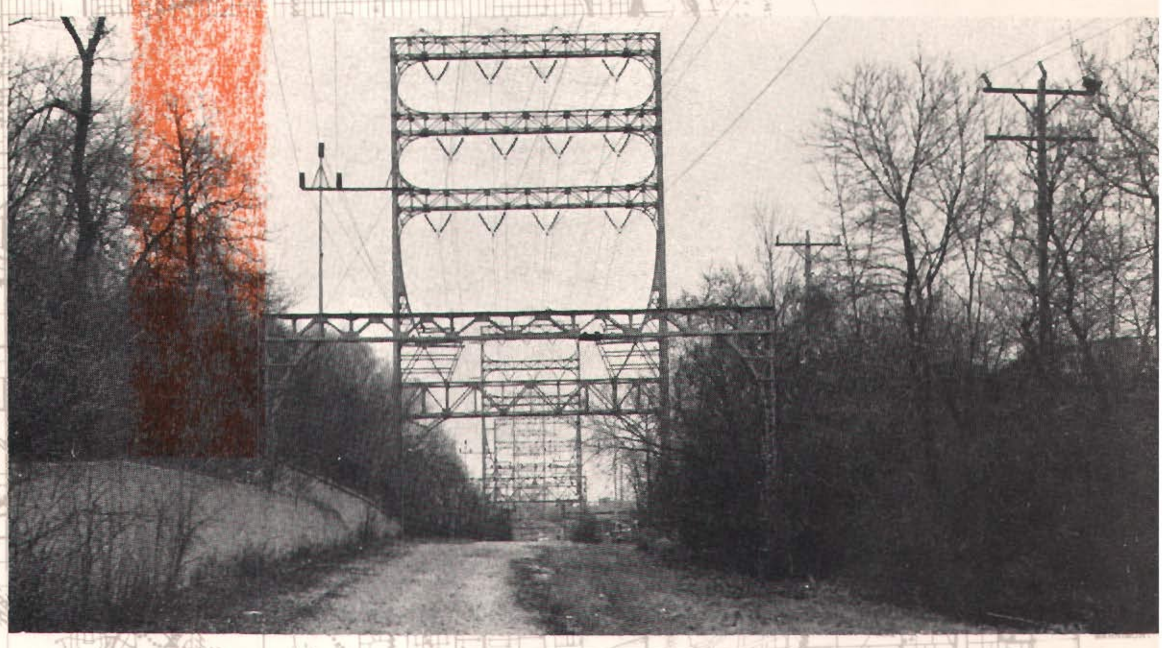
TECHNICAL REPORT NUMBER 23

TRANSIT-RELATED SOCIOECONOMIC, LAND USE, AND TRANSPORTATION CONDITIONS AND TRENDS IN THE MILWAUKEE AREA



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Special acknowledgement is due Mr. Otto P. Dobnick, SEWRPC Senior Planner, Mr. David P. Jukins, SEWRPC Senior Engineer, and Mr. Bruce E. Daniels of the firm of Howard Needles Tammen & Bergendoff for their contributions to this report.

Shown on the cover is an existing Wisconsin Electric Power Company power transmission trunk line and right-of-way in the vicinity of Milwaukee County Stadium and paralleling the East-West Freeway (IH 94), over which a segment of the four-track Local Rapid Transit Line of The Milwaukee Electric Railway & Light Company once operated. The steel power transmission towers shown were specially constructed in the late 1920's to accommodate the four-track interurban railway line.

SEWRPC photo.

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TRANSIT-RELATED SOCIOECONOMIC, LAND USE, AND TRANSPORTATION CONDITIONS AND TRENDS IN THE MILWAUKEE AREA

Prepared by the
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This technical report, one in a series of four technical reports and one planning report documenting the findings of the Milwaukee area primary transit system alternatives analysis, conducted by the Regional Planning Commission, was financed through a joint planning grant from the U. S. Department of Transportation, Urban Mass Transportation Administration; the Wisconsin Department of Transportation; and Milwaukee County.

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STATEMENT OF THE EXECUTIVE DIRECTOR

At the request of Milwaukee County, the Southeastern Wisconsin Regional Planning Commission in March of 1979 undertook a study to determine the best means of providing rapid transit service within the greater Milwaukee area. The objectives of the study—termed in federal planning jargon a primary transit system alternatives analysis—were: 1) to identify those corridors within the greater Milwaukee area which can support fixed guideway transit facility development; and 2) to identify those transit modes which can best provide such service within those corridors. These objectives required the Commission to reevaluate the feasibility within the greater Milwaukee area of providing rapid transit service by bus on freeway, bus on metered freeway, bus on reserved freeway lanes, bus on busway, light rail rapid transit, heavy rail rapid transit, and commuter rail transit.

The first step in the study involved the assembly of factual data on historic and existing population and economic activity levels and on related land use development patterns; on travel characteristics; on existing and planned highway transportation facilities and ordinary transit facilities and services; on public financial resources; on the natural resource base; and on available rights-of-way for rapid transit facility location. When considered together with data concerning the state-of-the-art of transit technology as set forth in a companion technical report, these data support the analyses essential to the formulation and evaluation of alternative rapid transit system plans for the Milwaukee area. The data presented in this report are intended to provide a better understanding of those characteristics of the greater Milwaukee area, and of the urbanizing Region of which the Milwaukee area is an integral part, that both affect and are affected by rapid transit system development. The data are also to be used in the refinement of the travel simulation models used in the identification of major travel corridors, and in the design and quantitative testing and evaluation of alternative rapid transit system plans for the greater Milwaukee area.

Much of the data presented in this report has been compiled from inventories completed under other Commission work programs, updated and adopted as necessary for the specific planning task at hand. Importantly, however, the report also presents the results of an entirely new inventory of the location, extent, and physical characteristics of all rights-of-way within the Region potentially suitable as locations for fixed rapid transit guideways, including abandoned electric interurban railway rights-of-way, electric power transmission line rights-of-way, freeway rights-of-way, and active and abandoned railway rights-of-way. In addition, the report presents the findings of an inventory and assessment of the physical ability of the existing railway lines within the Region to accommodate commuter rail service. In this inventory and assessment, the following characteristics of the railway routes were considered: construction to mainline railway engineering standards, access to the Milwaukee central business district and other major trip generators, existence of double track, presence of highway grade separations and highway grade-crossing protection devices, and costs required to rehabilitate the lines so as to provide track and roadbed able to safely accommodate high-speed commuter rail operations.

In addition to providing an important input to the conduct of the primary transit system alternatives analysis for the greater Milwaukee area, it is the hope of the Commission staff that this report will provide a reference of lasting value on those environmental and developmental characteristics of the Region pertinent to rapid transit system development, and particularly on the existing rights-of-way within the Region readily available for such system development.

Respectfully submitted,

Kurt W. Bauer
Executive Director

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Chapter I

INTRODUCTION

This technical report presents the basic planning and engineering data required to prepare a primary transit system plan for the Milwaukee area. Data are presented on population and economic activity levels and characteristics, land use development, travel habits and patterns, public financial resources, potential existing rights-of-way for primary transit, and existing and proposed transportation facilities. Data on trends in the changes in the basic socioeconomic characteristics of the Milwaukee area are also presented as may be pertinent to the transit planning effort.

This report thus represents the major findings of the inventory phase of the Milwaukee area primary transit system alternatives analysis. A second technical report completes the presentation of the findings of that inventory phase, focusing on the state-of-the-art of primary transit system technology. Much of the information presented in this technical report has been drawn from the planning data bank which has been assembled by the Regional Planning Commission through its continuing, comprehensive, areawide planning program. This technical report, however, attempts to focus that information on the specific needs of the primary transit system alternatives analysis. Also, as necessary, the data gathered under other Commission work programs have been updated for presentation in this report.

GEOGRAPHIC AREAS FOR INVENTORY PRESENTATION

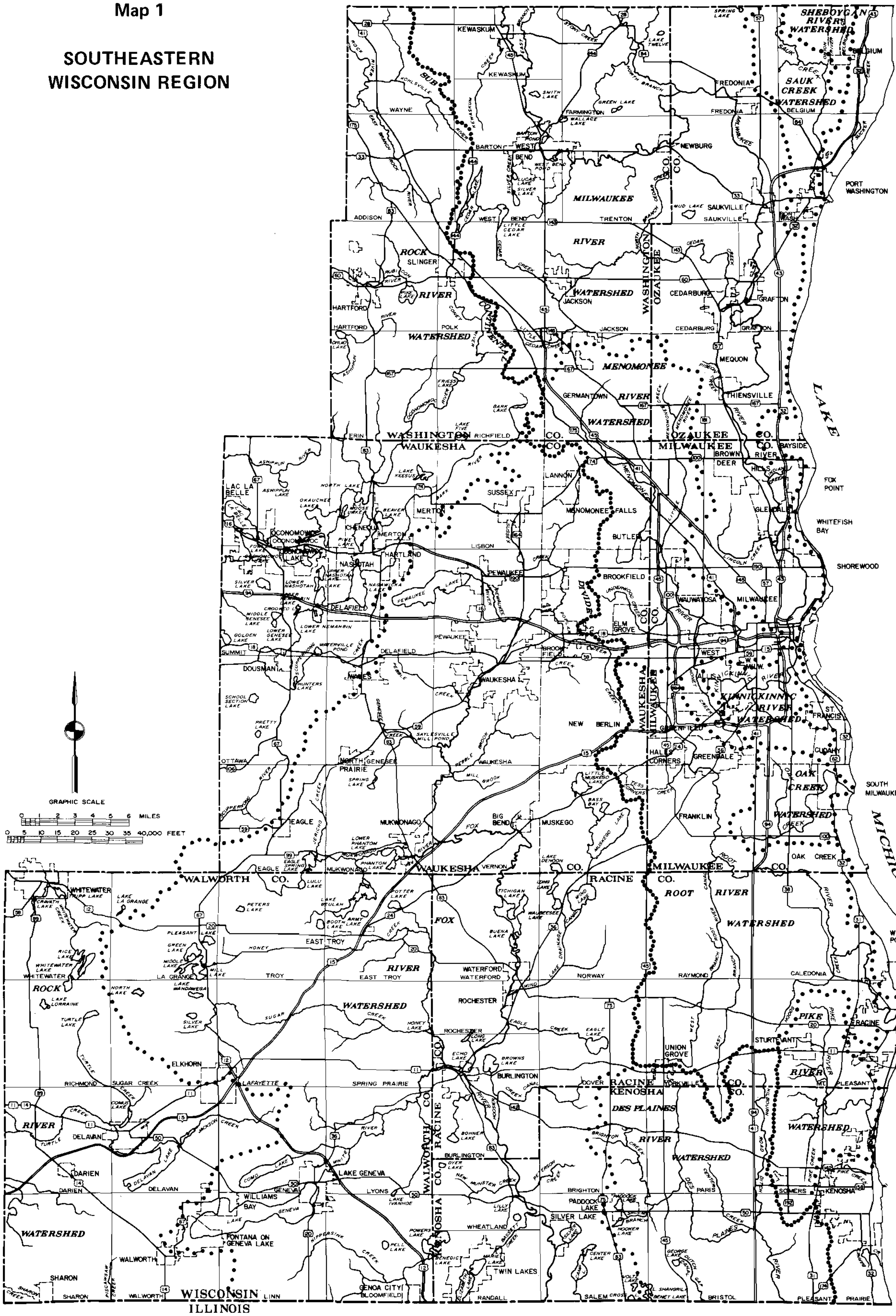
The basic inventory findings are presented in this report for three different levels of geographic detail: for the Southeastern Wisconsin Region as a whole, for each of the seven counties comprising the Region, and, for certain types of data, for special subareas of Milwaukee County particularly pertinent to transit planning.

Inventory findings are presented for the entire Region because the factors that influence land use development, travel habits and patterns, and transportation system needs in the Milwaukee area are pertinent to the entire Region. Accordingly, the Region is a natural socioeconomic unit for many types of planning, including transportation system planning, encompassing as it does the entire commuter shed of the greater Milwaukee area. Inventory data are also presented for each of the seven counties comprising the Region (see Map 1). This permits separate consideration of Milwaukee County, the major existing transit service area within the seven-county Region. It should be noted, however, that forecast data will be presented in a comparison document to this report by differing future transit service areas—areas which transcend the boundaries of Milwaukee County to encompass the true physical city envisioned to exist in the plan design year under various alternative futures. Consideration was given to also presenting the data for the Milwaukee urbanized area, the federally defined area which approximates the extent of the largest true physical "city" within the Region. This was rejected, however, on the basis that so doing would distort any analyses which attempted to relate transit use to population, employment, land use, and public financial resources, since the provision of urban transit service within the Milwaukee area is currently limited to Milwaukee County.

Certain of the basic inventory data are also presented in this report by subareas of Milwaukee County particularly pertinent to transit planning. These subareas represent important concentrations of transit trip origins and destinations, such as the central business district of the City of Milwaukee. It should be recognized here that much of the data on the population, economic activity, land use, and travel habits and patterns of the Region and its seven counties are available in the Commission files by small geographic areas for detailed planning analyses. These areas include, as shown on Map 2, 60 planning analysis areas used for land use and housing planning purposes, 1,220 traffic analysis zones used for transportation system simulation modeling purposes, and 10,800 U. S. Public Land Survey quarter sections, the smallest geographic areas for which some data are readily available. The boundaries of the quarter sections, traffic analysis zones, and planning analysis areas are related so that the smaller analytical areas are aliquot parts of the larger analyses areas such as the counties.

Map 1

SOUTHEASTERN WISCONSIN REGION

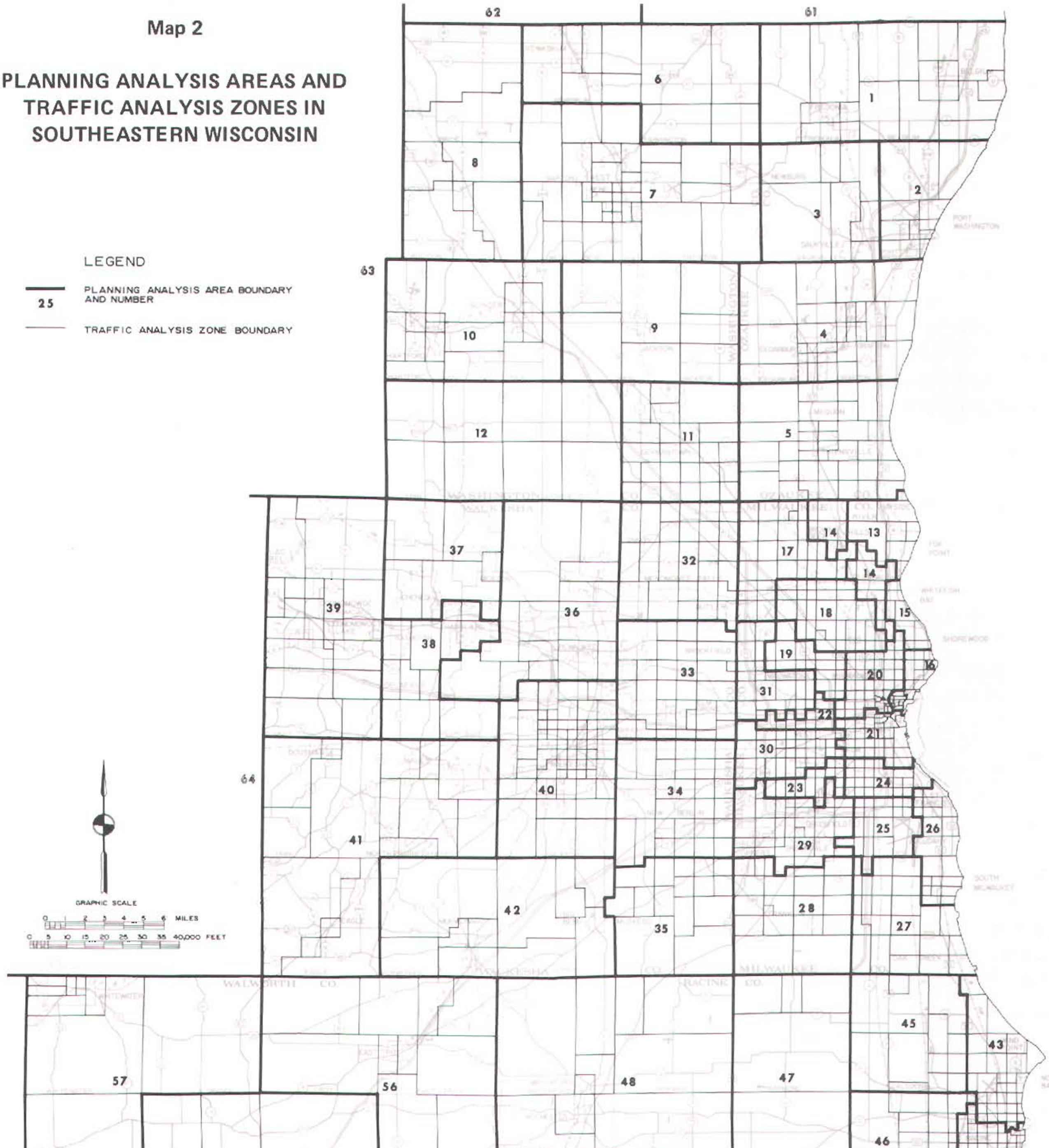


The seven-county Southeastern Wisconsin Planning Region comprises a total area of 2,689 square miles, or about 5 percent of total land and inland water area of the State of Wisconsin. The Region contains about 40 percent of the State's population and about one-half of the tangible wealth in the State, as measured by equalized assessed property valuation. The Region contains 154 general-purpose local units of government, and encompasses all or part of 11 major watersheds.

Source: SEWRPC.

Map 2

PLANNING ANALYSIS AREAS AND TRAFFIC ANALYSIS ZONES IN SOUTHEASTERN WISCONSIN



Planning analysis areas and traffic analysis zones comprise rational subareas for planning analysis purposes, and, as such, are used to assemble population, economic activity, and land use data, and permit, to the greatest extent possible, a clear depiction of actual and proposed land use and transportation system interactions. Although presented in a more aggregated form in this report, much of the population, economic activity, land use, and travel habit and pattern data presented herein have been developed and are available in the Commission files for the 60 planning analysis areas and the 1,220 traffic analysis zones in the Region.

Source: SEWRPC.

The data can also be presented by minor civil division, although such divisions do not normally comprise rational transportation planning units. Similarly, the data can be presented for certain areas utilized by the U. S. Bureau of the Census for statistical purposes including census tracts, urbanized areas, and standard metropolitan statistical areas. However, before data could be presented for minor civil divisions, census tracts, and urbanized areas, the size of these geographic areas would have to be estimated by combining traffic analysis zones or U. S. Public Land Survey quarter sections.

SCHEME OF PRESENTATION

Chapter II of this report presents a description of the current demographic and economic base of the Southeastern Wisconsin Region and its principal component parts as related to primary transit system development. With respect to the demographic base, the chapter presents data on the population size of the Region and its spatial distribution, and on the age, household size, income, and migration characteristics of the Region. With respect to the economic base, the chapter presents data on the employment size of the Region and its composition and spatial distribution, and on the public financial resources of the Region and of the Milwaukee urbanized area.

Chapter III presents an inventory of land use relevant to primary transit system development, with a discussion on the type, intensity, and distribution of land uses in the Region, emphasizing historical land use development over the last decade.

Chapter IV presents an inventory of the principal elements of the natural resource and public utility base of the Region. The information provided in this chapter is essential to the assessment of the environmental impacts of alternative and recommended primary transit systems for the Region.

Chapter V presents pertinent information on the characteristics of travel within the Region, including information on trip production and attraction, travel habits and patterns, and mode choice. Highlighted are major changes in travel behavior over the decade from 1963 through 1972, as determined by Commission travel inventories.

