy paints and synthetic indoor/outdoor carpeting.

LANDSCAPING, when done properly, can do a lot to direct flood waters away from your home.

Things to do...

- Ask your building inspector about any zoning restrictions on landscape alterations in your area.
- Build up the grade around your house so that water will flow away from your foundation.
- Clean your gutters out so they're not clogged or leaking.
- Attach flexible gutter extensions to your downspouts and sump pump exterior drains to direct water away from your house. (Extensions should be at least 3 feet in length.)
- Mudjack sidewalks and driveways to return them to their proper grade away from your house.

NOTE: Any adjustments to your landscape that may effect your neighbors should be discussed with them prior to implementing those adjustments.

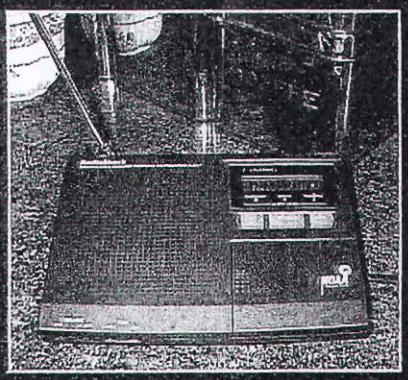
WARNING SYSTEMS, such as the NOAA weather radio with emergency alarm, broadcast continuous updates for your area directly from the National Weather Service 24 hours a day. You can purchase one at most radio/TV electronics stores.

Standard radio and television stations will also carry emergency weather and/or disaster information.

Things to know...

- *Flood Watch:* An advisory that flooding is possible within a designated area.
- *Flood Warning:* An advisory that flooding is occurring or imminent.
- *Urban and Small Stream Flood Advisory:* High potential of flooding along a river or stream.
- *Flash Flood:* The occurrence of a dangerous rise in the water level of a stream or overland area in a few hours or less.

Be sure to route rain water far away from the foundation.



A NOAA weather radio with an emergency alarm can give you enough time in a weather emergency to protect you and your family. Get one!

Milw. County Sheriff's Dept., Division of Emergency Management
414-278-4709

Milwaukee American Red Cross
414-342-8680

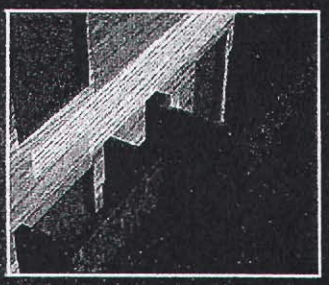
The Salvation Army
414-265-6360

Aging Services for Milw. County
414-289-6874

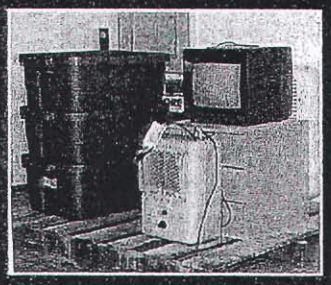
Better Business Bureau of WI
414-224-0900

The WI Dept. of Agricultural Trade & Consumer Protection
1-800-422-7128

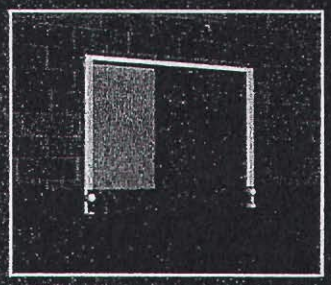
Make sure that the landscaping around your home slopes away from the foundation.



Flood walls around basement and low-lying windows should be no taller than 1.5'.



Pressure-treated lumber, cinder block, and pallets can be used to raise your belongings off the floor and out of floodwaters.



In case of impending flood, temporary shields can prevent water from entering your home.

ASSISTANCE

THE NATIONAL FLOOD INSURANCE PROGRAM or NFIP is a federal program that allows you to buy adequate flood insurance. Most homeowner's insurance policies DO NOT cover flood-related damage to your home!

Things covered by NFIP...

- Damage to your house and its contents caused by surface water flooding.
- Cost of moving and storing your belongings for up to 45 days.
- Expenses related to removing debris after flood.
- House structure up to $250,000.
- House contents up to $100,000.
- Renters belonging up to $100,000.
- Businesses up to $500,000.

BENEFITS OF NFIP...

- You don't have to wait in line for Federal Disaster Assistance that you may have to pay back later...with interest!
- Average cost of annual coverage is $316.00.
- You can get a policy at any time; however, there may be a 30-day waiting period before policy is effective.
- Not taxpayer supported.
- Available without Presidential declaration of disaster. (Federal Disaster Assistance is available in less than 50% of flood incidents!)

NOTE: NFIP does NOT cover damage caused by sewer back up, unless it is caused by overland flooding. Ask your insurance agent about a sewer back up rider for your existing homeowner's policy.

For more information, or to sign up, call your insurance agent or The National Flood Insurance Program 1-800-720-1090.

A PRESIDENTIAL DECLARATION OF DISASTER in the event of a flood, opens up numerous federal and state aid programs to flood victims. These programs are coordinated through the Federal Emergency Management Agency.

Programs include...

- Disaster Housing Grants for assistance with mortgage and rent, repair costs and mitigation costs.
- The U.S. Small Business Administration (SBA) for low interest loans to residences and businesses.
- The Individual and Family Grants for assistance with previously uncovered needs.
- Disaster Unemployment Assistance provides benefits to those out of work due to flooding.
- Farm Assistance to cover losses in farm property and/or production.
- IRS amended returns allowing deductions for casualty losses for under and uninsured victims.

The corresponding video is available through the Milwaukee County Federated Library System or by calling the Milwaukee County Sheriff's Department, Division of Emergency Management.

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Appendix C

EXCERPT FROM SEWRPC PLANNING REPORT NO. 36, SETTING FORTH OBJECTIVES, PRINCIPLES, AND STANDARDS USED IN PREPARING THE COMPREHENSIVE PLAN FOR THE OAK CREEK WATERSHED

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Chapter X

WATERSHED DEVELOPMENT OBJECTIVES, PRINCIPLES, AND STANDARDS

INTRODUCTION

The formulation of development objectives and supporting standards is one of the most important steps in the Commission watershed planning process. Soundly conceived watershed development objectives should incorporate the knowledge of many people who are informed not only about the watershed, but about the Region of which the watershed is an integral part. To the maximum extent possible, such objectives should be established by duly elected or appointed public officials legally assigned this task, assisted as necessary not only by planners and engineers but by interested and concerned citizen leaders as well. This is particularly important because of the value judgments inherent in any set of development objectives.

The active participation of duly elected public officials and citizen leaders in the overall regional planning program is implicit in the composition of the Southeastern Wisconsin Regional Planning Commission itself. Moreover, the Commission very early in its existence recognized the need to provide an even broader opportunity for the active participation of elected and appointed public officials, technicians, and citizens in the regional planning process. To meet this need the Commission established advisory committees to assist the Commission and its staff in the conduct of the regional planning program. One of these committees is the Oak Creek Watershed Committee, the composition of which is described in Chapter I. One of the important functions of this Committee is to assist in the formulation of a set of watershed development objectives and standards which can provide a sound basis for watershed plan design, test, and evaluation.

This chapter sets forth the set of watershed development objectives and supporting principles and standards approved by the Committee. Some of these objectives, principles, and standards were originally adopted by the Commission under related regional planning programs but were deemed relevant to formulation of a comprehensive plan for the Oak Creek watershed. Others were formulated specifically for the watershed plan.

In addition to presenting watershed development objectives, principles, and standards, this chapter discusses certain engineering design criteria and analytic procedures used in the watershed study to design alternative plan subelements, test the physical feasibility of those subelements, and make necessary economic comparisions between such subelements. The description of these criteria and procedures in this chapter is intended to provide an understanding by all concerned of the level of detail entailed in the watershed plan preparation, as well as of the need for refinement of some aspects of that plan prior to implementation.

BASIC CONCEPTS AND DEFINITIONS

The term "objective" is subject to a wide range of interpretation and application, and is closely linked to other terms often used in planning work which are similarly subject to a wide range of interpretation and application. The following definitions have, therefore, been adopted by the Commission in order to provide a common frame of reference:

1. Objective: a goal or end toward the attainment of which plans and policies are directed.

2. Principle: a fundamental, primary, or generally accepted tenet used to support objectives and prepare standards and plans.

3. Standard: a criterion used as a basis of comparison to determine the adequacy of plan proposals to attain objectives.

4. Plan: a design which seeks to achieve the agreed-upon objectives.

5. Policy: a rule or course of action used to ensure plan implementation.

6. Program: a coordinated series of policies and actions to carry out a plan.

Although this chapter deals primarily with the first three of these terms, an understanding of the interrelationship of the foregoing definitions and the basic concepts which they represent is essential to the following discussion of watershed development objectives, principles, and standards.

WATERSHED DEVELOPMENT OBJECTIVES

In order to be useful in the watershed planning process, objectives not only must be logically sound and related in a demonstrable and measurable way to alternative physical development proposals, but must be consistent with, and grow out of, regionwide development objectives. This is essential if the watershed plans are to comprise integral elements of a comprehensive plan for the physical development of the Region, and if sound coordination of regional and watershed development is to be achieved.

The Southeastern Wisconsin Regional Planning Commission has, in its planning efforts to date, adopted, after careful review and recommendation by various advisory and coordinating committees, a number of regional development objectives relating to land use, housing, transportation, sewerage, water quality management, air quality management, flood control, and recreation and open space preservation. These objectives, together with their supporting principles and standards, are set forth in previous Commission planning reports. Some of these objectives and standards are directly applicable to the Oak Creek watershed planning effort, and are hereby recommended for adoption as development objectives for the watershed.

Land Use Development Objectives

Seven of the eight regional land use development objectives adopted by the Commission under its regional land use planning program are directly applicable to the Oak Creek watershed planning effort.[1] These are:

1. A balanced allocation of space to the various land use categories which meets the social, physical, and economic needs of the regional population.

2. A spatial distribution of the various land uses which will result in a compatible arrangement of land uses.

3. A spatial distribution of the 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, wetlands, woodlands, and wildlife.

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 public services.

5. The development and conservation of residential areas within a physical environment that is healthy, safe, convenient, and attractive.

6. The preservation, development, and redevelopment of a variety of suitable industrial and commercial sites in terms of both physical characteristics and location.

7. The preservation and provision of open space to enhance the total quality of the regional 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.

Sanitary Sewerage System and Water Quality Management Planning Objectives

All five of the water quality management objectives adopted by the Commission under its regional water quality management planning effort are directly applicable to the Oak Creek watershed planning effort. These are:

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.

2. The development of land management and water quality control practices and facilities—inclusive of sanitary sewerage systems—

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[1] *The other land development objective is the preservation of land areas for agricultural uses in order to provide for certain types of agriculture, provide a reserve or holding zone for future needs, and ensure the preservation of those unique rural areas which provide wildlife habitat and which are essential to the shape and order of urban development.*

so as to meet the recommended water use objectives and supporting water quality standards as set forth on Map 44 and in Table 77.

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.

4. The development of land management and water quality control practices and facilities—inclusive of sanitary sewerage systems—that are both economical and efficient, meeting all other objectives at the lowest possible cost.

5. The development of water quality management systems—inclusive of the governmental units and their responsibilities, authorities, policies, procedures, and resources—and supporting revenue-raising mechanisms which are effective and locally acceptable, and which will provide a sound institutional 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.

Park and Open Space Objectives

Two of the seven park and open space objectives adopted by the Commission under its regional park and open space planning program are directly applicable to the Oak Creek watershed planning effort.[2] These are:

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 recreation activities.

2. The preservation of sufficient high-quality open space lands for the protection of the underlying and sustaining natural resource base and the enhancement of the social and economic well being and environmental quality of the Region.

Water Control Facility Development Objectives

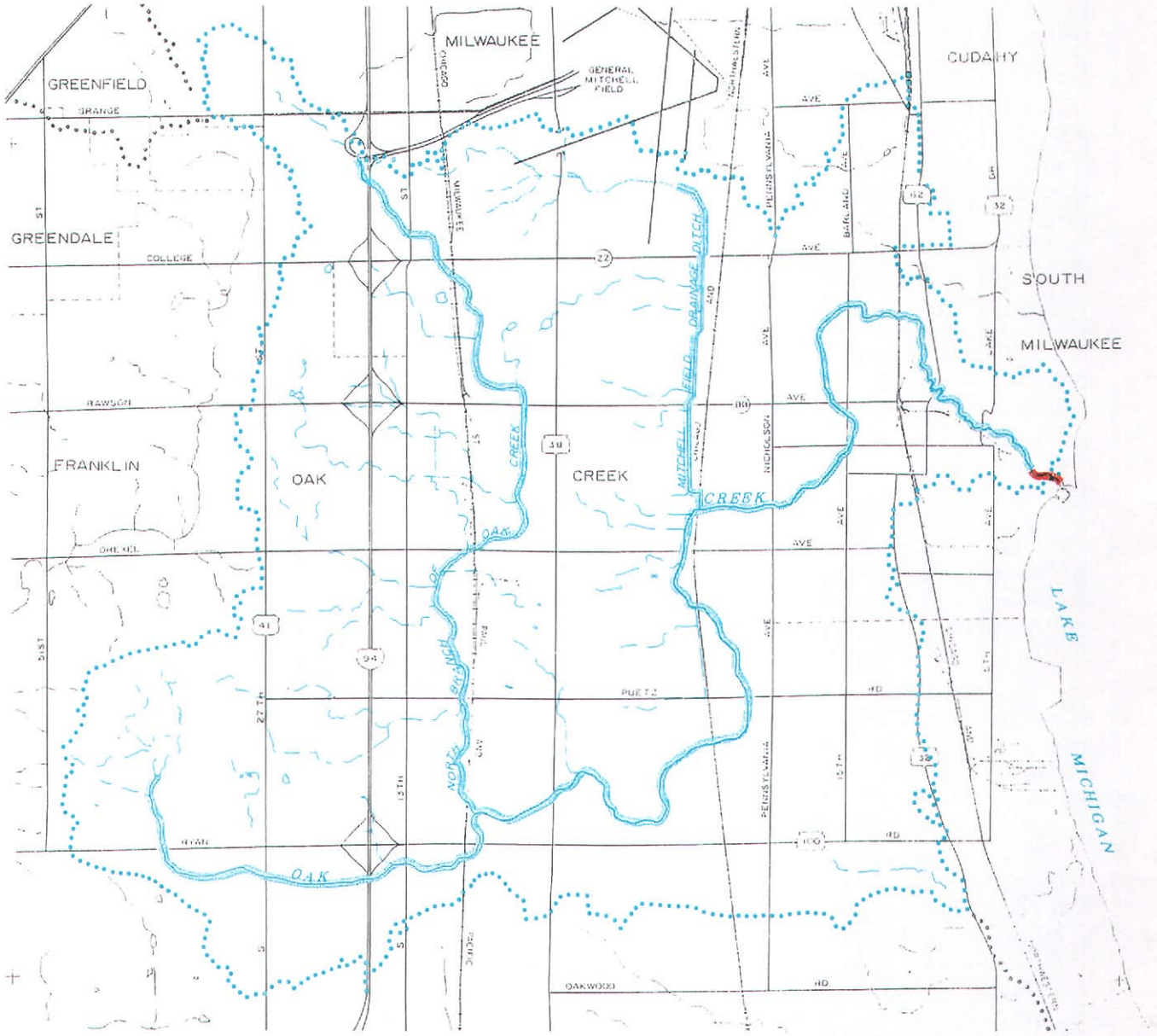
Two of the specific water control facility development objectives adopted by the Commission under its other comprehensive watershed planning programs are applicable to the Oak Creek watershed planning effort.[3] These are:

[2] *The other five park and open space objectives are: 1) the provision of sufficient outdoor recreation facilities to allow the resident population of the Region adequate opportunity to participate in intensive nonresource-oriented outdoor recreation activities; 2) the provision of sufficient outdoor recreation facilities to allow the resident population of the Region adequate opportunity to participate in intensive resource-oriented outdoor recreation activities; 3) the provision of sufficient outdoor recreation facilities to allow the resident population of the Region adequate opportunity to participate in extensive land-based outdoor recreation activities; 4) the provision of opportunities for participation by the resident population of the Region in extensive water-based outdoor recreation activities on the major inland lakes and rivers and on Lake Michigan, consistent with safe and enjoyable lake use and the maintenance of good water quality; and 5) the efficient and economical satisfaction of outdoor recreation and related open space needs, meeting all other objectives at the lowest possible cost. While these objectives are applicable to the watershed planning program, they should be applied at the local level as a joint effort by county agencies, school districts, and local community recreation agencies.*

[3] *The other two water control facility development objectives are: 1) an integrated system of land management and water quality control facilities and pollution abatement devices adequate to ensure a quality of lake water necessary to achieve established water use objectives; and 2) the attainment of sound groundwater resource development and protective practices to minimize the possibility for pollution and depletion of the groundwater resources. The inland lake water control facility objective is not applicable to the Oak Creek watershed planning program since there are no major lakes in the watershed. The groundwater objective is not applicable to the Oak Creek watershed planning program since the study prospectus did not identify groundwater quantity or quality as being significant problems in this watershed.*

Map 44

PRELIMINARY RECOMMENDED WATER USE OBJECTIVES FOR SURFACE WATERS IN THE OAK CREEK WATERSHED: 2000



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. The results of these analyses indicated that all of the streams analyzed in the Oak Creek watershed could be brought to "fishable and swimmable" standards.

Source: SEWRPC.

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.

2. An integrated system of land management and water quality control facilities and point and nonpoint source pollution abatement measures adequate to ensure the quality of surface water necessary to meet the established water use objectives and supporting water quality standards.

Principles and Standards

Complementing each of the foregoing land use, sanitary sewerage system and water quality management, park and open space, and water control facility development objectives are a planning principle which supports the objective and asserts its inherent validity, and a set of quantifiable planning standards which can be used to evaluate the relative or absolute ability of alternative plan designs to meet the stated objective. These principles and standards, as they apply to watershed planning and development, are set forth in Tables 73, 74, 75, and 76, and serve to facilitate quantitative application of the objectives during plan design, test, and evaluation.

With respect to water use objectives, the Wisconsin Department of Natural Resources currently classifies selected portions of the Oak Creek watershed stream system for warmwater fishery and aquatic life, recreational use, and minimum standards. These currently adopted water use objectives and the supporting standards are set forth on Map 43 and in Table 69 in Chapter IX.

Preliminary recommended water use objectives are shown on Map 44 and are identical to those set forth in Chapter II of Volume Two, Alternative Plans, of SEWRPC Planning Report No. 30, A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000, with the exception of objectives for the Mitchell Field Drainage Ditch which was not identified in that plan. The preliminary recommended water use objectives for Oak Creek, the North Branch of Oak Creek, and the Mitchell Field Drainage Ditch include the support of warmwater fish and aquatic life and full recreational use. A comparison of the preliminary recommended water use objectives with the water use objectives established by the Wisconsin Department of Natural Resources indicates that these objectives are identical with the exception of those for the Oak Creek estuary. As shown on Map 44, recommended water use objectives for the Oak Creek estuary are to be determined based on the results of further study, while the water use objectives used in practice by the Wisconsin Department of Natural Resources for the Oak Creek estuary include the support of a salmon fishery and full recreational use, based upon the fact that salmon are known to exist in the estuary at least at some times of the year. The water quality standards supporting these preliminary recommended water use objectives are set forth in Table 77. These recommendations are in conformance with the national water use objectives cited in Public Law 92-500, which call for the attainment wherever possible of water quality which is sufficient to support the protection and propagation of fish, shellfish, and other wildlife, and for the support of human recreation in and on the waters. Analyses conducted in development of the adopted regional water quality management plan indicate that the attainment of these "fishable-swimmable" water use objectives and the supporting water quality standards is feasible and realistic if the significant water pollution sources in the Oak Creek watershed are properly abated.

It should be noted that the planning standards herein recommended for adoption fall into two groups: comparative and absolute. The comparative standards, by their very nature, can be applied only through a comparison of alternative plan proposals. Absolute standards can be applied individually to each alternative plan proposal since they are expressed in terms of maximum, minimum, or desirable values. The standards set forth herein should serve as aids not only in the development, test, and evaluation of watershed land use and water control facility plans, but also in the development, test, and evaluation of local land use and community facility plans and in the development of plan implementation policies and programs as well.

Overriding Considerations

When applying the watershed development objectives, principles, and standards to the watershed plan elements, several overriding considerations must be recognized. First, it must be recognized that any proposed water control and water quality

Table 73

LAND USE DEVELOPMENT OBJECTIVES, PRINCIPLES, AND STANDARDS FOR THE OAK CREEK WATERSHED

OBJECTIVE NO. 1

A balanced allocation of space to the various land use categories which meets the social, physical, and economic needs of the regional population.

PRINCIPLE

The planned supply of land set aside for any given use should approximate the known and anticipated demand for that use.

STANDARDS

1. For each additional 100 dwelling units to be accommodated within the Region at each residential density, the following minimum amounts of residential land should be set aside:

No.	Residential Density Category	Net Area[a] (Acres/100 Dwelling Units)*	Gross Area[b] (Acres/100 Dwelling Units)*
1a	High-Density Urban[c]	8	13
1b	Medium-Density Urban[c]	23	32
1c	Low-Density Urban[c]	83	109
1d	Suburban[d]	167	204
1e	Rural[d]	500	588

*NOTE: In order to convert dwelling units to resident population, anticipated year 2000 persons-per-dwelling-unit averages were used. These averages range from a minimum of 2.6 persons per dwelling unit in Milwaukee County to a maximum of 3.5 persons per dwelling unit in Ozaukee and Washington Counties with an anticipated average of 2.9 persons per dwelling unit for the Region as a whole in 2000. According to the 1970 federal census, the average number of persons per dwelling unit ranged from a minimum of 3.0 persons per dwelling unit in Milwaukee County to a maximum of 3.7 persons per dwelling unit in Ozaukee and Waukesha Counties with an average of 3.2 persons per dwelling unit for the Region as a whole. In 1975, it is estimated that the average number of persons per dwelling unit ranged from a minimum of 2.8 persons per dwelling unit in Milwaukee County to a maximum of 3.6 persons per dwelling unit in Ozaukee and Waukesha Counties with an average of 3.0 persons per dwelling unit for the Region as a whole.

2. For each additional 1,000 persons to be accommodated within the Region, the following minimum amounts of public park and recreation land should be set aside:

No.	Public Park and Recreation Land Category[e]	Net Area[a] (Acres/1,000 Persons)	Gross Area[f] (Acres/1,000 Persons)
2a	Major	4	5
2b	Other	8	9

3. For each additional 100 industrial employees to be accommodated within the Region, the following minimum amounts of industrial land should be set aside:

No.	Industrial Land Category	Net Area[a] (Acres/100 Employees)	Gross Area[g] (Acres/100 Employees)
3a	Major and Other	7	9

4. For each additional 100 commercial employees to be accommodated within the Region, the following minimum amounts of commercial land should be set aside:

No.	Commercial Land Category	Net Area[a] (Acres/100 Employees)	Gross Area[g] (Acres/100 Employees)
4a	Major	1	3
4b	Other	2	6

(Table 73 continued)

5. For each additional 1,000 persons to be accommodated within the Region, the following minimum amounts of governmental and institutional land should be set aside:

No.	Governmental and Institutional Land Category	Net Area[a] (Acres/1,000 Persons)	Gross Area[h] (Acres/1,000 Persons)
5a	Major and Other	9	12

OBJECTIVE NO. 2

A spatial distribution of the various land uses which will result in a compatible arrangement of land uses.

PRINCIPLE

The proper allocation of uses to land can avoid or minimize hazards and dangers to health, safety, and welfare and maximize amenity and convenience in terms of accessibility to supporting land uses.

STANDARDS

1. Urban high-, medium-, and low-density residential uses should be located within planning units which are served with centralized public sanitary sewerage and water supply facilities and contain, within a reasonable walking distance, necessary supporting local service uses, such as neighborhood park, local commercial, and elementary school facilities, and should have reasonable access through the appropriate component of the transportation system to employment, commercial, cultural, and governmental centers and secondary school and higher educational facilities.

2. Rural and suburban density residential uses should have reasonable access through the appropriate component of the transportation system to local service uses; employment, commercial, cultural, and governmental centers; and secondary school and higher educational facilities.

3. Industrial uses should be located to have direct access to arterial street and highway facilities and reasonable access through an appropriate component of the transportation system to residential areas and to railway, seaport, and airport facilities and should not be intermixed with commercial, residential, governmental, recreational, or institutional land uses.

4. Regional commercial uses should be located in centers of concentrated activity on only one side of an arterial street and should be afforded direct access[i] to the arterial street system.

OBJECTIVE NO. 3

A spatial distribution of the 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, wetlands, woodlands, and wildlife.

PRINCIPLE

The proper allocation of uses to land can assist in maintaining an ecological balance between the activities of man and the natural environment which supports him.

1. Soils

Principle

The proper relation of urban and rural land use development to soils type and distribution can serve to avoid many environmental problems, aid in the establishment of better regional settlement patterns, and promote the wise use of an irreplaceable resource.

STANDARDS

1a. Sewered urban development, particularly for residential use, should not be located in areas covered by soils identified in the regional detailed operational soil survey as having severe or very severe limitations for such development.

1b. Unsewered suburban residential development should not be located in areas covered by soils identified in the regional detailed operational soil survey as having severe or very severe limitations for such development.

1c. Rural development, including agricultural and rural residential development, should not be located in areas covered by soils identified in the regional detailed operational soil survey as having severe or very severe limitations for such development.

2. Inland Lakes and Streams

Principle

Inland lakes and streams contribute to the atmospheric water supply through evaporation; provide a suitable environment for desirable and sometimes unique plant and animal life; provide the population with opportunities for certain scientific, cultural, and educational pursuits; constitute prime recreational areas; provide a desirable aesthetic setting for certain types of land use development; serve to store and convey flood waters; and provide certain water withdrawal requirements.

STANDARDS

2a (1). A minimum of 25 percent of the perimeter or shoreline frontage of lakes having a surface area in excess of 50 acres should be maintained in a natural state.

2a (2). Not more than 50 percent of the length of the shoreline of inland lakes having a surface area in excess of 50 acres should be allocated to urban development, except for park and outdoor recreational uses.

2a (3). A minimum of 10 percent of the shoreline of each inland lake having a surface area in excess of 50 acres should be maintained for public uses, such as a beach area, pleasure craft marina, or park.

2b (1). It is desirable that 25 percent of the shoreline of each inland lake having a surface area less than 50 acres be maintained in either a natural state or some low-intensity public use, such as park land.

2c (1). A minimum of 25 percent of both banks of all perennial streams should be maintained in a natural state.

2c (2). Not more than 50 percent of the length of perennial streams should be allocated to urban development, except for park and outdoor recreational uses.

2d. Floodlands[j] should not be allocated to any urban development[k] which would cause or be subject to flood damage.

2e. No unauthorized structure or fill should be allowed to encroach upon and obstruct the flow of water in the perennial stream channels[l] and floodways.[m]

3. Wetlands

Principle

Wetlands support a wide variety of desirable and sometimes unique plant and animal life; assist in the stabilization of lake levels and streamflows; trap and store plant nutrients in runoff, thus reducing the rate of enrichment of surface waters and obnoxious weed and algae growth; contribute to the atmospheric oxygen supply; reduce storm water runoff by providing area for floodwater impoundment and storage; contribute to groundwater supplies; trap soil particles suspended in runoff and thus reduce stream sedimentation; protect shoreland areas from erosion; and provide the population with opportunities for certain scientific, educational, and recreational pursuits.

STANDARD

3a. All wetland areas[n] adjacent to streams or lakes, all wetlands within areas having special wildlife and other natural values, and all wetlands having an area in excess of 50 acres should not be allocated to any urban development except limited recreation and should not be drained or filled. Adjacent surrounding areas should be kept in open space use, such as agriculture or limited recreation.

4. Woodlands[o]

Principle

Woodlands assist in maintaining unique natural relationships between plants and animals; reduce storm water runoff; contribute to the atmospheric oxygen supply; contribute to the atmospheric water supply through transpiration; aid in reducing soil erosion and stream sedimentation; provide the resource base for the forest product industries; provide the population with opportunities for certain scientific, educational, and recreational pursuits; and provide a desirable aesthetic setting for certain types of land use development.

STANDARDS

4a. A minimum of 10 percent of the land area of each watershed[p] within the Region should be devoted to woodlands.

4b. For demonstration and educational purposes, the woodland cover within each county should include a minimum of 40 acres devoted to each major forest type: dry, dry-mesic, mesic, wet-mesic, and wet. In addition, remaining examples of the native forest vegetation types representative of the presettlement vegetation should be maintained in a natural condition and be made available for research and educational use.

4c. A minimum regional aggregate of five acres of woodland per 1,000 population should be maintained for recreational pursuits.

5. Wildlife[q]

Principle

Wildlife, when provided with a suitable habitat, will supply the population with opportunities for certain scientific, educational, and recreational pursuits; comprises an integral component of the life systems which are vital to beneficial natural processes, including the control of harmful insects and other noxious pests and the promotion of plant pollination; provides a food source; offers an economic resource for the recreation industries; and serves as an indicator of environmental health.

STANDARD

5a. The most suitable habitat for wildlife—that is, the area wherein fish and game can best be fed, sheltered, and reproduced—is a natural habitat. Since the natural habitat for fish and game can best be achieved by preserving or maintaining in a wholesome state other resources such as soil, air, water, wetlands, and woodlands, the standards for each of these other resources, if met, would ensure the preservation of a suitable wildlife habitat and population.

OBJECTIVE NO. 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 public facility services.

PRINCIPLE

The transportation and public utility facilities and the land use pattern which these facilities serve and support are mutually interdependent in that the land use pattern determines the demand for, and loadings upon, transportation and utility facilities; and these facilities, in turn, are essential to, and form a basic framework for, land use development.

STANDARDS

1. Urban development should be located so as to maximize the use of existing transportation and utility systems.

2. The transportation system should be located and designed to provide access not only to all land presently devoted to urban development but to land proposed to be used for such urban development.

3. All land developed or proposed to be developed for urban medium-, high-, and low-density residential use should be located in areas serviceable by an existing or proposed public sanitary sewerage system and preferably within the gravity drainage area tributary to such a system.

4. All land developed or proposed to be developed for urban medium-, high-, and low-density residential use should be located in areas serviceable by an existing or proposed public water supply system.

5. All land developed or proposed to be developed for urban medium- and high-density residential use should be located in areas serviceable by existing or proposed primary, secondary, and tertiary mass transit facilities.

6. The transportation system should be located and designed to minimize the penetration of existing and proposed residential neighborhood units by through traffic.

7. Transportation terminal facilities, such as off-street parking, off-street truck loading, and mass transit loading facilities, should be located in close proximity to the principal land uses to which they are accessory.

OBJECTIVE NO. 5

The development and conservation of residential areas within a physical environment that is healthy, safe, convenient, and attractive.

PRINCIPLE

Residential areas developed in designed neighborhood units can assist in stabilizing community property values, preserving residential amenities, and promoting efficiency in the provision of public and community service facilities; can best provide a desirable environment for family life; and can supply the population with improved levels of safety and convenience.

(Table 73 continued)

STANDARDS

1. Urban high-, medium-, and low-density residential development should be located in neighborhood units which are physically self-contained within clearly defined and relatively permanent isolating boundaries, such as arterial streets and highways, major park and open space reservations, or significant natural features such as rivers, streams, or hills.

2. Urban residential neighborhood units should contain enough area to provide: housing for the population served by one elementary school and one neighborhood park; an internal street system which discourages penetration of the unit by through traffic; and all of the community and commercial facilities necessary to meet the day-to-day living requirements of the family within the immediate vicinity of its dwelling unit.

3. Suburban and rural density residential development should be located in areas where onsite soil absorption sewage disposal systems and private wells can be accommodated and access to other services and facilities can be provided through appropriate components of the transportation system at the community or regional level, thereby properly relating such development to a rural environment.

To meet the foregoing standards, land should be allocated in each urban and rural development category as follows:

Land Use Category	Percent of Area in Land Development Category					
	Urban High-Density (7.0 - 17.9 Dwelling Units/Net Residential Acre)	Urban Medium-Density (2.3 - 6.9 Dwelling Units/Net Residential Acre)	Urban Low-Density (0.7 - 2.2 Dwelling Units/Net Residential Acre)	Suburban Density (0.2 - 0.6 Dwelling Units/Net Residential Acre)	Rural Density (0.1 - 0.2 Dwelling Units/Net Residential Acre)	Agricultural (<0.2 Dwelling Units/Net Residential Acre)
Residential	66.0	71.0	76.5	82.0	85.0	6.0
Streets and Utilities	25.0	23.0	20.0	18.0	15.0	4.0
Parks and Playgrounds	3.5	2.5	1.5	--	--	--
Public Elementary Schools	2.5	1.5	0.5	--	--	--
Other Governmental and Institutional	1.5	1.0	1.0	--	--	--
Retail and Service	1.5	1.0	0.5	--	--	--
Nonurban	--	--	--	--	--	90.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

OBJECTIVE NO. 6

The preservation, development, and redevelopment of a variety of suitable industrial and commercial sites both in terms of physical characteristics and location.

PRINCIPLE

The production and sale of goods and services are among the principal determinants of the level of economic vitality in any society, and the important activities related to these functions require areas and locations suitable to their purpose.

STANDARDS

1. Regional industrial development should be located in planned industrial districts which meet the following standards:

   a. Minimum gross site area of 320 acres or a minimum employment of 3,500 persons.

   b. Direct access to the arterial street and highway system and access within two miles to the freeway system.

   c. Direct access to railroad facilities.

   d. Direct access to primary, secondary, and tertiary mass transit service.

   e. Access to a basic transport airport within a maximum travel time of 30 minutes and access to seaport facilities within a maximum travel time of 60 minutes.

   f. Available adequate water supply.

   g. Available adequate public sanitary sewer service.

h. Available adequate storm water management facilities.

i. Available adequate power supply.

j. Site should be covered by soils identified in the regional soils survey as having very slight, slight, or moderate limitations for industrial development.

2. Regional commercial development, which would include activities primarily associated with the sale of shopper's goods, should be concentrated in regional commercial centers which meet the following minimum standards:

a. Accessibility to a population of between 75,000 and 150,000 persons located within either a 20-minute one-way travel period or a 10-mile radius.

b. A minimum gross site area of 60 acres.

c. At least two general sales and service department stores offering a full range of commodities and price levels.

d. Direct access to the arterial street system.

e. Direct access to the primary, secondary, and tertiary mass transit service.

f. Available adequate water supply.

g. Available adequate sanitary sewer service.

h. Available adequate storm water management facilities.

i. Available adequate power supply.

j. The site should be covered by soils identified in the regional soils survey as having very slight, slight, or moderate limitations for commercial development.

In addition to the above minimum standards, the following site development standards are desirable:

k. Provision of off-street parking for at least 5,000 cars.

l. Provision of adequate off-street loading facilities.

m. Provision of well-located points of ingress and egress which are controlled to prevent traffic congestion on adjacent arterial streets.

n. Provision of adequate screening to serve as a buffer between the commercial use and adjacent noncommercial uses.

o. Provision of adequate building setbacks from major streets.

3. Local industrial development should be located in planned industrial districts which meet the following standards:

a. Direct access to the arterial street and highway system.

b. Direct access to mass transit facilities.

c. Available adequate water supply.

d. Available adequate public sanitary sewer service.

e. Available adequate storm water management facilities.

f. Available adequate power supply.

g. Site should be covered by soils identified in the regional soils survey as having very slight, slight, or moderate limitations for industrial development.

4. Local commercial development, which includes activities primarily associated with the sale of convenience goods and services, should be contained within the residential planning units, the total area devoted to the commercial use varying with the residential density:

(Table 73 continued)

a. In urban low-density areas, land devoted to local commercial centers should comprise at least 0.5 percent of the total gross neighborhood area, or about 3.2 acres per square mile of gross neighborhood area.

b. In urban medium-density areas, land devoted to local commercial centers should comprise at least 1.0 percent of the total gross neighborhood area, or about 6.4 acres per square mile of gross neighborhood area.

c. In urban high-density areas, land devoted to local commercial centers should comprise at least 1.5 percent of the total gross neighborhood area, or about 9.6 acres per square mile of gross neighborhood area.

OBJECTIVE NO. 7

The preservation and provision of open space[r] to enhance the total quality of the regional 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.

PRINCIPLE

Open space is the fundamental element required for the preservation, wise use, and development of such natural resources as soil, water, woodlands, wetlands, native vegetation, and wildlife; it provides the opportunity to add to the physical, intellectual, and spirtual growth of the population; it enhances the economic and aesthetic value of certain types of development; and it is essential to outdoor recreational pursuits.

STANDARDS[s]

1. Major or regional park and recreation sites should be provided within a 10-mile service radius of every dwelling unit in the Region and should have a minimum gross site area of 250 acres.

2. Local park and recreation sites should be provided within a maximum service radius of one mile of every dwelling unit in an urban area and should have a minimum gross site area of 5 acres.

3. Areas having unique scientific, cultural, scenic, or educational value should not be allocated to any urban or agricultural land uses; and adjacent surrounding areas should be retained in open space use, such as agriculture or limited recreation.

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[a] *Net land use area is defined as the actual site area devoted to a given use, and consists of the ground floor site area occupied by any buildings plus the required yards and open spaces.*

[b] *Gross residential land use area is defined as the net area devoted to this use plus the area devoted to all supporting land uses, including streets, neighborhood parks and playgrounds, elementary schools, and neighborhood institutional and commercial uses, but not including freeways and expressways and other community and areawide uses.*

[c] *Areas served, proposed to be served, or required to be served by public sanitary sewerage and water supply facilities require neighborhood facilities.*

[d] *Areas not served, not proposed to be served, nor required to be served by public sanitary sewerage and water supply facilities do not require neighborhood facilities.*

[e] *These categories do not include large open space areas not developed for active recreation use or school playgrounds.*

[f] *Gross public park and recreation area is defined as the net area devoted to active or intensive recreation use plus the adjacent "backup" lands and lands devoted to other supporting land uses such as roads and parking areas.*

[g] *Gross commercial and industrial area is defined as the net area devoted to commercial and industrial uses plus the area devoted to supporting land uses, including streets and off-street parking.*

[h] *Gross governmental and institutional area is defined as the net area devoted to governmental and institutional uses plus the area devoted to supporting land uses, including streets and onsite parking.*

[i] *Direct access implies adjacency or immediate proximity.*

(Table 73 continued)

[j] *Floodlands are herein defined as those lands inundated by a flood having a recurrence interval of 100 years where hydrologic and hydraulic engineering data are available, and as those lands inundated by the maximum flood of record where such data are not available.*

[k] *Urban development, as used herein, refers to all land uses except agriculture, water, woodlands, wetlands, open lands, and quarries.*

[l] *A stream channel is herein defined as that area of the floodplain lying either within legally established bulkhead lines or within sharp and pronounced banks marked by an identifiable change in flora and normally occupied by the stream under average annual high-flow conditions.*

[m] *Floodway lands are herein defined as those designated portions of the floodlands that will safely convey the 100-year recurrence interval flood discharge with small, acceptable upstream and downstream stage increases.*

[n] *Wetland areas, as used herein, are defined as those lands which are inundated or saturated by surface- or groundwater at a frequency and with a duration sufficient to support—and that under normal circumstances do support—a prevalence of vegetation typically adapted for life in saturated soil conditions and encompassing an area of one acre or more.*

[o] *The term woodland, as used herein, is defined as those areas one acre or more in size having 17 or more deciduous trees per acre, each measuring at least four inches in diameter at breast height and having 50 percent or more tree canopy coverage. In addition, coniferous tree plantations and reforestation projects are identified as woodlands by the Commission. It should be noted that all lowland wooded areas, such as tamarack swamps, are also classified as wetlands.*

[p] *A watershed, as used herein, is defined as a portion of the surface of the earth occupied by a surface drainage system discharging all surface water runoff to a common outlet and an area 25 square miles or larger in size.*

[q] *Includes all fish and game.*

[r] *Open space is defined as land or water areas which are generally undeveloped for urban residential, commercial, or industrial uses and are or can be considered relatively permanent in character. It includes areas devoted to park and recreation uses and to large land-consuming institutional uses, as well as areas devoted to agricultural use and to resource conservation, whether publicly or privately owned.*

[s] *It was deemed impractical to establish spatial distribution standards for open space, per se. Open spaces which are not included in the spatial distribution standards are: forest preserves and arboreta; major river valleys; lakes; zoological and botanical gardens; stadia; woodland, wetland, and wildlife areas; scientific areas; and agricultural lands whose location must be related to, and determined by, the natural resource base. It is intended that the park and open space standards set forth herein be supplemented by the more detailed park and open space standards set forth in SEWRPC Planning Report No. 27, A Regional Park and Open Space Plan for Southeastern Wisconsin.*

Source: SEWRPC.

Table 74

WATER QUALITY MANAGEMENT OBJECTIVES, PRINCIPLES, AND STANDARDS FOR THE OAK CREEK WATERSHED

OBJECTIVE NO. 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 storm water runoff control generated by the existing and proposed land uses.

PRINCIPLE

Sanitary sewerage and storm water drainage systems are essential to the development and maintenance of a safe, healthy, and attractive urban environment. The extension of existing sanitary sewerage and storm water drainage systems and the creation of new systems can be effectively used to guide and shape urban development both spatially and temporally.

STANDARDS

1. Sanitary sewer service should be provided to all existing areas of medium-[a] or high-density[b] urban development and to all areas proposed for such development in the regional land use plan.

2. Sanitary sewer service should be provided to all existing areas of low-density[c] urban development and to all areas proposed for such development in the regional land use plan where such areas are contiguous to areas of medium- or high-density urban development. Where noncontiguous low-density development already exists, the provision of sanitary sewer service should be contingent upon the inability of the underlying soil resource base to properly support onsite absorption waste disposal systems.

3. Engineered and partially engineered storm water management facilities[d] should be provided to all existing areas of low-, medium-, and high-density urban development and to all areas proposed for such development in the regional land use plan.

4. Where public health authorities declare that public health hazards exist because of the inability of the soil resource base to properly support onsite soil absorption waste disposal systems, sanitary sewer service should be provided.

5. Lands designated as primary environmental corridors on the regional land use plan should not be served by sanitary sewers except that development incidental to the preservation and protection of the corridors, such as parks and related outdoor recreation areas, and existing clusters of urban development in such corridors. Engineering analyses relating to the sizing of sanitary sewerage facilities and storm water management facilities should assume the permanent preservation of all undeveloped primary environmental corridor lands in natural open space uses.

6. Floodlands[e] should not be served by sanitary sewers except that development incidental to the preservation in open space uses of floodlands, such as parks and related outdoor recreation areas, and existing urban development in floodlands not recommended for eventual removal in comprehensive plans. Engineering analyses relating to the sizing of sanitary sewerage or storm water management facilities should not assume ultimate development of floodlands for urban use.

7. Significant concentrations[f] of lands covered by soils found in the regional soil survey to have very severe limitations for urban development even with the provision of sanitary sewer service should not be provided with such service. Engineering analyses relating to the sizing of sewerage or storm water management facilities should not assume ultimate urban development of such lands for urban use.

8. The timing of the extension of sanitary sewerage facilities should, insofar as possible, seek to promote urban development in a series of complete neighborhood units, with service being withheld from any new units in a given municipal sewer service area until previously served units are substantially developed and until existing units not now served are provided with service.

9. The sizing of sanitary sewerage and storm water management facility components should be based upon an assumption that future land use development will occur in general accordance with the adopted regional land use plan.

10. To the extent feasible, industrial wastes except clear cooling waters, as well as the sanitary wastes generated at industrial plants, should be discharged to municipal sanitary sewerage systems for ultimate treatment and disposal. The necessity to provide pretreatment for industrial wastes should be determined on an individual case-by-case basis and should consider any regulations relating thereto.

11. Rural land management practices will be given priority in areas which are designated as prime agricultural lands to be preserved in long-term use for the production of food and fiber.

(Table 74 continued)

OBJECTIVE NO. 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 as set forth on Map 44 and in Table 77.

PRINCIPLE

Sewage treatment plant effluent, industrial wastewater discharges, and rural and urban runoff are major contributors of pollutants to the streams and lakes of the Region; the location, design, construction, operation, and maintenance of sewage treatment plants, industrial wastewater outfalls, and storm water management facilities and the quality and quantity of the wastewater from such facilities has a major effect on stream and lake water quality and the ability of that water to support the established water uses.

STANDARDS

1. The level of treatment to be provided at each sewage treatment plant industrial wastewater outfall should be determined by water quality analyses directly related to the established water use objectives for the receiving surface water body. These analyses should demonstrate that the proposed treatment level will aid in achieving the water quality standards supporting each major water use objective as set forth on Map 44 and in Table 77.

2. The type and extent of storm water treatment or associated preventive land management practices to be applied within a hydrologic unit should be determined by water quality analyses directly related to the established water use objectives for the receiving surface water body. These analyses should demonstrate that the proposed treatment level or land management practices will aid in achieving the water quality standards supporting each major water use objective as set forth on Map 44 and in Table 77.

3. Domestic livestock should be fenced out of all lakes and perennial streams, and direct storm water runoff from the associated feeding areas to the lakes and perennial streams should be avoided so as to contribute to the achievement of the established water use objectives and standards.

4. The discharge of sewage treatment plant effluent directly to inland lakes should be avoided and sewage treatment plant discharges to streams flowing into inland lakes should be located and treated so as to contribute to the achievement of the established water use objectives and standards for those lakes.

5. The specific standards for sewage treatment at all sewage treatment plants discharging effluent to Lake Michigan shall be those established by the Federal Lake Michigan Enforcement Conference, or the amendments established thereto as a result of other subsequent federal administrative and enforcement actions.

6. Existing sewage treatment plants scheduled to be abandoned within the plan design period should provide only secondary waste treatment and disinfection of effluent unless a further degree of treatment is determined to be required to meet the established water use objectives and standards for the receiving surface water body.

7. Interim sewage treatment plants deemed necessary to be constructed prior to implementation of the long-range plan should provide levels of treatment determined by water quality analyses directly related to the established water use objectives and standards for the receiving surface water body.

8. Bypassing of sewage to storm sewer systems, open channel drainage courses, and streams should be prohibited.

9. Combined sewer overflows should be eliminated or adequately treated to meet the established water use objectives and standards for the receiving body of surface water.

10. Sewage treatment plants should be designed to perform their intended function and to provide their specified level of treatment under adverse conditions of inflow, should be of modular design with sufficient standby capacity to allow maintenance to be performed without bypassing influent sewage, and should not be designed to bypass any flow delivered by the inflowing sewers, but should incorporate an emergency bypass facility sufficient to protect sewage treatment equipment against flows in excess of the design hydraulic capacity of the plant.

11. All industrial sewage treatment plants should provide the best available wastewater treatment which is economically achievable.

12. All sanitary sewage treatment plants should provide the best practicable wastewater treatment technology.

13. No pollutants should be discharged by sanitary or industrial sewage treatment plants in amounts which would preclude the achievement of the recommended water use objectives or the supporting standards as set forth on Map 44 and in Table 77.

14. The orderly transition of lands from open space, agricultural, or other rural uses to urban uses through excavation, landshaping, and construction should be planned, designed, and conducted so as to contribute to the achievement of the established water use objectives and standards.

(Table 74 continued)

OBJECTIVE NO. 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.

PRINCIPLE

The improper design, installation, application, or maintenance of land management practices, sanitary sewerage system components, and storm water management components can adversely affect the natural and man-made environments; therefore, every effort should be made in such actions to properly relate to these environments and minimize any disruption or harm thereto.

STANDARDS

1. New and replacement sewage treatment plants, as well as additions to existing plants, should, wherever possible, be located on sites lying outside of the 100-year recurrence interval floodplain. When it is necessary to use floodplain lands for sewage treatment plants, the facilities should be located outside of the floodway so as to not increase the 100-year recurrence interval flood stage, and should be floodproofed to a flood protection elevation of two feet above the 100-year recurrence interval flood stage so as to assure adequate protection against flood damage and avoid disruption of treatment and consequent bypassing of sewage during flood periods. In the event that a floodway has not been established, or if it is necessary to encroach upon an approved floodway, the hydraulic effect of such encroachment should be evaluated on the basis of an equal degree of encroachment for a significant reach on both sides of the stream, and the degree of encroachment should be limited so as not to raise the peak stage of the 100-year recurrence interval flood by more than 0.1 foot.

2. Existing sewage treatment plants located in the 100-year recurrence interval floodplain should be floodproofed to a flood protection elevation of two feet above the 100-year recurrence interval flood stage so as to assure adequate protection against flood damage and avoid disruption of treatment and consequent bypassing of sewage during flood periods.

3. The location of new and replacement of old sewage treatment plants or storm water storage and treatment facilities should be properly related to the existing and proposed future urban development pattern as reflected in the regional land use plan and to any community or neighborhood unit development plans prepared pursuant to, and consistent with, the regional land use plan.

4. New and replacement sewage treatment plants, as well as additions to existing plants, should be located on sites large enough to provide for adequate open space between the plant and existing or planned future urban land uses; should provide adequate area for expansion to ultimate capacity as determined in the regional sanitary sewerage system plan; and should be located, oriented, and architecturally designed so as to complement their environs and to present an attractive appearance consistent with their status as public works.

5. The disposal of sludge from sewage treatment plants should be accomplished in the most efficient manner possible, consistent, however, with any adopted rules and regulations pertaining to air quality control and solid waste disposal.

6. Devices used for long-term or short-term storage of pollutants which are collected through treatment of wastewater or through the application of land management practices should, wherever possible, be located on sites lying outside of the 100-year recurrence interval floodplain. When it is necessary to use floodplain lands for such facilities, such devices should be located outside of the floodway so as not to increase the 100-year recurrence interval flood stage, and should be floodproofed to a flood protection elevation of two feet above the 100-year recurrence interval flood stage so as to assure adequate protection against flood damage and to avoid redispersal of the pollutants into natural waters during flood periods. In the event that a floodway has not been established, or if it is necessary to encroach upon an approved floodway, the hydraulic effect of such encroachment shall be evaluated on the basis of an equal degree of encroachment for a significant reach on both sides of the stream and the degree of encroachment shall be limited so as not to raise the peak stage of the 100-year recurrence interval flood by more than 0.1 foot. This standard is not intended to preclude the construction of storm water detention-retention facilities, such as small-scale cascade basins in series along a stream channel, which by their design require emplacement within a floodway or floodplain. In these cases, the effects on water quality and upstream flood stages must be considered explicitly.

7. There should be no discharge of heavy metals, pesticides, industrial chemicals, or other substances in quantities known to be toxic or hazardous to fish or other aquatic life.

8. Water quality should not be degraded beyond existing levels except where a demonstration of economic hardship or compelling social need is presented.

OBJECTIVE NO. 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.

(Table 74 continued)

PRINCIPLE

The total resources of the Region are limited and any undue investment in water pollution control systems must occur at the expense of other public and private investment; total pollution abatement costs, therefore, should be minimized while meeting and achieving all water quality standards and objectives.

STANDARDS

1. The sum of sanitary sewerage system operating and capital investment costs should be minimized.

2. The sum of storm water control facility and related land management practice operating and capital investment costs should be minimized through proper storm water management planning and design.

3. The total number of sanitary sewerage systems and sewage treatment facilities should be minimized in order to effect economies of scale and concentrate responsibility for water quality management. Where physical consolidation of sanitary sewer systems is uneconomical, administrative and operational consolidation should be considered in order to obtain economy in manpower utilization and to minimize duplication of administrative, laboratory, storage, and other necessary services, facilities, and equipment. The total number of diffuse pollution control facilities should be minimized in order to concentrate the responsibility for water quality management.

4. Maximum feasible use should be made of all existing and committed pollution control facilities, which should be supplemented with additional facilities only as necessary to serve the anticipated wastewater management needs generated by substantial implementation of the regional land use plan, while meeting pertinent water quality use objectives and standards.

5. The use of new or improved materials and management practices should be allowed and encouraged if such materials and practices offer economies in materials or construction costs or by their superior performance lead to the achievement of water quality objectives at a lesser cost

6. Sanitary sewerage systems, sewage treatment plants, and storm water management facilities should be designed for staged or incremental construction where feasible and economical so as to limit total investment in such facilities and to permit maximum flexibility to accommodate changes in the rate of population growth and the rate of economic activity growth, changes in water use objectives and standards, or changes in the technology for wastewater management.

7. When technically feasible and otherwise acceptable, alignments for new sewer construction should coincide with existing public rights-of-way in order to minimize land acquisition or easement costs and disruption to the natural resource base.

8. Clear water infiltration and inflows to the sanitary sewerage system should be reduced to the cost-effective level.

9. Sanitary sewerage systems and storm water management systems should be designed and developed concurrently to effect engineering and construction economies as well as to assure the separate function and integrity of each of the two systems; to immediately achieve the pollution abatement and drainage benefits of the integrated design; and to minimize disruption of the natural resource base and existing urban development.

OBJECTIVE NO. 5

The development of water quality management institutions—inclusive of the governmental units and their responsibilities, authorities, policies, procedures, and 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, storm water management systems, and land management practices.

PRINCIPLE

The activities necessary for the achievement of the established water use objectives and supporting standards are expensive; technically, administratively, and legally complex; and important to the economic and social well being of the residents of the Region. Such activities require a continuing, long-term commitment and attention from public and private entities. The conduct of such activities requires that the groups designated as responsible for plan implementation have sufficient financial and technical capabilities, legal authorities, and general public support to accomplish the specific tasks identified.

(Table 74 continued)

STANDARDS

1. Each designated management agency should develop and establish a system of user charges and industrial cost recovery to maintain accounts to support the necessary operation, maintenance, and replacement expenditures.

2. Maximum utilization should be made of existing institutional structures in order to minimize the number of agencies designated to implement the recommended water quality control measures, and the creation of new institutions should be recommended only where necessary.

3. To the greatest extent possible, the responsibility for water pollution control and abatement should be assigned to the most immediate local public agency or to the most directly involved private entity.

4. Each designated management group should have legal authority, financial resources, technical capability, and practical autonomy sufficient to assure the timely accomplishment of its responsibilities in the achievement of the recommended water use objectives and supporting standards as set forth on Map 44 and in Table 77.

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[a] *Medium-density development is defined as that development having an average dwelling unit density of 4.4 dwelling units per net residential acre, and a net lot area per dwelling unit ranging from 6,231 to 18,980 square feet.*

[b] *High-density development is defined as that development having an average dwelling unit density of 12.0 dwelling units per net residential acre and a net lot area per dwelling unit ranging from 2,439 to 6,230 square feet.*

[c] *Low-density development is defined as that development having an average dwelling unit density of 1.2 dwelling units per net residential acre and a net lot area per dwelling unit ranging from 18,981 to 62,680 square feet.*

[d] *Engineered storm water management facilities are defined herein as the systems or subsystems of storm water catchment, conveyance, storage, and treatment facilities comprised of structural controls including natural and man-made surface drains, subsurface piped drains, or combinations thereof, and of pumping stations, surface or subsurface storage or detention basins, infiltration systems, and other appurtenances associated therewith, and sized to accommodate estimated flows or quantities from the tributary drainage area as a result of a specified meteorologic or hydrologic event.*

[e] *Floodlands are defined as those lands, including floodplains, floodways, and channels, subject to inundation by the 100-year recurrence interval flood or where such data are not available, the maximum flood of record.*

[f] *Areas larger than 160 acres in extent.*

Source: SEWRPC.