In Chapter VI, the existing and planned transportation facilities and services of the Region are described with respect to their location, capacity, and use. Chapter VII presents an inventory and assessment of the potential of existing rights-of-way in the Milwaukee area to accommodate the location of primary transit facilities, as well as an assessment of the ability of existing railway lines to accommodate commuter rail service. Chapter VII summarizes the data presented in this technical report and integrates the findings of the report for application in the primary transit system alternatives analysis.

In conclusion, it should be noted that this technical report, together with its companion documents, SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology; SEWRPC Technical Report No. 25, Alternative Futures for Southeastern Wisconsin; and SEWRPC Technical Report No. 26, Milwaukee Area Alternative Primary Transit System Plan Preparation, Test, and Evaluation, is intended to document the procedures and data used, the alternatives developed and evaluated, and the decisions reached in the first phase of the primary transit system alternatives analysis for the Milwaukee area. The entire process is summarized, and the salient findings and resulting recommendations of the process set forth, in SEWRPC Planning Report No. 33, Milwaukee Area Primary Transit System Alternatives Analysis, which serves as the principal product of the first phase of the alternatives analysis. Chapter III of that report contains, in summary form, the inventory information presented in greater detail in this technical report.

Chapter II

DEMOGRAPHIC AND ECONOMIC ACTIVITY

INTRODUCTION

Inventories of population and economic activity are essential to sound land use and transportation system planning. Because such planning is intended to improve the environment in which people work and live, and because the primary purpose of all public facilities and services is to meet the needs of the resident population, an understanding of the size, composition, and spatial distribution of the population is essential to all planning for future development. Because the size, composition, and spatial distribution of the population is greatly influenced by the amount of growth and change in regional economic activity levels, there is an associated need for an understanding of the regional economic base.

This chapter presents a brief description of the historical and current economic and demographic trends in the Southeastern Wisconsin Region, particularly as they relate to land use and transportation planning for the Milwaukee primary transit system alternatives analysis. The presentation on the regional demographic base includes descriptions of population size, spatial distribution, and characteristics, with emphasis on such factors as age, race, household size, income levels, and migration levels and patterns. The presentation on the economic base of the Region includes descriptions of the labor force size, distribution, and participation rates; the amount and distribution of economic activity, as measured by the number of available jobs; and the industrial structure of the regional economy, including the characteristics of the principal economic activities that support the regional population.

This chapter is based on the vast amount of current and historic data assembled through the socioeconomic inventories conducted as part of the continuing, comprehensive, regional planning program, and provides a summary description of pertinent aspects of the socioeconomic base and structure of the Region. Detailed analyses of historical demographic and economic data obtained from national censuses were previously completed by the Commission as an integral part of its continuing planning program and have been documented in other Commission publications.[1]

It must be recognized that only limited data on demographic and economic trends in the Region since the last national census in 1970 are available. Current population estimates by civil division are prepared annually by the Wisconsin Department of Administration. The Wisconsin Department of Industry, Labor and Human Relations publishes current labor force information for the three standard metropolitan statistical areas (SMSA's) in the Region, which include all of the Region excepting Walworth County, and the U. S. Bureau of the Census has conducted special censuses of 33 civil divisions in the Region since 1970, and conducted a housing survey of the Milwaukee standard metropolitan statistical area in 1975. The information presented herein on the economic and demographic base of the Region has, therefore, been divided into two sections. The first section describes those historical demographic and economic trends measured by the U. S. Bureau of the Census at 10-year intervals up to the last completed census of 1970. The second section discusses trends in regional population and economic activity since 1970, using the estimated and necessarily less complete economic and demographic data available.

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[1] *See SEWRPC Planning Report No. 3, The Economy of Southeastern Wisconsin; SEWRPC Planning Report No. 4, The Population of Southeastern Wisconsin, and SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume One, Inventory Findings and Volume Two, Alternative and Recommended Plans.*

THE DEMOGRAPHIC BASE OF THE REGION TO 1970

Important to the study of the population of an area is an examination of the changes in the size, composition, and spatial distribution of that population over time. Such a time series analysis provides an overview of cumulative population change and thereby provides insights essential to the proper conduct of any land use and transportation system planning program.

Population Size

The population of an area constantly changes with the occurrence of vital events such as births and deaths, and through the inflow and outflow of people migrating from one area to another. Population increases result from births and the in-migration of people; population decreases result from deaths and the out-migration of people. Thus, population change is not a simple phenomenon, but is comprised of four major components: fertility (births), mortality (deaths), in-migration (inflows), and out-migration (outflows). The balance between births and deaths is termed "natural increase" and the balance between in-migration and out-migration is termed "net migration."

In 1970 the resident population of the Region totaled approximately 1,756,100 people, or about 1 percent of the total population of the United States and about 40 percent of the population of the State. The largest civil division in the Region—the City of Milwaukee—was the twelfth largest city in the nation in that year.

The federal census first included what is now the Southeastern Wisconsin Region in the 1850 Census of Population. The population of the Region has increased every decade since then. In the late 19th and early 20th centuries, the resident population of the Region increased rapidly, at rates of up to 222,000 persons per decade. Much of the population growth in this early period reflected the flow of immigrants into the United States and, in particular, the immigration of people of German and Polish nationalities into the Region. After a relatively small increase of only about 62,000 people during the years of the Great Depression, from 1930 to 1940, the population grew by about 173,000 people from 1940 to 1950, by about 333,000 people from 1950 to 1960—an historic peak—and by about 182,000 people from 1960 to 1970.

The rate of population increase in the Region since 1850 has been higher than that for the nation as a whole, with the exception of the 1860's, 1870's, 1930's, and 1960's. Similarly the Region experienced higher rates of growth than the State during 7 of the 12 decades since 1850 (see Table 1). By 1970 the population of the Region had increased to 1,756,100 people, an increase of 1,642,700

Table 1

POPULATION TRENDS IN THE UNITED STATES, WISCONSIN, AND THE REGION: SELECTED YEARS 1850-1970

Year	Region			Wisconsin			United States			Regional Population as a Percent of:	
	Population	Change From Preceding Time Period		Population	Change From Preceding Time Period		Population	Change From Preceding Time Period			
		Absolute	Percent		Absolute	Percent		Absolute	Percent	Wisconsin	United States
1850	113,389	- -	- -	305,391	- -	- -	23,191,876	- -	- -	37.1	0.49
1860	190,409	77,020	67.9	775,881	470,498	154.1	31,443,321	8,251,445	35.6	24.5	0.60
1870	223,546	33,137	17.4	1,054,670	278,789	35.9	38,448,371	7,005,050	22.6	21.2	0.58
1880	277,119	53,573	24.0	1,315,497	260,827	24.4	50,155,783	11,707,412	30.1	21.2	0.55
1890	386,774	109,655	39.6	1,693,330	377,833	28.7	62,947,714	12,791,931	25.5	22.8	0.61
1900	501,808	115,034	29.7	2,069,042	375,712	22.2	75,994,575	13,046,861	20.7	24.2	0.66
1910	631,161	129,353	25.8	2,333,860	264,818	12.8	91,972,266	15,977,691	21.0	27.0	0.69
1920	783,681	152,520	24.2	2,632,067	298,207	12.8	105,710,620	13,738,354	14.9	29.8	0.74
1930	1,006,118	222,437	28.4	2,929,006	306,939	11.7	122,775,046	17,064,426	16.1	34.2	0.82
1940	1,067,699	61,581	6.1	3,137,587	198,581	6.8	131,669,587	8,894,541	7.2	34.0	0,81
1950	1,240,618	172,919	16.2	3,434,575	296,988	9.5	151,325,798	19,656,211	14.9	36.1	0.82
1960	1,573,620	333,002	26.8	3,952,771	518,196	15.1	179,323,175	27,997,377	18.5	39.8	0.88
1970	1,756,086	182,466	11.6	4,417,933	465,162	11.8	203,184,772	23,861,597	13.3	39.7	0.86

Source: U. S. Department of Commerce, Social and Economoc Statistics Administration, Bureau of the Census; and SEWRPC.

persons over 1850. In 1970 the Region's population level was more than 14 times greater than the 1850 level. During this same period, the nation's population was slightly over seven times its 1850 level, while Wisconsin's population was over 13 times its 1850 level. Thus, the rate of increase of the regional population during this 120-year period was nearly twice that of the national increase, but only slightly greater than that of the State. As a result of this rapid growth, the regional share of the total national population increased from 0.49 percent in 1850 to 0.86 percent in 1970, and the regional share of the state population increased from 37 percent in 1850 to nearly 40 percent in 1970.

Since 1930, natural increase has been the dominant component in the Region's population growth, accounting for all of the population growth in the 1930's and 1960's, about 70 percent of the population growth in the 1940's, and about 67 percent of the population growth in the 1950's (see Table 2). Since the 1920's—at which time the registration of births and deaths became sufficiently complete to allow an accurate calculation of net migration and natural increase rates—net migration has been the dominant component in the Region's population growth only during the 1920's, when it accounted for about 60 percent of the population growth. Patterns and trends in both net migration and natural increase within the Region generally resemble those evident in the other large urbanizing regions of the United States. Viewed within the context of a larger historical record, these patterns and trends, both nationally and regionally, appear to signal the completion of two relatively long-term demographic phenomena. The first is the high natural population growth rate—characterized by rapidly increasing birthrates and declining deathrates—which marked the post-World War II period. The second is the massive rural to urban migration which occurred over a longer period of time and contributed to the high concentration of the nation's population in its metropolitan regions.

In the 1950's the metropolitan areas of the United States, including the three metropolitan areas within the Region, experienced unprecedented population increases. Nationally, high rates of in-migration coupled with high rates of natural increase came to be the expected trend in metropolitan areas. Evidence now exists that this trend changed on a national basis during the 1960's, when migration trends were reversed in many of the larger and older metropolitan areas of the United States; whereas high rates of in-migration had been experienced during the 1950's, high rates of out-migration were experienced during the 1960's. This reversal also occurred within the Region and particularly within Milwaukee County. Moreover, by 1970 birthrates nationally and within the Region had reached the lowest levels since the 1930's.

Table 2

RATES OF POPULATION CHANGE BASED ON NATURAL INCREASE AND NET MIGRATION IN THE REGION: 1920-1970

Decade	Total Change (percent)	Natural Increase (percent)	Net Migration (percent)
1920-1930	28.4	10.9	17.5
1930-1940	6.1	6.2	- 0.1
1940-1950	16.2	11.4	4.8
1950-1960	26.8	18.1	8.7
1960-1970	11.6	12.9	- 1.3

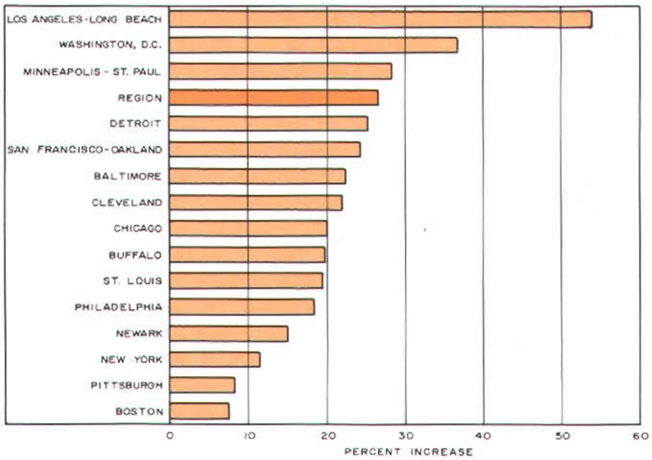
Source: U. S. Bureau of the Census and SEWRPC.

The combined effect of these two primary components of population growth—natural increase and net migration—was an increase of more than 333,000 persons in the regional population from 1950 to 1960 and of more than 182,000 persons from 1960 to 1970. During the 1950's natural increase accounted for an increase of more than 224,000 people in the resident population of the Region, or for 67 percent of the total regional population growth. Net migration accounted for the remainder of the population increase, or for more than 108,000 people. From 1960 to 1970, however, the population increase in the Region was entirely accounted for by a natural increase of about 203,000 people, which more than offset the net out-migration of more than 20,000 people over this same 10-year period.

From 1950 to 1960, only 3 of the 15 largest SMSA's in the nation experienced higher rates of growth than did the Southeastern Wisconsin Region (see Figure 1). During this period, the regional population increased by 27 percent—from 1,240,600 people to 1,573,600 people. From 1960 to 1970, however, 8 of the 15 largest SMSA's in the nation experienced higher rates of population growth than did the Region. The population of the Region increased by about 12 percent over

Figure 1

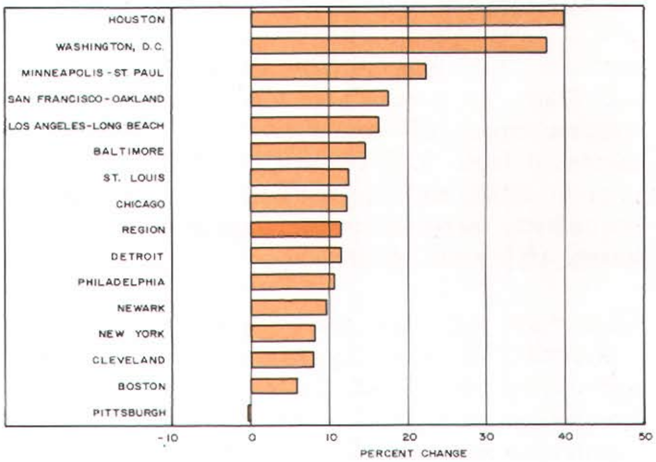
PERCENT INCREASE OF POPULATION IN THE 15 LARGEST STANDARD METROPOLITAN STATISTICAL AREAS IN THE UNITED STATES AND IN THE REGION: 1950-1960



Source: SEWRPC.

Figure 2

PERCENT INCREASE OF POPULATION IN THE 15 LARGEST STANDARD METROPOLITAN STATISTICAL AREAS IN THE UNITED STATES AND IN THE REGION: 1960-1970



Source: SEWRPC.

this decade, from 1,573,600 people in 1960 to 1,756,100 people in 1970 (see Figure 2). These declining population growth rates in the Region since 1950 are similar to the trends exhibited in many of the large SMSA's of the northeastern and midwestern United States. In contrast, many of the large SMSA's located in the southern and western sections of the nation have experienced stable or increasing population growth rates since 1950.

Population movements between metropolitan areas account for some of the migration observed between states during the 1960's, especially from the mature, industrialized states to the now rapidly developing southern and western states. Contributing to this movement are such factors as the out-migration of industry from the mature manufacturing centers of the nation to the southern United States; attendant increasing job opportunities in the southern states; and the retirement of older persons to warmer climates and to states with favorable tax treatment of estates and inheritance.

In earlier phases of the rural to urban transition, relocation of people both nationally and regionally was due principally to increasing job opportunities in the urban areas, to the increasing economic dominance of large farms in the agricultural industry, and to the related increased mechanization of farming processes. Since the 1960's, however, this rural migration pool has diminished and is no longer a major migration force.

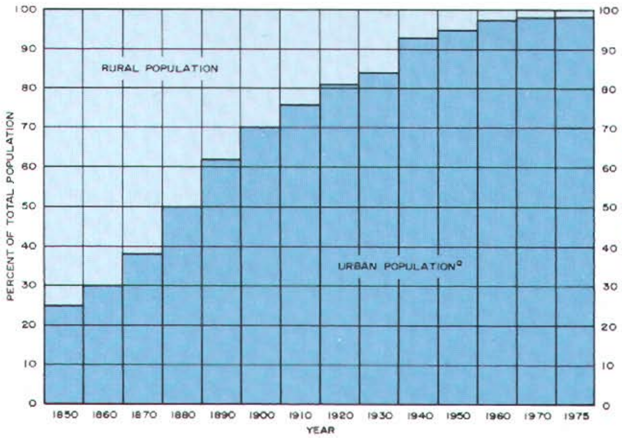
Population Distribution

The total number of inhabitants of a study area and their spatial distribution are important factors to be considered in any land use-transportation planning effort. The Southeastern Wisconsin Region, like most metropolitan regions in the United States, has become increasingly urban.[2] In 1850 the population of the Region was approximately 75 percent rural (farm) and 25 percent urban (nonfarm). By 1900 this relationship had nearly reversed to 30 percent rural and 70 percent urban. By 1960 almost 98 percent of the regional population was urban and only about 2 percent was rural. The rural-urban distribution of the regional population did not change significantly in the 1960's, so that in 1970, over 98 percent of the regional population was urban, while less than 2 percent was rural. The entire 120-year rural-urban population distribution change is shown graphically in Figure 3. This trend toward urbanization has been one of the most significant distributional changes taking place within the Region, State, and nation since the mid-1800's.

[2] *The urban population is defined as all persons living in incorporated or unincorporated places of 2,500 persons or more, and all persons living in other incorporated or unincorporated territories included within "urbanized areas" as defined by the U. S. Bureau of the Census.*

Figure 3

DISTRIBUTION OF URBAN AND RURAL POPULATION IN THE REGION: 1850-1970



[a] THE URBAN POPULATION IN 1950, 1960, 1970, AND 1975 INCLUDES THAT PORTION OF THE POPULATION CLASSIFIED AS BEING "URBAN" AND "RURAL NON-FARM" BY THE U.S. BUREAU OF THE CENSUS.

Source: U. S. Bureau of the Census and SEWRPC.

Population growth since 1900 has not been uniform throughout the Region. From 1900 to 1930, the highest rates of population increase occurred in the three urban counties of Milwaukee, Kenosha, and Racine. From 1930 to 1970, dispersion of the urban population and decentralization of urban work- and leisure-related activities reversed this trend. Varying rates of change in population growth in the Region have resulted in significant distributional shifts of population among the seven counties. The outlying counties, notably Ozaukee, Washington, and Waukesha, show the highest rates of population increase. As shown in Table 3, the most dramatic changes in population distribution from 1900 to 1970 occurred in Milwaukee and Waukesha Counties. The Milwaukee County proportion of the total regional population increased by about 6 percentage points from 1900 to 1930, and then decreased by about 12 percentage points from 1930 to 1970. In contrast, the Waukesha County proportion of the total regional population decreased by approximately 2 percentage points from 1900 to 1930, and increased by about 8 percentage points from 1930 to 1970.

The result of recent changes in population distribution has been an areawide spread of population around the three primarily urban counties of Milwaukee, Kenosha, and Racine. From 1960 to 1970, the proportion of the total regional population in these three counties decreased by about 5 percentage points, from 81 percent in 1960 to 76 percent in 1970, while the proportion of the total regional population in Ozaukee, Washington, and Waukesha Counties increased by 4 percentage points, from 16 percent in 1960 to 20 percent in 1970. This diffusion of population has resulted in the creation of many pressing areawide developmental and environmental problems, including rapidly changing land use, traffic congestion, air and water pollution, flooding, the loss of prime agricultural lands, and the general deterioration and destruction of the natural resource base.

Table 3

POPULATION DISTRIBUTION IN THE REGION BY COUNTY: SELECTED YEARS 1900-1970

County	1900		1930		1960		1970		Change 1960-1970	
	Population	Percent of Region	Population	Percent of Region	Population	Percent of Region	Population	Percent of Region	Absolute	Percent
Kenosha	21,707	4.3	63,277	6.3	100,615	6.4	117,917	6.7	17,302	17.2
Milwaukee . . .	330,017	65.8	725,263	72.1	1,036,047	65.8	1,054,249	60.1	18,202	1.7
Ozaukee	16,363	3.3	17,394	1.7	38,441	2.5	54,461	3.1	16,020	41.7
Racine	45,644	9.1	90,217	9.0	141,781	9.0	170,838	9.7	29,057	20.5
Walworth. . . .	29,259	5.8	31,058	3.1	52,368	3.3	63,444	3.6	11,076	21.1
Washington . .	23,589	4.7	26,430	2.6	46,119	2.9	63,839	3.6	17,720	38.4
Waukesha . . .	35,229	7.0	52,350	5.2	158,249	10.1	231,338	13.2	73,089	46.2
Region	501,808	100.0	1,005,989	100.0	1,573,620	100.0	1,756,086	100.0	182,466	11.6

Source: U. S. Bureau of the Census and SEWRPC.