Table 75

OUTDOOR RECREATION AND OPEN SPACE PLANNING OBJECTIVES, PRINCIPLES, AND STANDARDS FOR THE OAK CREEK WATERSHED

OBJECTIVE NO. 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 recreation activities.

PRINCIPLE

Attainment and maintenance of good physical and mental health is an inherent right of all residents of the Region. The provision of public general use outdoor recreation sites and related open space areas contributes to the attainment and maintenance of physical and mental health by providing opportunities to participate in a wide range of both intensive and extensive outdoor recreation activities. Moreover, an integrated park and related open space system properly related to the natural resource base, such as the existing surface water network, can generate the dual benefits of satisfying recreational demands in an appropriate setting while protecting and preserving valuable natural resource amenities. Finally, an integrated system of public general use outdoor recreation sites and related open space areas can contribute to the orderly growth of the Region by lending form and structure to urban development patterns.

A. PUBLIC GENERAL USE OUTDOOR RECREATION SITES

PRINCIPLE

Public general use outdoor recreation sites promote the maintenance of proper physical and mental health by providing opportunities to participate in such athletic recreational activities as baseball, swimming, tennis, and ice-skating--activities that facilitate the maintenance of proper physical health because of the exercise involved--as well as opportunities to participate in such less athletic activities as pleasure walking, picnicking, or just rest and reflection. These activities tend to reduce everyday tensions and anxieties and thereby help maintain proper physical and mental well being. Well-designed and properly located public general use outdoor recreation sites also provide a sense of community, bring people together for social and cultural as well as recreational activities, and thus contribute to the desirability and stability of residential neighborhoods and therefore the communities in which such facilities are provided.

STANDARDS

1. The public sector should provide general use outdoor recreation sites sufficient in size and number to meet the recreation demands of the resident population. Such sites should contain the natural resource or man-made amenities appropriate to the recreational activities to be accommodated therein and be spatially distributed in a manner which provides ready access by the resident population. To achieve this standard, the following public general use outdoor recreation site requirements should be met:

		Publicly Owned General Use Sites							
		Parks				Schools[a]			
Site Type	Size (gross acres)	Minimum Per Capita Public Requirements (acres per 1,000 persons)[d]	Typical Facilities	Maximum Service Radius (miles)[b] Urban[e]	Rural	Minimum Per Capita Public Requirements (acres per 1,000 persons)[f]	Typical Facilities	Maximum Service Radius (miles)[c] Urban[e]	Rural
I[g] Regional	250 or more	5.3	Camp sites, swimming beach, picnic areas, golf course, ski hill, ski touring trail, boat launch, nature study area, playfield, softball diamond, passive activity area[h]	10.0	10.0	--	--	--	--
II[i] Multicommunity	100-249	2.6	Camp sites, swimming pool or beach, picnic areas, golf course, ski hill, ski touring trail, boat launch, nature study area, playfield, softball and/or baseball diamond, passive activity area[h]	4.0[j]	10.0[j]	--	--	--	--
III[k] Community	25-99	2.2	Swimming pool or beach, picnic areas, boat launch, nature study area, playfield, softball and/or baseball diamond, tennis court, passive activity area[h]	2.0[l]	--	0.9	Playfield, baseball diamond, softball diamond, tennis court	0.5-1.0[m]	--
IV[n] Neighborhood	Less than 25	1.7	Wading pool, picnic areas, playfield, softball and/or baseball diamond, tennis court, playground, basketball goal, ice-skating rink, passive activity area[h]	0.5-1.0[o]	--	1.6	Playfield, playground, baseball diamond, softball diamond, tennis court, basketball goal	0.5-1.0[m]	--

2. Public general use outdoor recreation sites should, as much as possible, be located within the designated primary environmental corridors of the Region.

B. RECREATION-RELATED OPEN SPACE

PRINCIPLE

Effective satisfaction of recreation demands within the Region cannot be accomplished solely by providing public general use outdoor recreation sites. Certain recreational pursuits such as hiking, biking, pleasure driving, and ski touring are best provided for through a system of recreation corridors located on or adjacent to linear resource-oriented open space lands. A well-designed system of recreation corridors offered as an integral part of linear open space lands also can serve to physically connect existing and proposed public parks, thus forming a truly integrated park and recreation related open space system. Such open space lands, in addition, satisfy the human need for natural surroundings, serve to protect the natural resource base, and ensure that many scenic areas and areas of natural, cultural, or historic interest assume their proper place as form determinants for both existing and future land use patterns.

STANDARDS

The public sector should provide sufficient open space lands to accommodate a system of resource-oriented recreation corridors to meet the resident demand for extensive trail-oriented recreation activities. To fulfill these requirements the following recreation-related open space standards should be met:

1. A minimum of 0.16 linear mile of recreation related open space consisting of linear recreation corridors[P] should be provided for each 1,000 persons in the Region.

2. Recreation corridors should have a minimum length of 15 miles and a minimum width of 200 feet.

3. The maximum travel distance to recreation corridors should be five miles in urban areas and 10 miles in rural areas.

4. Resource-oriented recreation corridors should maximize use of:

   a. Primary environmental corridor as location for extensive trail-oriented recreation activities.

   b. Outdoor recreation facilities provided at existing public park sites.

   c. Existing recreation trail-type facilities within the Region.

OBJECTIVE NO. 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.

PRINCIPLE

Ecological balance and natural beauty within the Region are primary determinants of the ability to provide a pleasant and habitable environment for all forms of life and to maintain the social and economic well being of the Region. Preservation of the most significant aspects of the natural resource base, that is, primary environmental corridors and prime agricultural lands, contributes to the maintenance of the ecological balance, natural beauty, and economic well being of the Region.

A. PRIMARY ENVIRONMENTAL CORRIDORS

PRINCIPLE

The primary environmental corridors are a composite of the best individual elements of the natural resource base including surface water, streams, and rivers and their associated floodlands and shorelands; woodlands, wetlands, and wildlife habitat; areas of groundwater discharge and recharge; organic soils, rugged terrain, and high relief topography; and significant geological formations and physiographic features. By protecting these elements of the natural resource base, flood damage can be reduced, soil erosion abated, water supplies protected, air cleansed, wildlife population enhanced, and continued opportunities provided for scientific, educational, and recreational pursuits.

STANDARD

All remaining nonurban lands within the designated primary environmental corridors in the Region should be preserved in their natural state.

(Table 75 continued)

B. PRIME AGRICULTURAL LANDS

PRINCIPLE

Prime agricultural lands constitute the most productive farmlands in the Region and, in addition to providing food and fiber, contribute significantly to maintaining the ecological balance between plants and animals; provide locations close to urban centers for the production of certain food commodities which may require nearby population concentrations for an efficient production-distribution relationship; provide open spaces which give form and structure to urban development; and serve to maintain the natural beauty and unique cultural heritage of southeastern Wisconsin.

STANDARDS

1. All prime agricultural lands should be preserved.

2. All agricultural lands should be preserved that surround adjacent high-value scientific, educational, or recreational sites and are covered by soils rated in the regional detailed operational soil surveys as having very slight, slight, or moderate limitations for agricultural use.

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[a] *In urban areas the facilities commonly located in Type III or Type IV school outdoor recreation areas often provide a substitute for facilities usually located in parks by providing opportunities for participation in intensive nonresource-oriented activities.*

[b] *The identification of a maximum service radius for each park type is intended to provide another guideline to assist in the determination of park requirements and to assure that each resident of the Region has ready access to the variety of outdoor recreation facilities commonly located in parks.*

[c] *The identification of a maximum service radius for each school site is intended to assist in the determination of outdoor recreation facilities requirements and to assure that each urban resident has ready access to the types of facilities commonly located in school recreation areas.*

[d] *For Type I and Type II parks, which generally provide facilities for resource-oriented outdoor recreation activities for the total population of the Region, the minimum per capita acreage requirements apply to the total resident population of the Region. For Type III and Type IV sites, which generally provide facilities for intensive nonresource-oriented outdoor recreation activities primarily in urban areas, the minimum per capita acreage requirements apply to the resident population of the Region residing in urban areas.*

[e] *Urban areas are defined as areas containing a closely spaced network of minor streets which include concentrations of residential, commercial, industrial, governmental, or institutional land uses having a minimum total area of 160 acres and a minimum population of 500 persons. Such areas usually are incorporated and are served by sanitary sewerage systems. These areas have been further classified into the following densities: low-density urban areas or areas with 0.70 to 2.29 dwelling units per net residential acre, medium-density urban areas or areas with 2.30 to 6.99 dwelling units per net residential acre, and high-density urban areas or areas with 7.00 to 17.99 dwelling units per net residential acre.*

[f] *For public school sites, which generally provide facilities for intensive nonresource-oriented outdoor recreation activities, the minimum per capita acreage requirements apply to the resident population of the Region residing in urban areas.*

[g] *Type I sites are defined as large outdoor recreation sites having a multicounty service area. Such sites rely heavily for their recreational value and character on natural resource amenities. Type I parks provide opportunities for participation in a wide variety of resource-oriented outdoor recreation pursuits.*

[h] *A passive activity area is defined as an area within an outdoor recreation site which provides an opportunity for such less athletic recreational pursuits as pleasure walking, rest and relaxation, and informal picnicking. Such areas generally are located in all parks or in urban open space sites, and usually consist of a landscaped area with mowed lawn, shade trees, and benches.*

[i] *Type II sites are defined as intermediate size sites having a countywide or multicommunity service area. Like Type I sites, such sites rely for their recreational value and character on natural resource amenities. Type II parks, however, usually provide a smaller variety of recreation facilities and have smaller areas devoted to any given activity.*

[j] *In general, each resident of the Region should reside within 10 miles of a Type I or Type II park. It should be noted, however, that within urban areas having a population of 40,000 or greater, each urban resident should reside within four miles of a Type I or Type II park.*

[k] *Type III sites are defined as intermediate size sites having a multineighborhood service area. Such sites rely more on the development characteristics of the area to be served than on natural resource amenities for location.*

(Table 75 continued)

[l] *In urban areas the need for a Type III site is met by the presence of a Type II or Type I site. Thus, within urban areas having a population of 7,500 or greater, each urban resident should be within two miles of a Type III, II, or I park site.*

[m] *The typical service radius of school outdoor recreation facilities is governed by individual facilities within the school site and by population densities in the vicinity of the site. In high-density urban areas each urban resident should reside within 0.5 mile of the facilities commonly located in a Type III or Type IV school outdoor recreation area; in medium-density urban areas each resident should reside within 0.75 mile of facilities commonly located in Type III or Type IV school outdoor recreation areas; and in low-density urban areas each urban resident should reside within one mile of the facilities commonly located in a Type III or Type IV school outdoor recreation area.*

[n] *Type IV sites are defined as small sites which have a neighborhood as the service area. Such sites usually provide facilities for intensive nonresource-oriented outdoor recreation activities and are generally provided in urban areas. Recreation lands at the neighborhood level should most desirably be provided through a joint community-school district venture, with the facilities and recreational land are required to be provided on one site available to serve the recreation demands of both the school student and resident neighborhood population. Using the Type IV park standard of 1.7 acres per thousand residents and the school standard of 1.6 acres per thousand residents, a total of 3.3 acres per thousand residents or approximately 21 acres of recreation lands in a typical medium-density neighborhood would be provided. These acreage standards relate to lands required to provide for recreation facilities typically located in a neighborhood and are exclusive of the school building site and associated parking area and any additional natural areas which may be incorporated into the design of the park site such as drainageways and associated storm water retention basins, areas of poor soils, and floodland areas.*

[o] *The maximum service radius of Type IV parks is governed primarily by the population densities in the vicinity of the park. In high-density urban areas, each urban resident should reside within 0.5 mile of a Type IV park; in medium-density urban areas, each resident should reside within 0.75 mile of a Type IV park; and in low-density urban areas, each urban resident should reside within one mile of a Type IV park. It should be noted that the requirement for a Type IV park also is met by a Type I, II, or III park within 0.5-1.0 mile service radii in high-, medium-, and low-density urban areas, respectively. Further, it should be noted that in the application of the service radius criterion for Type IV sites, only multiuse parks five acres or greater in area should be considered as satisfying the maximum service radius requirement.*

[p] *A recreation corridor is defined as a publicly owned continuous linear expanse of land which is generally located within scenic areas or areas of natural, cultural, or historical interest and which provides opportunities for participation in trail-oriented outdoor recreation activities especially through the provision of trails designated for such activities as biking, hiking, horseback riding, nature study, and ski touring. In the Region in 1973 only Milwaukee County, with an extensive parkway system, and the Wisconsin Department of Natural Resources, with the Kettle Moraine State Forest—Southern Unit, possessed the continuous linear lands required to develop such a recreation corridor.*

Source: SEWRPC.

Table 76

WATER CONTROL FACILITY DEVELOPMENT OBJECTIVES, PRINCIPLES, AND STANDARDS FOR THE OAK CREEK WATERSHED

OBJECTIVE NO. 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.

PRINCIPLE

Reliable local municipal storm water drainage facilities cannot be properly planned, designed, or constructed except as integral parts of an areawide system of floodwater conveyance and storage facilities centered on major drainageways and perennial waterways designed so that the hydraulic capacity of each waterway opening and channel reach abets the common aim of providing for the storage, as well as the movement, of floodwaters. Not only does the land use pattern of the tributary drainage area affect the required hydraulic capacity, but the effectiveness of the floodwater conveyance and storage facilities affects the uses to which land within the tributary watershed, and particularly within the riverine areas of the watershed, may properly be put.

STANDARDS

1. All new and replacement bridges and culverts over waterways shall be designed so as to accommodate, according to the categories listed below, the designated flood events without overtopping of the related roadway or railroad track and resultant disruption of traffic by floodwaters.

   a. Minor and collector streets used or intended to be used primarily for access to abutting properties: a 10-year recurrence interval flood discharge.

   b. 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.

   c. Freeways and expressways: a 100-year recurrence interval flood discharge.

   d. Railroads: a 100-year recurrence interval flood discharge.

2. All new and replacement bridges and culverts over waterways, including pedestrian and other minor bridges, in addition to meeting the applicable above-specified requirements, shall be designed so as to accommodate the 100-year recurrence interval flood event without raising the peak stage, either upstream or downstream, more than 0.1[a] foot above the peak stage for the 100-year recurrence interval flood, as established in the adopted comprehensive watershed plan. Larger permissible flood stage increases may be acceptable for reaches having topographic or land use conditions which could accommodate the increased stage without creating additional flood damage potential upstream or downstream of the proposed structure.

3. The waterway opening of all new and replacement bridges shall be designed so as to readily facilitate the passage of ice floes and other floating debris, and thereby avoid blockages often associated with bridge failure and with unpredictable backwater effects and flood damages. In this respect it should be recognized that clear spans and rectangular openings are more efficient than interrupted spans and curvilinear openings in allowing the passage of ice floes and other floating debris.

4. Certain new or replacement bridges and culverts over waterways, including pedestrian and other minor bridges, so located with respect to the stream system that the accumulation of floating ice or other debris may cause significant backwater effects with attendant danger to life, public health, or safety, or attendant serious damage to homes, industrial and commercial buildings, and important public utilities, shall be designed so as to pass the 100-year recurrence interval flood with at least 2.0 feet of freeboard between the peak stage and the low concrete or steel in the bridge span.

5. Standards 1, 3, and 4 shall also be used as the criteria for assessment of the adequacy of the hydraulic capacity and structural safety of existing bridges or culverts over waterways and thereby serve, within the context of the adopted comprehensive watershed plan, as the basis for crossing modification or replacement recommendations designed to alleviate flooding and other problems.

6. Channel modifications, dikes, and floodwalls should be restricted to the minimum number and extent absolutely necessary for the protection of existing and proposed land use development, consistent with the land use element of the comprehensive watershed plan and with any storm water management plans. The upstream and downstream effect of such structural works on flood discharges and stages shall be determined, and any such structural works which may significantly increase upstream or downstream peak flood discharges should be used

only in conjunction with complementary facilities for the storage and movement of the incremental floodwaters through the watershed stream system. Channel modifications, dikes, or floodwalls shall not increase the height of the 100-year recurrence interval flood by more than 0.1[a] foot in any unprotected upstream or downstream stream reaches. Increases in flood stages in excess of 0.1[a] foot resulting from any channel, dike, or floodwall construction shall be contained within the upstream or downstream extent of the channel, dike, or floodwall, except where topographic or land use conditions could accommodate the increased stage without creating additional flood damage potential.

7. The height of dikes and floodwalls shall be based on the high water surface profiles for the 100-year recurrence interval flood prepared under the comprehensive watershed study, and shall be capable of passing the 100-year recurrence interval flood with a freeboard of at least two feet.

8. The construction of channel modifications, dikes, or floodwalls shall be deemed to change the limits and extent of the associated floodways and floodplains. However, no such change in the extent of the associated floodways and floodplains shall become effective for the purposes of land use regulation until such time as the channel modifications, dikes, or floodwalls are actually constructed and operative. Any development in a former floodway or floodplain located to the landward side of any dike or floodwall shall be provided with adequate drainage so as to avoid ponding and associated damages.

9. Reduced regulatory flood protection elevations and accompanying reduced floodway or floodplain areas resulting from any proposed dams or diversion channels shall not become effective for the purposes of land use regulation until the reservoirs or channels are actually constructed and operative.

10. All water control facilities other than bridges and culverts, such as dams and diversion channels, so located on the stream system that failure would damage only agricultural lands and isolated farm buildings, shall be designed to accommodate at least the hydraulic loadings resulting from a 100-year recurrence interval flood. Water control facilities so located on the stream system that failure could jeopardize public health and safety, cause loss of life, or seriously damage homes, industrial and commercial buildings, and important public utilities or result in closure of principal transportation routes shall be designed to accommodate a flood that approximates the standard project flood or the more severe probable maximum flood, depending on the ultimate probable consequences of failure.[b]

11. All water control facilities should be compatible with existing local storm water management plans and as flexible as practical to accommodate future local storm water management planning.

PRINCIPLE

Floodlands that are unoccupied by, and not committed to, urban development should be retained in an essentially natural open space condition supplemented with the development of selected areas for public recreational uses. Maintaining floodlands in open uses will serve to protect one riverine community from the adverse effects of the actions of others by discouraging floodland development which would significantly aggravate existing flood problems or create new flood problems upstream or downstream; will preserve natural floodwater conveyance and storage capacities; will avoid increased peak flood discharges and stages; will contribute to the preservation of wetland, woodland, and wildlife habitat as part of a continuous linear system of open space, and will immeasurably enhance the quality of life for both the urban and rural population by preserving and protecting the recreational, aesthetic, ecological, and cultural values of riverine areas.

STANDARDS

1. All public land acquisitions, easements, floodland use regulations, and other measures intended to eliminate the need for water control facilities shall, in all areas not already in intensive urban use or committed to such use, encompass at least all of the riverine areas lying within the 100-year recurrence interval flood inundation line.

2. Where hydraulic floodways are to be delineated, they shall to the maximum extent feasible accommodate existing, committed, and planned floodplain land uses.

3. In the determination of a hydraulic floodway, the hydraulic effect of the potential floodplain encroachment represented by the floodway shall be evaluated on the basis of an equal degree of encroachment for a significant reach on both sides of the stream, and the degree of encroachment shall be limited so as to not raise the peak stage of the 100-year recurrence interval flood by more than 0.1[a] foot. Larger stage increases may be acceptable if appropriate legal arrangements are made with affected local units of government and property owners.

OBJECTIVE NO. 2

An integrated system of land management and water quality control facilities and pollution abatement devices adequate to assure a quality of surface water necessary to support recreational use, a warmwater fishery, other aquatic life, and a salmon fishery.

PRINCIPLE

Surface water is one of the most valuable resources of southeastern Wisconsin; and, even under the effects of increasing population and economic activity levels, the potential of natural stream waters to serve a reasonable variety of beneficial uses, in addition to the single-purpose function of waste transport and assimilation, should be protected and preserved.

(Table 76 continued)

STANDARDS

1. All waters shall meet those water quality standards set forth in Table 77 of this report commensurate with the adopted water use objectives.

2. Water quality standards commensurate with adopted water use objectives are applicable at all times except during periods when streamflows are less than the average minimum seven-day low flow expected to occur on the average of once every 10 years.

3. Flood control and storm water management facilities should be designed to minimize the negative impacts on fish and other aquatic life and to support the water use objectives set forth on Map 44 and in Table 77.

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[a] *Although Commission watershed studies conducted prior to the Kinnickinnic River watershed study have used a standard of 0.5 foot—a standard that is interpreted by the Commission staff to mean no significant stage increase—that standard was reduced in the Kinnickinnic River and Pike River watershed reports in order to be consistent with revisions to the Wisconsin Administrative Code. Chapter NR 116 of the Code, "Wisconsin's Floodplain Management Program," was revised by the Wisconsin Department of Natural Resources in July 1977 so as to specify a maximum computed stage increase of only 0.1 foot. This Department standard, which is numerically more stringent than the standard adopted earlier by the Commission and previously used by the Wisconsin Department of Natural Resources, may be waived by the Department only if "appropriate legal arrangements have been made with all affected local units of government and all property owners for any increased flood elevations on those properties."*

Although the Commission has adopted the numerically more stringent allowable stage increase in order to be consistent with the Wisconsin Administrative Code, the Commission staff has expressed concern with the use of 0.1 foot and, more particularly, with the accuracy of hydraulic computations that is implied by that standard. The Commission staff, in an April 18, 1977 letter to Mr. Thomas P. Fox, Chairman, Wisconsin Natural Resources Board, stated that "while it is true that the output from a computer backwater program may be stated with a precision of 0.1 foot—given the state of the art—no one can presently claim an accuracy of such work within 0.1 foot. It would appear to us that an accuracy level of 0.5 foot would be more reasonable. In 1985, the Wisconsin Department of Natural Resources Board approved revisions to the Wisconsin Administrative Code which provide for a maximum computed increase in flood stage of 0.01 foot, or, in effect, permit no increase in flood stage.

[b] *These flood events, which have been formulated and used by the U. S. Army Corps of Engineers, are defined and discussed in Chapter VII of SEWRPC Planning Guide No. 5, Floodland and Shoreland Development Guide, November 1968.*

Source: SEWRPC.

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Appendix D

FLOODLAND MANAGEMENT ALTERNATIVES FOR THE OAK CREEK WATERSHED

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Table D-1

PRINCIPAL FEATURES, COSTS, AND BENEFITS OF FLOODLAND MANAGEMENT ALTERNATIVES FOR THE OAK CREEK MAIN STEM

Alternative			Economic Analysis[a]									Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[b]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Annual Benefits	Excess of Annual Benefits Over Costs	Benefit-Cost Ratio	Benefit-Cost Ratio Greater Than 1.0	Positive	Negative
1	Storage	a. Construct storage basin near Southbranch Industrial Park along the upper Oak Creek main stem b. Construct 3,653 acre-foot storage basin north of E. Forest Hill Avenue, west of Pennsylvania Avenue along the lower Oak Creek main stem	No	--	--	--	--	--	--	--	--	Would not impact instream habitat	Would require an impractically large amount of storage to provide sufficient flow and stage reduction
2	Levee/Berm	a. Construct 1,900 feet of six-foot-high berm to protect three industrial properties along upper Oak Creek main stem b. Construct 1,500 feet of six-foot-high berm to protect 11 commercial buildings along lower Oak Creek main stem c. Provide interior drainage behind berms d. Acquire one residential property along upper Oak Creek and six residential properties along lower Oak Creek	Yes	$ 5,388,000	$341,600	$ 28,690	$370,290	$131,610	-$238,680	0.4	No	Eliminates structure flood damages	Potential for flooding if interior drainage system fails Does not address negative channel slope along upper Oak Creek main stem

Table D-1 (continued)

Alternative			Economic Analysis[a]										
												Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[b]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Annual Benefits	Excess of Annual Benefits Over Costs	Benefit-Cost Ratio	Benefit-Cost Ratio Greater Than 1.0	Positive	Negative
3	Conveyance	a. Widen and deepen 1.4 miles of the upper Oak Creek main stem b. Widen and deepen 2.0 miles of the lower Oak Creek main stem c. Floodproof one industrial structure along the upper Oak Creek main stem d. Acquire one residential property along upper Oak Creek and six residential properties along lower Oak Creek	Yes	$10,960,000	$694,870	$136,620	$831,490	$131,610	-$699,880	0.2	No	Eliminates structure flood damages Eliminates negative channel slope along upper Oak Creek main stem	High cost Permitting may be a problem Requires costly stream restoration measures Requires mitigation storage or flood easements
4	Buyout/ Floodproofing[c]	a. Floodproof three industrial structures along the upper Oak Creek main stem and 11 commercial structures along the lower Oak Creek main stem b. Acquire one residential property along upper Oak Creek and six residential properties along lower Oak Creek	Yes	$ 2,340,000	$148,360	$ 10,000	$158,360	$131,610	-$ 26,750	0.8	No	Eliminates structure flood damages Highest benefit-cost ratio	Potential for residual nuisance flooding Does not address issue of negative channel slope along upper Oak Creek main stem

[a]Economic analyses are based on an annual interest rate of 6 percent and a 50-year amortization period and project life. Amounts shown are in 1999 dollars.

[b]Includes engineering, administration, and contingencies.

[c]Alternative 4 recommended for advanced planning.

Source: Milwaukee Metropolitan Sewerage District and SEWRPC.

Table D-2

PRINCIPAL FEATURES, COSTS, AND BENEFITS OF FLOODLAND MANAGEMENT ALTERNATIVES FOR THE NORTH BRANCH OF OAK CREEK

Alternative			Economic Analysis[a]									Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[b]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Annual Benefits	Excess of Annual Benefits Over Costs	Benefit-Cost Ratio	Benefit-Cost Ratio Greater Than 1.0	Positive	Negative
1	Storage	a. Construct 88 acre-foot storage basin in Maitland Park upstream of S. 13th Street along upper North Branch b. Construct 670 acre-foot storage basin at City of Oak Creek police station property along lower North Branch	No	--	--	--	--	--	--	--	--	Would not impact instream habitat Could incorporate wetland features to basins	Does not eliminate structure flooding Maitland Park basin would occupy entire park area Does not address low storm sewer at S. 13th Street
2	Levee/Berm	a. Construct 2,500 feet of six- to eight-foot-high berm to protect four industrial and one commercial structures along upper North Branch b. Construct 700 feet of six- to eight-foot-high berm to protect one apartment building along lower North Branch c. Provide interior drainage behind berms d. Acquire one residential property along upper North Branch and one residential property along lower North Branch	Yes	$3,392,000	$215,000	$ 30,400	$245,500	$ 96,590	-$148,910	0.4	No	Eliminates structure flood damages	Potential for flooding if interior drainage system fails Does not address low storm sewer at S. 13th Street

Table D-2 (continued)

Alternative			Economic Analysis[a]										
												Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[b]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Annual Benefits	Excess of Annual Benefits Over Costs	Benefit-Cost Ratio	Benefit-Cost Ratio Greater Than 1.0	Positive	Negative
3	Conveyance	a. Widen and deepen 1.0 mile of the upper North Branch between sheet pile drop structure and S. 13th Street b. Widen 6,500 feet of the lower North Branch from W. Puetz Road to upstream of Drexel Avenue c. Floodproof four industrial and one commercial structures along the upper North Branch d. Acquire one residential property along the upper North Branch	Yes	$8,880,000	$563,000	$ 82,100	$645,100	$ 96,590	-$548,510	0.1	No	Eliminates structure flood Addresses low storm sewer at S. 13th Street	High cost Permitting may be a problem 22 residential properties impacted by widened channel Requires mitigation storage or flood easements Potential problem with contaminated sediment disposal
4	Buyout/ Floodproofing[c]	a. Floodproof four industrial and one commercial structures along the upper North Branch and one apartment building along the lower North Branch b. Acquire one residential property along the upper North Branch and one residential property along the lower North Branch	Yes	$ 902,000	$ 57,200	$ 2,900	$ 60,100	$ 96,590	$ 36,490	1.6	Yes	Eliminates structure flood damages Positive benefit-cost ratio	Potential for residual nuisance flooding Does not address low storm sewer at S. 13th Street

[a]Economic analyses are based on an annual interest rate of 6 percent and a 50-year amortization period and project life. Amounts shown are in 1999 dollars.

[b]Includes engineering, administration, and contingencies.

[c]Alternative 4 recommended for advanced planning.

Source: Milwaukee Metropolitan Sewerage District and SEWRPC.

Table D-3

PRINCIPAL FEATURES, COSTS, AND BENEFITS OF FLOODLAND MANAGEMENT ALTERNATIVES FOR TRIBUTARY N2

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
1	Regional Detention	a. Construct detention basin in the southeast quadrant of the IH 94/W. College Avenue interchange b. Construct detention basin along west end of motel property, south of basin in Item a c. Combined area of two basins is 11 acres, combined storage is 45 acre-feet d. Install additional culvert at Pelton Drive	Yes	$1,105,000	$70,100	$2,000	$72,100	Would not affect instream habitat May help control downstream channel erosion by reducing discharge Eliminates structure flooding	Requires coordination with Wisconsin Department of Transportation Uncertainty of obtaining land or easements
2	Conveyance	a. Widen and deepen 2,600 feet of channel downstream of S. 13th Street by up to two feet b. Replace existing culverts at S. 13th Street, Pelton Drive, and three private drives c. Acquire land or easements along three acres between S. 13th Street and Pelton Drive	Yes	$1,260,000	$79,900	--[e]	$79,900[f]	Eliminates structure flood damages	Higher cost Permitting may be a problem May require mitigation storage or flood easements

[a] *Economic analyses are based on an annual interest rate of 6 percent and a 50-year amortization period and project life. Amounts shown are in 1998 dollars.*

[b] *Economic benefits are not presented as flood damages were not quantified under the stormwater management master plan.*

[c] *Includes engineering, administration, and contingencies.*

[d] *Alternative 1 recommended for implementation.*

[e] *Operation and maintenance costs were not computed for this alternative since it was not recommended for implementation.*

[f] *Does not include operation and maintenance costs.*

Source: City of Oak Creek and SEWRPC.

Table D-4

PRINCIPAL FEATURES, COSTS, AND BENEFITS OF FLOODLAND MANAGEMENT ALTERNATIVES FOR TRIBUTARY O19A

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
1	Detention	--	No	--	--	--	--	--	Upstream watershed fully developed. No Sites available for detention basin
2	Conveyance[d]	a. Remove existing driveway culvert upstream of E. Puetz Road b. Install new culvert under abandoned interurban railway embankment or lower embankment to allow overflow to the east along south side of E. Puetz Road c. Install a new culvert under E. Puetz Road near Nicholson Road to allow overflow to return to main channel d. Lower about 400 feet of E. Puetz Road to allow overtopping to the north during major flood events	Yes	$304,000	$19,300	$0	$19,300	Eliminates structure flooding	Requires easement from Milwaukee County to cross abandoned interurban embankment E. Puetz Road would be overtopped during major flood events

[a] *Economic analyses are based on an annual interest rate of 6 percent and a 50-year amortization period and project life. Amounts shown are in 1998 dollars.*

[b] *Economic benefits are not presented as flood damages were not quantified under the stormwater management master plan.*

[c] *Includes engineering, administration, and contingencies.*

[d] *Alternative recommended for implementation.*

Source: City of Oak Creek and SEWRPC.

Appendix E

FLOODLAND MANAGEMENT ALTERNATIVES FOR THE ROOT RIVER WATERSHED

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Table E-1

PRINCIPAL FEATURES, COSTS, AND BENEFITS OF STORMWATER DRAINAGE AND FLOODLAND MANAGEMENT ALTERNATIVES FOR THE CRAYFISH CREEK SUBWATERSHED

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
1	Conveyance to Root River Via Route A	a. Construct new channel to convey Crayfish Creek to Root River downstream from present confluence b. Bulkhead existing Crayfish Creek culverts under Union Pacific Railroad c. Construct 500 feet of earthen berm along E. County Line Road d. Deepen and widen Crayfish Creek between E. County Line Road and Elm Road e. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad	No	$ 900,000	$ 57,000	--[d]	--[d]	Flooding and drainage problems partly abated	Problem due to backup of Root River floodwaters not abated
2	Diversion Conveyance to Oak Creek	a. Elevate E. County Line Road from 15th Avenue extended to about 500 feet west of Union Pacific Railroad b. Widen and regrade Crayfish Creek to flow northward to abandoned interurban railway right-of-way c. Construct diversion channel to Oak Creek	No	$1,600,000	$102,000	--[d]	--[d]	Duration of flooding reduced	Flooding and drainage problems would remain about the same as existing condition
3	Diversion Conveyance to Lake Michigan–A	a. Construct diversion channel to Lake Michigan b. Elevate E. County Line Road c. Bulkhead existing Crayfish Creek culvert under E. County Line Road d. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad	Yes	$8,900,000	$565,000	--[d]	--[d]	Resolves flooding and drainage problems to a high degree	High capital cost

Table E-1 (continued)

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
4	Diversion Conveyance to Lake Michigan–B	a. Construct diversion channel to Lake Michigan b. Elevate E. County Line Road c. Bulkhead existing Crayfish Creek culvert under E. County Line Road d. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad	Yes	$8,900,000	$5656,000	$6,000	$571,000	Resolves flooding and drainage problems to a high degree	High capital cost
5	Diversion Conveyance to Lake Michigan–C	a. Construct diversion channel to Lake Michigan b. Elevate E. County Line Road c. Bulkhead existing Crayfish Creek culvert under E. County Line Road	Yes	$11,000,000	$698,000	--[d]	--[d]	Resolves flooding and drainage problems to a high degree	High capital cost
6	Diversion Conveyance to Lake Michigan–E	a. Construct diversion channel to Lake Michigan b. Elevate E. County Line Road c. Bulkhead existing Crayfish Creek culvert under E. County Line Road	Yes	$11,000,000	$698,000	--[d]	--[d]	Resolves flooding and drainage problems to a high degree	High capital cost
7	Conveyance to Root River Via Route A with Backwater Gates	a. Construct new channel to convey Crayfish Creek to Root River downstream from present confluence b. Bulkhead existing Crayfish Creek culverts under Union Pacific Railroad c. Elevate E. County Line Road from 15th Avenue extended to 450 feet west of Union Pacific Railroad d. Deepen and widen Crayfish Creek between E. County Line Road and Elm Road e. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad	Yes	$ 1,300,000	$ 82,000	$4,000	$ 86,000	Significantly reduces flooding and drainage problems	Some residual problems due to closure of Crayfish Creek outlet for extended periods

Table E-1 (continued)

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
8	Diversion Conveyance to Oak Creek	a. Elevate E. County Line Road from 15th Avenue extended to about 500 feet west of Union Pacific Railroad b. Widen and regrade Crayfish Creek to flow northward to abandoned interurban railway right-of-way c. Construct diversion channel to Oak Creek d. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad e. Installation of backwater gates on culverts under berm in Item d	No	$1,900,000	$121,000	--[d]	--[d]	Significantly reduces flooding and drainage problems	Some residual problems due to closure of diversion outlet for extended periods
9	Pumping to Root River	a. Construct 500 feet of earthen berm along E. County Line Road b. Deepen and widen Crayfish Creek between E. County Line Road and Elm Road c. Install pumping station at upstream side of County Line Road berm	Yes	$2,800,000	$177,000	$11,000	$188,000	Resolves flooding and drainage problems to a high degree	Pumping affected by potential power outage or breakdown
10	Pumping to Oak Creek	a. Elevate E. County Line Road from 15th Avenue extended to about 500 feet west of Union Pacific Railroad b. Widen and regrade Crayfish Creek to flow northward to abandoned interurban railway right-of-way c. Construct diversion channel to Oak Creek d. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad	Yes	$3,800,000	$241,000	--[d]	--[d]	Resolves flooding and drainage problems to a high degree	Higher cost than Alternative 9 May increase flood problems on Oak Creek

Table E-1 (continued)

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
10	(continued)	e. Install pumping station along berm in item d west of Pennsylvania Avenue f. Install force main across berm from pumping station to diversion channel							
11	Diversion Pumping to Lake Michigan	a. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad b. Elevate E. County Line Road from 15th Avenue extended to Union Pacific Railroad c. Widen and regrade Crayfish Creek to flow northward to Elm Road d. Install pumping station at Elm Road e Install force main from pumping station to Union Pacific Railroad right-of-way f. Enlarge existing drainage channel to convey diverted water to Lake Michigan	Yes	$5,700,000	$361,000	$14,000	$375,000	Resolves flooding and drainage problems to a high degree	High capital cost
12	Storage and Conveyance to Root River Via Route A	a. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad b. Elevate E. County Line Road from 15th Avenue extended to Union Pacific Railroad c. Widen and deepen Crayfish Creek from Elm Road to just downstream of E. County Line Road d. Install backwater gates on the Crayfish Creek culverts at E. County Line Road e. Construct detention basin north of E. County Line Road	Yes	$4,200,000	$266,000	$50,000	$316,000	Significantly reduces flooding and drainage problems Detention basin mitigates potential downstream impact	Some residual problems due to closure of Crayfish Creek outlet for extended periods

Table E-1 (continued)

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
13	Storage and Diversion by Conveyance to Oak Creek	a. Elevate E. County Line Road from 15th Avenue extended to about 500 feet west of Union Pacific Railroad b. Widen and regrade Crayfish Creek to flow northward to abandoned interurban railway right-of-way c. Construct diversion channel to Oak Creek d. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad e. Installation of backwater gates on culverts under berm in item d f. Construct detention basin south of berm in item e, between Pennsylvania Avenue and Union Pacific Railroad	Yes	$5,400,000	$343,000	--[d]	--[d]	Significantly reduces flooding and drainage problems Detention basin mitigates potential downstream impact	Some residual problems due to closure of diversion outlet for extended periods Higher cost than Alternative 12
14	Storage and Pumping to Root River[e]	a. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad b. Elevate E. County Line Road from 15th Avenue extended to Union Pacific Railroad c. Install pumping station at upstream side of County Line Road berm d. Install force main under E. County Line Road e. Deepen and widen Crayfish Creek between E. County Line Road and Elm Road f. Construct detention basin next to pumping station	Yes	$3,100,000	$197,000	$45,000	$242,000	Resolves flooding and drainage problems to a high degree Lower cost than other alternatives involving pumping	Pumping affected by potential power outage or breakdown

Table E-1 (continued)

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
15	Storage and Diversion Pumping to Oak Creek	a. Elevate E. County Line Road from 15th Avenue extended to about 500 feet west of Union Pacific Railroad b. Widen and regrade Crayfish Creek to flow northward to abandoned interurban railway right-of-way c. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad d. Install pumping station along berm in item d west of Pennsylvania Avenue e. Install force main across berm from pumping station to diversion channel f. Construct detention basin south of berm in item c, west of Pennsylvania Avenue	Yes	$3,500,000	$222,000			Resolves flooding and drainage problems to a high degree	May increase flood problems on Oak Creek Higher cost than Alternative 14
16	Storage and Pumping to Lake Michigan	a. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad b. Elevate E. County Line Road from 15th Avenue extended to Union Pacific Railroad c. Widen and regrade Crayfish Creek to flow northward to Elm Road d. Install pumping station at Elm Road e. Install force main from pumping station to Union Pacific Railroad right-of-way f. Construct detention basin next to pumping station	Yes	$4,900,000	$311,000	--[d]	--[d]	Resolves flooding and drainage problems to a high degree Detention basin mitigates potential downstream impact	Higher cost than other alternatives involving storage

Table E-1 (continued)

Alternative			Economic Analysis[a,b]						
								Nontechnical and Noneconomic Considerations	
Number	Name	Description	Technically Feasible	Capital Cost[c]	Annual Amortized Capital Cost	Annual Operation and Maintenance Cost	Total Annual Cost	Positive	Negative
17	Conveyance to Root River via Route D[e]	a. Construct new channel to convey Crayfish Creek to Root River downstream from present confluence b. Bulkhead existing Crayfish Creek culverts under Union Pacific Railroad c. Elevate E. County Line Road from 15th Avenue extended to 450 feet west of Union Pacific Railroad d. Deepen and widen Crayfish Creek between E. County Line Road and Elm Road e. Construct earthen berm along E. Fitzsimmons Road extended from 15th Avenue to just west of Union Pacific Railroad	Yes	$1,400,000	$89,000	$3,000	$92,000	Significantly reduces flooding and drainage problems Low cost	Some residual problems due to closure of diversion outlet for extended periods

[a] *Economic analyses are based on an annual interest rate of 6 percent and a 50-year amortization period and project life. Amounts shown are in 1985 dollars.*

[b] *Economic benefits were not quantified. Benefits are limited to improved stormwater drainage.*

[c] *Includes engineering, administration, and contingencies.*

[d] *Operation and maintenance costs were not computed as this alternative was rejected for further consideration under the initial screening process.*

[e] *Elements of Alternatives 14 and 17 incorporated into recommended plan.*

Source: SEWRPC.

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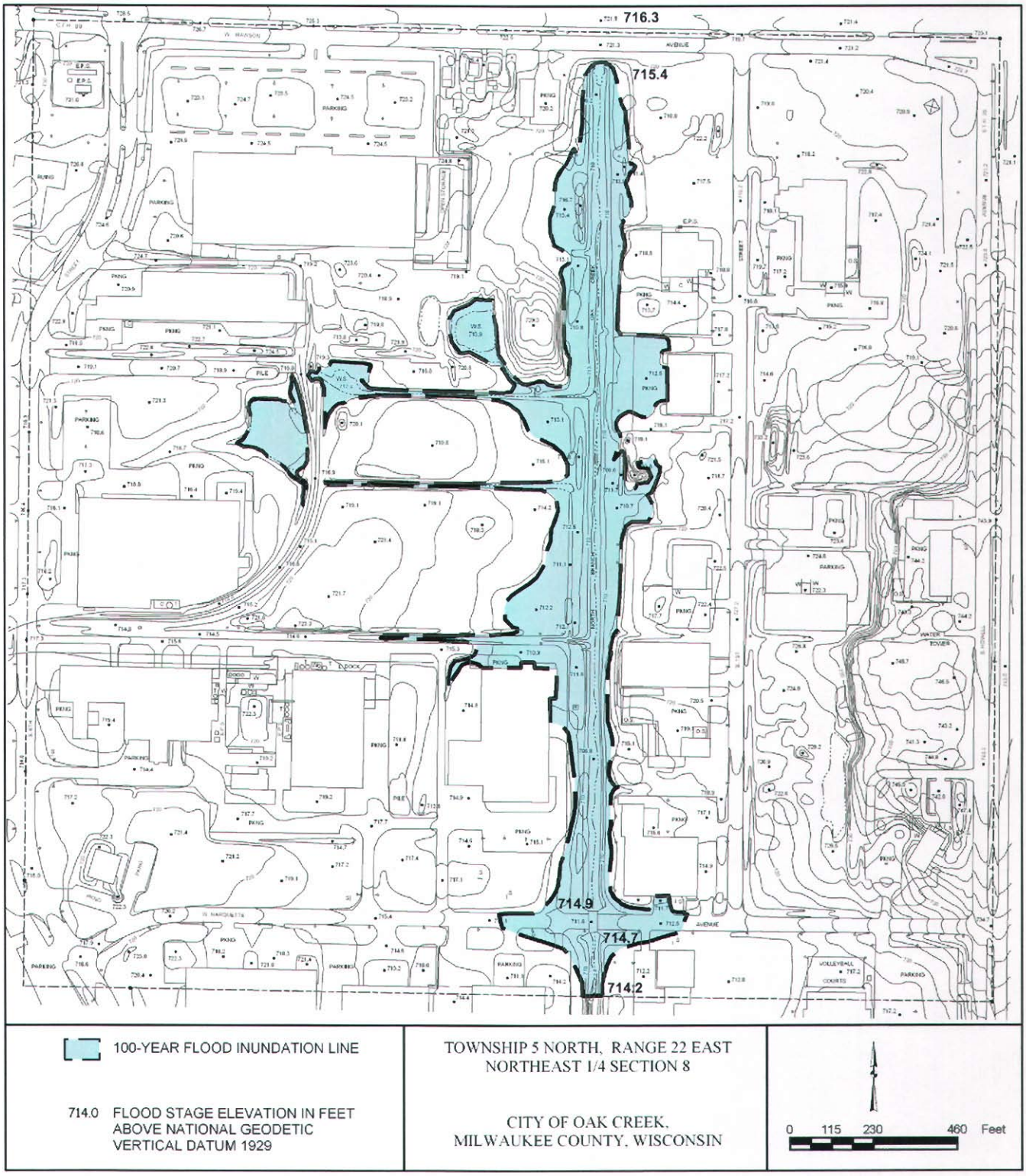
Appendix F

PORTION OF A TYPICAL FLOOD HAZARD MAP WITHIN THE CITY OF OAK CREEK



Source: SEWRPC.

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Appendix G

SELECTED DATA ON BUILDINGS THAT ARE POTENTIALLY WITHIN THE 100-YEAR RECURRENCE INTERVAL FLOODPLAIN IN THE CITY OF OAK CREEK

Table G-1

STRUCTURE FLOOD DAMAGE SUMMARY
CITY OF OAK CREEK, WISCONSIN

Flood Recurrence Interval	Number of Buildings in Floodplain	Flood Damages			Expected Annual Flood Damage
		Direct	Indirect	Total	
100-Year	19	$213,290	$45,910	$259,200	$ 5,184
50-Year	18	188,520	40,330	228,850	9,154
10-Year	13	33,370	13,360	46,730	22,898
Total	--	--	--	--	$37,236

Source: SEWRPC.

Table G-2

EXPECTED ANNUAL FLOOD DAMAGE PER PROPERTY
CITY OF OAK CREEK, WISCONSIN

Building Identification Number	Town and Range	USPLS Section	Tax Key Number	Type of Improvement	Stream	2001 Assessed Value of Improvements[a]	2002 Market Value of Improvements	Flood Damages			Expected Annual Flood Damages[b]
								100-Year	50-Year	10-Year	
1	05 22	SE 09	780-9006	Residential	Oak Creek	$ 61,400	$ 65,738	$ 9,740	$ 8,690	--	$ 542
2	05 22	NE 16	815-9988	Commercial	Oak Creek	7,800	8,351	2,370	2,130	$ 1,410	824
3	05 22	NE 16	"	Commercial	Oak Creek	7,800	8,351	2,930	2,690	2,000	1,146
4	05 22	NE 16	"	Commercial	Oak Creek	7,800	8,351	3,050	2,790	2,100	1,202
5	05 22	NE 16	"	Commercial	Oak Creek	7,800	8,351	2,970	2,700	2,020	1,157
6	05 22	NE 16	"	Commercial	Oak Creek	7,800	8,351	2,790	2,520	1,850	1,063
7	05 22	NE 16	"	Commercial	Oak Creek	7,800	8,351	2,700	2,440	1,780	1,024
8	05 22	NE 16	"	Commercial	Oak Creek	7,800	8,351	2,630	2,370	1,680	971
9	05 22	NE 16	"	Commercial	Oak Creek	7,800	8,351	2,440	2,270	1,480	865
10	05 22	NE 16	"	Commercial	Oak Creek	14,300	15,310	4,340	3,860	2,580	1,505
11	05 22	NE 16	"	Commercial	Oak Creek	8,800	9,422	3,920	3,630	2,860	1,625
12	05 22	NE 16	"	Commercial	Oak Creek	81,600	87,365	35,590	32,840	25,870	14,702
13	05 22	NW 17	812-9001	Apartment	North Br. Oak Creek	1,112,000	1,190,563	171,630	152,730	--	9,542
14	05 22	SE 08	782-9018	Commercial	North Br. Oak Creek	39,400	42,184	2,580	-	--	52
16	05 22	SW 34	971-9002-002	Farm Building	Crayfish Creek	9,800	10,492	1,930	1,810	690	449
17	05 22	SW 34	"	Farm Building	Crayfish Creek	9,800	10,492	870	740	--	47
18	05 22	NW 5	717-9978	Commercial	Tributary N2	42,300	45,288	4,230	3,070	--	207
19	05 22	NW 5	717-9986	Commercial	Tributary N2	3,700	3,961	850	760	410	248
20	05 22	SW 29	925-9004	Residential	Tributary R2	121,200	129,763	1,640	810	--	65
--	--	--	Total	--	--	$1,566,700	$1,677,386	$259,200	$228,850	$46,730	$37,236

[a]Assessed values of building Nos. 2 through 12 are proportionated from the total assessed value of the improvements $167,100. Assessed value of building No. 13 is taken as one-third of the total value of improvements $3,335,900. Assessed value of building No. 14 is assumed to be 30 percent of the total value of improvements $131,200. Assessed values of building Nos. 15 through 17 are assumed to be 10 percent of the total value of improvements $98,100.

*[b]Expected annual flood damage is computed according to a formula: E = 0.02*D100 + 0.04*D50 + 0.49*D10 in which D100, D50, and D10 refer to flood damages incurred by 100-, 50-, and 10-year recurrence interval flood events respectively.*

Source: SEWRPC.

Table G-3

STRUCTURE DAMAGES BY 10-YEAR FLOOD
CITY OF OAK CREEK, WISCONSIN

Building Identification Number	Town and Range	USPLS Section	Tax Key Number	Type of Improvement	Stream	Ground Elevation at Building[a] (feet NGVD)	Assumed First Floor Elevation (feet NGVD)	10-Year Flood Elevation[b] (feet NGVD)	Depth of Inundation Relative to First Floor (feet)	2001 Assessed *Value of* Improvements[a]	2002 Market Value of Improvements	Market Value of Improvements Plus Contents[c]	Percent Damages	Damages		
														Direct	*Indirect*[d]	Total
2	05 22	NE 16	815-9988	Commercial	Oak Creek	661.3	661.3	661.51	0.21	$ 7,800	$ 8,351	$ 12,527	8.1	$ 1,010	$ 400	$ 1,410
3	05 22	NE 16	"	Commercial	Oak Creek	660.7	660.7	661.53	0.83	7,800	8,351	12,527	11.4	1,430	570	2,000
4	05 22	NE 16	"	Commercial	Oak Creek	660.6	660.6	661.54	0.94	7,800	8,351	12,527	12.0	1,500	600	2,100
5	05 22	NE 16	"	Commercial	Oak Creek	660.7	660.7	661.55	0.85	7,800	8,351	12,527	11.5	1,440	580	2,020
6	05 22	NE 16	"	Commercial	Oak Creek	660.9	660.9	661.56	0.66	7,800	8,351	12,527	10.5	1,320	530	1,850
7	05 22	NE 16	"	Commercial	Oak Creek	661.0	661.0	661.57	0.57	7,800	8,351	12,527	10.1	1,270	510	1,780
8	05 22	NE 16	"	Commercial	Oak Creek	661.1	661.1	661.58	0.48	7,800	8,351	12,527	9.6	1,200	480	1,680
9	05 22	NE 16	"	Commercial	Oak Creek	661.3	661.3	661.59	0.29	7,800	8,351	12,527	8.5	1,060	420	1,480
10	05 22	NE 16	"	Commercial	Oak Creek	661.4	661.4	661.60	0.20	14,300	15,310	22,965	8.0	1,840	740	2,580
11	05 22	NE 16	"	Commercial	Oak Creek	660.2	660.2	661.60	1.40	8,800	9,422	14,133	14.4	2,040	820	2,860
12	05 22	NE 16	"	Commercial	Oak Creek	660.3	660.3	661.63	1.33	81,600	87,365	131,048	14.1	18,480	7,390	25,870
16	05 22	SW 34	971-9002-002	Farm Building	Crayfish Creek	665.0	665.5	665.08	-0.42	9,800	10,492	12,066	4.1	490	200	690
18	05 22	NW 5	717-9978	Commercial	Tributary N2	738.5	739.0	738.13	-0.87	42,300	45,288	52,081	0.0	--	--	--
19	05 22	NW 5	717-9986	Commercial	Tributary N2	742.0	742.5	742.40	-0.10	3,700	3,961	4,555	6.3	290	120	410
20	05 22	SW 29	925-9004	Residential	Tributary R2	688.6	688.6	687.57	-1.05	121,200	129,763	149,227	0.0	--	--	--
--	--	--	Total	--	--	--	--	--	--	$344,100	$368,409	$486,287	--	$33,370	$13,360	$46,730

[a] *Ground level of the property as shown on topographic maps prepared in 1993 for Milwaukee County. (* Ground level surveyed by MMSD in 1999.)*

[b] *Flood stage determined from SEWRPC MCAMLIS/MMSD Flood Hazard Mapping Program (2002) for Oak Creek and North Branch of Oak Creek and from SEWRPC WRSP 260,* Crayfish Creek Hydrologic and Hydraulic Analyses *(1994) for Crayfish Creek.*

[c] *1.5 times the building market value if the depth of inundation relative to first floor is + or 0, 1.15 times if -.*

[d] *40 percent of direct damage for commercial/industrial/agricultural buildings, 15 percent for residential buildings.*

Source: SEWRPC.

Table G-4

STRUCTURE DAMAGES BY 50-YEAR FLOOD
CITY OF OAK CREEK, WISCONSIN

Building Identification Number	Town and Range	USPLS Section	Tax Key Number	Type of Improvement	Stream	Ground Elevation at Building[a] (feet NGVD)	Assumed First Floor Elevation (feet NGVD)	50-Year Flood Elevation[b] (feet NGVD)	Depth of Inundation Relative to First Floor (feet)	2001 Assessed Value of Improvements[a]	2002 Market Value of Improvements	Market Value of Improvements Plus Contents[c]	Percent Damages	Damages		
														Direct	Indirect[d]	Total
1	05 22	SE 09	780-9006	Residential	Oak Creek	660.3	661.3	660.81	-0.49	$ 61,400	$ 65,738	$ 75,599	10.0	$ 7,560	$ 1,130	$ 8,690
2	05 22	NE 16	815-9988	Commercial	Oak Creek	661.3	661.3	662.25	0.95	7,800	8,351	12,527	12.1	1,520	610	2,130
3	05 22	NE 16	"	Commercial	Oak Creek	660.7	660.7	662.26	1.56	7,800	8,351	12,527	15.3	1,920	770	2,690
4	05 22	NE 16	"	Commercial	Oak Creek	660.6	660.6	662.27	1.67	7,800	8,351	12,527	15.9	1,990	800	2,790
5	05 22	NE 16	"	Commercial	Oak Creek	660.7	660.7	662.28	1.58	7,800	8,351	12,527	15.4	1,930	770	2,700
6	05 22	NE 16	"	Commercial	Oak Creek	660.9	660.9	662.29	1.39	7,800	8,351	12,527	14.4	1,800	720	2,520
7	05 22	NE 16	"	Commercial	Oak Creek	661.0	661.0	662.30	1.30	7,800	8,351	12,527	13.9	1,740	700	2,440
8	05 22	NE 16	"	Commercial	Oak Creek	661.1	661.1	662.31	1.21	7,800	8,351	12,527	13.5	1,690	680	2,370
9	05 22	NE 16	"	Commercial	Oak Creek	661.3	661.3	662.32	1.02	7,800	8,351	12,527	12.9	1,620	650	2,270
10	05 22	NE 16	"	Commercial	Oak Creek	661.4	661.4	662.33	0.93	14,300	15,310	22,965	12.0	2,760	1,100	3,860
11	05 22	NE 16	"	Commercial	Oak Creek	660.2	660.2	662.33	2.13	8,800	9,422	14,133	18.3	2,590	1,040	3,630
12	05 22	NE 16	"	Commercial	Oak Creek	660.3	660.3	662.36	2.06	81,600	87,365	131,048	17.9	23,460	9,380	32,840
13	05 22	NW 17	812-9001	Apartment	North Br. Oak Creek	704.3*	705.3	704.72	-0.58	1,112,000	1,190,563	1,369,147	9.7	132,810	19,920	152,730
16	05 22	SW 34	971-9002-002	Farm Building	Crayfish Creek	665.0	665.5	665.73	0.23	9,800	10,492	15,738	8.2	1,290	520	1,810
17	05 22	SW 34	"	Farm Building	Crayfish Creek	665.6	666.1	665.73	-0.37	9,800	10,492	12,066	4.4	530	210	740
18	05 22	NW 5	717-9978	Commercial	Tributary N2	738.5	739.0	738.60	-0.40	42,300	45,288	52,081	4.2	2,190	880	3,070
19	05 22	NW 5	717-9986	Commercial	Tributary N2	742.0	742.5	742.90	0.40	3,700	3,961	5,942	9.1	540	220	760
20	05 22	SW 29	925-9004	Residential	Tributary R2	688.6	688.6	689.20	0.58	121,200	129,763	194,645	0.3	580	230	810
--	--	--	Total	--	--	--	--	--	--	$1,527,300	$1,635,202	$1,993,575	--	$188,520	$40,330	$228,850

[a] *Ground level of the property as shown on topographic maps prepared in 1993 for Milwaukee County. (* Ground level surveyed by MMSD in 1999.)*

[b] *Flood stage determined from SEWRPC MCAMLIS/MMSD Flood Hazard Mapping Program (2002) for Oak Creek and North Branch of Oak Creek and from SEWRPC WRSP 260,* Crayfish Creek Hydrologic and Hydraulic Analyses *(1994) for Crayfish Creek.*

[c] *1.5 times the building market value if the depth of inundation relative to first floor is + or 0, 1.15 times if -.*

[d] *40 percent of direct damage for commercial/industrial/agricultural buildings, 15 percent for residential buildings.*

Source: SEWRPC.