Population Characteristics

Equally important considerations in transportation system planning are certain population characteristics, including age composition, race, household size, and personal income. Some of these characteristics, such as age, have indirect implications for land use and transportation planning since they affect the rate of population growth and change through natural increase. Age is also a factor in migration. Other population characteristics, such as household size and personal income, have a direct effect on housing needs and on certain important considerations in land use and transportation planning such as travel demand, travel habits, and travel characteristics, including the choice of transportation mode.

The changing distribution within selected age groups of the Region's population is shown in Table 4. The proportion of persons 65 years of age and older has steadily increased from 5 percent in 1930 to nearly 10 percent in 1970. Proportionately, the more mature working-age group, aged 45 to 64, has been the most constant over time, ranging from 17 to 23 percent of the total regional population. The younger working-age group of the population, aged 15 to 44, has declined since 1920 from about 50 percent of the total regional population to only 40 percent in 1970. The proportion of persons within the Region under 15 years of age has fluctuated widely since 1920. Nearly 30 percent of the population was under 15 years of age in 1920 and again in 1970. However, in 1940 this age group represented under 23 percent of the population, and in 1960 over 30 percent of the population. Much of the change in the proportion of these age groups, in the Region especially in those groups under 15 years of age and 65 years of age and older, can be accounted for by fluctuations in the birthrates and deathrates during these periods.

A more detailed breakdown of the age composition of the regional population for 1950, 1960, and 1970 is shown in Table 5. As shown, the proportion of the total population of five of the 17 age groups increased from 1950 to 1960 and from 1960 to 1970. In addition, three age groups which had experienced decreases between 1950 and 1960 increased in population between 1960 and 1970. The largest increase in the share of the total regional population from 1950 to 1960 was experienced by the 5 to 9 year age group, which increased by about 3 percentage points—from nearly 8 percent of the total in 1950 to nearly 11 percent in 1960. From 1960 to 1970, the largest increase in the share of total regional population was experienced by the 15 to 19 year age group, which increased from almost 7 percent of the total in 1960 to over 9 percent in 1970. Proportionately, the second largest increase in the share of the total regional population was experienced by the 10 to 14 year age group, which increased by 2 percentage points in each decade from 1950 to 1970.

Table 4

GENERALIZED AGE COMPOSITION OF THE POPULATION IN THE REGION: SELECTED YEARS 1920-1970

Age Group	Population											
	1920		1930		1940		1950		1960		1970	
	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Under 15. . . .	224,528[a]	28.7	266,523	26.5	240,544	22.5	304,077	24.5	494,704	31.4	523,391	29.8
15-44.	395,281	50.4	513,442	51.0	523,384	49.0	553,142	44.6	615,034	39.1	708,236	40.4
45-64.	163,872	20.9	173,383	17.2	233,864	21.9	283,898	22.9	322,943	20.5	354,845	20.2
65 and Older. .	- -[b]	- -	52,209	5.2	69,907	6.6	99,501	8.0	140,939	9.0	169,415	9.6
All Ages	783,681	100.0	1,006,118[c]	100.0	1,067,699	100.0	1,240,618	100.0	1,573,620	100.0	1,755,887[d]	100.0

[a] *This number is an estimate.*

[b] *The number of persons age 65 and older for 1920 is included in the total for persons 45 to 64 years of age.*

[c] *This column does not add to total because 561 persons did not report their ages.*

[d] *The 1970 regional population of 1,755,887 excludes 199 persons who were added subsequent to the conduct of the 1970 census and not allocated to the various age group categories.*

Source: U. S. Bureau of the Census and SEWRPC.

Table 5

DETAILED AGE COMPOSITION OF THE POPULATION IN THE REGION: 1950, 1960, AND 1970

Age Group	1950 Number	1950 Percent of Total	1960 Number	1960 Percent of Total	1970 Number	1970 Percent of Total	Net Change 1950-1960 Number	Net Change 1950-1960 Percent	Net Change 1960-1970 Number	Net Change 1960-1970 Percent
Under 5	127,140	10.2	190,197	12.1	153,243	8.7	63,057	49.6	- 36,954	- 19.4
5-9.	96,595	7.8	166,608	10.6	183,283	10.4	70,013	72.5	16,675	10.0
10-14.	80,342	6.5	137,896	8.8	186,865	10.6	57,554	71.6	48,969	35.5
15-19.	78,949	6.4	103,817	6.6	163,033	9.3	24,868	31.5	59,216	57.0
20-24.	93,453	7.5	94,011	6.0	132,672	7.5	558	0.6	38,661	41.1
25-29.	102,038	8.2	100,014	6.4	114,042	6.5	- 2,024	- 2.0	14,028	14.0
30-34.	96,252	7.8	108,477	6.9	98,001	5.6	12,225	12.7	- 10,476	- 9.7
35-39.	94,477	7.6	108,543	6.9	95,857	5.5	14,066	14.9	- 12,686	- 11.7
40-44.	87,973	7.1	100,175	6.4	104,631	6.0	12,202	13.9	4,456	4.4
45-49.	81,577	6.6	94,877	6.0	103,140	5.9	13,300	16.3	8,263	6.3
50-54.	77,227	6.2	85,559	5.4	93,714	5.3	8,332	10.8	8,155	9.5
55-59.	68,622	5.5	76,281	4.8	85,424	4.9	7,659	11.2	9,143	12.0
60-64.	56,472	4.6	66,226	4.2	72,567	4.1	9,754	17.3	6,341	9.6
65-69.	41,591	3.4	55,454	3.5	57,494	3.3	13,863	33.3	2,040	3.7
70-74.	27,736	2.2	40,977	2.6	46,711	2.7	13,241	47.7	5,734	14.0
75-84.	25,716	2.1	37,468	2.4	52,762	3.0	11,752	45.7	15,294	40.8
85 and Older. .	4,458	0.3	7,040	0.4	12,448	0.7	2,582	57.9	5,408	76.8
All Ages	1,240,618	100.0	1,573,620	100.0	1,755,887	100.0	333,002	26.8	182,267	11.6

Source: U. S. Bureau of the Census and SEWRPC.

The increases in the share of total regional population in the youthful and elderly age groups from 1950 to 1970 are significant when compared to the decreasing proportionate shares of the population in the 30 to 50 year age groups. Together, the 30 to 34 and 35 to 39 year age groups actually decreased by more than 23,000 persons from 1960 to 1970. The gains in population at the upper and lower ends of the age structure bear with them important implications for public policy formulation in the areas of education, recreation, health and welfare, transportation, and housing.

The racial composition of the regional population has also been changing (see Table 6). In the 1970 census, nearly 93 percent of the regional population was reported as white,[3] compared to 95 percent reported as white in 1960. The balance of the population was nonwhite, a category which includes persons reporting their race as black, American Indian, Asian, or another race. In both 1960 and 1970, the overwhelming majority—over 90 percent—of the nonwhite population in the Region was comprised of persons of the black race.

[3] *The Spanish-American population is included in the white population category because Spanish-Americans are not defined as a separate race by the U. S. Bureau of the Census. In 1970 there were more than 30,000 persons of Spanish language in the Region, representing nearly 2 percent of the regional population.*

Table 6

RACIAL COMPOSITION OF THE POPULATION IN THE REGION: 1960 AND 1970

Race	1960 Number	1960 Percent of Total	1970 Number	1970 Percent of Total
White	1,499,662	95.3	1,626,056	92.6
Nonwhite				
Black.	69,591	4.4	119,321	6.8
American Indian . .	2,225	0.1	4,617	0.3
Japanese	748	0.1	1,237	0.1
Chinese.	603	0.1	1,234	- -[a]
Filipino	247	- -[a]	693	- -[a]
Other.	538	- -[a]	2,729	0.2
Subtotal	73,952	4.7	129,831	7.4
Total	1,573,614	100.0	1,755,887	100.0

[a] *The percent of the total population is less than one-tenth of 1 percent.*

Source: U. S. Bureau of the Census and SEWRPC.

Table 7

RACIAL COMPOSITION OF THE POPULATION IN THE REGION BY COUNTY: 1970

County	Population											
			Nonwhite									
	White		Black		American Indian		Other		Subtotal		Total	
	Number	Percent of County Population	Number	Percent of County Population	Number	Percent of County Population	Number	Percent of County Population	Number	Percent of County Population	Number	Percent of County Population
Kenosha	115,623	98.1	1,930	1.6	143	0.1	221	0.2	2,294	1.9	117,917	100.0
Milwaukee . . .	939,989	89.2	106,033	10.1	3,717	0.3	4,324	0.4	114,074	10.8	1,054,063	100.0
Ozaukee	54,197	99.6	92	0.2	61	0.1	71	0.1	224	0.4	54,421	100.0
Racine	159,511	93.4	10,572	6.2	343	0.2	412	0.2	11,327	6.6	170,838	100.0
Walworth. . . .	62,879	99.1	287	0.5	56	0.1	222	0.3	565	0.9	63,444	100.0
Washington . .	63,652	99.7	45	0.1	62	0.1	80	0.1	187	0.3	63,839	100.0
Waukesha . . .	230,205	99.5	362	0.2	235	0.1	563	0.1	1,160	0.5	231,365	100.0
Region	1,626,056	92.6	119,321	6.8	4,617	0.3	5,893	0.3	129,831	7.4	1,755,887	100.0

Source: U. S. Bureau of the Census and SEWRPC.

As indicated in Table 7, the nonwhite population comprised about 2 percent of the total population in Kenosha County, nearly 11 percent in Milwaukee County, about 7 percent in Racine County, and less than 1 percent in the other counties of the Region in 1970. Furthermore, the nonwhite populations of the Region are concentrated in the central cities of Kenosha, Milwaukee, and Racine. Nearly 96 percent of the nonwhite population in the Region and 98 percent of all blacks in the Region resided in these three cities in 1970.

One of the most important characteristics of the regional population with respect to land use and facilities planning is the number and size of the households.[4] Almost 70,600 households were added to the Region between 1960 and 1970, an increase of 15 percent, as shown in Table 8. This compares with an increase of 111,400 households, or 31 percent, from 1950 to 1960. Since the rate of household growth was greater than the total population increase during this period, the number of people per household declined, from 3.36 in 1950 to 3.30 in 1960 to 3.20 in 1970.

[4] *A household is composed of all persons who occupy a group of rooms or a single room which constitutes a housing unit, i.e., separate living quarters. The household is a useful unit of analysis not only for comprehensive planning agencies, but for market analysts, public utility companies, and real estate firms.*

Within the Region, the greatest relative increase in the number of households from 1960 to 1970 occurred in suburban Waukesha, Ozaukee, and Washington Counties, with increases of 46, 42, and 39 percent, respectively, as shown in Table 9. Waukesha and Ozaukee Counties also had the largest increases in the 1950's, 80 and 58 percent, respectively. These increases are consistent with the previously discussed trends in population growth and distribution within the Region. The number of households in Milwaukee County increased by 8 percent from 1960 to 1970, the smallest relative increase in the Region, and by 26 percent in the 1950's, the second smallest relative increase for that period. With the exception of Milwaukee County, the rates of increase in the number of households in the Region were nearly equal to the rates of population increase during the same period. The number of households in Milwaukee County has increased at a more rapid rate than has the county population since 1960.

Kenosha, Milwaukee, Racine, Walworth, and Washington Counties experienced declines in the average number of people per household from 1960 to 1970. The largest decline occurred in Milwaukee County, where the average number of people per household declined from 3.21 in 1960 to 3.04 in 1970. Washington County experienced the smallest decline, only 0.01 person per household. Rapid increases in the number of households—especially one-person households—together with a declining birthrate have combined to cause the decline in household size. Ozaukee County was the only county in which the average

Table 8

HOUSEHOLD POPULATION TRENDS IN THE REGION: 1950-1970

Household Characteristics	1950	1960	1970	Change: 1950-1960		Change: 1960-1970	
				Absolute	Percent	Absolute	Percent
Total Number of Households	354,544	465,913	536,486	111,369	31.4	70,573	15.1
Household Population . .	1,190,193	1,537,235	1,714,200	347,042	29.1	176,965	11.5
Persons per Household . .	3.36	3.30	3.20	- 0.6	- 1.8	- 0.10	- 3.0

Source: U. S. Bureau of the Census and SEWRPC.

Table 9

NUMBER OF HOUSEHOLDS AND PERSONS PER HOUSEHOLD IN THE REGION BY COUNTY: 1950, 1960, AND 1970

County	Number of Households					Number of Persons per Household			Percent of Total Population Living in Households		
				Percent Change							
	1950	1960	1970	1950-1960	1960-1970	1950	1960	1970	1950	1960	1970
Kenosha	21,958	29,545	35,468	34.6	20.0	3.36	3.36	3.26	98.0	98.9	98.1
Milwaukee . . .	249,232	314,875	338,605	26.3	7.5	3.34	3.21	3.04	95.4	97.5	97.6
Ozaukee	6,591	10,417	14,753	58.0	41.6	3.51	3.65	3.66	99.0	98.9	99.1
Racine	31,399	40,736	49,796	29.7	22.2	3.37	3.39	3.35	96.5	97.5	97.7
Walworth. . . .	12,369	15,414	18,544	24.6	20.3	3.25	3.28	3.16	96.6	96.5	92.3
Washington . .	9,396	12,532	17,385	33.4	38.7	3.55	3.64	3.63	98.5	98.8	98.9
Waukesha . . .	23,599	42,394	61,935	79.6	46.1	3.51	3.66	3.66	96.3	98.0	98.0
Region	354,544	465,913	536,486	31.4	15.1	3.36	3.30	3.20	95.9	97.7	97.6

Source: U. S. Bureau of the Census and SEWRPC.

household size increased in 1970, while in Waukesha County the household size remained at the 1960 level.

Personal income in the Region has been increasing at a relatively rapid rate. As shown in Table 10, total personal income within the Region increased nearly 32 percent from 1960 to 1970, measured in constant 1967 dollars. This increase, however, was less than the national and state increases during this period, and less than the regional increase—71 percent—from 1950 to 1960, when the rate of personal income growth in the Region exceeded both the state and national increases.

The increase in per capita income since 1960 has also been slightly less in the Region than in the State or nation. Per capita income levels in the Region increased by about 18 percent from 1960 to 1970, measured in constant 1967 dollars, compared to increases in Wisconsin and the nation of 26 and 29 percent, respectively. The level of per capita income in the Region, however, has remained consistently higher than the State and national levels.

When the per capita income levels of the individual constituent counties are compared (see Table 11), it is apparent that the per capita income level for Milwaukee County has increased at a lower rate between 1950 and 1970 than that for all but two other counties. As a result, Milwaukee County no longer has the highest per capita income level within the Region. By 1970, Waukesha and Ozaukee Counties had exceeded the per capita income level of Milwaukee County, with Ozaukee County showing the largest absolute and percentage increase in per capita income level, increasing from $1,199 in 1950 to $3,709 in 1970—an actual dollar increase of $2,510, or over 209 percent.

Table 10

INCOME TRENDS IN THE UNITED STATES, WISCONSIN, AND THE REGION: SELECTED YEARS 1950-1970

Geographic Area and Income Measure	Year			Change 1950 to 1960		Change 1960 to 1970	
	1950	1960	1970	Number	Percent	Number	Percent
United States							
Total Income (in millions)							
Actual	$165,063	$331,700	$635,563	$166,637	101.0	$303,863	91.6
Constant[a] . . .	228,612	374,390	546,966	145,778	63.8	172,576	46.1
Per Capita Income							
Actual	1,070	1,849	3,128	779	72.8	1,279	69.2
Constant[a] . . .	1,481	2,087	2,692	606	40.9	605	29.0
Wisconsin							
Total Income (in millions)							
Actual	$ 3,581	$ 7,287	$ 13,457	$ 3,706	103.5	$ 6,170	84.7
Constant[a] . . .	4,960	8,225	11,581	3,265	65.8	3,356	40.8
Per Capita Income							
Actual	1,043	1,844	3,046	801	76.8	1,202	65.2
Constant[a] . . .	1,445	2,081	2,621	636	44.0	540	25.9
Region							
Total Income (in millions)							
Actual	$ 1,660	$ 3,492	$ 6,029	$ 1,832	110.4	$ 2,537	72.7
Constant[a] . . .	2,299	3,941	5,189	1,642	71.4	1,248	31.7
Per Capita Income							
Actual	1,338	2,219	3,433	881	65.8	1,214	54.7
Constant[a] . . .	1,853	2,505	2,954	652	35.2	449	17.9

[a] *Adjusted for price change; base year 1967 equals 100.0.*

Source: U. S. Bureau of the Census; U. S. Department of Labor; Wisconsin Department of Administration; and SEWRPC.

RECENT CHANGES IN THE DEMOGRAPHIC BASE OF THE REGION

Significant changes have occurred in the population of the Region since 1970. The most apparent indicator of these changes has been a virtual halt in regional population growth, a change from the pattern of continuous population increase that has characterized the Region for more than a century. Less apparent but nonetheless important changes in the number of households, in household size, and in age structure have also occurred.

Table 11

TOTAL AND PER CAPITA INCOME FOR THE REGION BY COUNTY: 1950, 1960, AND 1970

County	Year			Change 1950-1960		Change 1960-1970		Change 1950-1970	
	1950	1960	1970	Absolute	Percent	Absolute	Percent	Absolute	Percent
Kenosha County									
Total Income (in millions)									
Actual	$ 94	$ 220	$ 362	$ 126	134.0	$ 142	64.5	$ 268	285.1
Constant[a]	130	248	312	118	90.8	64	25.8	182	140.0
Per Capita Income									
Actual	1,250	2,187	3,070	937	75.0	883	40.4	1,820	145.6
Constant[a]	1,731	2,469	2,643	738	42.6	174	7.0	912	52.7
Milwaukee County									
Total Income (in millions)									
Actual	$1,209	$2,371	$3,680	$1,162	96.1	$1,309	55.2	$2,471	204.4
Constant[a]	1,674	2,677	3,168	1,003	59.9	491	18.3	1,494	89.2
Per Capita Income									
Actual	1,388	2,289	3,491	901	64.9	1,202	52.5	2,103	151.5
Constant[a]	1,922	2,584	3,006	662	34.4	422	16.3	1,084	56.4
Ozaukee County									
Total Income (in millions)									
Actual	$ 28	$ 82	$ 202	$ 54	192.9	$ 120	146.3	$ 174	621.4
Constant[a]	39	93	174	54	138.5	81	87.1	135	346.1
Per Capita Income									
Actual	1,199	2,133	3,709	934	77.9	1,576	73.9	2,510	209.3
Constant[a]	1,661	2,408	3,193	747	45.0	785	32.6	1,532	92.2
Racine County									
Total Income (in millions)									
Actual	$ 147	$ 296	$ 557	$ 149	101.4	$ 261	88.2	$ 410	278.9
Constant[a]	204	334	480	130	63.7	146	43.7	276	135.3
Per Capita Income									
Actual	1,341	2,088	3,260	747	55.7	1,172	56.1	1,919	143.1
Constant[a]	1,857	2,357	2,807	500	26.9	450	19.1	950	51.2
Walworth County									
Total Income (in millions)									
Actual	$ 44	$ 93	$ 186	$ 49	111.4	$ 93	100.0	$ 142	322.7
Constant[a]	61	105	160	44	72.1	55	52.4	99	162.3
Per Capita Income									
Actual	1,058	1,776	2,932	718	67.9	1,156	65.1	1,874	177.2
Constant[a]	1,465	2,005	2,524	540	36.9	519	35.4	1,059	72.3
Washington County									
Total Income (in millions)									
Actual	$ 35	$ 86	$ 201	$ 51	145.7	$ 115	133.7	$ 166	474.3
Constant[a]	48	97	173	49	102.1	76	78.3	125	260.4
Per Capita Income									
Actual	1,032	1,865	3,149	833	80.7	1,284	68.8	2,117	205.1
Constant[a]	1,429	2,106	2,711	677	47.4	605	28.7	1,282	89.7
Waukesha County									
Total Income (in millions)									
Actual	$ 103	$ 344	$ 841	$ 241	234.0	$ 497	144.0	$ 738	716.5
Constant[a]	143	388	724	245	171.3	336	86.7	581	406.3
Per Capita Income									
Actual	1,199	2,174	3,635	975	81.3	1,461	67.2	2,436	203.2
Constant[a]	1,661	2,454	3,130	793	47.7	676	27.5	1,469	88.4
Region									
Total Income (in million)									
Actual	$1,660	$3,492	$6,029	$1,832	110.4	$2,537	72.6	$4,369	263.2
Constant[a]	2,300	4,450	5,191	2,150	93.5	741	16.6	2,891	125.7
Per Capita Income									
Actual	1,338	2,219	3,433	881	65.8	1,214	54.7	2,095	156.6
Constant[a]	1,853	2,505	2,956	652	35.2	451	18.0	1,103	59.5

[a] *Based on the Consumer Price Index, 1967 = 100.0.*

Source: U. S. Bureau of the Census; U. S. Department of Labor; Wisconsin Department of Administration; and SEWRPC.