Table G-5

STRUCTURE DAMAGES BY 100-YEAR FLOOD
CITY OF OAK CREEK, WISCONSIN

Building Identification Number	Town and Range	USPLS Section	Tax Key Number	Type of Improvement	Stream	Ground Elevation at Building[a] (feet NGVD)	Assumed First Floor Elevation (feet NGVD)	100-Year Flood Elevation[b] (feet NGVD)	Depth of Inundation Relative to First Floor (feet)	2001 Assessed Value of Improvements[a]	2002 Market Value of Improvements	Market Value of Improvements Plus Contents[c]	Percent Damages	Damages		
														Direct	Indirect[d]	Total
1	05 22	SE 09	780-9006	Residential	Oak Creek	660.3	661.3	661.10	-0.20	$ 61,400	$ 65,738	$ 75,599	11.2	$ 8,470	$ 1,270	$ 9,740
2	05 22	NE 16	815-9988	Commercial	Oak Creek	661.3	661.3	662.53	1.23	7,800	8,351	12,527	13.5	1,690	680	2,370
3	05 22	NE 16	"	Commercial	Oak Creek	660.7	660.7	662.54	1.84	7,800	8,351	12,527	16.7	2,090	840	2,930
4	05 22	NE 16	"	Commercial	Oak Creek	660.6	660.6	662.55	1.95	7,800	8,351	12,527	17.4	2,180	870	3,050
5	05 22	NE 16	"	Commercial	Oak Creek	660.7	660.7	662.56	1.86	7,800	8,351	12,527	16.9	2,120	850	2,970
6	05 22	NE 16	"	Commercial	Oak Creek	660.9	660.9	662.57	1.67	7,800	8,351	12,527	15.9	1,990	800	2,790
7	05 22	NE 16	"	Commercial	Oak Creek	661.0	661.0	662.58	1.58	7,800	8,351	12,527	15.4	1,930	770	2,700
8	05 22	NE 16	"	Commercial	Oak Creek	661.1	661.1	662.59	1.49	7,800	8,351	12,527	15.0	1,880	750	2,630
9	05 22	NE 16	"	Commercial	Oak Creek	661.3	661.3	662.60	1.30	7,800	8,351	12,527	13.9	1,740	700	2,440
10	05 22	NE 16	"	Commercial	Oak Creek	661.4	661.4	662.61	1.21	14,300	15,310	22,965	13.5	3,100	1,240	4,340
11	05 22	NE 16	"	Commercial	Oak Creek	660.2	660.2	662.61	2.41	8,800	9,422	14,133	19.8	2,800	1,120	3,920
12	05 22	NE 16	"	Commercial	Oak Creek	660.3	660.3	662.63	2.33	81,600	87,365	131,048	19.4	25,420	10,170	35,590
13	05 22	NW 17	812-9001	Apartment	North Br. Oak Creek	704.3*	705.3	705.03	-0.27	1,112,000	1,190,563	1,369,147	10.9	149,240	22,390	171,630
14	05 22	SE 08	782-9018	Commercial	North Br. Oak Creek	709.9	710.4	709.94	-0.46	39,400	42,184	48,512	3.8	1,840	740	2,580
16	05 22	SW 34	971-9002-002	Farm Building	Crayfish Creek	665.0	665.5	665.83	0.33	9,800	10,492	15,738	8.8	1,380	550	1,930
17	05 22	SW 34	"	Farm Building	Crayfish Creek	665.6	666.1	665.83	-0.27	9,800	10,492	12,066	5.1	620	250	870
18	05 22	NW 5	717-9978	Commercial	Tributary N2	738.5	739.0	738.83	-0.17	42,300	45,288	52,081	5.8	3,020	1,210	4,230
19	05 22	NW 5	717-9986	Commercial	Tributary N2	742.0	742.5	743.10	0.60	3,700	3,961	5,942	10.2	610	240	850
20	05 22	SW 29	925-9004	Residential	Tributary R2	688.6	688.6	689.72	1.10	121,200	129,763	194,645	0.6	1,170	470	1,640
--	--	--	Total	--	--	--	--	--	--	$1,566,700	$1,677,386	$2,042,086	--	$213,290	$45,910	$259,200

[a] *Ground level of the property as shown on topographic maps prepared in 1993 for Milwaukee County. (* Ground level surveyed by MMSD in 1999.)*

[b] *Flood stage determined from SEWRPC MCAMLIS/MMSD Flood Hazard Mapping Program (2002) for Oak Creek and North Branch of Oak Creek and from SEWRPC WRSP 260,* Crayfish Creek Hydrologic and Hydraulic Analyses *(1994) for Crayfish Creek.*

[c] *1.5 times the building market value if the depth of inundation relative to first floor is + or 0, 1.15 times if -.*

[d] *40 percent of direct damage for commercial/industrial/agricultural buildings, 15 percent for residential buildings.*

Source: SEWRPC.

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Appendix H

EXCERPT FROM CITY OF OAK CREEK STORMWATER MANAGEMENT MASTER PLAN IDENTIFYING FLOODING AND DRAINAGE PROBLEM AREAS IN THE CITY

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Table 3-10 Water Resource Conditions

	Oak Creek, North Branch of Oak Creek, and Mitchell Drainage Ditch [1]	**Root River and Crayfish Creek** [1]
Potential Biological Use[1]	Warm water sport fish community	Warm water sport fish community
Current Condition	Not meeting potential biological use	Not meeting potential biological use
Problems or Threats to Potential Use	Loss of fish and invertebrate habitat Trophic /community imbalance: nuisance vegetation Stream flow fluctuation or low flow Embedded substrate Turbidity Temperature extremes Toxicity (potential) Size and depth Bacteria	Loss of fish and invertebrate habitat Trophic /community imbalance: nuisance vegetation Embedded substrate Toxicity (potential) Turbidity Bacteria
Pollutants or Limiting Factors Causing Problems or Threats	Channelization; bank debrushing; drainage of wetlands; ponding Nutrients Low flow and flashy flow Sediment Metals; pesticides	Channelization; bank debrushing; drainage of wetlands; construction site erosion; streambank erosion Nutrients Sediment Metals; pesticides

Source: Wisc.Adm.Code NR104 and Hey and Associates, Inc.

1 Other Tributaries of the Oak Creek and Root River have not been classified by the State of Wisconsin

Stream Maintenance Conditions

As part of the preparation of this project, R. A. Smith and Associates, Inc. conducted a stream inventory to identify areas of active channel erosion, sediment deposition, and channel blockage. The inventory was conducted in summer of 1996. The inventory involved walking the entire reaches of every mapped stream in the City of Oak Creek. Each reach was photographed for permanent documentation.

The results of the inventory were summarized on a 1-inch equals 1000-foot map that has been provided to the City Engineering staff.

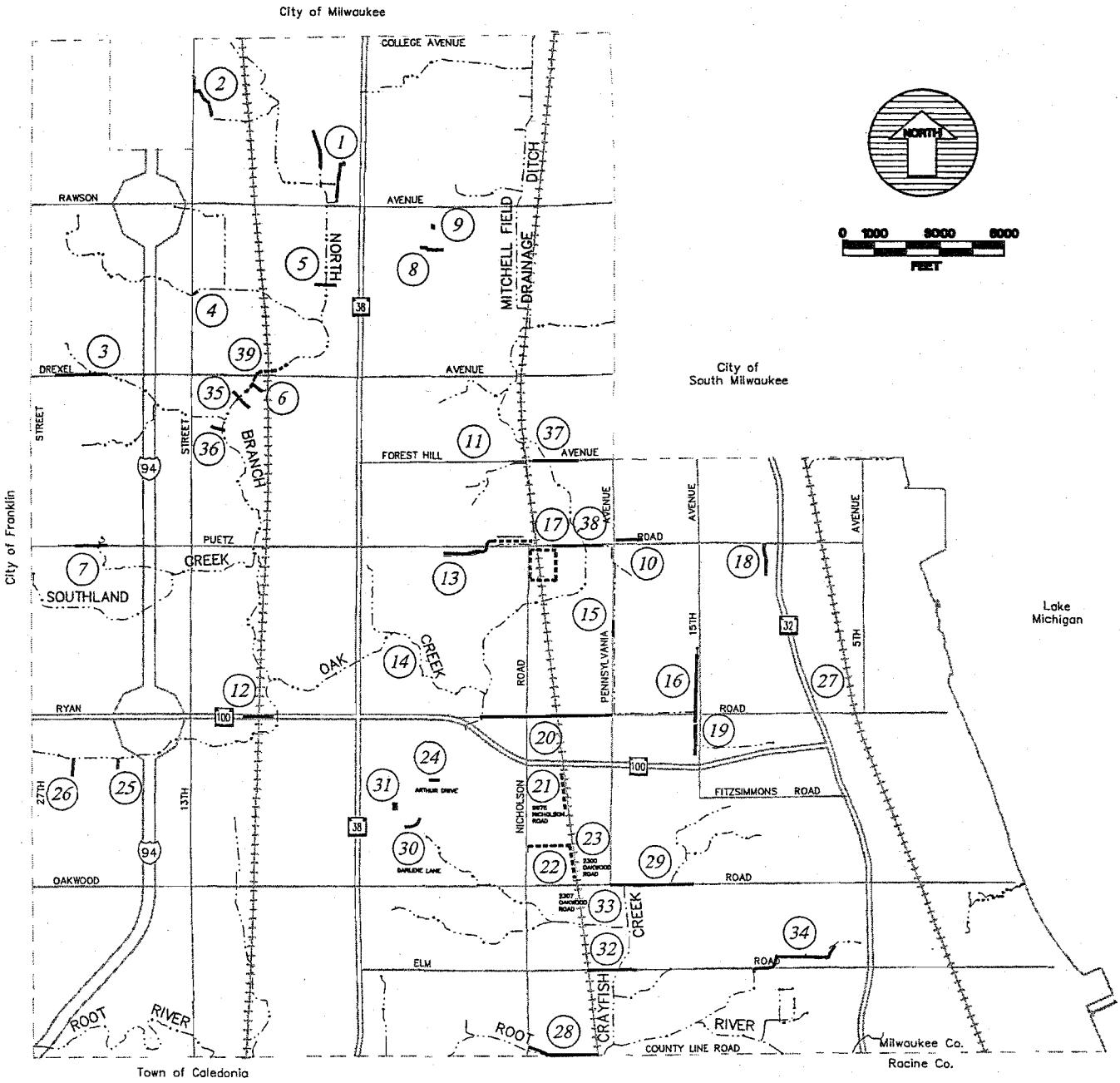
Reported Flooding and Drainage Problems

City staff and residents were asked to report flooding and drainage problems in the study area. Early in the project, city staff compiled a list of 14 areas that have had ongoing flooding and drainage problems. An open house meeting was held on Saturday October 29, 1995 to solicit comments and problem reports from residents of the City. At this meeting, maps of the City were used to discuss various drainage and flooding situations and 23 problem areas were identified. Several additional problem areas were identified by the City in October 1998. These reported problems were reviewed with the Stormwater Management Committee and categorized into three groups. The first group was the problems to be addressed in this study, as shown in Table 3-11 and on Figure 3-6.

Table 3-11 Reported Flooding and Drainage Problems within Project Scope

ID No.	Location	Reported Problem	Section	Qtr Sec.
1	6931 S. Howell Ave.	drainage blocked	5	SE
2	S. 13th St. & Pelton Dr.	street and adjacent area flooding	5	NW
3	S. 20th St. and Drexel Ave.	street flooding	7	SW
4	7538 S. 13th St.	easement not consistent with stream location	8	SW
5	Marquette Ave.	storm sewer outlet below channel	8	NE
6	Between Drexel Ave. and Wildwood Dr.	storm sewer outlet below channel	17	NW
7	2000 block W. Puetz Rd.	street flooding	18	SW
8	7289 S. Quincy Ave.	sewer surcharge from field upstream	9	NW
9	7152 S. Taylor Ave.	basement flooding	9	NW
10	E. Puetz Rd. & Pennsylvania Ave. - Sharon Dr.	storm sewer outlet below channel	15	SW
11	1020 E. Forest Hill Ave.	drainage blocked	16	NE
12	700 W. Ryan Rd.	frequent underpass flooding	20	SW
13	Stonegate Drainageway	houses at risk of flooding	21	NE
14	Parkway Estates & Oak View Ln.	storm sewer outlet below channel	21	SW
15	9000 S. Pennsylvania Ave.	street flooding	22	NE
16	S. 15th Ave. north of E. Ryan Rd.	street flooding and poor drainage	22	SE
17	8768 Nicholson Rd	poor drainage	22	NW
18	S. 11th Ave.-Madeira Dr. to E. Puetz Rd.	local flooding	23	NW
19	15th Ave. - STH 100 to E. Ryan Rd.	street flooding	26	NW
20	E. Ryan Rd. – Pennsylvania Ave. to west of Nicholson Rd.	street flooding	27	NW
21	9978 S. Nicholson Rd.	drainage blocked	27	NW
22	10016 S. Nicholson Rd. and 1834 E. Oakwood Rd.	drainage blocked	27	SW
23	2300 E. Oakwood Rd.	poor drainage	27	SW
24	Arthur Dr.	street flooding	28	NW
25	Ridgeview Dr.	storm sewer outlet below channel	30	NW
26	Southbranch Blvd. & Reinhart Dr.	storm sewer outlet below channel	30	NW
27	9310 S. 8th Ave.	street flooding	23	SE
28	2200 E. County Line Rd. to Nicholson Rd.	street flooding	34	SW
29	2400 to 3200 E. Oakwood Rd.	street flooding	27	SE
30	Darlene Ln.	street flooding	28	SW
31	410 E. Robert Rd.	poor drainage	28	SW
32	2200 to 2600 E. Elm Rd.	street flooding	34	SE
33	2307 E. Oakwood Rd.	poor drainage	34	NW
34	E. Elm Rd.-Chicago Rd. to Shangri La Ct.	poor drainage	35	NE-NW

Figure 3-6
Reported Flooding and Drainage Problems



Legend

— PROBLEM AREA IDENTIFIED BY CITY

---- PROBLEM AREA IDENTIFIED AT OPEN HOUSE

(31) PROBLEM I.D. NUMBER

Alternatives and recommendations for the problem areas in Table 3-11 are discussed in Chapter 6.

The second group of reported problems consisted of problems related to flooding on the main stem of Oak Creek, as shown in Table 3-12 and on Figure 3-6. These problems were referred to the Metropolitan Sewerage District to be addressed in the update of the Watercourse System Plan.

Table 3-12 Reported Flooding and Drainage Problems to Be Addressed by MMSD

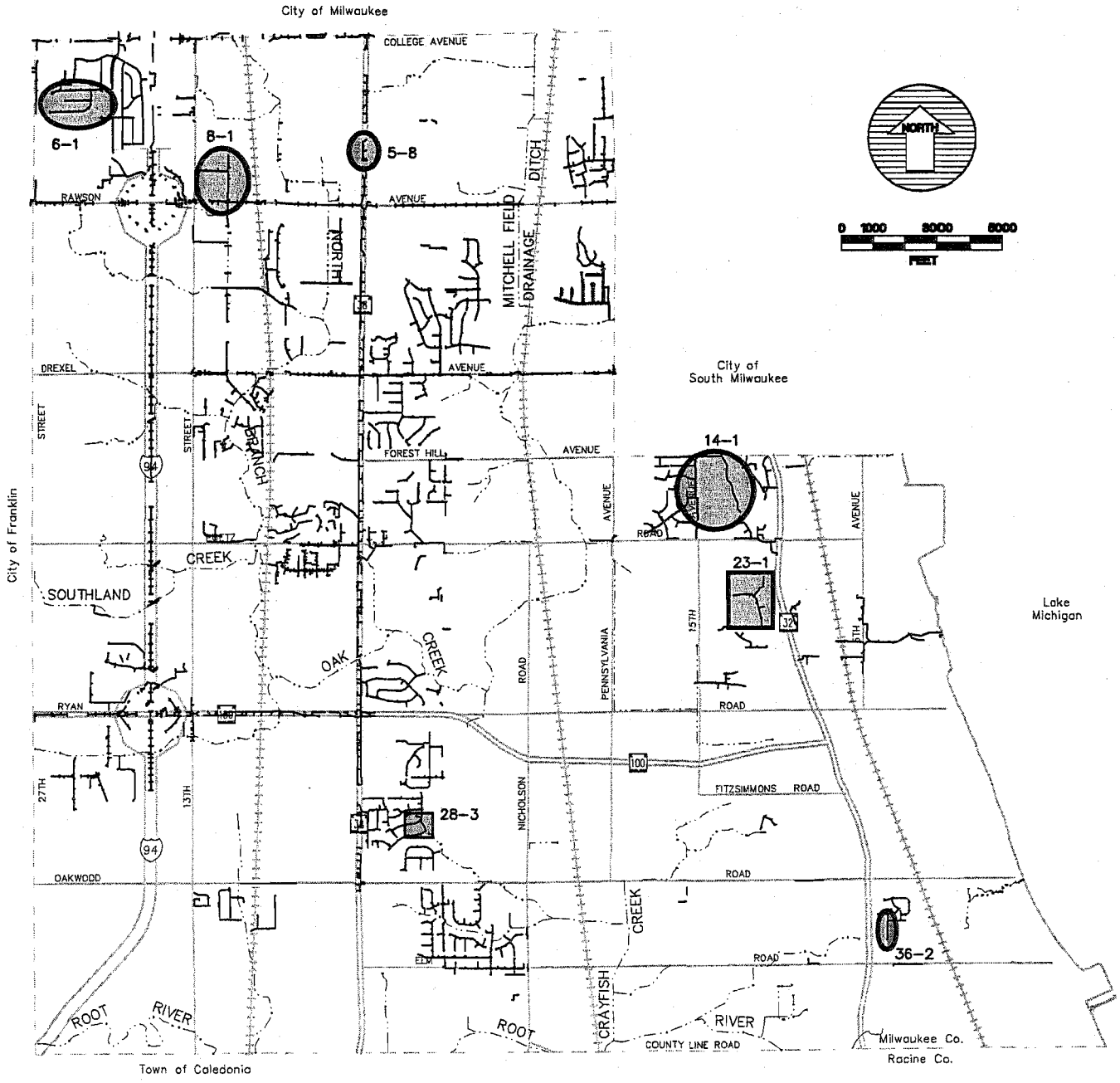
ID No.	Location	Problem	Section	Qtr Sec.
35	Wildwood Bridge	street flooding	17	NW
36	W. Weatherly Dr.	street flooding	17	NW
37	1600 block E. Forest Hill Ave.	street flooding	15	NW
38	2000 block E. Puetz Rd.	street flooding	15	NW
39	S. Wildwood and S. 6th St.	channel blocked	17	NW

The third category consisted of problems already addressed by the City and minor drainage problems being addressed by the City. These problems are listed in Table 3-13.

Table 3-13 Reported Flooding and Drainage Problems Addressed by City

Location	Problem	Section	Qtr Sec.
2330-34 E. Chestnut Dr.	drainage	3	SW
7463 S. Highfield Ct.	drainage	10	NW
3675 E. Ryan Rd.	drainage	26	N
10181 S. Nicholson Rd.	drainage & easement	27	SW
3443 E. Puetz Rd.	drainage	23	NW
10730 S. Howell Ave.	drainage	33	SW
McGraw Dr.	street flooding	33	NE
S. 4th Ave. and E. Studio Ln.	drainage	36	NW
10570 S. Chicago Rd.	drainage	36	NW
10585 S. Chicago Rd.	drainage	36	NW
drainage map correction	None	5	SE

Figure 4-4
Deficient Storm Sewer Systems



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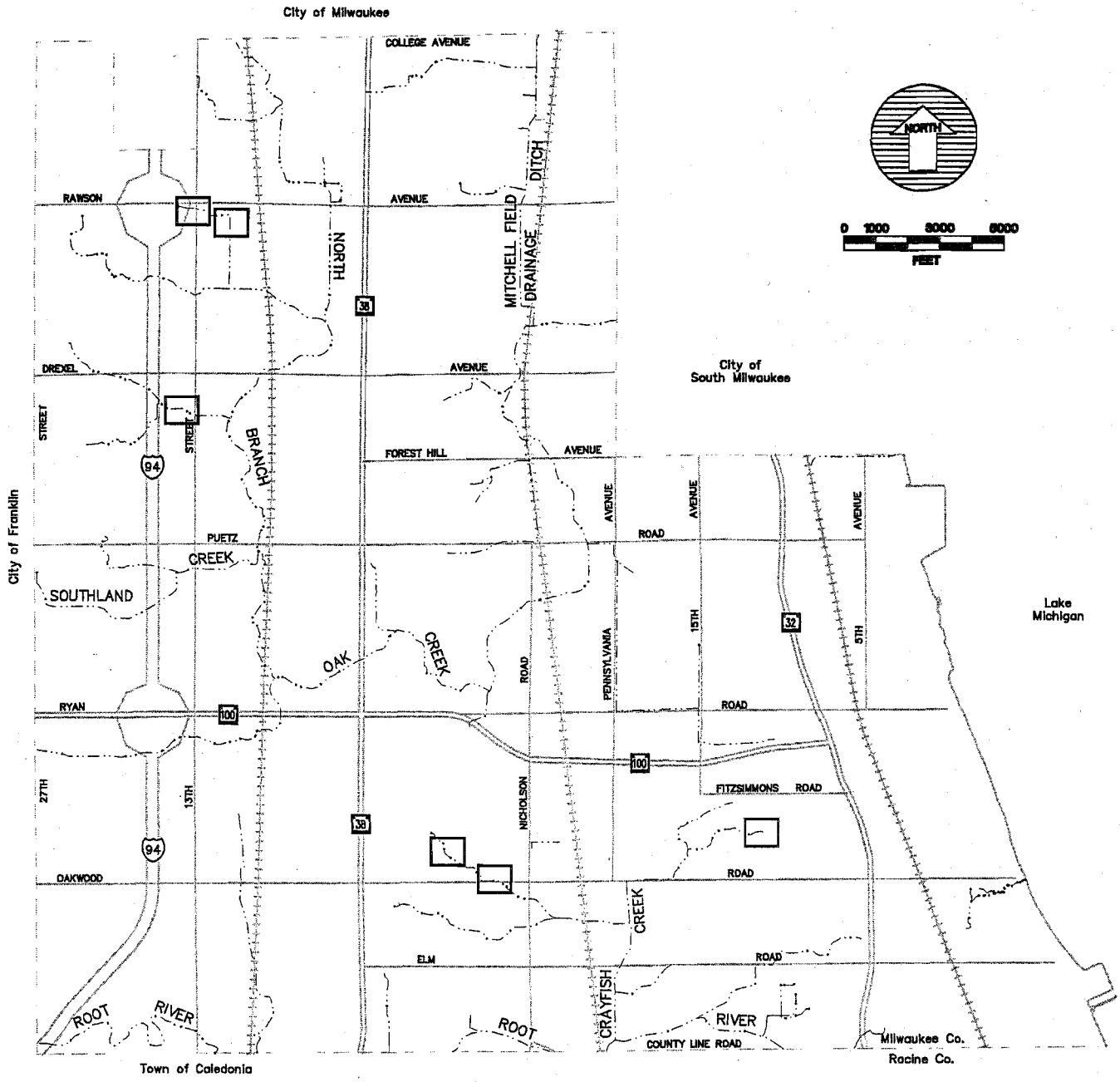
- STORM SEWER LOCATIONS
- 8-1 STORM SEWER SYSTEM NUMBER
- CAPACITY LESS THAN PEAK 10-YEAR FREQUENCY STORM FLOW
- FLOODING PROBLEM DUE TO INADEQUATE CAPACITY

Figure 4-7
Flooding Problem Areas



Appendix I

EXCERPT FROM CITY OF OAK CREEK STORMWATER MANAGEMENT MASTER PLAN DESCRIBING STORMWATER DRAINAGE AND FLOOD MITIGATION ALTERNATIVES CONSIDERED

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North Branch Oak Creek Watershed

Blocked Drainage at 6931 S. Howell Avenue – Problem 1

This drainage problem is at the confluence of Tributary N1 and the North Branch of Oak Creek. The problem area is on the east bank north of Rawson Avenue in the 100-year floodplain. The floodplain includes wetland and wooded areas. Wetlands have existed in portions of the area for several decades, based on 1976 and 1961 topographic mapping. Remnants of ditches are evident, but trees have grown and some of the ditches have been closed off. The 100-year flood stage on the North Branch covers much of the area. Additional floodplain is caused by backwater at the culvert that crosses Tributary N1 immediately upstream of its confluence with the North Branch.

Conveyance alternatives to relieve the drainage problem may be used if the area is not a regulated wetland. Areas which are not wetlands may be drained by clearing existing ditches of trees and other obstructions or adding drain tile lines or additional ditches. The boundaries of wetlands in the area should be delineated prior to initiating any drainage modifications. Drainage changes are the responsibility of the property owners.