Population Size

As indicated in Table 12, the estimated 1978 resident population of the Region was approximately 1,773,500 people—only 14,400, or 1 percent, more people than there were in the Region in 1970. More importantly, the available data indicate that the Region may have lost population since 1975. Between 1970 and 1975 the Region's resident population is estimated to have increased by approximately 32,000 people to a level of 1,788,000 people—an increase of about 2 percent over the 1970 level of 1,756,000 people. Between 1975 and 1978 the resident population of the Region is estimated to have actually decreased from 1,788,000 people to 1,773,500—a decrease of about 1 percent. If confirmed by the 1980 national census, this would mark the first time in its recorded history that the seven-county Region as a whole has lost population. General fertility declines partially account for the reduced rates of population growth noted. Within the Region, State, and nation, current fertility levels are among the lowest on record. Available data on births and deaths in the Region suggest that the rate of natural increase in the Region through the 1970's will be approximately equal to the 6.2 percent rate of natural increase that occurred during the 1930's, which was the lowest 10-year rate for the period 1920 to 1970—the period for which reasonably reliable data on migration and natural increase are available.

Table 12

POPULATION TRENDS IN THE REGION BY COUNTY: 1970-1978

County	Population		Change 1970-1978	
	1970	1978	Absolute	Percent
Kenosha	117,917	126,244	8,327	7.06
Milwaukee . . .	1,054,249	954,109	- 100,140	- 9.50
Ozaukee	54,461	70,431	15,970	29.32
Racine	170,838	177,452	6,614	3.87
Walworth. . . .	63,444	69,161	5,717	9.01
Washington . .	63,839	84,114	20,275	31.76
Waukesha . . .	231,335	288,973	57,638	24.92
Region	1,756,083	1,770,484	14,401	0.82

Source: Wisconsin Department of Administration and SEWRPC.

Changes in resident population levels within the Region since 1970 are only partially explained by declining fertility, however. Prior to 1970, net out-migration occurred only during the 1930's—at a rate of 0.1 percent per decade—and the 1960's—at a rate of 1.3 percent per decade—and was substantially offset in each of these decades by natural increase. However, since 1970, and particularly since 1975, net out-migration has become a significant component of population change in the Region. Between 1970 and 1977, the net out-migration rate was 3.3 percent, which offset approximately 75 percent of the population change that was attributable to natural increase. The increased rates of net out-migration and the reduced rates of natural increase noted have combined to produce for the 1970 through 1978 period the smallest rate of total population change in the Region's history.

Population Distribution

Although overall regional population growth has apparently come to a virtual halt, the distribution of the population in the Region has continued to change significantly. The populations of Ozaukee, Washington, and Waukesha Counties have each increased 25 percent or more since 1970 (see Table 13). The populations of Kenosha, Racine, and Walworth Counties have also grown since 1970 but at more moderate rates of less than 10 percent. Milwaukee County's population has declined about 10 percent since 1970, representing an absolute population loss of about 100,000 people.

These changes indicate that the dispersion of urban population into the outlying areas of the Region—a trend which began early in the present century—is continuing, even though the resident population level of the Region has been virtually stable between 1970 and 1978. As shown in Table 13, the most dramatic changes in population distribution continue to occur—as they have since 1930—in Milwaukee and Waukesha Counties. The Milwaukee County proportion of the total regional population decreased about 6 percentage points—from 60.1 percent to 53.9 percent—between 1970 and 1978. In contrast, the Waukesha County proportion of the total regional population increased by about 3 percentage points—from 13.2 percent to 16.3 percent—during the same period. The remaining five counties showed increases of from 0.3 to 1.2 percentage points in their proportions of total regional population.

Table 13

POPULATION DISTRIBUTION IN THE REGION BY COUNTY: 1970-1978

County	1970		1978		Change 1970-1978	
	Population	Percent of Region	Population	Percent of Region	Absolute	Percent
Kenosha	117,917	6.7	126,244	7.1	8,327	7.06
Milwaukee . . .	1,054,249	60.1	954,109	53.9	- 100,140	- 9.50
Ozaukee	54,461	3.1	70,431	4.0	15,970	29.32
Racine.	170,838	9.7	177,452	10.0	6,614	3.87
Walworth. . . .	63,444	3.6	69,161	3.9	5,717	9.01
Washington . .	63,839	3.6	84,114	4.8	20,275	31.76
Waukesha. . . .	231,335	13.2	288,973	16.3	57,638	24.92
Region	1,756,083	100.0	1,770,484	100.0	14,401	0.82

Source: Wisconsin Department of Administration and SEWRPC.

Population Characteristics

Among the more difficult population information to obtain during the periods between decennial censuses are data concerning the composition and characteristics of the resident population of small geographic areas such as the Region. Differential and ever-changing age-specific rates of fertility, mortality, and migration make the estimation of the characteristics of the population of small areas especially error-prone. Special censuses, however, do provide limited information on population characteristics during the intercensal periods. Such censuses are conducted by the U.S. Bureau of the Census for individual civil divisions within the Region when these civil divisions challenge annual population estimates made by the Wisconsin Department of Administration for the purpose of distributing state-shared taxes on the basis of population size. In addition, civil divisions desiring more current information about their population may contract with the Census Bureau for a special census. A number of special censuses have been taken within the Region over the past few years. The data resulting from these censuses provide information on the changes within those civil divisions in total population, in the age and sex composition of the population, and in total and occupied housing units. Such data are useful for evaluating changes in the number of households and in average household size.

Prior to 1974, the Census Bureau released only total population figures obtained from special censuses of civil divisions of under 10,000 population, and tabulated population age, race, and sex distribution and household counts for areas of 10,000 or more. Beginning in 1974, censuses for all civil divisions included age, race, and sex distribution tabulations, and beginning in 1975, household and housing unit counts were also included in all censuses, regardless of the population of the civil division.

The special censuses conducted in certain civil divisions in southeastern Wisconsin between January 1, 1975, and April 1, 1979 (see Table 14) provide valuable data on changes in regional population characteristics, because these special censuses enumerated approximately 45 percent of the Region's resident population. While data from the special censuses cannot be compared with the county data previously presented in this report, they nevertheless provide important indicators of recent changes in characteristics of the regional population.[5]

[5] *For a detailed discussion of special census reports, see SEWRPC Technical Report No. 22, Recent Population Growth and Change in Southeastern Wisconsin: 1970-1977.*

Table 14

SPECIAL CENSUSES CONDUCTED IN THE SOUTHEASTERN WISCONSIN REGION: 1970-1979

Civil Division	Date of Special Census
Village of Saukville	August 7, 1972
Village of Jackson	November 15, 1972
Village of Rochester	February 2, 1973
Town of Somers	February 7, 1973
Village of Twin Lakes	February 14, 1973
Town of Sugar Creek	May 1, 1973
Village of Wales	May 7, 1973
Town of Caledonia	May 8, 1973
Village of Grafton	June 7, 1973
Town of Mukwonago	August 8, 1973
Town of Wheatland	August 14, 1973
Village of Germantown	January 3, 1974
City of St. Francis	May 6, 1974
Town of Delafield	May 20, 1974
City of Brookfield	June 4, 1974
Town of Pewaukee	June 20, 1974
Village of Silver Lake	September 5, 1974
Village of West Milwaukee	December 2, 1974
City of Milwaukee	March 3, 1975
Town of Pleasant Prairie	February 23, 1976
Town of Somers	February 27, 1976
Town of Barton	December 9, 1976
City of Oak Creek	December 14, 1976
City of Whitewater	January 19, 1977
Town of Cedarburg	February 8, 1977
Town of Waukesha	March 1, 1977
Town of Merton	August 1, 1977
Town of Richfield	September 8, 1977
City of Port Washington	December 6, 1977
Town of Oconomowoc	January 17, 1978
Village of Germantown	January 18, 1978
Town of Genesee	January 19, 1978
Town of Saukville	February 13, 1978
Village of West Milwaukee	April 6, 1978
Village of Wales	April 17, 1978
City of Greenfield	July 19, 1978
Town of Grafton	September 19, 1978
Town of Somers	February 21, 1979

Source: U. S. Bureau of the Census, Wisconsin Department of Administration, and SEWRPC.

Analyses of the results of the special censuses indicate that the population of the Region is aging. A comparison of median ages computed for 1970 and for the date of the special censuses (see Table 15) indicates that the median age has increased in 14 of the civil divisions examined. In six of these civil divisions, the median age has increased by three or more years. Only the Cities of Whitewater and Milwaukee and the Village of Wales have experienced a decrease in median age since 1970. The largest of the three observed decreases was - 0.3 year. General fertility declines account for some of the observed increases in median age, as evidenced by the fact that all 17 civil divisions experienced a decrease in the proportion of their total population under five years of age between 1970 and the date of their respective special censuses.

Table 15

CHANGE IN MEDIAN AGE IN SELECTED CIVIL DIVISIONS IN SOUTHEASTERN WISCONSIN SINCE 1970

Civil Division	Median Age		Change in Years
	1970 Census	Special Census	
City of Milwaukee	28.2	28.1	- 0.1
City of Oak Creek	22.9	25.9	3.0
City of Port Washington	24.8	28.3	3.5
City of Whitewater	21.4	21.2	- 0.2
Village of Germantown	22.4	26.8	4.4
Village of Wales	24.8	24.5	- 0.3
Village of West Milwaukee	38.9	40.4	1.5
Town of Barton	23.2	24.3	1.1
Town of Cedarburg	24.1	27.3	3.2
Town of Genesee	24.1	26.7	2.6
Town of Merton	28.0	29.5	1.5
Town of Oconomowoc	29.0	29.9	0.9
Town of Pleasant Prairie	25.5	28.5	3.0
Town of Richfield	23.1	26.4	3.3
Town of Saukville	25.6	27.6	2.0
Town of Somers	26.0	27.5	1.5
Town of Waukesha	27.3	28.3	1.0

Source: U. S. Bureau of the Census and SEWRPC.

Special census results also indicate that the number of households in the Region is increasing (see Table 16), even in areas which are experiencing a rapid population decline such as the City of Milwaukee. From 1950 to 1960, the number of households in the Region increased by 111,400, or 31 percent. Between 1960 and 1970, the number of households increased by 70,600, or 15 percent. Perhaps more importantly, the rate of household increase is greater than the rate of population increase in those civil divisions experiencing population growth. Of the civil divisions examined, only the Village of West Milwaukee has experienced a decrease in the number of households since 1970. As might be expected in view of the observed differential rates of change in households in these civil divisions, average household size has continued to decline (see Table 17). Between 1950 and 1970, the number of persons per household declined from 3.36 to 3.20. Special census results for those civil divisions analyzed indicate, in all cases, a decrease in household size since 1970.

Table 16

CHANGE IN NUMBER OF HOUSEHOLDS IN SELECTED CIVIL DIVISIONS IN SOUTHEASTERN WISCONSIN SINCE 1970

Civil Division	Households		Change	
	1970 Census	Special Census	Number	Percent
City of Milwaukee	236,981	240,608	3,627	1.53
City of Oak Creek	3,585	4,569	984	27.45
City of Port Washington	2,459	2,778	319	12.97
City of Whitewater	2,257	2,805	548	24.28
Village of Germantown	1,744	2,974	1,230	70.53
Village of Wales	185	489	304	164.32
Village of West Milwaukee	1,845	1,809	- 36	- 1.95
Town of Barton	419	575	156	37.23
Town of Cedarburg	956	1,384	428	44.77
Town of Genesee	846	1,310	464	54.85
Town of Merton	1,274	1,635	361	28.34
Town of Oconomowoc	1,794	2,075	281	15.66
Town of Pleasant Prairie	3,303	3,658	355	10.75
Town of Richfield	1,502	2,149	647	43.08
Town of Saukville	409	472	63	15.40
Town of Somers	2,115	2,560	445	21.04
Town of Waukesha	1,206	1,756	559	46.35

Source: U. S. Bureau of the Census and SEWRPC.

Table 17

CHANGE IN HOUSEHOLD SIZE IN SELECTED CIVIL DIVISIONS IN SOUTHEASTERN WISCONSIN SINCE 1970

Civil Division	Household Size		Change	
	1970 Census	Special Census	Number	Percent
City of Milwaukee	2.96	2.72	- 0.24	- 8.14
City of Oak Creek	3.88	3.39	- 0.49	- 12.63
City of Port Washington	3.52	3.02	- 0.50	- 14.20
City of Whitewater	2.99	2.11	- 0.88	- 29.43
Village of Germantown	4.00	3.27	- 0.73	- 18.25
Village of Wales	3.74	3.58	- 0.16	- 4.28
Village of West Milwaukee	2.35	1.91	- 0.44	- 18.72
Town of Barton	3.88	3.70	- 0.18	- 4.64
Town of Cedarburg	3.95	3.72	- 0.23	- 5.82
Town of Genesee	3.75	3.59	- 0.16	- 4.27
Town of Merton	3.47	3.40	- 0.07	- 2.02
Town of Oconomowoc	3.32	3.18	- 0.14	- 4.22
Town of Pleasant Prairie	3.61	3.26	- 0.35	- 9.70
Town of Richfield	3.94	3.67	- 0.27	- 6.85
Town of Saukville	3.71	3.41	- 0.30	- 8.09
Town of Somers	3.44	3.00	- 0.44	- 12.79
Town of Waukesha	3.66	3.55	- 0.11	- 3.01

Source: U. S. Bureau of the Census and SEWRPC.

The racial composition of the Region's population has also continued to change since 1970. Of all civil divisions for which special censuses have been taken, only the City of Milwaukee has a significant black population component. As shown in Table 18, the black population in the City of Milwaukee increased by almost 18 percent between 1970 and 1975. During this same time period, the total population of the City of Milwaukee decreased by approximately 7 percent. Additionally, the 1975 enumerated black population in the City of Milwaukee was approximately 4,300 people more than the 1970 enumerated black population in the entire Region. Because the black population residing in the City of Milwaukee represented approximately 88 percent of the black population residing in the Region in 1970, this noted increase is an indication that the black component of the regional population has increased since 1970.

Table 18

BLACK POPULATION CHANGE IN THE CITY OF MILWAUKEE: 1970-1975

Black Population		Change	
1970	1975	Number	Percent
105,088	123,689	18,601	17.70

Source: U. S. Bureau of the Census and SEWRPC.

THE ECONOMIC BASE OF THE REGION: 1950 to 1970

Changes in the population of an area are generally closely related to changes in the amount of economic activity in that area. Historical population and employment trends have followed quite similar patterns in the Region. This is true not only because much of the population migration into an area is dependent upon the availability of jobs in that area, but because jobs must ultimately be available in order to retain the natural increase component of population change. The rapid historical growth of population in the Region may, therefore, be basically attributed to increasing economic activity in the Region.

Labor Force Size and Composition

The labor force of an area is defined as those residents 14 years of age and older enumerated at their place of residence who are either employed at one or more jobs or actively seeking employment, and is that segment of the population which can be most closely related to the economy. It is the employed portion of the labor force that provides the economic support for the total population.

Table 19 shows the changes in the labor force in the United States, Wisconsin, and the Region from 1950 to 1970. During this 20-year period, the

Table 19

LABOR FORCE TRENDS IN THE UNITED STATES, WISCONSIN, AND THE REGION BY COUNTY: SELECTED YEARS 1950-1970

County	Labor Force			Change: 1950-1960		Change: 1960-1970		Change: 1950-1970	
	1950	1960	1970	Absolute	Percent	Absolute	Percent	Absolute	Percent
Kenosha	32,600	39,800	47,700	7,200	22.1	7,900	19.8	15,100	46.3
Milwaukee	386,500	433,100	458,600	46,600	12.1	25,500	5.9	72,100	18.6
Ozaukee	9,600	14,400	22,400	4,800	50.0	8,000	55.5	12,800	133.3
Racine	46,800	55,000	69,300	8,200	17.5	14,300	26.0	22,500	4.8
Walworth.	16,500	20,500	26,800	4,000	24.2	6,300	30.7	10,300	62.4
Washington . . .	14,300	17,400	26,100	3,100	21.7	8,700	50.0	11,800	82.5
Waukesha	33,800	58,500	93,600	24,700	73.1	35,100	60.0	59,800	176.9
Region	540,100	638,700	744,500	98,600	18.3	105,800	16.6	204,400	37.8
Wisconsin	1,396,400	1,533,000	1,799,300	136,600	9.8	266,300	17.4	402,900	28.8
United States	59,304,000	68,144,000	82,897,000	8,840,000	14.9	14,753,000	21.6	23,593,000	39.8

Source: U. S. Bureau of the Census and SEWRPC.

labor force in the Region increased from about 540,100 people in 1950 to about 638,700 in 1960 and about 744,500 in 1970—an overall increase of 204,400 people, or 38 percent. This percentage increase was greater than that for Wisconsin and less than that for the United States during the same period. These labor force trends indicate that during this period, the Region experienced difficulty in competing for economic growth with other parts of the United States. Within the Region, the labor force in both Ozaukee and Waukesha Counties more than doubled from 1950 to 1970. Only in the three urban counties of Kenosha, Milwaukee, and Racine did the labor force increase less than 50 percent from 1950 to 1970. It should also be noted that since the labor force is enumerated at place of residence, the size of the labor force in individual counties does not necessarily reflect a concomitant number of job opportunities within these same counties. For example, many of the members of the labor force in the suburban areas of Ozaukee, Washington, and Waukesha Counties work at jobs in Milwaukee County, while some members of the labor force in Milwaukee County hold jobs in outlying counties.

The labor force participation rate is the relationship between the labor force and the total working age population. This rate is a useful analytical tool for identifying trends and fluctuations in the population which may indicate changing economic or social conditions. The labor force participation rate is defined as the proportion of the total population 14 years of age and older who are in the labor force. Labor force participation in the Region has been increasing since 1950. The proportion of the population 14 years of age and older in the labor force increased from 57 percent in 1950 to 58 percent in 1960 and 59 percent in 1970 (see Tables 20 and 21).

This increase in labor force participation is due largely to the increase in the proportion of females in the working age population who have either obtained a job or are actively seeking employment. From 1950 to 1970, female labor force participation increased from 32 percent to 43 percent, while male participation decreased from 82 percent to 76 percent. Although male participation rates have continued to decline, over 62 percent of the 1970 labor force was comprised of males. The labor force participation rate pattern exhibited by the Region is also apparent in each of the seven constituent counties, with the exception of Kenosha County, where the total labor force rate has decreased slightly between 1950 and 1970, as shown in Table 21. The proportion of males in the labor force has consistently decreased, while the proportion of females has consistently increased during the period 1950 to 1970 at the county level. Table 21 also shows a high degree of uniformity in the labor force participation rates among the seven counties within the Region, with the total participation rates ranging from about 57 percent in Walworth County to about 61 percent in Washington County in 1970. The observed 1950 to 1970 trends in labor force participation may be anticipated to continue because of the following

Table 20

PARTICIPATION OF THE POPULATION IN THE LABOR FORCE IN THE REGION: SELECTED YEARS 1950-1970

Population 14 Years and Over	1950	1960	1970	Change 1950-1960		Change 1960-1970		Change 1950-1970	
				Absolute	Percent	Absolute	Percent	Absolute	Percent
Male	466,938	534,824	604,341	67,886	14.5	69,517	13.0	137,403	29.4
Female	485,157	565,703	664,204	80,546	16.6	98,501	17.4	179,047	36.9
Total	952,095	1,100,527	1,268,545	148,432	15.6	168,018	15.3	316,450	33.2
Labor Force									
Male	384,946	432,433	456,918	47,487	12.3	24,485	5.7	71,972	18.7
Female	155,111	206,300	287,596	51,189	33.0	81,296	39.4	132,485	85.4
Total	540,057	638,733	744,514	98,676	18.3	105,781	16.6	204,457	37.9
Labor Force Participation Rate				Change 1950-1960		Change 1960-1970		Change 1950-1970	
Male	82.4	80.0	75.6	- 1.6		- 5.2		- 6.8	
Female	32.0	36.5	43.3	4.5		6.8		11.3	
Total	56.7	58.0	58.7	1.3		1.2		2.5	

Source: U. S. Bureau of the Census and SEWRPC.

factors: increasing emphasis on formal education or training, especially among the male population; retirement from the labor force at younger ages; the decision of young adults to start families at later ages; the decision of young adults to have smaller families; the desire of older women to help meet family financial needs or simply return to work; and the increasing number of females who choose to pursue a career other than that of homemaker.

Size of the Economy

For planning purposes, perhaps the best measure of economic activity is the number of employment opportunities, or jobs, available to the residents of a planning area. The amount of economic activity in the Region, as measured by the number of available jobs, has changed at varying rates since 1950. There was a rapid increase in the number of jobs available in the Region from 1950 to 1957, followed by a sharp decline in 1958, corresponding to a national economic recession. From 1958 to 1960, another rapid increase in the number of jobs available was observed followed by another sharp decline in 1961, which again corresponded to a national economic recession. From 1962 to 1972, job growth within the Region proceeded at a steady rate except for a slight economic slowdown from 1966 to 1967, and a decline in 1971 as a result of the 1970 economic recession.

The historical trend in regional economic activity has generally paralleled the historical trend in national economic activity, as shown in Table 22. Fluctuations and periods of economic expansion and recession have typically been much greater for the Region, however, than for the nation due to the high concentration of regional economic activity in the production of capital goods. Capital goods production, as a derived demand, is highly responsive to lesser fluctuations in general consumer demand for goods and services. In spite of these fluctuations, however, from 1954 to 1970 the relative rate of growth in economic activity in the Region, as measured by the number of available jobs, was consistently higher than that of the nation.

Unemployment rates in the Region have been consistently lower than those of the State and the nation for the period 1950 to 1970. The relatively low unemployment rate in the Region is probably related to the fact that there are higher proportions of skilled and semiskilled blue collar workers in the regional labor force than in the national labor force. There is also a higher proportion of white collar clerical and sales workers in the regional labor force than in the national labor force according to the 1970 federal census. There are, however, lower proportions of professionals, managers, and public officials in the regional labor

Table 21

PARTICIPATION OF THE POPULATION IN THE LABOR FORCE IN THE REGION BY COUNTY: 1950, 1960, AND 1970

County	1950	1960	1970	Change 1950-1960		Change 1960-1970		Change 1950-1970	
				Absolute	Percent	Absolute	Percent	Absolute	Percent
Kenosha									
Population 14 Years and Older									
Male	28,471	34,920	40,568	6,449	22.6	5,648	16.2	12,097	42.5
Female	28,249	34,626	43,326	6,377	22.6	8,700	25.1	15,077	53.4
Total	56,720	69,546	83,894	12,826	22.6	14,348	20.6	27,174	47.9
Labor Force									
Male	24,631	28,490	30,154	3,859	15.7	1,664	5.8	5,523	22.4
Female	7,963	11,334	17,633	3,371	42.3	6,299	55.6	9,670	121.4
Total	32,594	39,824	47,787	7,230	22.2	7,963	20.0	15,193	46.6
Labor Force Participation Rate (percent)									
Male	86.0	81.6	74.3	-4.4	--	-7.3	--	-11.7	--
Female	28.2	32.7	40.7	4.5	--	8.0	--	12.5	--
Total	57.5	57.3	57.0	-0.2	--	-0.3	--	-0.5	--
Milwaukee									
Population 14 Years and Older									
Male	328,554	355,597	366,609	27,043	8.2	11,012	3.1	38,055	11.6
Female	347,915	382,985	413,476	35,070	10.1	30,491	8.0	65,561	18.8
Total	676,469	738,582	780,085	62,113	9.2	41,503	5.6	103,616	15.3
Labor Force									
Male	269,813	287,107	274,665	17,294	6.4	12,442	4.3	4,852	1.8
Female	116,643	145,994	183,921	29,351	25.2	29,351	25.2	67,278	57.7
Total	386,456	433,101	458,586	46,645	12.1	25,485	5.9	25,485	6.6
Labor Force Participation Rate (percent)									
Male	82.1	80.7	74.9	-1.4	--	-5.8	--	-7.2	--
Female	33.5	38.1	44.5	4.6	--	6.4	--	11.0	--
Total	57.1	58.6	58.8	1.5	--	0.2	--	1.7	--
Ozaukee									
Population 14 Years and Older									
Male	8,714	12,397	18,265	3,683	42.3	5,868	47.3	9,551	109.6
Female	8,388	12,652	18,855	4,264	50.8	6,203	49.0	10,467	124.8
Total	17,102	25,049	37,120	7,947	46.5	12,071	48.2	20,018	117.0
Labor Force									
Male	7,321	10,332	14,484	3,011	41.1	4,152	40.2	7,163	97.8
Female	2,334	4,117	7,901	1,783	76.4	3,784	91.9	5,567	238.5
Total	9,655	14,449	22,385	4,794	49.6	7,936	54.9	12,730	131.8
Labor Force Participation Rate (percent)									
Male	84.0	83.3	79.3	-0.7	--	-4.0	--	-4.7	--
Female	27.8	32.5	41.9	4.7	--	9.4	--	14.1	--
Total	56.4	57.7	60.3	1.3	--	2.6	--	3.9	--
Racine									
Population 14 Years and Older									
Male	41,047	46,785	57,226	5,738	14.0	10,441	22.3	16,179	39.4
Female	41,740	49,342	62,074	7,602	18.2	12,732	25.8	20,334	48.7
Total	82,787	95,127	119,200	12,340	14.9	24,073	25.3	36,413	44.0
Labor Force									
Male	34,432	37,560	43,767	3,128	9.1	6,207	16.5	9,335	27.1
Female	12,371	17,431	25,502	5,060	40.9	8,071	46.3	13,131	106.1
Total	46,803	54,991	69,269	8,188	17.5	14,278	26.0	22,466	48.0
Labor Force Participation Rate (percent)									
Male	83.9	80.3	76.5	-3.6	--	-3.8	--	-7.4	--
Female	29.6	35.3	41.1	5.7	--	5.8	--	11.5	--
Total	56.5	57.8	58.1	1.3	--	0.3	--	1.6	--

Table 21 (continued)

County	1950	1960	1970	Change 1950-1960		Change 1960-1970		Change 1950-1970	
				Absolute	Percent	Absolute	Percent	Absolute	Percent
Walworth									
Population									
14 Years and Older									
Male	15,801	18,259	23,086	2,458	15.5	4,827	26.4	7,285	46.1
Female	15,651	18,830	24,257	3,179	20.3	5,427	28.8	8,606	55.0
Total	31,452	37,089	47,343	5,637	17.9	10,254	27.6	15,891	50.5
Labor Force									
Male	12,443	14,010	16,366	1,567	12.6	2,356	16.8	3,923	31.5
Female	4,012	6,454	10,487	2,442	60.9	4,033	62.5	6,475	161.4
Total	16,455	20,464	26,853	4,009	24.4	6,389	31.2	10,398	63.2
Labor Force Participation Rate (percent)									
Male	78.7	76.7	70.9	- 2.0	- -	- 5.8	- -	- 7.8	- -
Female	25.6	34.3	43.2	8.7	- -	8.8	- -	17.6	- -
Total	52.3	55.2	56.7	2.9	- -	1.5	- -	4.4	- -
Washington									
Population									
14 Years and Older									
Male	12,652	15,237	21,123	2,585	20.4	5,886	38.6	8,471	66.9
Female	12,193	15,223	21,843	3,030	24.8	6,620	43.5	9,650	79.1
Total	24,845	30,460	42,966	5,615	22.6	12,506	41.1	18,121	72.9
Labor Force									
Male	10,621	12,445	16,470	1,824	17.2	4,025	32.3	5,849	55.1
Female	3,637	4,947	9,576	1,310	36.0	4,629	48.3	6,119	168.2
Total	14,258	17,392	26,046	3,134	22.0	8,654	49.7	11,788	82.7
Labor Force Participation Rate (percent)									
Male	83.9	81.7	78.0	- 2.2	- -	- 3.7	- -	- 5.9	- -
Female	29.8	32.5	43.8	2.7	- -	11.3	- -	14.0	- -
Total	57.4	57.1	60.6	- 0.3	- -	3.5	- -	3.2	- -
Waukesha									
Population									
14 Years and Older									
Male	31,699	51,629	77,464	19,930	62.9	25,835	50.0	45,765	144.4
Female	31,021	52,028	80,373	21,007	67.7	28,345	54.5	49,352	159.1
Total	62,720	103,657	157,837	40,937	65.3	54,180	52.3	95,117	151.6
Labor Force									
Male	25,685	42,489	61,012	16,804	65.4	18,523	43.4	35,327	137.5
Female	8,151	16,023	32,576	7,872	96.6	16,553	103.3	24,425	299.7
Total	33,836	58,512	93,588	24,676	72.9	35,076	59.9	59,752	176.6
Labor Force Participation Rate (percent)									
Male	81.0	82.3	78.8	1.3	- -	- 3.5	- -	- 2.2	- -
Female	26.3	30.8	40.5	4.5	- -	9.7	- -	14.2	- -
Total	53.9	56.4	59.3	2.5	- -	2.9	- -	5.4	- -
Region									
Population									
14 Years and Older									
Male	466,938	534,824	604,341	67,886	14.5	69,517	13.0	137,403	29.4
Female	485,157	565,703	664,204	80,546	16.6	98,501	17.4	179,047	36.9
Total	952,095	1,100,527	1,268,545	148,432	15.6	168,018	15.3	316,450	33.2
Labor Force									
Male	384,946	432,433	456,918	47,487	12.3	24,485	5.7	71,972	18.7
Female	155,111	206,300	287,596	51,189	33.0	81,296	39.4	132,485	85.4
Total	540,057	638,733	744,514	98,676	18.3	105,781	16.6	204,457	37.9
Labor Force Participation Rate (percent)									
Male	82.4	80.0	75.6	- 1.6	- -	- 5.2	- -	- 6.8	- -
Female	32.0	36.5	43.3	4.5	- -	6.8	- -	11.3	- -
Total	56.7	58.0	58.7	1.3	- -	1.2	- -	2.5	- -

Source: U. S. Bureau of the Census and SEWRPC.

Table 22

EMPLOYMENT TRENDS IN THE UNITED STATES, WISCONSIN, AND THE REGION BY COUNTY: SELECTED YEARS 1950-1970

County	Employment			Change 1950-1960		Change 1960-1970		Change 1950-1970	
	1950	1960	1970	Absolute	Percent	Absolute	Percent	Absolute	Percent
Kenosha	27,700	40,100	39,200	12,400	44.8	- 900	- 2.2	11,500	41.5
Milwaukee . . .	438,100	486,200	510,900	48,100	11.0	24,700	5.1	72,800	16.6
Ozaukee	6,200	9,500	17,900	3,300	53.2	8,400	88.4	11,700	188.7
Racine	43,200	48,500	61,900	5,300	12.3	13,400	27.6	18,700	43.3
Walworth. . . .	12,300	18,300	24,200	6,000	48.8	5,900	32.2	11,900	96.7
Washington . .	9,700	14,500	20,300	4,800	49.5	5,800	40.0	10,600	109.3
Waukesha . . .	15,500	30,800	67,200	15,300	98.7	36,400	118.2	51,700	333.5
Region	552,700	647,900	741,600	95,200	17.2	93,700	14.5	188,900	34.2
Wisconsin	1,348,100	1,582,800	1,842,400	234,700	17.4	259,600	16.4	494,300	36.7
United States	58,911,000	65,798,500	78,662,000	6,887,500	11.7	12,863,500	19.5	19,751,000	33.5

Source: U. S. Department of Labor; Wisconsin Department of Industry, Labor, and Human Relations; and SEWRPC.

force than in the national labor force, reflecting in part the fact that the regional economy is not as heavily oriented toward high technology research industries as are the economies in other areas of the United States, such as the Pacific states.

Distribution of Economic Activity

Significant changes in the distribution of economic activity within the Region have occurred since 1950, as shown in Table 23. In 1960, 75 percent of the economic activity of the Region, as measured by jobs, was located in Milwaukee County. An additional 14 percent was located in Kenosha and Racine Counties combined. Therefore, approximately 89 percent of the regional economic activity in 1960 was located in these three urban counties. By 1970, the proportion of the economic activity of the Region located in Milwaukee County had declined to 69 percent, while the proportion of the regional economic activity concentrated in the three urban counties of Kenosha, Milwaukee, and Racine combined had decreased to about 82 percent. Over the 10-year period, therefore, the trend in the intraregional distribution of jobs was toward a decreasing concentration of jobs in these three urban counties, with an increasing concentration of jobs in the four outlying counties.

Table 23

DISTRIBUTION OF JOBS IN THE REGION BY COUNTY: SELECTED YEARS 1960-1970

County	1950		1960		1970		Change (percent)		
	Number of Jobs	Percent	Number of Jobs	Percent	Number of Jobs	Percent	1950-1960	1960-1970	1950-1970
Kenosha	27,700	5.0	40,100	6.2	39,200	5.3	1.2	- 0.9	0.3
Milwaukee . . .	438,100	79.3	486,200	75.0	510,900	68.9	- 4.3	- 6.1	- 10.4
Ozaukee	6,200	1.1	9,500	1.5	17,900	2.5	0.4	1.0	1.4
Racine	43,200	7.8	48,500	7.5	61,900	8.2	- 0.3	0.7	0.4
Walworth. . . .	12,300	2.2	18,300	2.8	24,200	3.3	0.6	0.5	1.1
Washington . .	9,700	1.8	14,500	2.2	20,300	2.7	0.4	0.5	0.9
Waukesha . . .	19,500	2.8	30,800	4.8	67,200	9.1	2.0	4.3	6.3
Region	552,700	100.0	647,900	100.0	741,600	100.0	- -	- -	- -

Source: U. S. Bureau of the Census; Wisconsin Department of Industry, Labor, and Human Relations; and SEWRPC.

Waukesha County experienced the largest increase in the proportion of regional jobs—from 5 percent in 1960 to 9 percent in 1970. During the same period, the proportion of the regional activity in Ozaukee, Washington, and Walworth Counties increased, as measured by jobs, from between one-half of a percentage point to 1 percentage point between 1960 and 1970. These trends reflect a continuation of the decentralization of manufacturing and service-oriented activities from the highly urban areas to the more suburban and rural-urban fringe areas of the Region.

Structure of the Economy

For land use-transportation planning purposes, the character of the regional economy can probably best be described in terms of its industrial structure, because the number and types of industry directly affect land use and transportation needs. In this regard, economic activity in the Region can be classified into nine major industry groups: 1) agriculture; 2) construction and mining; 3) manufacturing; 4) wholesale trade; 5) retail trade; 6) transportation, communication, and utilities; 7) finance, insurance, and real estate; 8) private services; and 9) government services and education.

As shown in Table 24 and Figure 4, economic activity within the Region is heavily concentrated in manufacturing, although this concentration has diminished over time. In 1960 about 276,600 of the Region's 647,900 jobs—about 43 percent of total regional jobs—were in manufacturing. By

Table 24

REGIONAL EMPLOYMENT BY MAJOR EMPLOYMENT CATEGORY: 1960-1970

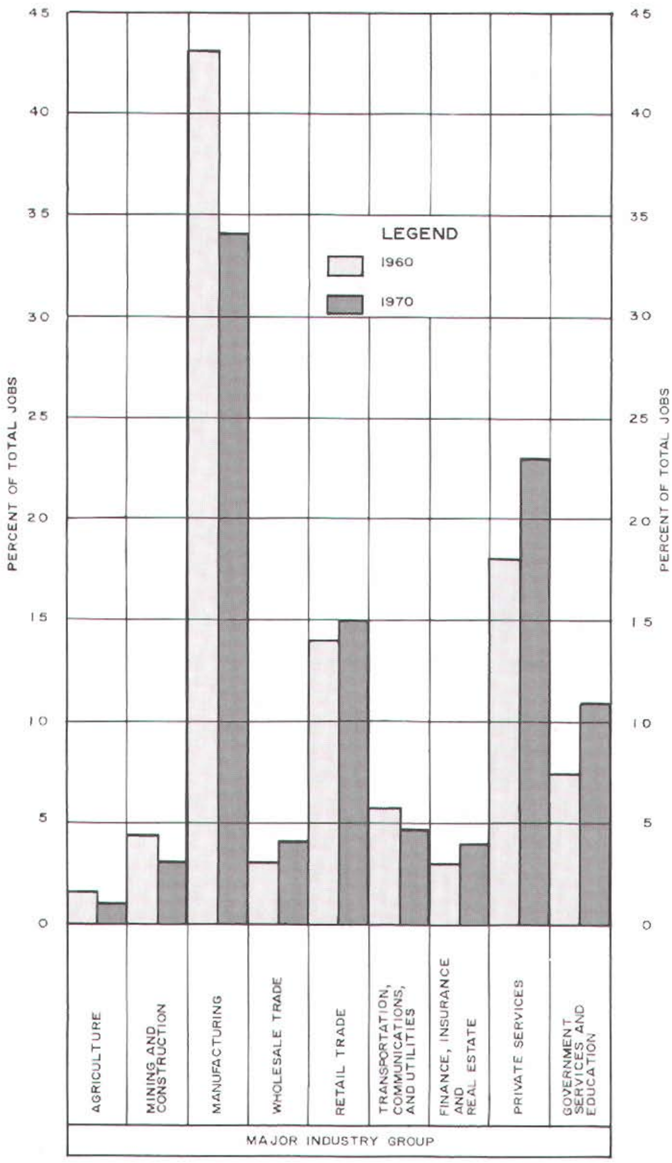
Employment Group	Employment		Change 1960-1970	
	1960	1970	Absolute	Percent
Agriculture	12,900	10,600	- 2,300	- 17.8
Construction and Mining	28,800	24,000	- 4,800	- 16.7
Manufacturing				
Food and Kindred Products	21,300	18,900	- 2,400	- 11.3
Printing and Publishing	13,800	14,900	1,100	8.0
Primary Metals	19,400	22,500	3,100	16.0
Fabricated Metals	18,300	24,600	6,300	34.4
Nonelectrical Machinery	58,800	68,100	9,300	15.8
Electrical Equipment	40,900	36,500	- 4,400	- 10.8
Transportation Equipment	33,400	22,000	- 11,400	- 34.1
Other Manufacturing	70,700	43,500	- 27,200	- 38.5
Manufacturing Subtotal	276,600	251,000	- 25,600	- 9.2
Wholesale Trade	18,700	32,000	13,300	71.1
Retail Trade	90,200	111,200	21,000	23.3
Transportation, Communication, and Utilities	35,100	36,000	900	2.6
Finance, Insurance, and Real Estate	23,000	31,200	8,200	35.6
Private Services[a]	114,500	166,900	52,400	45.8
Government Services and Education	48,100	78,700	30,600	63.6
Total Employment	647,900	741,600	93,700	14.5

[a] *Includes the self-employed and domestic household workers.*

Source: Wisconsin Department of Industry, Labor and Human Relations and SEWRPC.