Flooding at S. 13th Street to Pelton Drive – Problem 2

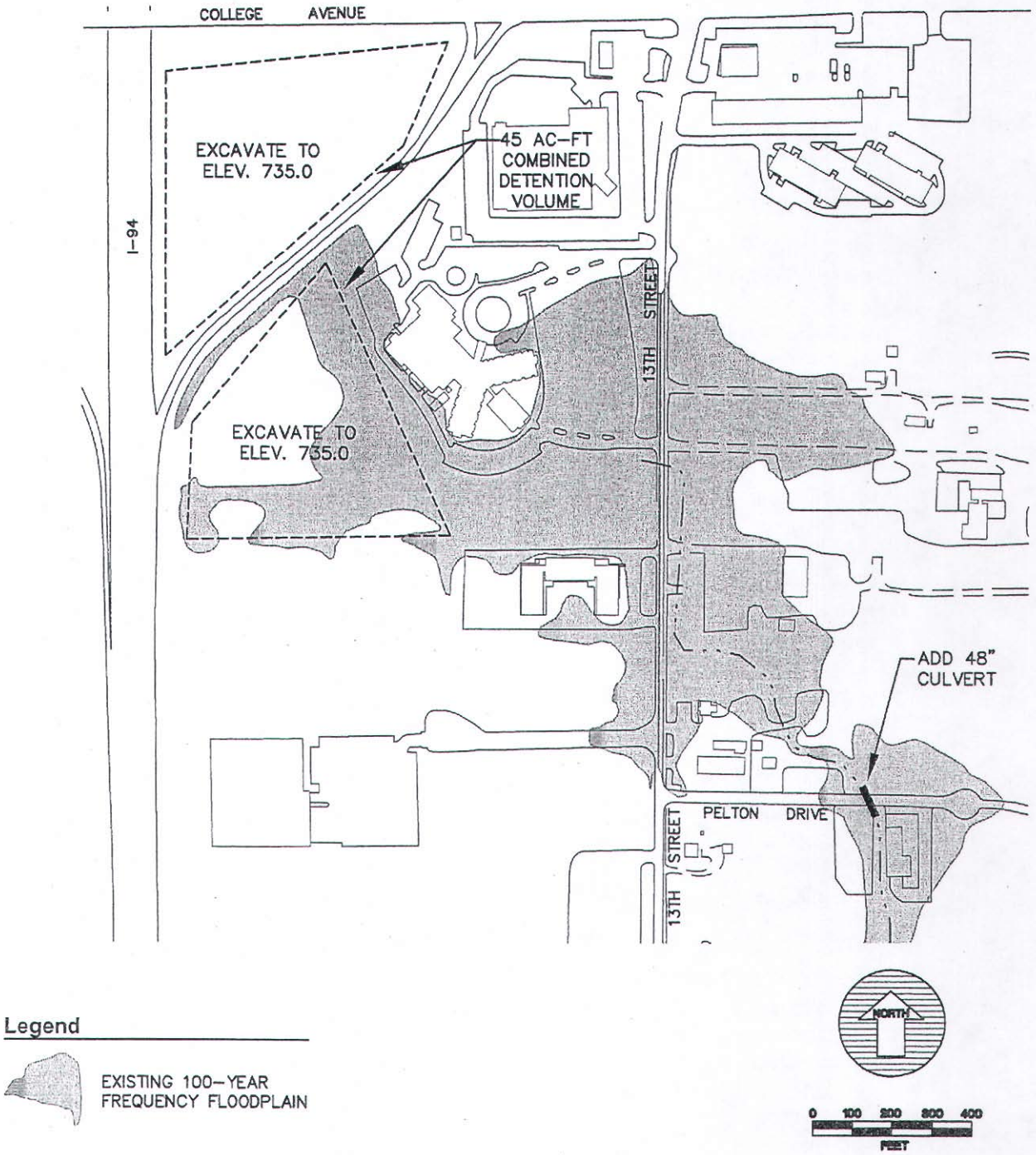
The Tributary N2 watershed is fully developed in the City of Milwaukee and nearly developed in the City of Oak Creek. Remaining development is downstream of the flooding problem areas. Therefore, flood flows cannot be reduced through detention controls on future development. The 2-year frequency storm causes overtopping at Pelton Drive, but elsewhere is within the existing channel. Larger storms cause flooding at Pelton Drive and west of S. 13th Street and affect four existing commercial buildings.

Regional Detention Alternative

Limiting flow at S.13th Street to the 2-year frequency flow rate or less would minimize the flooding problem. Two possible detention sites exist upstream of 13th Street, as shown on Figure 6-1. The southeast quadrant of the College Avenue and IH-94 interchange could be used to detain flows from the north. The land west of the Ramada Inn could be used to detain flows from the west. These two sites have a combined area of 11 acres and would provide up to 45 acre-feet of storage. Both sites would be required to avoid roadway overtopping during 10-year frequency events and to minimize flood depths on streets during 100-year frequency events.

The Pelton Drive crossing would need to be enlarged with an additional culvert pipe to provide capacity for the 2-year frequency flow under this alternative. This alternative would cost $940,000 to construct and approximately $165,000 for land. Cooperation of the Department of Transportation would be required for the detention in the interchange and land acquisition or easement would be required for the land west of Ramada. Both detention sites are in the City of Milwaukee.

Figure 6-1
Tributary N2 - Problem 2
Detention Alternative (Recommended)



Conveyance Alternative

Improving the conveyance system from S. 13th Street downstream to the railroad could mitigate flooding problems. As shown on Figure 6-2, this alternative would consist of widening and deepening the channel and replacing culverts at S. 13th Street, three private drives, and Pelton Drive. Replacement culverts would be the equivalent of concrete box culverts approximately 10 feet wide by 5 feet high. Approximately 1000 feet of channel upstream of Pelton Drive would be lowered as much as one foot and approximately 1500 feet of channel downstream of Pelton Drive would be lowered as much as two feet. The channel top width would be approximately 50 feet or less with a bottom width of 8 feet and 3 horizontal to 1 vertical sideslopes. The channel would be turf with a natural low flow channel within the bottom. Acquisition or easements would be required for 3 acres from Pelton Drive to S. 13th Street. This alternative would cost $1,215,000 to construct and approximately $45,000 for land.

Flooding at S. 20th Street and Drexel Avenue - Problem 3

Flooding occurs on Tributary N7 at the Drexel Avenue and S. 20th Street crossings because the roads are low relative to downstream flood elevations. The stream channel controls the downstream flood elevations for 10-year frequency and smaller storm events. The first downstream private driveway crossing about 550 feet east of S. 20th Street controls flood stages in larger events. During a 100-year frequency event, the driveway causes backwater approximately two feet above Drexel Avenue and S. 20th Street, and creates substantial detention storage north of Drexel Avenue (in Falk Park) and southwest of the intersection of Drexel Avenue and S. 20th Street.

If roadway overtopping during events larger than the 10-year frequency is not tolerable, the solution must address the downstream driveway crossing. Because these are collector streets that could be flooded during severe events, alternatives for the 10-year frequency event are presented.

On-Site Detention Alternative

Upstream of 20th Street the watershed has approximately 105 acres of land, or 34 percent of the tributary area, available for development. On-site detention is not feasible because the amount of developable land in the upstream watershed is insufficient to effect a reduction in the downstream flows. With zero runoff from the developable land, the 10-year frequency flow at the problem area is still three times the available capacity.

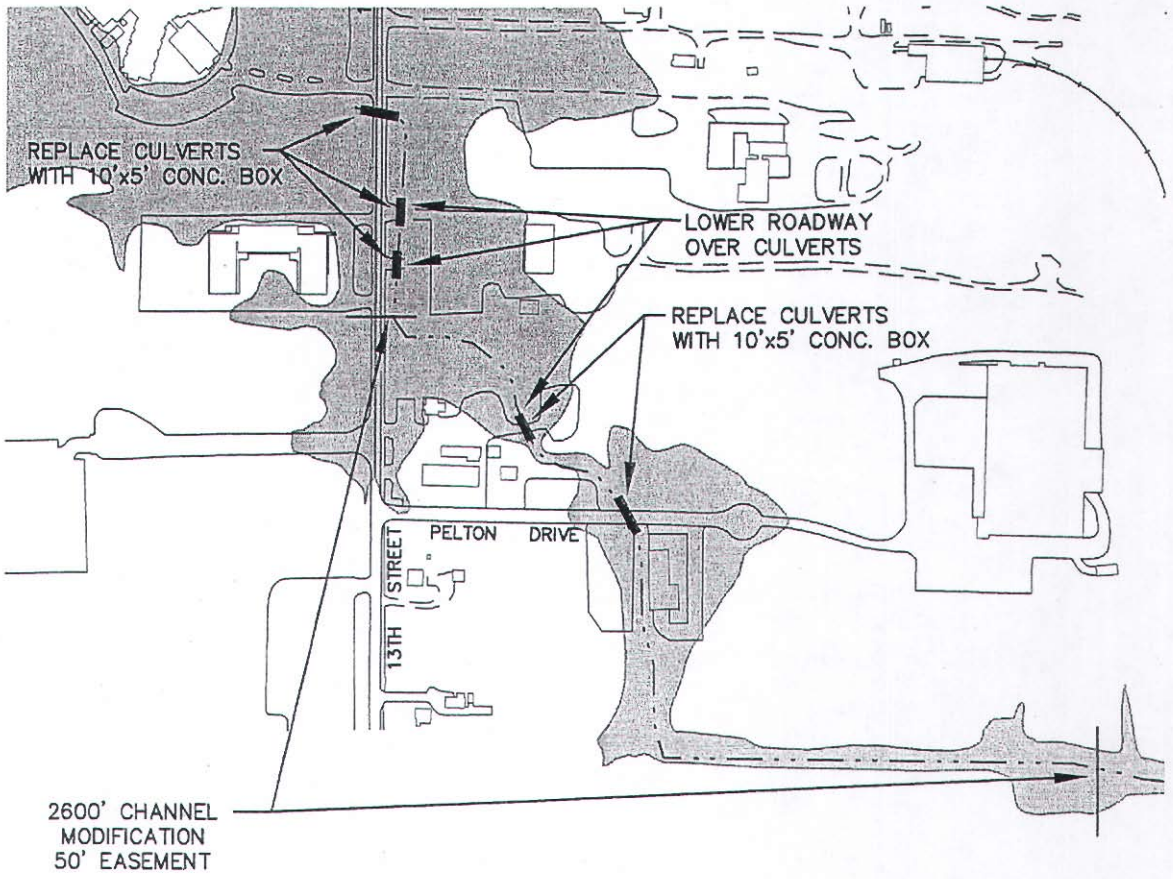
Regional Detention Alternative

To mitigate flooding of Drexel Avenue and S. 20th Street with only detention would require sufficient storage upstream of Drexel Avenue to reduce the flow to about 60cfs. This degree of detention would require substantial excavation in Falk Park and is not considered practicable.

Conveyance Alternative

Adding culverts at Drexel Avenue and at S. 20th Street would not reduce road overtopping unless the capacity of the downstream private driveway crossing would also be increased. Enlarging the driveway culvert would increase the downstream flows for events greater than the 10-year and worsen downstream flooding. Substantial volumes of natural detention storage exist upstream of Drexel Avenue and upstream of S. 20th Street. These storage areas reduce the downstream flows and should be retained. The private driveway and culvert should be maintained in place through an easement or other mechanism.

Figure 6-2
Tributary N2 - Problem 2
Conveyance Alternative



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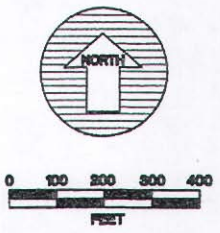
EXISTING 100-YEAR
FREQUENCY FLOODPLAIN



Flood Protection Alternative

Raising Drexel Avenue and S. 20th Street to elevation 715.0 would prevent road overtopping during 10-year frequency storm events and decrease the depth over the road for the 100-year event to about 0.5 foot. Downstream flows would not increase during the 100-year frequency event. Additional culverts under Drexel Avenue west of S. 20th Street would be required to equalize the natural detention storage on the north and south sides of the street. The 100-year frequency flood elevations are a result of backwater from the downstream private drive and would not be changed significantly. As shown on Figure 6-3, approximately 800 feet of Drexel Avenue and 200 feet of S. 20th Street would be raised. The private driveway and culvert should be maintained in place through an easement or other mechanism. The estimated total construction cost of this alternative is $201,000 and $10,000 for easements..

Lack of Easement at 7538 S. 13th Street - Problem 4

Tributary N5 crosses this property after flowing in an east-northeasterly direction from the culvert beneath S. 13th Street. The stream is approximately 70 feet outside of the drainage easement boundaries for a distance of approximately 250 feet. The floodplain boundaries extend beyond the existing drainage easement.

To allow the City access to maintain the stream, the easement boundaries should be revised to coincide with the actual stream location.

An alternative would be to relocate the stream to be within the easement. This would require that the culvert crossing S. 13th Street be relocated approximately 200 feet north. The stream would have to be relocated similarly on the west side of S. 13th Street to match the culvert location. Milwaukee County is designing a replacement for this culvert. This alternative was suggested by the City and rejected by the property owner.

Storm Sewer at Marquette Avenue – Problem 5

The outlet pipes of storm sewer systems 8-7 and 8-8 are approximately 0.3 feet below the streambed at this location. The capacity analysis indicates that the systems have sufficient capacity to convey 10-year recurrence interval flows. The analysis assumes that the outlet pipes are clear of sediment and debris. Therefore, periodic maintenance is necessary to ensure that the predicted capacity is available.

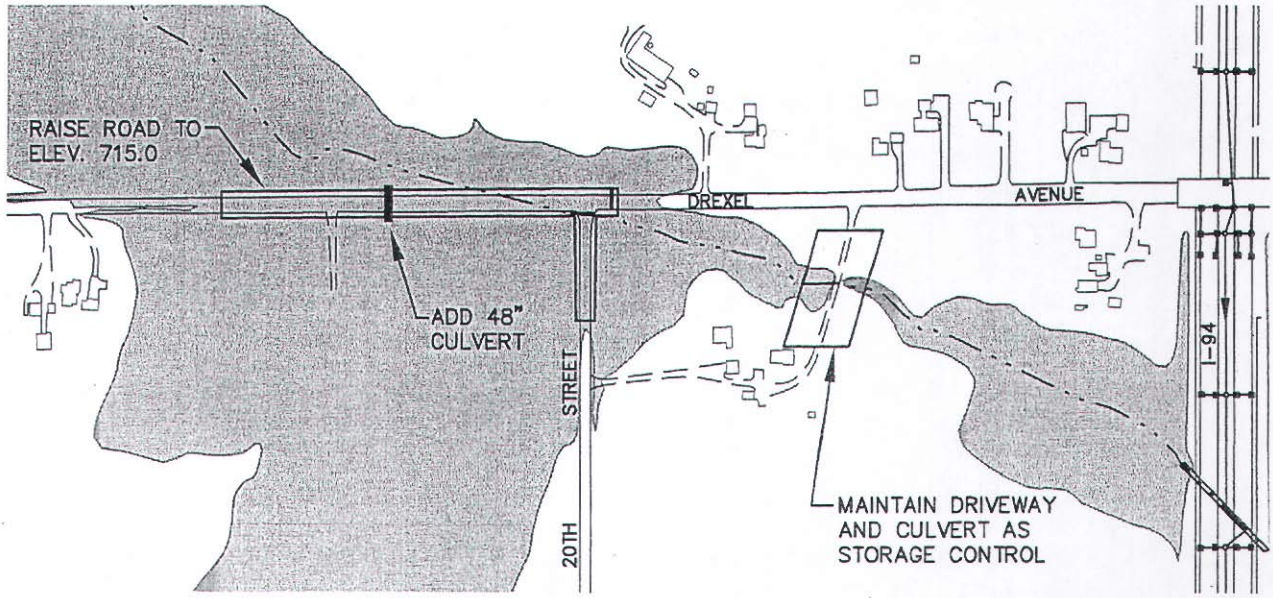
Storm Sewer at Wildwood Drive - Problem 6

The outlet pipe of storm sewer system 17-2 is approximately 0.2 feet below the streambed between Drexel Avenue and Wildwood Drive. The capacity analysis indicates that the storm sewer system has sufficient capacity to convey the peak 10-year recurrence interval flow without surcharging. The analysis assumes that the outlet pipes are clear of sediment and debris. Therefore, periodic maintenance is necessary to ensure that the predicted capacity is available.

Street flooding in 2000 Block of W. Puetz Road – Problem 7

The City addressed flooding over W. Puetz Road in 1998 by installing a 57" x 38" culvert, in addition to the existing 42" x 29" culvert, and raising the road 0.5 feet. In addition, a detention facility was constructed immediately upstream in conjunction with the Apple Creek Subdivision.

Figure 6-3
Tributary N7 - Problem 3
Flood Protection Alternative (Recommended)



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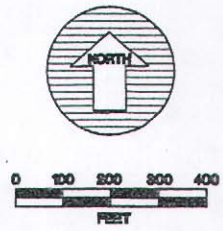
EXISTING 100-YEAR
FREQUENCY FLOODPLAIN



Mitchell Field Drainage Ditch Watershed

Sewer surcharging at 7289 S. Quincy Avenue – Problem 8

Runoff from the agricultural field west of S. Quincy Avenue reportedly surcharges storm sewer system 9-1. The capacity analysis indicates that the storm sewer system has sufficient capacity to convey 10-year recurrence interval flows without surcharging at the manholes. Surcharging may occur at the yard inlets along the sewer. Runoff from the agricultural field may not be adequately directed into the storm sewer and therefore flow into the backyards. There does not appear to be either an easement or a defined overflow route west of Quincy Avenue for flows that exceed the storm sewer capacity. The City should obtain an easement for the storm sewer.

Alternative solutions would be increasing the size of the storm sewer system, grading an overflow swale, or upstream detention to reduce the peak flows. With any alternative, grading to create a diversion berm or swale along the east border of the field is recommended to direct runoff to the storm sewer.

Regional Detention Alternative

A detention basin could be constructed west of the inlet, possibly as part of future land development activities. The detention facility design should also address overflow during storms larger than the design frequency. Detention would provide the additional benefit of reduced peak flows downstream into storm sewer system 9-2. This alternative would cost approximately $50,000 to construct and acquisition of approximately 2 acres of land would be required at a cost of $30,000.

Conveyance Alternatives

Enlarging the storm sewer would require replacing approximately 900 feet of pipe from the inlet, west of S. Quincy Avenue to the outlet at S. Shepard Avenue. This alternative would cost $545,000 to construct.

Constructing an overflow swale between the houses west of Quincy Avenue would direct excess runoff to the street where it would flow south and east. The grading for a swale would alter the landscape of two developed lots. This alternative would cost $21,000 to construct and would require a 30-foot wide easement. The $1,500 easement would cover the existing storm sewer and the overflow swale.

Basement flooding at 7152 S. Taylor Avenue – Problem 9

The drainage system in the problem area consists of roadside ditches and culverts beneath driveways and roads. The problem area is at the low point in the street on the southeast corner of S. Taylor Avenue and E. Missouri Avenue. The ditch does not have an adequate outlet to the north or to the west. The natural drainage route from the corner is toward the southeast.

Detention Alternative

A detention facility at the west end of Missouri Avenue to control runoff from the agricultural field may benefit the problem area. However, it would address less than half of the tributary drainage area and would not be expected to solve the problem. Detention is not a feasible alternative for this problem.

Conveyance Alternative

Constructing a swale toward the southeast along the property line would accommodate runoff in the natural flow direction. There is sufficient elevation difference to drain the roadside ditch toward the rear lot line over a distance of less than 200 feet. The swale would be 2 to 3 feet deep and would require an easement. This alternative would cost $14,000 to construct and an easement at a cost of approximately $2,000.

Oak Creek - Main Stem Watershed

Storm Sewer at E. Puetz and Pennsylvania Avenue – Problem 10

The outlet pipes of storm sewer systems 15-5 and 15-6 are reported to be below the streambed. Based on the available information, the outlet pipes are more than 1 foot above the Oak Creek streambed at this location. The capacity analysis indicates that the systems have sufficient capacity to convey 10-year recurrence interval flows. The analysis assumes that the outlet pipes are clear of sediment and debris. Therefore, periodic maintenance is necessary to ensure that the predicted capacity is available.

Blocked Drainage at 1020 E. Forest Hill Avenue – Problem 11

The driveway culvert discharges to a low area that is higher than the Oak Creek Tributary O19A floodplain. The low area appears to be formed by a natural depression and swale.

Conveyance alternatives to relieve the drainage problem may be used if the area is not a regulated wetland. Areas that are not wetlands may be drained by adding drain tile lines or additional ditches. Drainage changes are the responsibility of the property owners.

Road Flooding at 700 W. Ryan Road (STH 100) – Problem 12

The railroad underpass is subject to frequent flooding. The underpass is drained by a storm sewer system to the Oak Creek. High stages on the creek prevent drainage from the underpass. Creek waters also backup through the storm sewer and cause prolonged flooding of Ryan Road as long as the creek stages are high. The low point in Ryan Road is approximately 3 feet below the 10-year frequency flood stage and 4 feet below the 100-year frequency flood stage on the creek.

Detention Alternative

The capacity of the pumping station could be reduced if the stormwater was routed to a detention basin prior to pumping. However, such a detention basin would have to be lower than the road and would require substantial overburden excavation to achieve storage at this low elevation. The land requirement and the excavation requirement make this alternative infeasible.

Conveyance Alternative

To mitigate the problem it would be necessary to disconnect the storm sewer system from the creek. This would require a pumping station on the storm sewer to lift stormwater into the creek. The 73-acre drainage area to the underpass would require a pumping station with a capacity of approximately 50cfs to handle a 10-year frequency storm event without flooding. During less frequent, more severe, storm events, short-duration temporary flooding of the underpass would be expected to continue to occur. This alternative would cost $733,000 to construct. There would also be significant operation and maintenance costs. Resolution of this problem must involve the Wisconsin Department of Transportation.

Note: After preparation and review of the draft report, MMSD initiated design and construction of the conveyance alternative to address the road flooding problem on Ryan Road.

Flooding in Stonegate Estates, south of E. Puetz Road – Problem 13

Several houses and a portion of Stonegate Drive along Tributary O19A are subject to flooding caused by limited downstream culvert capacity and the lack of an overflow route. The existing culverts and roadside ditch along the north side of Puetz Road are adequate for 2-year frequency flows. Larger storms cause driveway overtopping and the elevation of Puetz Road causes flooding in the Stonegate subdivision.

Detention Alternatives

The upstream watershed is fully developed and there are no sites to construct detention facilities with sufficient storage capacity upstream of the problem area.

Conveyance Alternative

As shown on Figure 6-4, additional conveyance could be provided along the south side of Puetz Road for major storms. This alternative would consist of removing the culvert crossing south of Puetz Road and grading the abandoned railroad right-of-way embankment to allow flow toward the east along the south side of Puetz Road. The low area south of Puetz Road would convey flow toward Nicholson Road. Approximately 400 feet of Puetz Road would be lowered to allow flow over the road to the north during major storms. A new culvert beneath Puetz Road would drain the overflow route south of Puetz Road. An easement would have to be obtained from Milwaukee County for crossing the abandoned railroad right-of-way where a bike trail is being planned. This alternative would cost $299,000 to construct, and approximately $5,000 for land easements.

Storm Sewer at Parkway Estates and Oak View Lane – Problem 14

The outlet pipe of storm sewer system 21-9 is reported to be below the streambed. Based on the available information, the outlet pipe is approximately 0.9 feet above the streambed. The capacity analysis indicates that the storm sewer system has sufficient capacity to convey the peak 10-year recurrence interval flow without surcharging. The analysis assumes that the outlet pipes are clear of sediment and debris. Therefore, periodic maintenance is necessary to ensure that the predicted capacity is available.

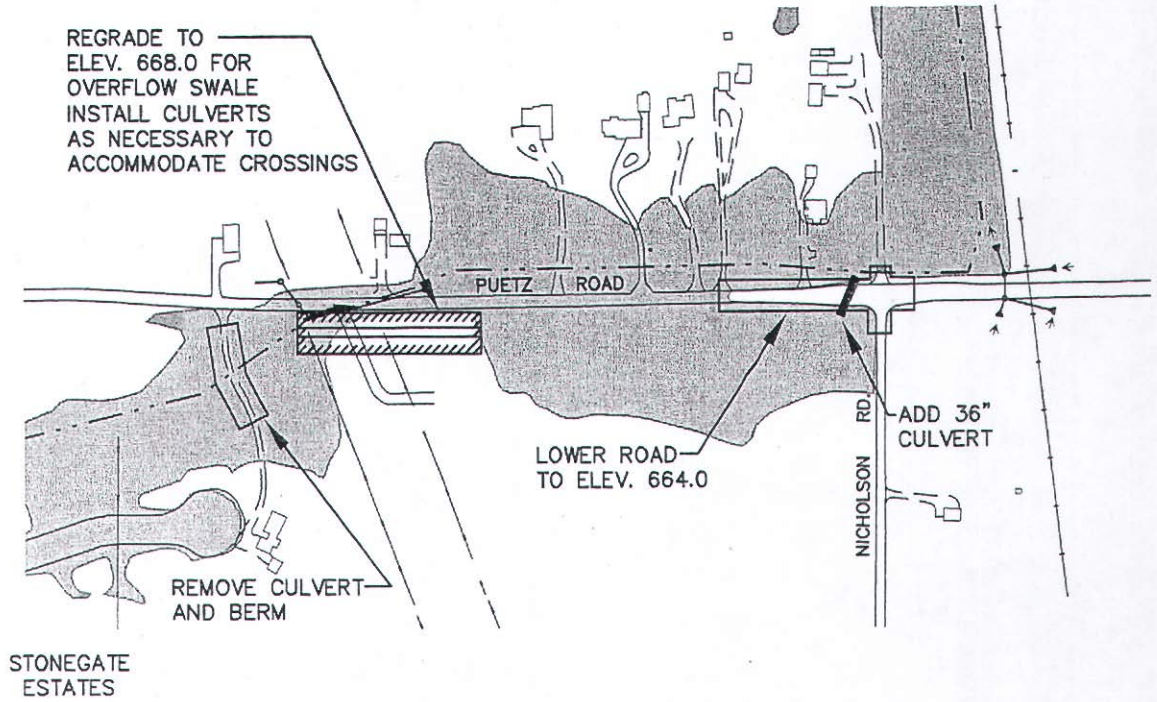
Flooding at 9000 S. Pennsylvania Avenue – Problem 15

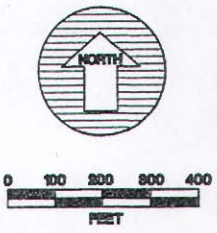
Road flooding along Tributary O16 will be mitigated by reconstruction of the road in 2000. The City intends to consolidate the drainage ditches to the west side of the road. The ditch along the east side of the road would be eliminated. Cross culverts would be placed at the locations of swales on the east side of the road. This design was evaluated in the hydrologic-hydraulic analysis and found to be adequate to address drainage needs and minimize road flooding.

Flooding of S. 15th Avenue north of E. Ryan Road – Problem 16

Development of Hidden Ponds subdivision reportedly increased the flow in Tributary O17 along S.15th Avenue, causing road flooding, washed out driveway culverts, and safety concerns. The City designed and constructed a detention facility to mitigate the problems. This design was evaluated in the hydrologic-hydraulic analysis. With the detention basin, the peak flows reaching S.15th Avenue are approximately 65 percent of the flows without the detention. However, the ditch and culverts along S.15th Avenue are insufficient to carry the projected 2-year frequency flows.

Figure 6-4
Tributary O19A - Problem 13
Conveyance Alternative (Recommended)





Additional conveyance capacity is needed to supplement the detention at Hidden Ponds subdivision. As shown on Figure 6-5, four additional culverts north of Woodview Avenue with diversion swales would direct stormwater flow toward the west. Approximately 1 acre for drainage easements would be needed. This alternative would cost $203,000 to construct and $15,000 in land costs.

Drainage at Puetz Road and Nicholson Road – Problem 17

This problem is caused by the lack of depth in the ditch between Puetz Road and the Oak Creek along the west side of the railroad, east of Nicholson Road. Lowering the ditch bottom would not be expected to lower the flood stages along this tributary. Backwater from the E. Forest Hill Avenue crossing extends upstream to Puetz Road. The E. Forest Hill Avenue culvert has capacity for the 10-year frequency flows without overtopping.

Conveyance Alternative A

The culverts along E. Puetz Road and at E. Forest Hill Avenue are approximately two feet lower than the ditch elevation. Apparently there is an underground utility cable that has prevented the ditch from being lowered. Lowering the ditch bottom approximately 2.5 feet along the 2750-foot long route from Puetz Road north to Forest Hill Avenue, as shown on Figure 6-6, would mitigate the poor drainage problem. This ditch appears to be within the railroad right-of-way and approval from the railroad would be required. This alternative would cost $384,000 to construct, excluding unusual utility relocation costs. Land costs would be approximately $48,000 for 3.2 acres.