Figure 4

PERCENTAGE DISTRIBUTION OF JOBS BY MAJOR CATEGORY IN THE REGION: 1960-1970



Source: Wisconsin Department of Industry, Labor and Human Relations and SEWRPC.

1970, the number of manufacturing jobs had decreased by about 9 percent to approximately 251,000 jobs, while the total number of regional jobs increased by about 14 percent to 741,600 jobs. In 1970 manufacturing comprised about 34 percent of all regional jobs, decline of about 9 percentage points since 1960.

Although manufacturing jobs decreased in both absolute and proportional terms between 1960 and 1970, wholesale trade, retail trade, finance, insurance, and real estate, private services, and government services and education all showed growth in both total jobs and proportion of total regional jobs. Wholesale trade grew by about 13,300 jobs, or about 71 percent; retail trade by about 21,000 jobs, or about 23 percent; private services by about 52,400 jobs, or about 46 percent; and government services and education by about 30,600 jobs, or about 64 percent. The proportion of total regional jobs in the private service category increased by about 5 percentage points. During this same period, agriculture and construction and mining experienced declines of about 2,300 jobs and 4,800 jobs, respectively. These trends are similar to changes taking place in the nation over the same time period. Both nationally and regionally, the economy has become less manufacturing-oriented and more service-oriented.

In spite of its relative decline in importance in the regional economy, manufacturing has historically been the largest employer of any of the major industry groups. While there was a slight decline in the number of manufacturing jobs in the Region between 1960 and 1970, a number of manufacturing groups experienced employment increases. Nonelectrical machinery grew by about 9,300 jobs, or about 16 percent; fabricated metals by about 6,300 jobs, or about 34 percent; and primary metals by about 3,100 jobs, or about 16 percent. The largest decreases in jobs among manufacturing groups occurred in transportation equipment and electrical equipment, which experienced decreases of 11,400 jobs and 4,400 jobs, respectively.

RECENT CHANGES IN THE ECONOMIC BASE OF THE REGION

In 1978 the Region's labor force was estimated to be comprised of 891,700 people. This represents an increase of 147,200 people, or 20 percent, over the 1970 level of 744,500 people. Employment in the Region during 1978 was estimated at 851,800 jobs, an increase of 110,200 jobs, or 15 percent, over the 1970 level of 741,600 jobs.

As shown in Table 25, all of the Region's counties experienced employment gains between 1970 and 1978, for a regional increase of 110,200 jobs. The greatest absolute county employment increase, about 51,300 jobs, occurred in Milwaukee County. The greatest rates of employment increase since 1970 occurred in Ozaukee and Waukesha Counties—33 percent and 38 percent, respectively.

The relative proportion of total regional jobs in Milwaukee County declined between 1970 and 1978, despite an absolute increase in employment within the County (see Table 26). In 1970 about 69 percent of the regional employment was located in Milwaukee County; however, by 1978, the Milwaukee County share of regional employment had decreased approximately 3 percentage points to 66 percent of regional employment. In contrast, the proportion of total regional employment in Waukesha County increased from about 9 percent in 1970 to about 11 percent in 1978. The relative share of total regional employment in the remaining five counties remained relatively stable.

Table 25

EMPLOYMENT TRENDS IN THE REGION BY COUNTY: 1970-1978

County	Employment		Change 1970-1978	
	1970	1978	Absolute	Percent
Kenosha	39,200	44,500	5,300	13.5
Milwaukee . . .	510,900	562,200	51,300	10.0
Ozaukee	17,900	23,800	5,900	33.0
Racine	61,900	74,800	12,900	20.8
Walworth. . . .	24,200	28,900	4,700	19.4
Washington . .	20,300	24,700	4,300	21.2
Waukesha . . .	67,200	92,900	25,700	38.2
Region	741,600	851,800	110,200	14.9

Source: Wisconsin Department of Industry, Labor and Human Relations, and SEWRPC.

Table 26

DISTRIBUTION OF JOBS IN THE REGION BY COUNTY: 1970-1978

County	1970		1978		Change (percent)
	Number of Jobs	Percent	Number of Jobs	Percent	
Kenosha	39,200	5.3	44,500	5.2	- 0.1
Milwaukee . . .	510,900	68.9	562,200	66.0	- 2.9
Ozaukee	17,900	2.5	23,800	2.8	0.3
Racine	61,900	8.2	74,800	8.8	0.6
Walworth. . . .	24,200	3.3	28.900	3.4	0.1
Washington . .	20,300	2.7	24,700	2.9	0.2
Waukesha . . .	67,200	9.1	92,900	10.9	1.8
Region	741,600	100.0	851,800	100.0	- -

Source: Wisconsin Department of Industry, Labor and Human Relations, and SEWRPC.

The largest absolute increase in employment by any major employment group between 1970 and 1978 occurred in the private services group, which increased by 56,500 jobs—from 166,900 to 223,400, or by 34 percent (see Table 27). The next largest absolute employment increase occurred in the government services category, which increased by 15,900 jobs—from 78,700 to 94,600, or by 20 percent.

Retail trade employment increased by 13,400 jobs between 1970 and 1978, from 111,200 to 124,600, or by 12 percent, and wholesale trade employment increased by 7,200 jobs, from 32,000 to 39,200, or by 22 percent, during the same period. Other major employment groups showing sizable increases were construction and mining, which increased by 4,600 jobs, or 19 percent, and finance, insurance, and real estate, which increased by 5,600 jobs, or 18 percent. Total manufacturing employment increased by 6,800 jobs, from 251,000 to 257,800, or by 3 percent, during the period, with major increases occurring in fabricated metals—8,100 jobs, or 33 percent—in nonelectrical machinery—5,700 jobs, or 8 percent—and in food and kindred products—1,600 jobs, or 8 percent. Significant decreases in manufacturing employment occurred in primary metals and in transportation equipment—4,900 jobs, or 22 percent, and 1,500 jobs, or 7 percent, respectively.

Between 1970 and 1978, two major shifts occurred in the employment structure of the Region. As shown in Figure 5, manufacturing employment declined from about 34 percent of the 1970 total regional employment to about 30 percent of the 1978 total regional employment; however, manufacturing still remains the largest single industry group in the Region in terms of both relative and absolute employment. Private service employment, meanwhile, gained significantly between 1970 and 1978—from about 23 percent of the 1970 total regional employment to about 26 percent of the 1978 total regional employment. The remaining industry groups show only slight shifts in relative importance.

The approximate 15 percent increase in the number of jobs in the Region since 1970, coupled with a total regional population increase of less than 1 percent for the same period, presents an apparent paradox. A relatively healthy and growing national economy is continuing to create new jobs. In the Region, however, these newly created jobs

Table 27

REGIONAL EMPLOYMENT BY MAJOR EMPLOYMENT CATEGORY: 1970-1978

Employment Group	Employment		Change 1970-1978	
	1970	1978	Absolute	Percent
Agriculture	10,600	9,500	- 1,100	- 10.4
Construction and Mining	24,000	28,600	4,600	19.2
Manufacturing				
Food and Kindred Products	18,900	20,500	1,600	8.5
Printing and Publishing	14,900	14,500	- 400	- 2.7
Primary Metals	22,500	17,600	- 4,900	- 21.8
Fabricated Metals	24,600	32,700	8,100	32.9
Nonelectrical Machinery	68,100	73,800	5,700	8.4
Electrical Equipment	36,500	37,300	800	2.2
Transportation Equipment	22,000	20,500	- 1,500	- 6.8
Other Manufacturing	43,500	40,900	- 2,600	- 6.0
Manufacturing Subtotal	251,000	257,800	6,800	2.7
Wholesale Trade	32,000	39,200	7,200	22.5
Retail Trade	111,200	124,600	13,400	12.1
Transportation, Communication, and Utilities	36,000	37,300	1,300	3.6
Finance, Insurance, and Real Estate	31,200	36,800	5,600	17.9
Private Services[a]	166,900	223,400	56,500	33.8
Government Services and Education	78,700	94,600	15,900	20.2
Total Employment	741,600	851,800	110,200	14.9

[a] *Includes the self-employed and domestic household workers.*

Source: Wisconsin Department of Industry, Labor and Human Relations and SEWRPC.

are not resulting in net in-migration—as has occurred in the past—but are being absorbed by the existing regional population base. At least three factors appear to be making this absorption possible: the rapidly increasing labor force participation rates among women, an apparent trend toward individuals holding more than one job, and the changing age structure of the Region's resident population.

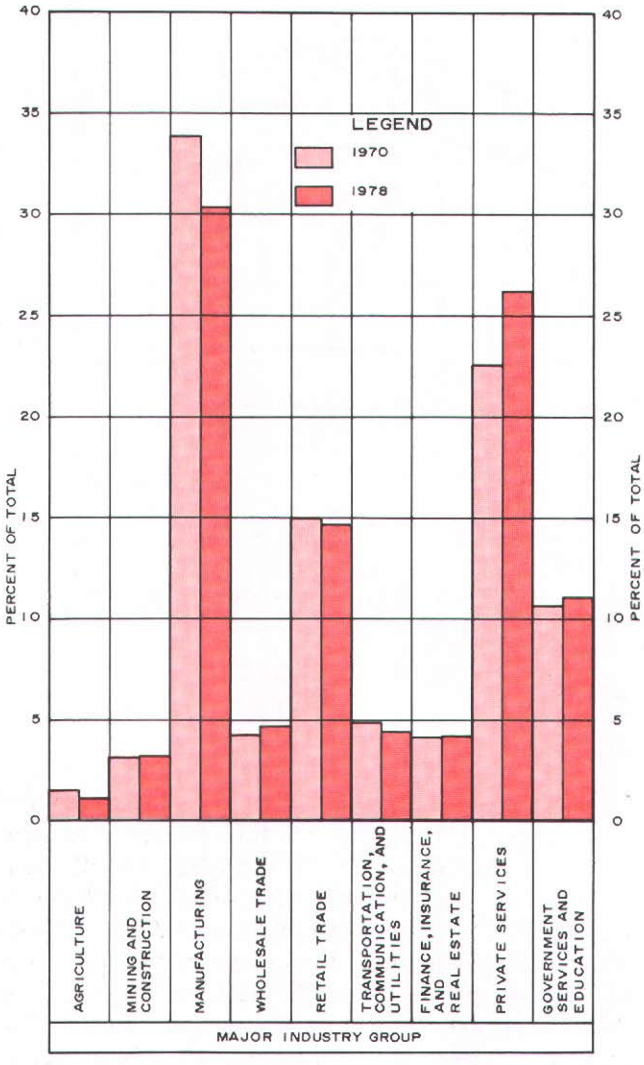
Although current statistics for the Region are not available, most observers agree that women are presently entering the labor force at much greater rates than they have in the past. Equally important in explaining the Region's ability to accommodate new jobs without a concomitant growth in the resident population is the changing age structure of the Region's population. Special censuses conducted in the Region since the 1970 federal census generally indicate an overall aging of the Region's population since 1970, resulting in a greater proportion of the total resident population in the working age category in 1978 than in 1970.

THE PUBLIC FINANCIAL RESOURCE BASE OF THE REGION

A review of the existing and historical public financial resource base of the Region and of the proportionate share of that resource base which has been allocated for the construction, operation, and maintenance of transportation facilities and services in the Region is pertinent to any transportation system planning effect. The share of the public resource base available for transportation and, in particular, transit purposes is greatly affected by the need for other public facilities and

Figure 5

PERCENTAGE DISTRIBUTION OF JOBS BY MAJOR EMPLOYMENT CATEGORY IN THE REGION: 1970-1978



Source: Wisconsin Department of Industry, Labor and Human Relations and SEWRPC.

services. Knowledge of the portion of total public revenues and expenditures historically allocated to transportation will be particularly useful in determining the levels of funds that will be available in the future for transportation plan implementation and, especially, primary transit system plan implementation in the conduct of the Milwaukee area primary transit system alternatives analysis.

To aid in evaluating the current status of public financial resources and to allow comparison with historical levels of revenues and expenditures as well as with forecast levels, all dollar amounts contained in this section on public financial resources are stated in 1976 dollar amounts, unless specifically noted. The dollar amounts were adjusted to the 1976 level based upon the Consumer Price Index for the Milwaukee area. This index attempts to measure the average annual changes in the price inflation of goods and services. Between 1960 and 1976, the level of price inflation resulted in an increase of more than 85 percent in the Consumer Price Index for the Milwaukee area.

General Revenue Patterns in the Region

Total public revenues of local governments in the Region, including school districts, counties, cities, villages, and towns, increased steadily from 1960 to 1976. As shown in Figure 6, the combined public revenues of local units of government in the Region increased from about $926 million in 1960 to about $1,913 million in 1976—an overall real increase of $987 million, or 107 percent.

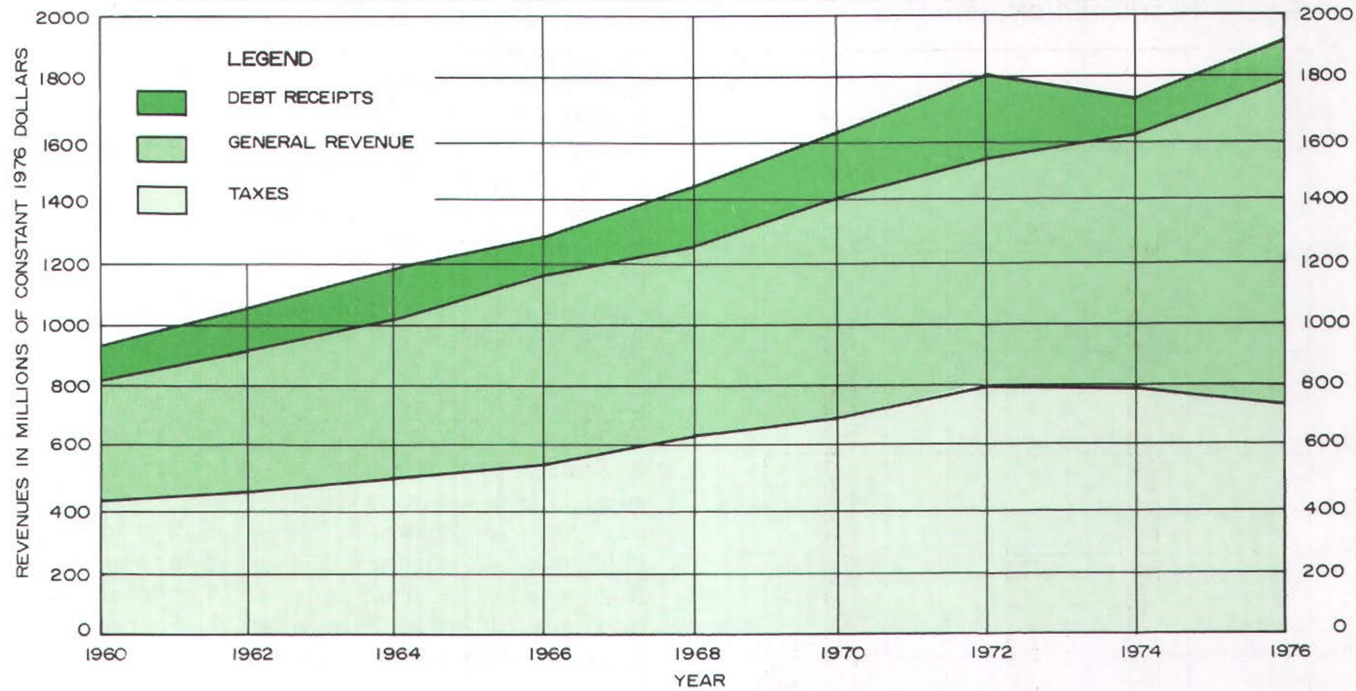
The money raised each year by local governments for transportation purposes comes from three primary sources: tax revenues, including both returned state and local property taxes; public industry, including earnings from selected public facilities and services such as hospitals, airports, parks, and utilities; and general revenues, including receipts from borrowing, state and federal transportation aids to local units of government, and miscellaneous revenues. The degree to which each of these individual revenue categories is relied upon varies considerably among the different governmental units and agencies in the Region.

Since 1960, the property tax levy has consistently been the major source of revenue for local governments in the Region. As shown in Table 28, per capita property taxes for local, county, school, and state purposes in the Region increased from about $267 per capita in 1960 to about $416 per capita in 1976—an overall increase of about 56 percent, measured in constant 1976 dollars. However, it should be noted that the per capita property tax has declined since 1972, when the per capita rate peaked at about $443 per capita.

On a county level, as shown in Table 28, Milwaukee County has the highest total tax rate of the seven counties comprising the Region; however,

Figure 6

COMPOSITION OF PUBLIC REVENUES FOR ALL SCHOOL DISTRICTS AND GENERAL-PURPOSE UNITS OF GOVERNMENT IN THE REGION: SELECTED YEARS 1960-1976



Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; and SEWRPC.

the rate of change in the per capita tax rate for Milwaukee County was the second lowest of the seven counties over the period 1960 through 1976. The largest percentage increase in per capita tax levies occurred in Ozaukee County, where total per capita tax levies increased 96 percent between 1960 and 1976, when stated in constant 1976 dollars.

Funds needed for the operation of local governments that are not received from other sources are principally supplied by the property tax levy. As such, the property tax is a residual source of government revenue, and may be expected to vary significantly by year and type of government as total local government revenues and expenditures change. Overall, the present tax levies for all general-purpose units of government in the Region, with the exception of counties, are generally well below the tax levy ceiling imposed by the Wisconsin Legislature. The availability of future governmental revenues from property tax levies, therefore, maintains flexibility as long as the property tax remains the important source of revenue that it is now.

The full, or equalized, value of all taxable real and personal property in the Region increased from $16.15 billion in 1960 to $25.75 billion in 1976—an overall increase of about $9.6 billion, or 59 percent, measured in constant 1976 dollars (see Table 29). The rate of increase in the full value of taxable property in the Region has not been distributed evenly among the seven counties. The rapidly urbanizing counties of Washington, Ozaukee, and Waukesha experienced the most rapid increases in the full value of taxable property from 1960 to 1976, while the urban counties of Kenosha, Milwaukee, and Racine experienced the slowest increases over the same 16-year period.