The utilities in conflict with lowering the ditch bottom should be specifically identified and utility relocation alternatives should be evaluated during the preliminary engineering design. If deepening the existing ditch is not permitted by the railroad, a new channel in a new easement on adjacent properties would be required at a much greater construction cost.

Conveyance Alternative B

An alternative outlet from the intersection of E. Puetz Road and S. Nicholson Road would be toward the east rather than to the north as shown on Figure 6-6. An east outlet would be a shorter distance to the Oak Creek, by approximately 1400 feet. Although the flood stages in the creek at E. Puetz Road are approximately 0.8 feet higher than at the existing outlet north of E. Forest Hill Avenue, this would be offset by a shorter channel and larger culvert. The east route would require a new culvert beneath the railroad and a channel along the north side of Puetz Road. Railroad approval for a new pipe crossing would be required. There are no permanent driveways or structures in the route. The utility cable discussed above may also influence this alternative. This alternative would cost $383,000 to construct, excluding unusual utility relocation costs. Land costs would be $23,000 for approximately 1.5 acres.

Storm Sewer in S. 11th Avenue south of E. Puetz Road – Problem 18

The west ditch along S. 11th Avenue has been enclosed over time with 21-inch diameter corrugated metal pipes causing local flooding, especially near E. Puetz Rd. The City has considered replacing this system with a 54" sewer.

Conveyance Alternative

The capacity analysis indicates that the proposed 54-inch diameter storm sewer system would have sufficient capacity to convey the peak 10-year recurrence interval flows without surcharging. This conveyance alternative would cost $500,000 to construct.

Figure 6-5
Tributary O17 - Problem 16
Conveyance Alternative (Recommended)

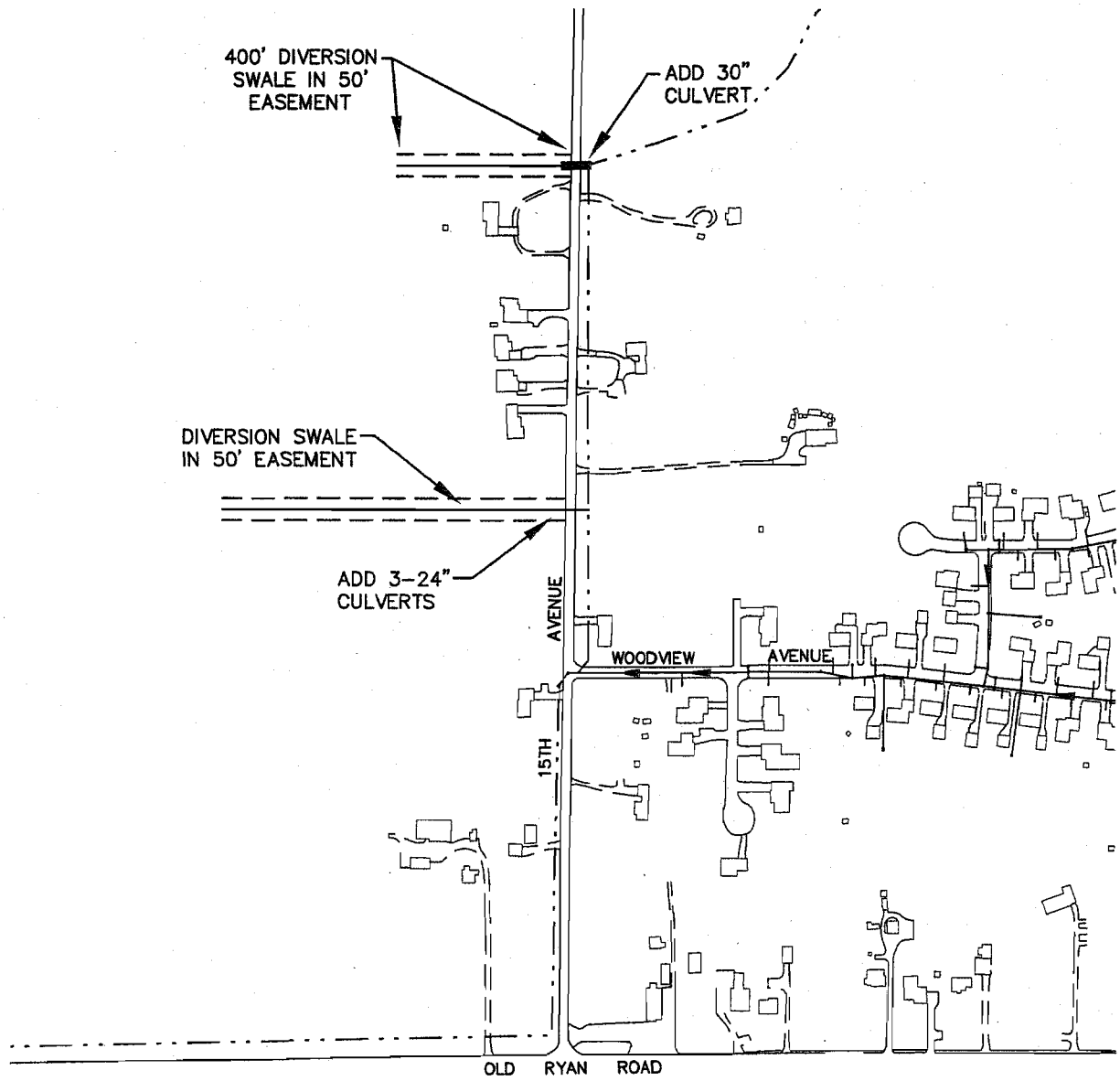
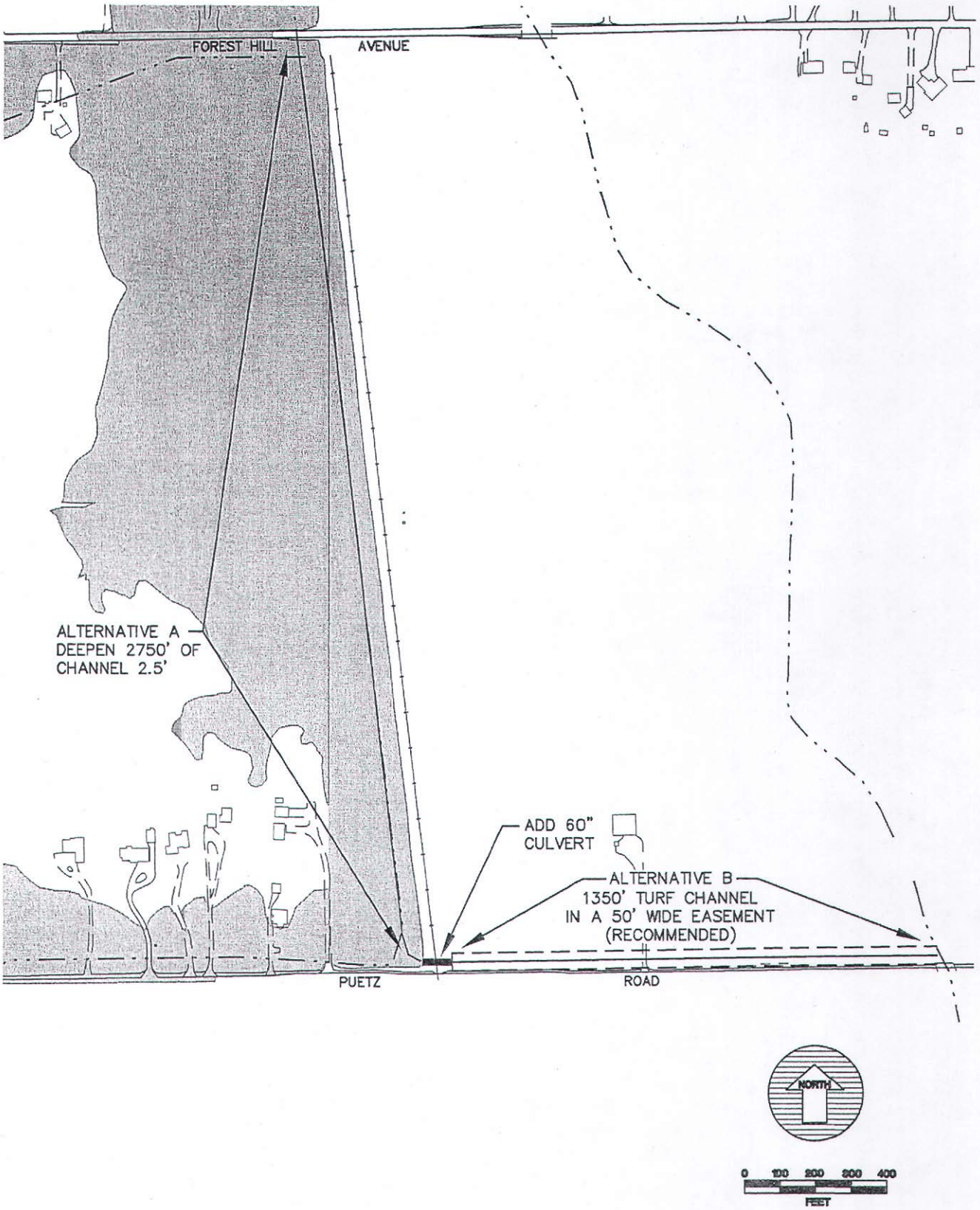


Figure 6-6
Tributary O19A - Problem 17
Drainage Alternative



Flooding at S. 15th Avenue south of E. Ryan Road – Problem 19

The City reports that the road floods along Tributary O16 due to lack of conveyance from the east side to the west side of the road. The analysis indicates that a 3-foot x 4-foot box culvert should be added approximately 500 feet south of E. Ryan Road. This alternative would cost $75,000 to construct.

Flooding along E. Ryan Road, Pennsylvania to Nicholson Avenue – Problem 20

The road is approximately at elevation 665.7 to 666 feet. The 100-year frequency flood stage is 667.2 and the 10-year frequency flood stage on Oak Creek is 666.1. The only solution to the problem is to raise the road and provide adequate culverts to convey the flow without increasing the upstream stage. The three culverts crossing this road are adequate. Approximately 4000 feet of road would need to be raised ½ to 1 foot to elevate the road above the 10-year recurrence interval flood stage. This construction is estimated to cost $622,000.

Blocked Drainage at 9978 S. Nicholson Road – Problem 21

This property drains toward the east, to a ditch along the east side of the railroad. The railroad ditch appears to drain to the north toward the Oak Creek. The ditch drains to the north through a culvert beneath STH 100 and also drains east through a culvert beneath the railroad. This area is within the 10-year recurrence interval floodplain of Oak Creek. There does not appear to specific blockage, which if removed would improve the drainage in this area.

The ditch and culverts beneath the railroad could be surveyed to determine if dredging would improve the flow of surface water. The boundaries of wetlands in the area should be delineated prior to initiating any drainage modifications. Permits must be obtained from the U.S. Army Corps of Engineers for drainage of regulated wetlands. Drainage changes are the responsibility of the property owners.

Blocked Drainage 10016 S. Nicholson Road and 1834 E. Oakwood Road – Problem 22

This problem was reportedly attributed to an uncompleted drainage ditch and sediment in the ditch and culverts along Oakwood Road. The hydrologic analysis concluded that this area is at the southern boundary of the Oak Creek watershed, although it may drain toward Crayfish Creek under some conditions. The area is quite flat and contains numerous wetlands.

To address the reported problems, the City should determine if a drainage easement exists on this property and return full rights to the property owner if the easement is not needed. The ditch and culverts along Oakwood Road could be surveyed to determine if dredging would improve the flow of surface water from agricultural lands or wetlands. Permits must be obtained from the U.S. Army Corps of Engineers for drainage of regulated wetlands. The boundaries of wetlands in the area should be delineated prior to initiating any drainage modifications. Drainage changes are the responsibility of the property owners.

Blocked Drainage 2300 E. Oakwood Road – Problem 23

The reported problem consists of increased flooding and worsening drainage over the past 25 years due to STH 100 construction and lack of ditch maintenance along Pennsylvania Avenue. This area is at the southern boundary of the Oak Creek watershed, although it may drain toward Crayfish Creek under some conditions. The area is quite flat and contains numerous wetlands. The ditch and culverts along Oakwood Road should be surveyed to determine if dredging would improve the flow of surface water from agricultural lands or wetlands. Permits must be obtained from the U.S. Army Corps of Engineers for drainage of regulated wetlands. The boundaries of wetlands in the area should be delineated prior to initiating any drainage modifications. Drainage changes are the responsibility of the property owners.

Storm Sewer Outlet at Arthur Drive – Problem 24

The outlet pipe of storm sewer system 28-2 is back-pitched and is approximately 2.8 feet below the grade of the receiving wetland at the headwater of Tributary O11. The capacity analysis indicates that the storm sewer system has sufficient capacity to convey the peak 10-year recurrence interval flow without surcharging above the street. The analysis assumes that the outlet pipes are clear of sediment and debris. Therefore, periodic maintenance is necessary to ensure that the predicted capacity is available.

Relaying the outlet pipe with a positive gradient to the channel invert would require extending the 30-inch storm sewer approximately 1450 feet. As shown on Figure 6-7, the storm sewer route would be north along Shepard Avenue approximately 750 feet and then east 700 feet. A 0.32 acre easement would be needed for the east segment. This alternative would cost $632,000 to construct. Land costs would be $5,000.

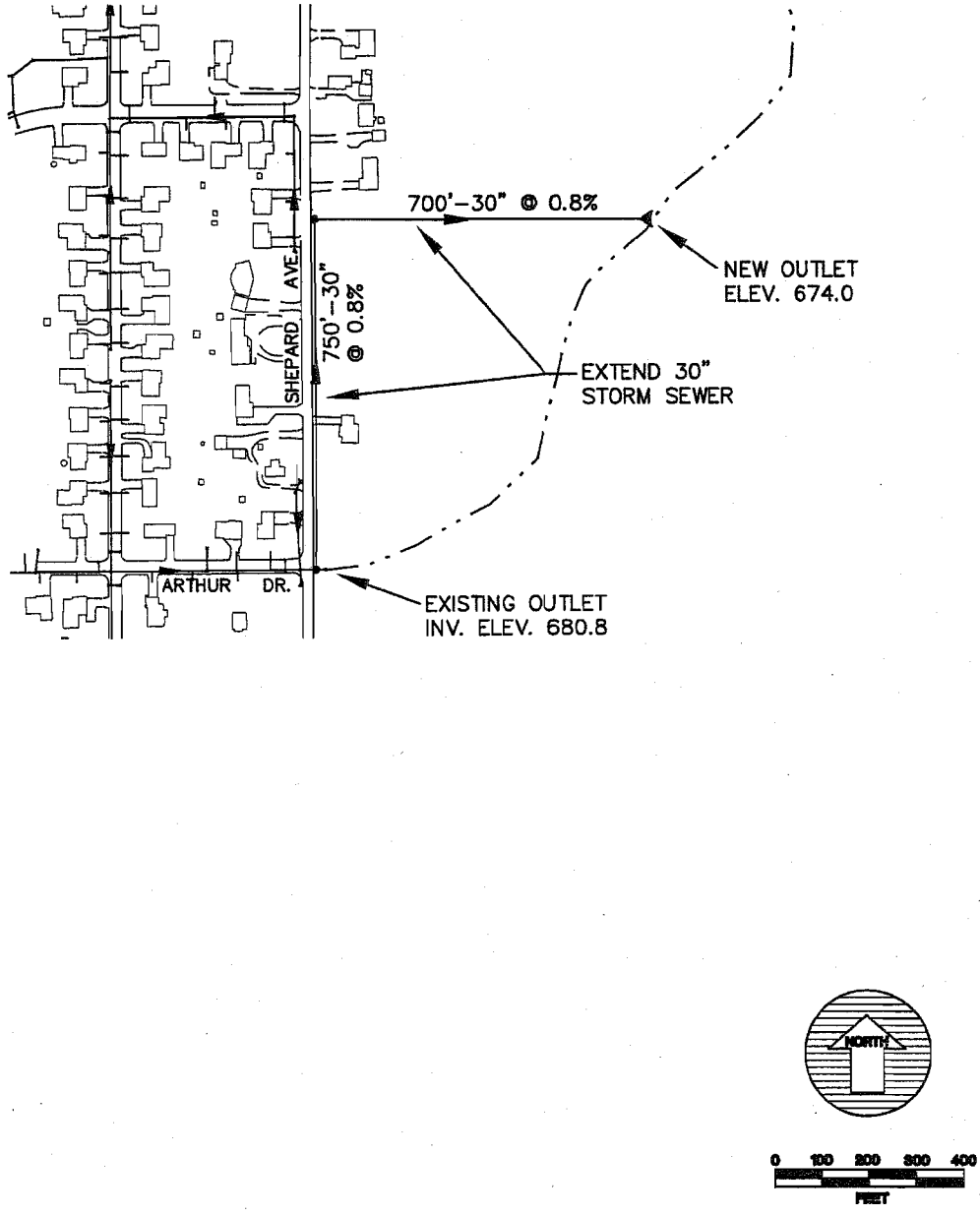
Storm Sewer at Ridgeview Drive – Problem 25

The outlet pipe of storm sewer system 30-9 is approximately 1.7 feet below the channel streambed. The capacity analysis indicates that the storm sewer system has sufficient capacity to convey the peak 10-year recurrence interval flow without surcharging. The analysis assumes that the outlet pipes are clear of sediment and debris. Therefore, periodic maintenance is necessary to ensure that the predicted capacity is available. Relaying the outlet pipe with a positive gradient to the channel invert may be necessary to avoid frequent maintenance.

Storm Sewer at Southbranch Blvd. and Reinhart Drive – Problem 26

The outlet pipe of storm sewer system 30-6 is reported to be below the streambed. Based on the available information, the outlet pipe is approximately 0.4 feet above the streambed. The capacity analysis indicates that the storm sewer system has sufficient capacity to convey the peak 10-year recurrence interval flow without surcharging. The analysis assumes that the outlet pipes are clear of sediment and debris. Therefore, periodic maintenance is necessary to ensure that the predicted capacity is available.

Figure 6-7
Tributary O11
Conveyance Alternative



Lake Michigan Watershed

Runoff to Street at 9310 S. 8th Avenue – Problem 27

This problem was reported to be sediment and runoff onto 8th Street caused by grading changes on the property south of the end of 8th Street. Runoff from the area previously drained to the east and not toward the street. The site grading should be corrected to maintain this flow direction. Erosion control measures should be used by the property owner to prevent sediment discharge from the site.

Root River Watershed

Flooding of County Line Road east of Nicholson Road – Problem 28

County Line Road is approximately at elevation 665.6. The 10-year frequency flood stage on the Root River is 667. The only solution to the problem is to raise approximately 2200 feet of the road approximately 1.5 to 2 feet. This construction is estimated to cost $384,000. Right-of-way acquisition from Milwaukee County may be required depending on the road width and the right-of-way boundaries.

Root River – Crayfish Creek Subwatershed

The remaining problems are related to drainage and street flooding at road crossings in the Crayfish Creek watershed. Some of these problems were addressed in a previous study, Stormwater Management Plan for the Crayfish Creek Subwatershed (Southeastern Wisconsin Regional Planning Commission, 1988). A subsequent letter report to the City of Oak Creek and Milwaukee County addressed specific problems in greater detail (Southeastern Wisconsin Regional Planning Commission, 1994). These previous analyses and drainage recommendations were reviewed and generally found to be sound.

Flooding at E. Oakwood Road Crossing – Problem 29

The previous study hydraulic analysis indicates that the Oakwood Road crossing of Crayfish Creek is above the 100-year recurrence interval floodplain under existing and future watershed conditions. If the actual conditions differ from the analysis and road flooding occurs, the only feasible solution is to raise the road and provide adequate culverts to convey the flow without increasing the upstream stage. Additional field survey and analysis beyond the scope of this plan is needed to determine the extent of this solution.

Flooding at Darlene Lane– Problem 30

The outlet pipe of storm sewer system 28-3 is approximately 5.7 feet below the channel streambed at Tributary C1. This sewer system drains the Shepard Hills Subdivision at S. Darlene Lane and S. Robert Court. Part of the capacity problem is an undersized, back-pitched portion of storm sewer at the outlet of the system. The 66-inch storm sewer connects to a 50-foot long section of 54-inch corrugated metal pipe (CMP) at the outlet. The outlet section is back-pitched to meet the existing open channel. This situation results in sewer backup and subsequent street and yard flooding during frequent storm events.

During this study, the City requested early consideration of mitigation measures for this problem area. A safe overland flow route was recommended for water from S. Darlene Lane during storms that exceed the capacity of the storm sewer system. The existing topography causes ponding on Darlene Lane in excess of 3 ft. deep before water can overflow from the street. An overflow route beginning at the top of the curb and extending to the ditch south of E. Oak Lane would reduce the potential ponding depth on Darlene Lane to less than 2 feet during a 100-year recurrence interval storm. The existing 20 ft. wide easement is sufficient to create an overflow from Darlene Lane to Oak Lane. An additional easement would be required for the swale from the north side of Oak Lane to the ditch.

The City constructed an overflow between the house and driveway using a culvert in 1998.

Two alternatives are available to address the problem of the back-pitched storm sewer outlet. Alternative A would consist of increasing the 50-foot section of outlet storm sewer from a 54-inch to a minimum 66-inch pipe. The pipe would need to be inspected annually and cleaned out whenever sediment exceeds 1 foot, to maintain capacity. This alternative would reduce the existing elevations by approximately 0.5 feet and would eliminate surface flooding at S. Darlene Lane during a 10-year recurrence interval, 1-hour duration storm event. The estimated construction cost is $15,000 for this alternative.

Alternative B would consist of replacing the 54-inch outlet pipe with 66-inch RCP as in Alternative 1 and cleaning out the channel from the storm sewer outlet to Shepard Avenue and implementing routine maintenance program of removing nuisance vegetation from the new channel. This would lower the channel elevation at the outlet by about 2.3 feet, allowing for less back-pitch on the outlet pipe. The channel cleaning would require a dredging permit from the Wisconsin DNR. The estimated construction cost is $65,000 for this alternative.

Flooding at 410 E. Robert Road – Problem 31

Standing water in the backyard and flooding within 20 feet of the house were reported at this problem location. The City has designed an additional catchbasin and 105 feet of storm sewer within the drainage easement in the backyard. The catchbasin will connect to the storm sewer already in the adjacent yard. This solution should adequately address the problem.

Flooding at E. Elm Road Crossing – Problem 32

The previous study hydraulic analysis indicates that Elm Road is above the 100-year recurrence interval floodplain of Crayfish Creek under existing and future watershed conditions. If the actual conditions differ from the analysis and road flooding occurs, the only feasible solution is to raise the road and provide adequate culverts to convey the flow without increasing the upstream stage. Additional field survey and analysis beyond the scope of this plan is needed to determine the extent of this solution. Right-of-way acquisition from Milwaukee County may be required depending on the road width and the right-of-way boundaries.

Poor Drainage at 2307 E. Oakwood Road – Problem 33

This problem is caused primarily by the low elevation of the property. The previous studies stated that removal of sediment from the West Branch and Crayfish Creek would improve the drainage only along the southern margin of the property. Further resolution of the problem would require drain tiles with pumping to lower the water level. Drainage changes such as tiling and pumping are the responsibility of the property owner. Solutions were previously identified by SEWRPC.

Poor Drainage along E. Elm Road from Chicago Road to Shangri La Court – Problem 34

Development east of S. Chicago Road has increased the runoff volume to the wetland north of Elm Road and west of Chicago Road. The water elevation in the wetland during rain events has increased in recent years. The wetland drains southwest through a culvert crossing Elm Road.

The wetland is a natural retention area for upstream runoff and should be retained. Drainage along Elm Road could be improved with a storm sewer as recommended in the previous studies.

Problems Identified by Floodplain Analysis

Alternative solutions to the problems identified in the hydrologic-hydraulic analysis are discussed in the subsequent section by tributary watershed. The locations are shown in Figure 4-6.

Tributary N4

Tributary N4 has flooding problems between S. 10th Street and west of 13th Street at the upstream study limit near the exit ramp from northbound I-94.

Flooding West of S. 13th Street

West of 13th Street, the floodplain includes a portion of the eastbound lanes of Rawson Avenue. Milwaukee County Department of Public Works is replacing the culvert at 13th Street on Tributary N4. The new culvert will reduce the flood stage and mitigate flooding of Rawson Avenue west of 13th Street.

Flooding between S. 10th Street and S. 13th Street

Flooding occurs at the north end of the S. 10th Street boulevard, just south of Rawson Avenue. At this location, the stream channel enters a storm sewer system. The storm sewer inlet does not have sufficient capacity and causes flooding of S. 10th Street and adjacent private properties. The 100-year floodplain includes one residential property east of S. 13th Street.

On-Site Detention Alternative

The Tributary N4 watershed has approximately 70 acres of land, or 16 percent of the total watershed area to be developed. The future development lands are located north of Rawson Avenue and along S. 13th Street. Because the potential development is a small portion of the watershed and in scattered locations, on-site detention is not a feasible alternative to achieve reductions in flood flows.

Detention Alternative

Mitigating the flooding problem with only detention would require sufficient storage upstream of S. 13th Street to reduce the peak flow from 340 cfs to 140 cfs. The potential locations for regional detention facilities in the watershed are the areas within the interchange of Rawson Avenue and I-94. The northeast quadrant of the interchange already provides storage and peak flow attenuation. The potential detention storage areas will be reduced by additional on and off ramps proposed for construction. There are no detention sites in the watershed where sufficient storage could be created to achieve the flow reductions needed to resolve the flooding problem.

Conveyance Alternative

As shown on Figure 6-8, modifying the connection to the storm sewer system at S. 10th Street would reduce the backwater and flooding at S. 10th Street. The existing stub of 5-foot x 8-foot box culvert would be extended 175 feet north to the channel location. Hydraulically smooth curved transitions would be constructed to guide flow into the new box culvert and through the connection to the existing stub. Modifying approximately 1050 feet of the channel upstream of S. 10th Street would remove the residential property from the floodplain at S. 13th Street. The channel would be enlarged to lower the 100-year frequency flood stages by at least 1 foot. This alternative would require a 50-foot wide easement and cost $689,000 to construct. Land costs would be approximately $18,000.

Tributary N7

Tributary N7 has flooding problems at Drexel Avenue, S. 20th Street, Willow Drive, and S. 13th Street.

Branch N7A does not have any flooding problems, although S. 20th Street would be overtopped during the 2-year and larger frequency storms. The depth of flow over the road for the 100-year event would be about 0.5 foot. The culvert at S. 20th Street was replaced in 1997 with the same size culvert.

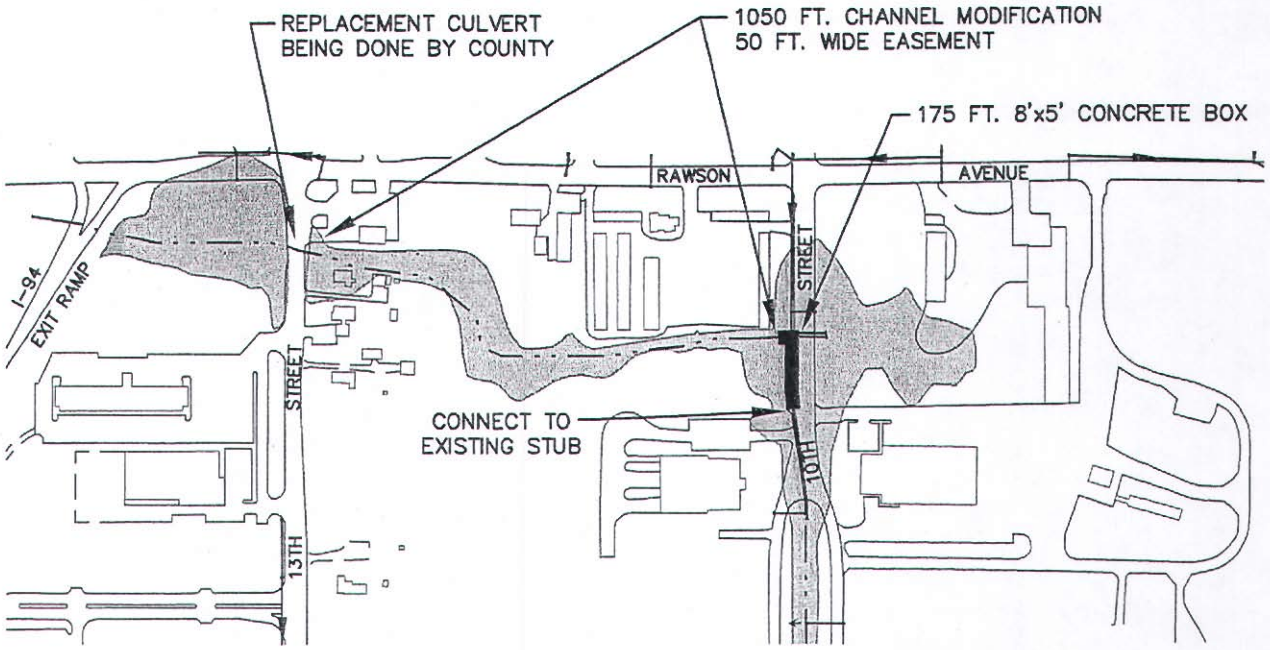
Flooding at S. 13th Street and Willow Drive

The S. 13th Street crossing has adequate capacity for the 10-year frequency event, but is overtopped by the 100-year frequency storm event. Willow Drive is overtopped by the 10-year frequency event, partly due to backwater from S. 13th Street. The 100-year frequency event includes flooding of two residential properties. Lowering the 100-year frequency flood stage upstream of S. 13th Street by at least 2 feet would be required to remove S. 13th Street and the private properties from the floodplain. Willow Drive is 2 feet lower than S. 13th Street and would still be overtopped for the 10- and 100-year events.

On-site Detention Alternative

Upstream of S. 13th Street, the watershed has approximately 266 acres of land, or 40 percent of the tributary area, available for development. On-site detention is not feasible because the amount of developable land remaining in the upstream watershed is insufficient to effect the flow reductions necessary to mitigate the flooding. With zero runoff from the developable land, the 10-year frequency flow at the problem area is approximately the same as the available capacity and the 100-year frequency flow is two times the available capacity.

Figure 6-8
Tributary N4
Conveyance Alternative (Recommended)



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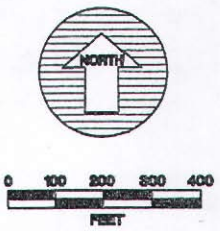
EXISTING 100-YEAR
FREQUENCY FLOODPLAIN



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Without additional detention in the watershed, the 100-year frequency peak flow from Tributary N7 under future development conditions is only 3 percent greater than under existing conditions.

Regional Detention Alternative

To mitigate flooding of S. 13th Street and Willow Drive with detention would require sufficient storage upstream of Willow Drive to reduce the flow to approximately 150 cfs. To achieve this reduction, detention would be required on both Tributaries N7 and N7A. There are three potential sites for detention storage areas: on Tributary N7 east of I-94 to Willow Drive, on N7 west of I-94, on N7A west of I-94. The most feasible site for the larger storage area is on Tributary N7A west of I-94. As shown on Figure 6-9, this site requires the least amount of excavation to create storage and much of the future development upstream of S. 13th Street will occur in its watershed. Tributary N7 has considerable natural detention storage that reduces its peak flows downstream of S. 20th Street. Additional storage on Tributary N7 between I-94 and Willow Drive would require less excavation than a basin west of I-94.

As shown on Figure 6-9, the storage on Tributary N7A would consist of excavation and construction of an earthen berm approximately 900 feet long just west of I-94. The berm would be 11 feet high at its highest point to create approximately 33 acre-feet of detention storage. The normally dry detention basin would require portions of three parcels (approximately 20 acres) plus access from S. 20th Street. Although approximately ½ acre of wetland would need to be filled to construct the dam, the existing wetlands in the bottom would remain and could be expanded. The WDNR may consider the facility a dam and Administrative Code NR 333 regulations may apply. If only this basin was constructed, the reduced 10- and 100-year discharges at Willow Drive (125 and 250 cfs, respectively) would approximately equal the existing 2- and 10-year discharges (125 and 240 cfs, respectively.)

The storage on Tributary N7, east of I-94, would consist of an off-channel basin designed to take flow from just downstream of the I-94 culvert and release it at a reduced rate upstream of Willow Drive. The excavated basin would provide 22 acre-feet of detention storage on approximately 6 acres. This basin, along with the detention proposed on N7A, would reduce the 100-year discharge at S. 13th Street to 145 cfs. Both detention facilities would be needed to prevent flooding at S. 13th Street and Willow Road. The estimated total construction cost of this alternative is $722,000. Land costs would be $390,000.

Conveyance Alternative

As shown on Figure 6-10, this alternative would consist of replacing culverts at S. 13th Street and Willow Drive to increase capacity. An additional 6-foot wide by 4-foot high concrete box would be installed at S. 13th Street. The existing culverts at Willow Drive would be replaced with two 66-inch diameter corrugated metal pipe culverts. Willow Drive would also be raised to a minimum elevation of 711.0. This alternative would provide capacity to convey the future condition 100-year frequency flood flows without overtopping 13th Street. Willow Drive would convey the 10-year flows without overtopping and have about 0.4 foot of flow over the street during a 100-year frequency event. The estimated total construction cost of this alternative is $300,000.

Figure 6-9
Tributary N7
Detention Alternative

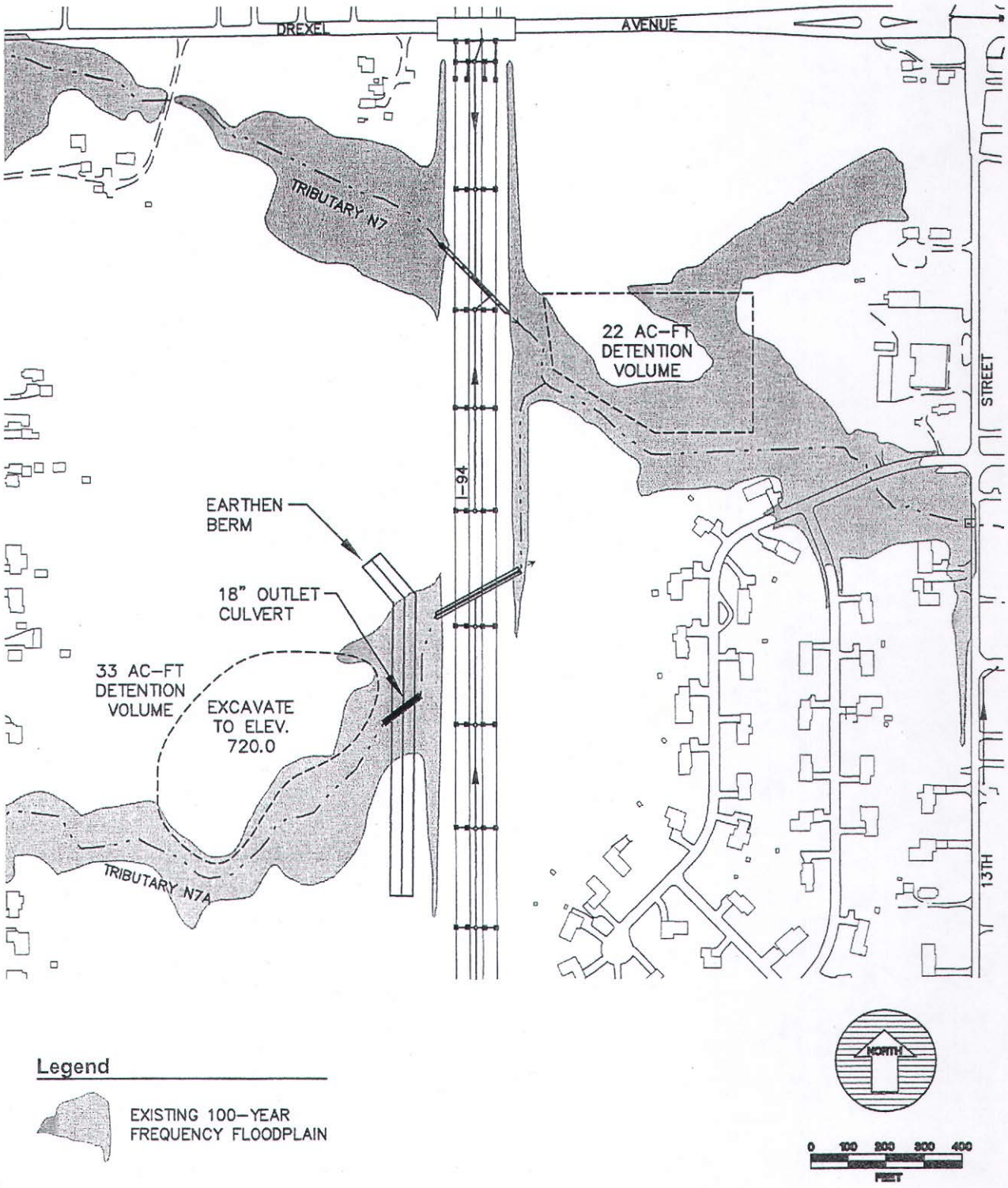

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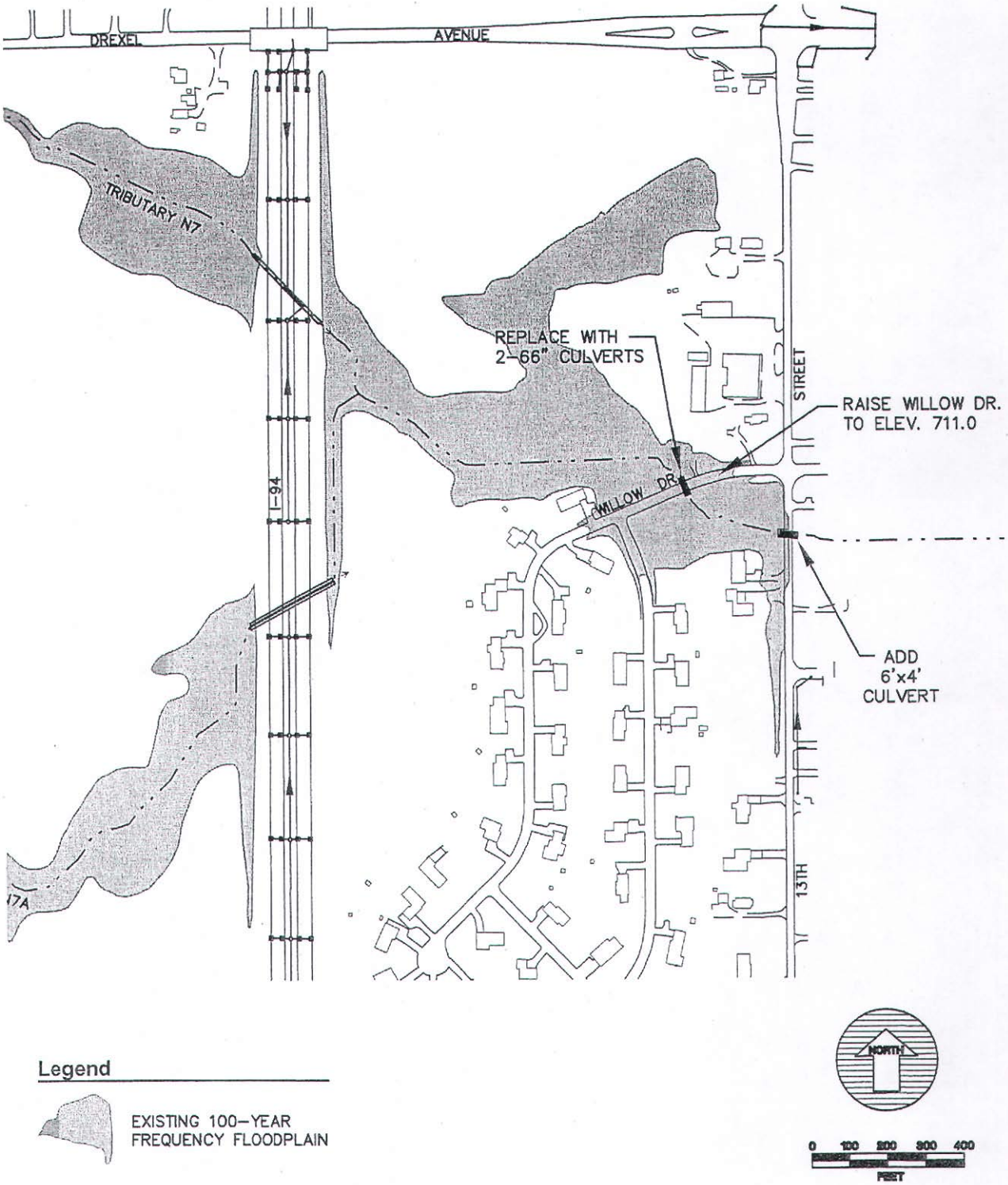
Figure 6-10
Tributary N7
Conveyance Alternative (Recommended)



Tributary C1

This tributary watershed is developed in the upper portion and developing in the lower portion. Future condition flows will not increase significantly from the existing flows. There are several problem areas along the tributary that were defined by the hydrologic-hydraulic analysis. Although there several culverts with restricted capacities, the roads are overtopped and the crossings do not retain sufficient floodwater storage to reduce the downstream flows. The culvert sizes may be increased without causing additional flooding downstream.

Flooding Upstream of Shepard Avenue

The inadequate capacity of the culverts for flows larger than the 2-year frequency event and the high road elevation will be expected to cause backwater upstream to a depth of more than 2 feet on Darlene Lane during severe infrequent storm events. Detention solutions are not available because of full development upstream. Additional capacity is required. As shown on Figure 6-11, three additional 48-inch culverts would provide sufficient capacity to alleviate flooding during a 10-year frequency storm and reduce the backwater flooding depth on Darlene Lane to less than one foot during a 100-year frequency storm event. These additional culverts would cost $80,000 to construct.

Flooding Upstream of W. Oakwood Road

The floodplain boundary includes two houses north of Oakwood Road and west of Nicholson Road. The flood stages are caused by backwater at the west driveway culvert and by Oakwood Road. Additional capacity is required to reduce the 100-year frequency flood stages. As shown on Figure 6-11, two additional 48-inch culverts at the west driveway, lowering the west driveway approximately 6 inches, and an additional 6 by 4 foot box culvert at Oakwood Road would provide sufficient capacity to alleviate flooding during a 10-year frequency storm. This alternative would reduce the 100-year frequency flood stages to remove the house from the 100-year frequency floodplain. These additional culverts would cost $181,000 to construct.

Tributary C3

Flooding at S. 11th Avenue

The hydrologic-hydraulic analysis identified flooding over S. 11th Avenue for 10-year recurrence interval and larger storm events. This street is the only access to the subdivision. The 100-year flood stage is 0.65 feet over the road and the 10-year frequency flood stage is 0.2 feet over the low point in the road.

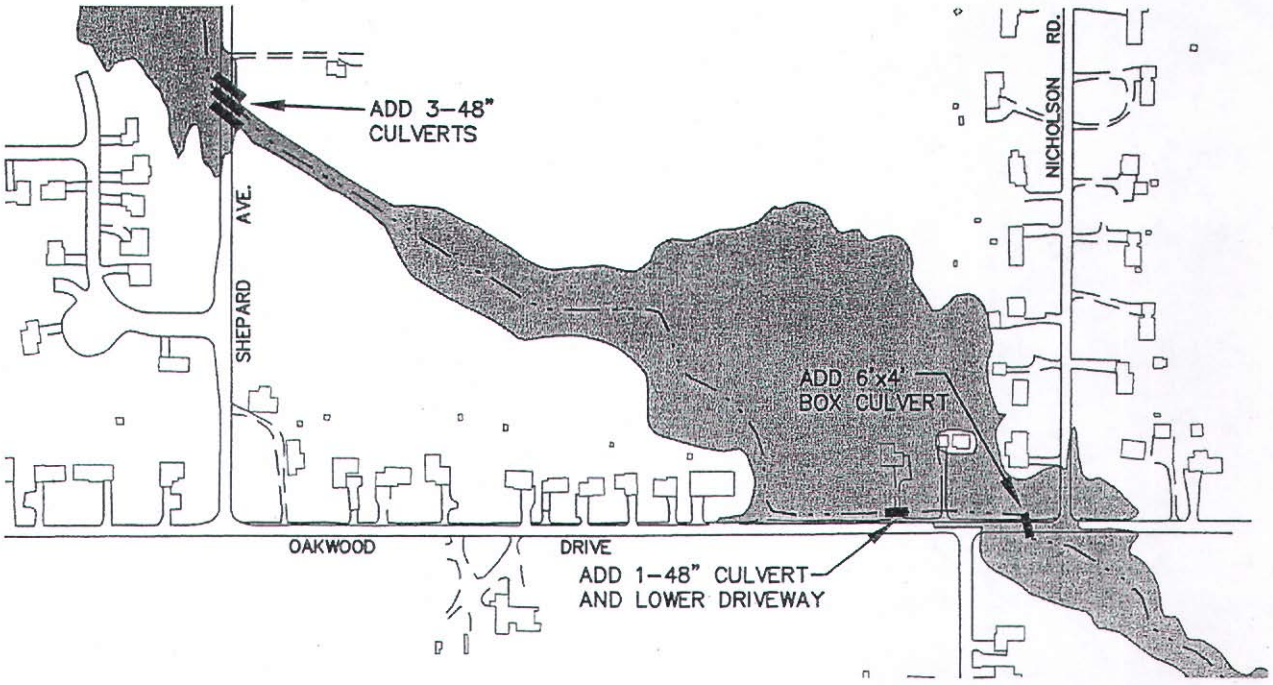
Detention Alternatives

Much of the upstream tributary area is undeveloped agricultural land that is zoned to remain in agricultural use. Therefore detention in conjunction with new development is not likely in the near future. A detention basin east of 11th Avenue could be used to reduce the peak flow and mitigate the flooding.

Conveyance Alternative

Mitigating the flooding problem would require replacing the two existing culverts at S. 11th Avenue with a 10' x 3' box culvert. This culvert would reduce the 10-year recurrence interval flood stages lower than the road and the 100-year stage to 0.2 over the road. This replacement culvert would cost $187,000 to construct.

Figure 6-11
Tributary C1
Conveyance Alternative (Recommended)



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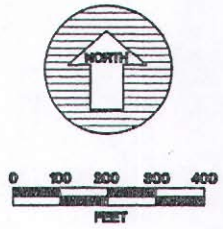
EXISTING 100–YEAR
FREQUENCY FLOODPLAIN



Appendix J

EXCERPT FROM CITY OF OAK CREEK STORMWATER MANAGEMENT MASTER PLAN SUMMARIZING PLAN RECOMMENDATIONS AND IMPLEMENTATION

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Summary of Stormwater Management Recommendations

Flood Control and Drainage Recommendations

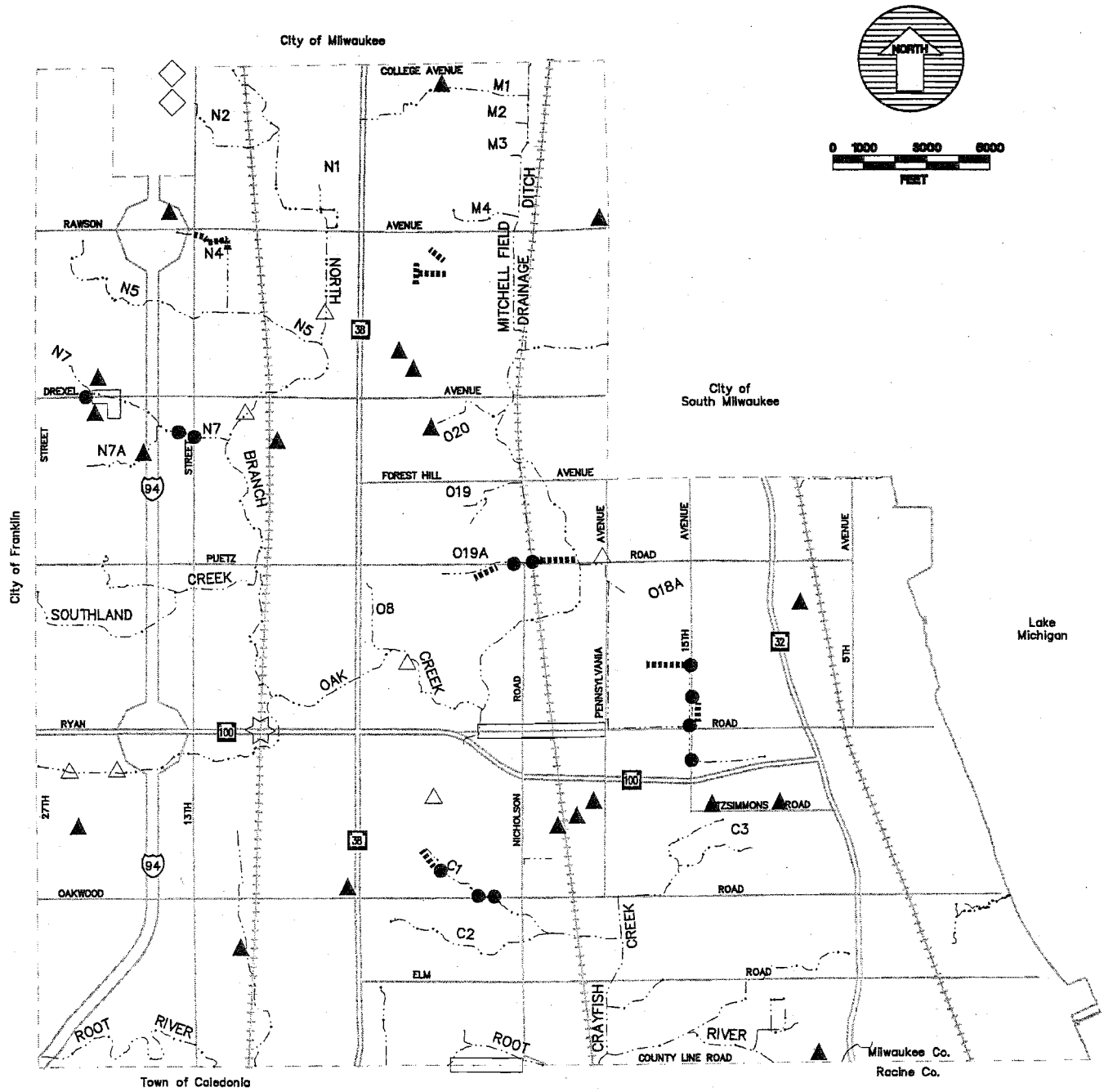
Recommended solutions for the flooding and drainage problem areas are summarized in Table 8-1 and illustrated in Figure 8-2. These recommendations are, in general, the least cost alternatives unless there are overriding considerations such as adverse ecological impacts, implementation barriers, or safety concerns. The recommended priority and implementing agency are identified for each recommendation in Table 8-1.

Table 8-1 Flood Control and Drainage Recommendations

Tributary Stream	Recommendation	Capital Improvement Cost (1)	Annual O&M Cost	Implementing Agency	Priority
North Branch	Maintain storm sewer outlet at Marquette Ave.	--	$1,000	City	Inspect Annually
North Branch	Maintain storm sewer outlet at Drexel Ave. and Wildwood Dr.	--	$1,000	City	Inspect Annually
N2	Detention west of S. 13th St. and additional culvert at Pelton Dr. (coordinate with water quality recommendation for wet detention basin)	$ 1,105,000	$2,000	City & WDOT	9
N5	Revise easement at 7538 S. 13th St.	--	--	City	17
N4	Channel modification downstream of S.13th St. to box culvert at S. 10th St.	$ 689,000	--	City	7
N7	Culverts at Willow Dr. and S. 13th St. and raise Willow Dr.	$ 300,000	--	City	13
N7	Raise road and additional culvert at S. 20th St. and Drexel Ave. Obtain control of private driveway.	$ 211,000	--	City	8
Mitchell Field Drainage Ditch	Diversion berm and overflow swale at 7289 S. Quincy Ave.	$ 22,500	--	City	12
Mitchell Field Drainage Ditch	Swale along north property line at 7152 S. Taylor Ave.	$ 16,000	--	City	11
Oak Creek	Maintain storm sewer outlet at E. Puetz Rd. & Pennsylvania Ave. (coordinate with water quality recommendation for wet detention basin)	--	$1,000	City	Inspect Annually
Oak Creek	Pumping Station at 700 W. Ryan Rd. (STH 100)	$ 733,000	$ 40,000	City & WDOT	1
Oak Creek	Maintain storm sewer outlet at Parkway Estates & Oak View Ln.	--	$1,000	City	Inspect Annually
Oak Creek	Install storm sewer S. 11th Ave. (south of E. Puetz Rd.) to Madeira Dr.	$500,000	--	City	3
Oak Creek	Raise E. Ryan Rd. – Pennsylvania Ave. to west of Nicholson Rd.	$ 622,000	--	City	15
Oak Creek	Maintain storm sewer outlet at Southbranch Blvd. & Reinhart Dr.	--	$1,000	City	Inspect Annually
O11	Maintain storm sewer outlet at Arthur Dr.	--	$1,000	City	Inspect Annually
O15	Additional culverts and swales at S. 15th Ave. north of E. Ryan Rd.	$ 218,000	--	City	6
O16	Additional culvert at 15th Ave. south of E. Ryan Rd.	$ 75,000	--	City	10
O17	Reconstruct road and add culverts at 9000 S. Pennsylvania Ave.	City road project	--	City	14
O19A	Overflow grading south of E. Puetz Rd. east of S. Shepard Ave. Lower road and add culverts at Puetz Rd. and Nicholson Rd.	$ 304,000	--	City	4
O19A	Culvert under railroad north of Puetz Rd. and channel to Oak Creek east of Nicholson Rd.	$ 406,000	--	City	4

(1) Easement and land acquisition costs are not included.

Figure 8-1
Flood Control and
Drainage Recommendations



Legend

C3	TRIBUTARY NAME
●	CULVERT
	CHANNEL OR SWALE
▲	PRESERVE NATURAL STORAGE
	FLOOD PROTECTION
☆	PUMPING STATION
△	STORM OUTLET MAINTENANCE
◇	DETENTION BASIN

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Table 8-1 Flood Control and Drainage Recommendations (continued)

Tributary Stream	Recommendation	Capital Construction Cost (1)	Annual O&M Cost	Implementing Agency	Priority
Root River	Raise E. County Line Rd. west of Nicholson Rd.	$ 384,000	--	City	18
Crayfish Creek	Evaluate raising E. Oakwood Rd.	--	--	City	19
Crayfish Creek	Evaluate raising E. Elm Rd.	--	--	City	20
C1	Rebuild storm sewer outlet and clean channel downstream of Darlene Ln.	$65,000	$1,000	City	2
C1	Culverts at S. Shepard Ave.	$ 80,000	--	City	5
C1	Culverts at E. Oakwood Rd.	$ 181,000	--	City	5
C3	Control development flows upstream of S. 11th Ave.	--	--	City	16
Total		$5,911,500	$ 49,000		

(1) Easement and land acquisition costs are not included.

Water Quality Recommendations

The suspended sediment loading from the study area, from all sources, is estimated at 8,570,000 pounds per year. Implementation of the water quality recommendations, outlined in Table 8-3 and illustrated in Figure 8-2, will result in an annual reduction of more than 3,620,000 pounds per year of suspended sediment, or 42% of the total loading. Combined with the housekeeping practices outlined in Table 8-2, the plan recommendations should reach the 50% total suspended solids reduction goal. Implementation of the High Priority recommendations results in a 27% reduction in suspended sediment loading. Implementation of the Medium Priority recommendations in addition to the High Priority items would raise the sediment reduction level to 32%.