Borrowing was another major source of revenue for local units of government. Revenues from borrowing are most often used to finance needed public facilities which can be amortized over a considerable period of time. The length of time a municipality or special-purpose district other than a sewerage district may amortize a borrowed debt is generally limited by state law to 20 years. However, in the Region, Racine, Milwaukee, and Waukesha Counties are exempt from this law

Table 28

PER CAPITA PROPERTY TAXES IN THE REGION BY COUNTY: SELECTED YEARS 1960-1976

County	Per Capita Property Taxes (in constant 1976 dollars)									Change 1960-1976	
	1960	1962	1964	1966	1968	1970	1972	1974	1976	Absolute	Percent
Kenosha											
Local	$ 58.51	$ 56.01	$ 57.25	$ 60.05	$ 55.97	$ 67.93	$ 74.86	$ 68.66	$ 71.83	$ 13.32	23.0
State	2.82	1.89	1.97	2.16	2.23	1.92	2.00	2.01	2.33	- 0.49	- 17.4
County . . .	52.42	57.72	52.93	58.04	91.35	67.21	72.26	48.89	39.24	- 13.18	- 25.1
School . . .	116.37	122.31	141.88	180.35	192.61	211.51	220.54	168.66	181.95	65.58	56.4
Total	$229.13	$237.93	$254.04	$300.59	$342.17	$348.57	$369.66	$288.23	$295.36	$ 66.23	28.9
Milwaukee											
Local	$ 99.99	$100.90	$113.52	$113.49	$120.63	$117.22	$128.69	$135.29	$129.73	$ 29.74	29.7
State	2.07	2.03	2.04	1.98	2.10	2.18	2.24	2.26	2.51	0.44	21.3
County . . .	92.68	94.23	99.64	103.42	106.75	126.09	134.41	91.04	82.77	- 9.91	- 10.7
School . . .	114.24	119.90	132.35	145.33	179.75	213.73	235.80	220.30	249.86	135.62	118.7
Total	$321.50	$317.06	$347.56	$364.26	$409.33	$459.22	$501.15	$450.89	$464.88	$143.38	44.6
Ozaukee											
Local	$ 35.82	$ 33.21	$ 27.90	$ 26.43	$ 24.85	$ 20.75	$ 37.72	$ 56.27	$ 61.46	$ 25.64	71.6
State	2.20	2.05	2.08	2.32	2.55	2.25	2.79	2.51	3.13	0.93	42.3
County . . .	25.60	26.50	30.33	34.44	41.59	39.51	41.69	31.52	36.95	11.35	44.3
School . . .	133.99	133.71	167.86	205.79	239.55	281.62	325.55	253.27	285.87	151.88	113.4
Total	$197.63	$195.51	$228.15	$268.96	$308.55	$344.15	$407.75	$343.57	$387.41	$189.78	96.0
Racine											
Local	$ 66.52	$ 55.50	$ 52.84	$ 56.07	$ 64.11	$ 63.50	$ 77.93	$ 80.65	$104.47	$ 37.95	57.1
State	1.89	1.81	1.88	1.92	2.03	1.96	2.02	2.07	2.32	0.43	22.8
County . . .	36.52	35.28	36.13	24.74	42.25	54.88	84.82	53.86	43.98	7.46	20.4
School . . .	109.95	121.70	137.97	153.89	190.42	212.15	215.20	167.06	180.45	70.50	64.1
Total	$214.88	$214.28	$228.83	$246.16	$298.81	$332.50	$379.98	$303.64	$331.23	$116.35	54.1
Walworth											
Local	$ 43.18	$ 41.69	$ 40.68	$ 41.49	$ 45.21	$ 31.98	$ 47.25	$ 41.51	$ 59.64	$ 16.46	38.1
State	2.33	2.25	2.47	2.69	2.92	2.68	3.02	3.15	3.60	1.27	54.5
County . . .	62.45	63.42	64.68	68.48	72.87	66.45	90.49	66.82	71.65	9.20	14.7
School . . .	155.67	158.27	196.02	228.68	268.39	290.78	312.70	278.19	280.52	124.85	80.2
Total	$263.64	$265.62	$303.86	$341.34	$389.39	$391.89	$453.45	$389.65	$415.41	$151.77	57.6
Washington											
Local	$ 44.65	$ 37.13	$ 28.93	$ 28.06	$ 31.36	$ 30.70	$ 48.38	$ 52.28	$ 56.18	$ 11.53	25.8
State	1.74	1.80	2.13	2.13	2.15	2.16	2.52	2.51	2.80	1.06	60.9
County . . .	39.83	43.90	42.65	38.51	52.23	48.15	57.35	43.70	43.36	3.53	8.9
School . . .	118.65	125.80	148.96	168.70	214.42	262.13	303.22	251.24	256.21	137.56	115.9
Total	$204.91	$208.62	$221.41	$237.38	$300.17	$343.27	$411.47	$349.74	$358.56	$153.65	75.0
Waukesha											
Local	$ 50.96	$ 46.19	$ 40.59	$ 38.78	$ 40.61	$ 42.61	$ 66.18	$ 56.76	$ 62.46	$ 11.50	22.6
State	2.00	1.80	1.85	1.92	2.15	2.32	3.14	2.70	3.04	1.04	52.0
County . . .	40.67	33.89	34.44	34.61	51.57	39.51	47.99	41.17	41.71	1.04	2.6
School . . .	150.17	141.50	168.07	179.91	211.01	259.00	288.33	247.33	263.30	113.13	75.3
Total	$243.79	$223.37	$244.97	$255.22	$305.34	$343.48	$401.17	$347.96	$370.50	$126.71	52.0
Region											
Local	$ 70.47	$ 86.47	$ 73.79	$ 77.99	$ 80.99	$ 85.25	$ 97.58	$104.23	$104.57	$ 34.10	48.4
State	1.93	1.94	1.92	2.03	1.95	2.03	2.32	2.34	2.64	0.71	36.8
County . . .	71.60	74.22	76.81	79.64	86.56	92.14	95.53	72.32	65.72	- 5.88	- 8.2
School . . .	122.55	127.41	151.77	168.36	198.72	215.87	247.29	221.12	242.92	120.37	98.2
Total	$266.55	$290.04	$304.29	$328.02	$368.22	$395.29	$442.72	$400.01	$415.85	$149.30	56.0

Source: Wisconsin Department of Revenue, Bureau of Local Fiscal Information; and SEWRPC.

Table 29

FULL VALUE OF REAL AND PERSONAL PROPERTY IN THE REGION BY COUNTY: SELECTED YEARS 1960-1976

County	Full Value[a] (in millions of constant 1976 dollars)									Change 1960-1976	
	1960	1962	1964	1966	1968	1970	1972	1974	1976	Absolute	Percent
Kenosha	$ 918.1	$ 1,048.3	$ 1,149.7	$ 1,248.9	$ 1,278.3	$ 1,231.9	$ 1,335.6	$ 1,483.3	$ 1,662.7	$ 744.6	81.1
Milwaukee . . .	10,777.1	10,972.8	11,128.9	11,503.0	12,111.3	12,421.0	12,465.8	12,936.6	13,445.2	2,668.1	24.8
Ozaukee	424.8	470.6	510.1	571.2	650.0	809.7	890.9	1,034.7	1,150.9	726.1	170.9
Racine	1,346.4	1,448.4	1,544.5	1,680.7	1,756.2	1,807.3	1,928.9	2,129.8	2,314.6	968.2	71.9
Walworth. . . .	612.3	650.1	725.6	795.3	875.0	975.7	1,155.2	1,230.8	1,372.2	759.9	124.1
Washington . .	425.4	458.3	576.8	619.2	711.1	818.1	951.9	1,105.9	1,237.2	811.8	190.8
Waukesha . . .	1,648.5	1,819.5	2,027.8	2,308.2	2,692.1	3,048.1	3,438.3	4,094.6	4,563.0	2,914.5	176.8
Region	$16,152.6	$16,868.0	$17,663.4	$18,726.5	$20,074.0	$21,111.8	$22,166.6	$24,015.7	$25,745.8	$9,593.2	59.4

[a] *The full value ("equalized value") of real and personal property represents the assessed value of all real estate and improvements thereto and the assessed value of such property as livestock, merchants' inventories, manufacturers' inventories, furniture and fixtures, machinery, and tools adjusted to current market value and equalized statewide by the State of Wisconsin Bureau of Property Taxation.*

Source: Wisconsin Department of Revenue, Bureau of Property Taxation; and SEWRPC.

because they meet statutory population requirements enabling them to amortize bond issues for county land acquisition purposes up to a maximum of 50 years. Many municipalities and school districts do not extend their debt repayment period to the maximum time allowable by state law because of the expected efficiency period, or life cycle, of the project being funded, and because of the effect that the annual land repayment premiums have on the current or anticipated future fiscal stability of the respective unit of government. Presently, the levels of total bonded indebtedness of the general-purpose units of government in the Region are below their respective debt ceiling limits imposed by the Wisconsin Legislature, and the relative importance of debt receipts as a revenue source has declined because of the curtailed construction of schools and highways in the Region. Future revenues from debt financing, therefore, may be utilized by many governments in the Region to provide funding for public facilities to accommodate additional urban growth and development in the Region.

A growing portion of local government revenue has been comprised of state-collected taxes and fees which are returned to local units of government and school districts. The sources of these state-collected monies are individual and corporate state income taxes, sales and use taxes, excise taxes, utility taxes, and motor vehicle taxes and fees. A significant share of these state-collected monies is returned to the local units of government and school districts in the form of aids, shared taxes, property tax relief, and property tax offsets. The remainder of these state-collected monies is used by the State for the administration of state programs. State-collected revenues returned to the local units of government and school districts within the Region have increased from $301 million, or about 25 percent of total local revenues, in 1964, to $737 million, or over 38 percent of the total local revenues, in 1976, measured in constant 1976 dollars, as shown in Table 30. This is an increase of $436 million, or over 144 percent, in state payments to local units of government in the Region. While state-collected monies returned to the Region have grown over time, not all forms of these returned revenues have increased uniformly. The amount of money returned to local governments in the form of transportation aids has declined from a peak of over $22 million in 1968 to about $15 million in 1976—a decrease of $7 million, or about 32 percent. In contrast, health and social service aids and aids to education have increased from a low of $94 million in 1964 to about $394 million in 1976—an increase of $300 million, or about 220 percent.

The percentage of monies collected by the State and returned to local units of government in the Region has also increased since 1964, as shown in Table 30. In 1964, only about 52 percent of the money collected by the State from within the Region was returned to the local governments and school districts within the Region. In 1976, however, 68 percent of the monies collected in the Region by the State were returned to the local units of government in the Region. However, the percentage of state-collected monies returned to

Table 30

STATE-COLLECTED TAXES AND FEES AND STATE-RETURNED AIDS BY COUNTY IN THE REGION: SELECTED YEARS 1964-1976

County	Millions of Constant 1976 Dollars							Change 1964-1976	
	1964	1966	1968	1970	1972	1974	1976	Absolute	Percent
Kenosha									
State-Collected Taxes and Fees	$ 40.4	$ 36.5	$ 39.1	$ 51.0	$ 63.2	$ 69.2	$ 70.0	$ 29.6	73.3
State-Returned Aids	18.3	17.2	20.8	27.8	34.5	45.1	46.1	27.8	151.9
Returns as a Percent of Collections	45.3	47.1	53.2	54.5	54.6	65.2	65.8	20.5	- -
Milwaukee									
State-Collected Taxes and Fees	$ 385.8	$ 437.8	$ 474.2	$ 530.5	$ 581.7	$ 592.5	$ 603.4	$ 217.6	56.4
State-Returned Aids	204.0	231.5	273.4	316.9	368.9	460.7	464.2	260.2	127.5
Returns as a Percent of Collections	52.9	52.9	57.7	59.7	63.4	77.8	76.9	24.0	- -
Ozaukee									
State-Collected Taxes and Fees	$ 16.7	$ 20.2	$ 24.7	$ 29.2	$ 35.7	$ 41.0	$ 45.6	$ 28.9	173.1
State-Returned Aids	7.5	9.3	11.9	16.3	17.0	21.5	21.3	13.8	184.0
Returns as a Percent of Collections	44.9	46.0	48.2	55.8	47.6	52.4	46.8	1.9	- -
Racine									
State-Collected Taxes and Fees	$ 49.0	$ 60.5	$ 66.3	$ 82.3	$ 90.6	$ 98.5	$ 104.9	$ 55.9	114.1
State-Returned Aids	24.2	29.1	37.0	46.9	53.0	67.4	72.9	48.7	201.2
Returns as a Percent of Collections	49.4	48.1	55.8	57.0	58.5	68.4	69.5	20.1	- -
Walworth									
State-Collected Taxes and Fees	$ 16.3	$ 19.9	$ 20.8	$ 26.8	$ 31.6	$ 33.5	$ 36.3	$ 20.0	122.7
State-Returned Aids	8.8	9.8	11.7	14.0	16.2	19.3	19.9	11.1	126.1
Returns as a Percent of Collections	54.0	49.2	56.2	52.2	51.3	57.6	54.9	0.9	- -
Washington									
State-Collected Taxes and Fees	$ 16.1	$ 19.2	$ 23.9	$ 30.5	$ 36.1	$ 41.2	$ 45.6	$ 29.5	183.2
State-Returned Aids	7.5	9.4	11.8	17.2	18.8	25.6	27.1	19.6	261.3
Returns as a Percent of Collections	46.6	49.0	49.4	56.4	52.1	62.1	59.4	12.8	- -
Waukesha									
State-Collected Taxes and Fees	$ 60.1	$ 76.0	$ 98.7	$ 121.2	$ 144.6	$ 162.7	$ 183.0	$ 122.9	204.5
State-Returned Aids	31.4	39.2	52.6	66.0	70.4	85.3	85.5	54.1	172.3
Returns as a Percent of Collections	52.2	51.6	53.3	54.5	48.7	52.4	47.3	- 4.9	- -
Region									
State-Collected Taxes and Fees	$ 584.4	$ 670.1	$ 747.7	$ 871.5	$ 983.5	$1,038.6	$1,088.8	$ 504.4	86.3
State-Returned Aids	301.7	345.5	419.2	505.1	578.8	724.9	737.0	435.3	144.3
Returns as a Percent of Collections	51.6	51.6	56.1	58.0	58.9	69.8	67.7	16.1	- -
State									
State-Collected Taxes and Fees	$1,266.0	$1,443.5	$1,630.9	$1,979.1	$2,256.0	$2,374.3	$2,537.9	$1,271.9	100.5
State-Returned Aids	757.7	854.2	1,023.1	1,238.4	1,399.4	1,736.4	1,790.9	1,033.2	136.4
Returns as a Percent of Collections	59.8	59.2	62.7	62.6	62.0	73.1	70.6	10.8	- -

Source: Wisconsin Department of Revenue, Bureau of Local Financial Assistance; and SEWRPC.

the Region has consistently been lower than the average percentage of monies returned by the State. Within the Region only Milwaukee County receives a percentage of state-returned payments that is higher than the statewide average percentage for such payments, as shown in Table 30.

General Revenue Patterns for Municipal Units of Government in Milwaukee County

Total revenues for the municipal units of government in Milwaukee County increased between 1960 and 1976. As shown in Table 31 and Figure 7, the total revenues collected within Milwaukee County increased from $484 million in 1960 to about $774 million in 1976—an increase of $291 million, or 60 percent, measured in constant 1976 dollars. During this same period, tax receipts for local governmental purposes increased from $238 million to over $315 million—an increase of over $77 million, or 32 percent. Thus, tax receipts increased at a rate slower than the overall rate of increase in total revenues. As a result,

Table 31

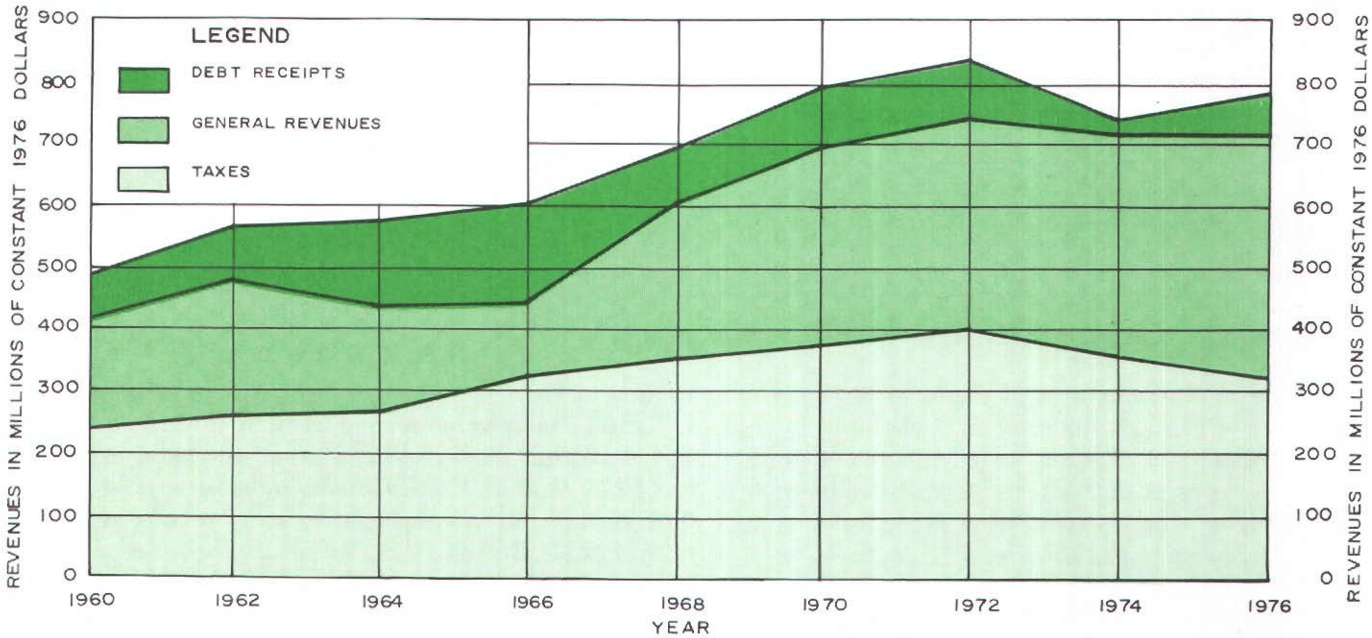
TOTAL REVENUES AND EXPENDITURES FOR ALL MUNICIPAL UNITS OF GOVERNMENT IN MILWAUKEE COUNTY: SELECTED YEARS 1960-1976

Year	Revenues (in millions of constant 1976 dollars)			Expenditures (in millions of constant 1976 dollars)		
	Tax Receipts	Debt Receipts	Total Receipts	General Expenditures	Debt Retirement	Total Expenditures
1960	$238.4	$ 66.5	$483.7	$ 20.6	$38.0	$468.7
1962	260.3	62.6	539.8	31.8	36.3	510.7
1964	270.1	137.8	573.6	59.2	47.8	538.3
1966	320.5	166.8	601.0	62.7	73.6	606.6
1968	348.0	94.4	695.5	86.5	79.6	623.7
1970	374.2	93.3	786.8	163.7	82.3	708.7
1972	403.1	95.9	836.1	150.3	66.2	805.1
1974	355.7	24.3	734.1	81.6	68.6	714.1
1976	315.6	58.9	773.9	88.3	45.9	787.0

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; and SEWRPC.

Figure 7

COMPOSITION OF PUBLIC REVENUES FOR THE GENERAL-PURPOSE UNITS OF GOVERNMENT IN MILWAUKEE COUNTY: SELECTED YEARS 1960-1976



Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; and SEWRPC.

tax receipts comprised only about 41 percent of total revenues in 1976, compared with over 49 percent of the total revenues collected within Milwaukee County by the municipal units of government in 1960. The importance of debt receipts as a revenue source also declined between 1960 and 1976. In 1960 debt receipts comprised about 14 percent of total municipal revenues in Milwaukee County; by 1976, the relative importance of debt receipts as a revenue source had declined to only 7 percent of total revenues.

General Expenditure Patterns in the Region

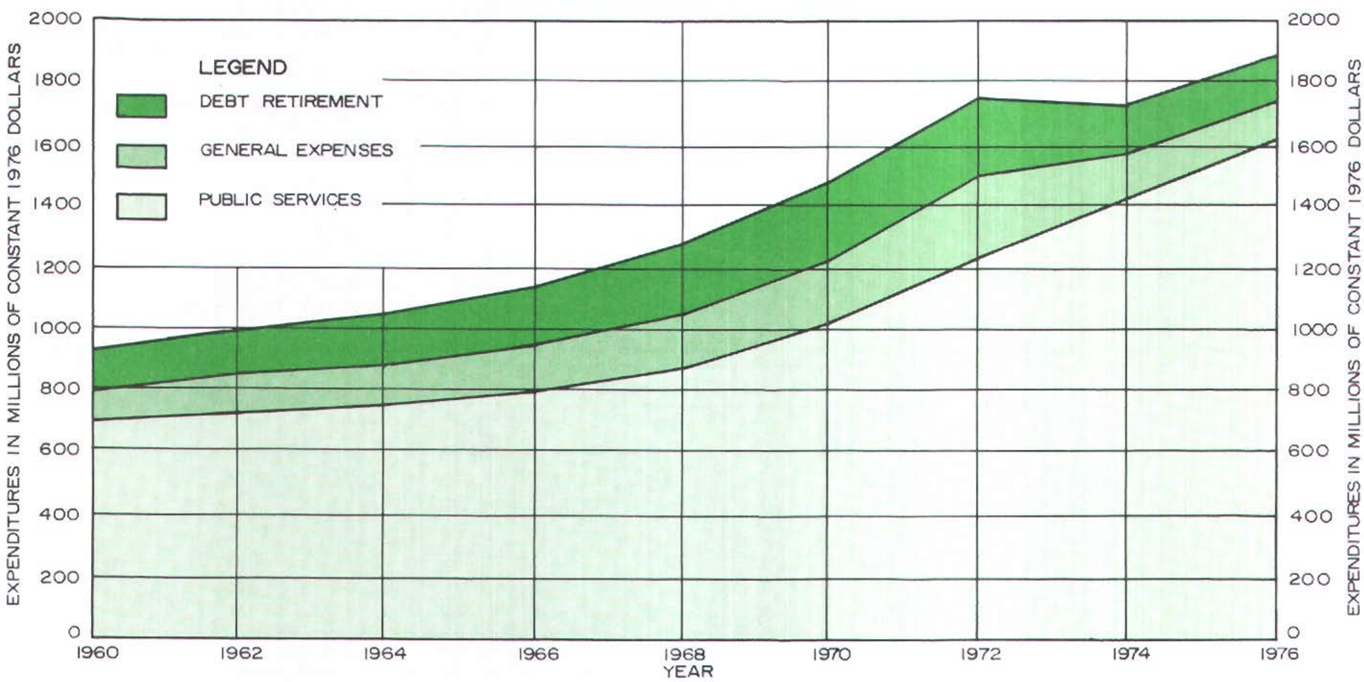
Between 1960 and 1976, the combined expenditures for all counties, cities, villages, towns, and public and vocational school districts in the Region increased by about $956 million, or 103 percent—from $924 million in 1960 to about $1,880 million in 1976, measured in constant 1976 dollars (see Figure 8). As previously noted, total revenues of local governments in the Region increased from $926 million in 1960 to $1,913 million in 1976—an increase of $987 million, or 107 percent. It should be noted that total government revenues exceeded total expenditures each year from 1960 to 1976. These revenue surpluses were brought forward from the previous year to become part of the following year's funding resources.

Governmental expenditures can be classified into three major categories: debt service expenditures; general expenses, including expenditures for the administration of general government administration; and public service expenditures, including expenses and outlays for facilities and services such as recreation, highways, streets, bridges, health, sanitation, welfare, public industries, the protection of people and property, and all expenditures by general-purpose governments and school districts for educational purposes. The relative importance of each of these expenditure categories as a major expenditure item will vary by type of government and year.

The three largest categories of expenditure by governments in the Region in 1976 in order of importance were education; health, sanitation, and welfare; and protection of persons and property. In 1976 these three categories together accounted for expenditures of $1,313 million, or 70 percent

Figure 8

DISTRIBUTION OF PUBLIC EXPENDITURES BY ALL SCHOOL DISTRICTS AND GENERAL-PURPOSE UNITS OF GOVERNMENT IN THE REGION: SELECTED YEARS 1960-1976



Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; and SEWRPC.

of all governmental expenditures, while in 1960, these three categories accounted for about $598 million in expenditures, or 64 percent of all governmental expenditures.

Expenditures by all general-purpose units of government in the Region for the construction, operation, and maintenance of highways, streets, and bridges totaled about $190 million in 1976, or 10 percent of total local expenditures, compared to $160 million in 1960, or 17 percent of total local governmental expenditures during that year. Table 32 shows the amounts of total expenditures for highway-related purposes in the Region made by local units of government, by the State, and by the federal government from 1960 to 1976. Table 33 indicates the proportion of total highway expenditures contributed by local units of government, by the state, and by the federal government.

Capital expenditures for highways, streets, and bridges in the Region by local units of government, the State, and by the federal government totaled about $107 million in 1976, compared to $76 million in 1960, as shown in Table 34 and Figure 9. In 1960, cities accounted for the largest proportion of capital expenditures for highway purposes in the Region, contributing 46 percent of total capital expenditures for highway purposes (see Table 35). From 1962 to 1964, the federal government contributed the largest proportion

Table 32

TOTAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN THE REGION BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976

Government Type	Total Highway Expenditures (in millions of constant 1976 dollars)									Change 1960-1976	
	1960	1962	1964	1966	1968	1970	1972	1974	1976	Absolute	Percent
Federal	$ 16.7	$ 39.0	$ 49.3	$ 36.1	$ 16.6	$ 38.7	$ 29.8	$ 35.2	$ 48.1	31.4	188.0
State	13.3	16.7	14.2	40.0	35.7	43.1	17.8	17.4	13.6	0.3	2.3
County	26.3	43.4	34.5	55.4	37.4	25.5	31.9	29.4	35.2	8.9	33.8
City	82.9	86.9	80.2	87.9	49.1	81.5	84.2	59.5	75.8	-7.1	-8.6
Village	13.0	12.3	12.6	17.9	18.6	17.6	21.1	10.9	8.5	-4.5	-34.6
Town	6.5	6.7	6.6	8.7	10.7	9.5	15.9	7.6	8.3	1.8	27.7
Total	$158.7	$205.0	$197.4	$246.0	$168.1	$215.9	$199.7	$160.0	$189.5	30.8	19.4

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; Wisconsin Department of Transportation; and SEWRPC.

Table 33

PERCENT DISTRIBUTION OF TOTAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN THE REGION BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976

Government Type	Percent of Total Highway Expenditures									Percent Change 1960-1976
	1960	1962	1964	1966	1968	1970	1972	1974	1976	
Federal	10.5	19.0	25.0	12.6	9.9	17.9	14.9	22.0	25.3	14.8
State	8.4	8.1	7.2	16.7	21.2	20.2	8.9	10.8	7.2	-1.2
County	16.5	21.2	17.5	23.1	22.3	11.8	15.9	18.4	18.6	2.1
City	52.3	42.4	40.6	36.6	29.2	37.7	41.9	37.2	40.0	-12.3
Village	8.2	6.0	6.4	7.4	11.1	8.2	10.5	6.8	4.5	-3.7
Town	4.1	3.3	3.3	3.6	6.3	4.4	7.9	4.8	4.4	0.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	--

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; Wisconsin Department of Transportation; and SEWRPC.

Table 34

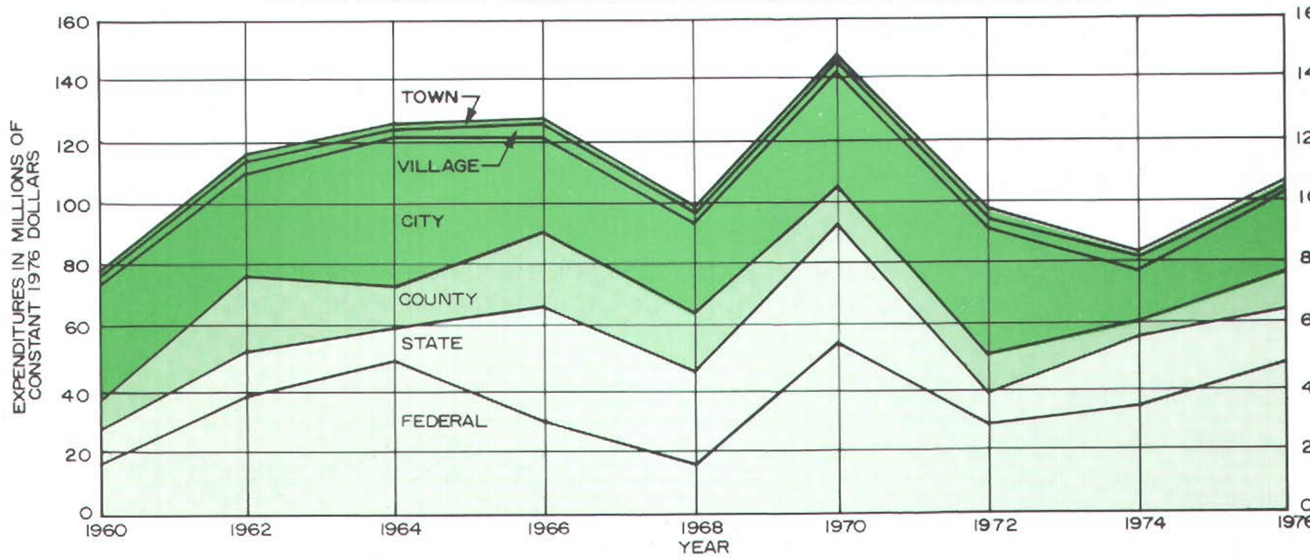
CAPITAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN THE REGION BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976

Government Type	Total Capital Expenditures (in millions of constant 1976 dollars)									Change 1960-1976	
	1960	1962	1964	1966	1968	1970	1972	1974	1976	Absolute	Percent
Federal	$16.7	$ 39.0	$ 49.3	$ 30.2	$16.6	$ 55.7	$29.8	$35.2	$ 48.1	31.4	188.0
State	10.0	13.1	10.3	35.8	30.5	36.8	10.1	21.2	15.9	5.9	59.0
County	10.0	23.4	13.2	23.9	17.1	12.0	12.0	4.4	12.8	2.8	28.0
City.	35.0	35.8	49.1	31.7	30.2	37.1	39.3	16.4	26.8	- 8.2	- 23.4
Village	3.5	3.6	3.4	5.5	3.4	3.5	3.4	4.4	2.2	- 1.3	- 37.1
Town.	0.9	0.7	0.7	1.2	1.3	1.3	1.4	1.6	1.2	0.3	33.3
Total	$76.1	$115.6	$126.0	$128.3	$99.1	$146.4	$96.0	$83.2	$107.0	30.9	40.6

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; and SEWRPC.

Figure 9

CAPITAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN THE REGION BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976



Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; Wisconsin Department of Transportation; and SEWRPC.

of capital expenditures for highway purposes in the Region, due primarily to accelerated freeway construction. Because of increasing state participation and decreasing federal participation in freeway and expressway construction from 1966 to 1968, the proportion of total construction expenditures accounted for by federal expenditures decreased, while state capital construction expenditures increased significantly. After 1968, however, federal capital expenditures again showed rapid increases, reflecting roadway and safety improvements on the federal interstate highway system in addition to actual highway construction and reconstruction.

Although the sources of capital highway expenditures have varied considerably from year to year since 1960, the proportion of total highway expenditures accounted for by capital expenditures has remained somewhat stable for the local units of government, as can be observed by comparing

Table 35

PERCENT DISTRIBUTION OF CAPITAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN THE REGION BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976

Government Type	Percent of Total Capital Expenditures									Percent Change 1960-1976
	1960	1962	1964	1966	1968	1970	1972	1974	1976	
Federal	22.0	33.8	39.1	23.6	16.8	29.9	31.1	42.3	44.9	22.9
State	13.1	11.3	8.2	27.9	30.8	28.4	10.6	25.5	14.9	1.8
County	13.1	20.2	10.4	18.6	17.3	9.3	12.5	5.3	12.0	- 1.1
City	46.0	30.9	39.0	24.7	30.4	28.7	40.9	19.7	25.0	- 2.1
Village	4.6	3.1	2.7	4.3	3.4	2.7	3.5	5.3	2.1	- 2.5
Town	1.2	0.7	0.6	0.9	1.3	1.0	1.4	1.9	1.1	- 0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	- -

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; and SEWRPC.

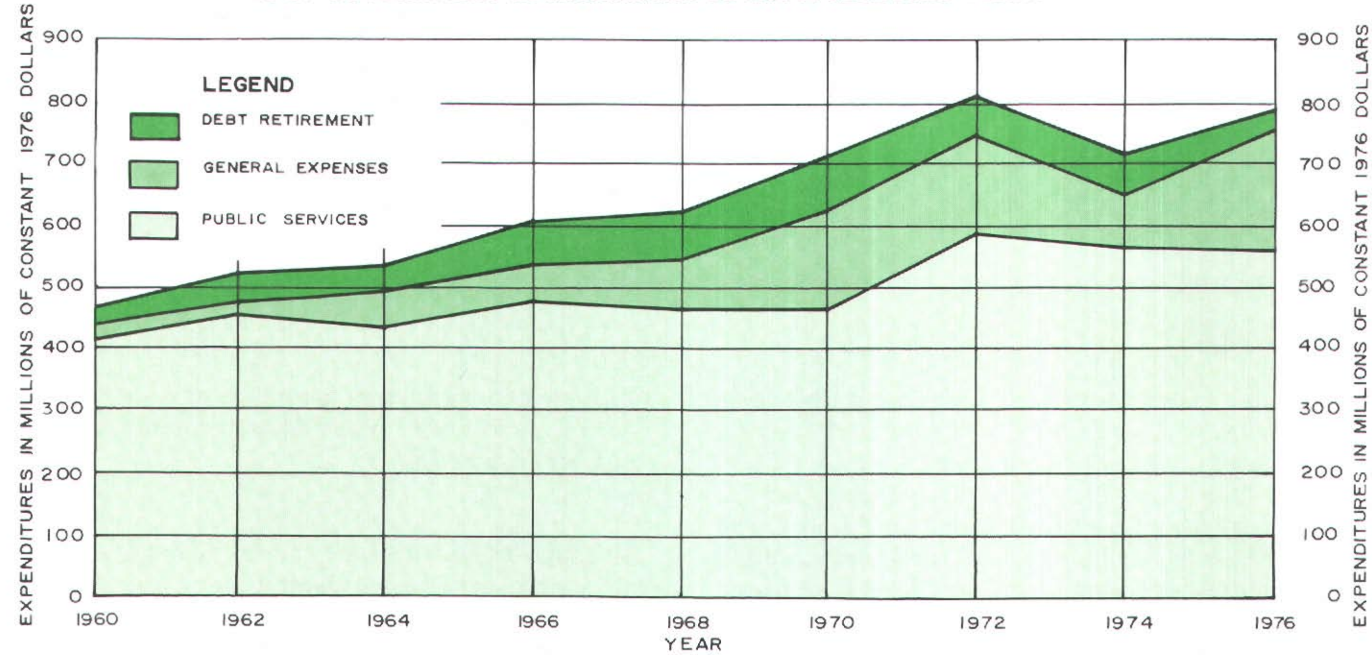
Tables 32 and 34. Counties in the Region devoted about 40 percent of total highway expenditures to capital improvements between 1960 and 1976, while cities expended about 44 percent, villages about 23 percent, and towns about 14 percent of total expenditures for capital improvements.

General Expenditure Patterns for All Municipal Units of Government in Milwaukee County

Between 1960 and 1976, the total combined expenditures of all general-purpose units of government in Milwaukee County increased from about $469 million to $787 million—an increase of $318 million, or about 68 percent, measured in constant 1976 dollars, as shown in Table 31. During this same period, the general expenditures by the municipal units of government increased from about $21 million to over $88 million, an increase of $67 million, or 329 percent. However, debt retirement expenditures for the municipal units of government in Milwaukee County increased only by about $8 million, or 21 percent—from $38 million in 1960 to $46 million in 1976. These expenditures reflect the decreased level of borrowing between the mid-1960's and 1976, as shown in Figure 10.

Figure 10

COMPOSITION OF PUBLIC EXPENDITURES FOR THE GENERAL-PURPOSE UNITS OF GOVERNMENT IN MILWAUKEE COUNTY: SELECTED YEARS 1960-1976



Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; and SEWRPC.

As shown in Table 36, total expenditures by the municipal units of government in Milwaukee County for the construction, operation, and maintenance of highways, streets, and bridges increased from over $80 million in 1960 to over $135 million in 1976—an increase of $55 million, or 68 percent. As mentioned above, total expenditures within Milwaukee County also increased by 68 percent during this period, indicating that the proportion of total expenditures utilized for highways, streets, and bridges remained relatively unchanged. Table 37 indicates the proportion of total highway expenditures in Milwaukee County contributed by local units of government, by the State, and by the federal government. Capital expenditures, however, increased from an estimated $52 million in 1960 to about $67 million in 1976—an increase of $15 million, or only about 29 percent, as shown in Table 38 and Figure 11. Thus, it would appear that while total highway expenditures by all units of government in Milwaukee County increased in proportion to total expenditure increases, a greater proportion of this money was being spent on operation and maintenance, rather than on capital construction projects. Table 39 indicates the proportion of capital expenditures in Milwaukee County contributed by local units of government, by the State, and by the federal government.

FINANCIAL RESOURCES: MASS TRANSIT

Mass transit was not publicly funded in the Milwaukee urbanized area until 1975 and, therefore, was not included in historical public expenditure data collection. In 1975 Milwaukee County obtained a federal grant from the U. S. Department of Transportation, Urban Mass Transporta-

Table 36

TOTAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN MILWAUKEE COUNTY BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976

Government Type	Total Highway Expenditures (in millions of constant 1976 dollars)									Change 1960-1976	
	1960	1962	1964	1966	1968	1970	1972	1974	1976	Absolute	Percent
Federal	$10.9	$29.4	$ 29.3	$ 36.1	$ 8.6	$ 27.4	$ 27.5	$13.3	$ 28.8	17.9	163.3
State	5.2	6.2	9.1	29.0	20.0	11.5	11.1	8.8	9.7	4.5	86.5
County	13.5	13.3	11.9	23.3	20.2	8.2	13.2	12.3	30.7	17.2	127.4
City	46.6	44.8	43.6	43.5	41.2	70.7	68.2	43.7	62.7	16.1	34.5
Village	4.3	3.8	6.2	5.4	4.2	4.2	3.1	4.8	3.5	- 0.8	- 18.6
Total	$80.5	$97.5	$100.1	$137.3	$94.2	$122.0	$123.1	$82.9	$135.4	54.9	68.2

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; Wisconsin Department of Transportation; and SEWRPC.

Table 37

PERCENT DISTRIBUTION OF TOTAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN MILWAUKEE COUNTY BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976

Government Type	Percent of Total Highway Expenditures									Percent Change 1960-1976
	1960	1962	1964	1966	1968	1970	1972	1974	1976	
Federal	13.5	30.2	29.3	26.3	9.1	22.5	22.3	16.0	21.2	7.7
State	6.5	6.4	9.1	21.1	21.2	9.4	9.0	10.6	7.2	0.7
County	16.8	13.6	11.9	17.0	21.4	6.7	10.7	14.8	22.7	5.9
City	57.9	45.9	43.5	31.7	43.7	58.0	55.5	52.8	46.3	- 11.6
Village	5.3	3.9	6.2	3.9	4.6	3.4	2.5	5.8	2.6	- 2.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	- -

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; Wisconsin Department of Transportation; and SEWRPC.

Table 38

CAPITAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN MILWAUKEE COUNTY BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976

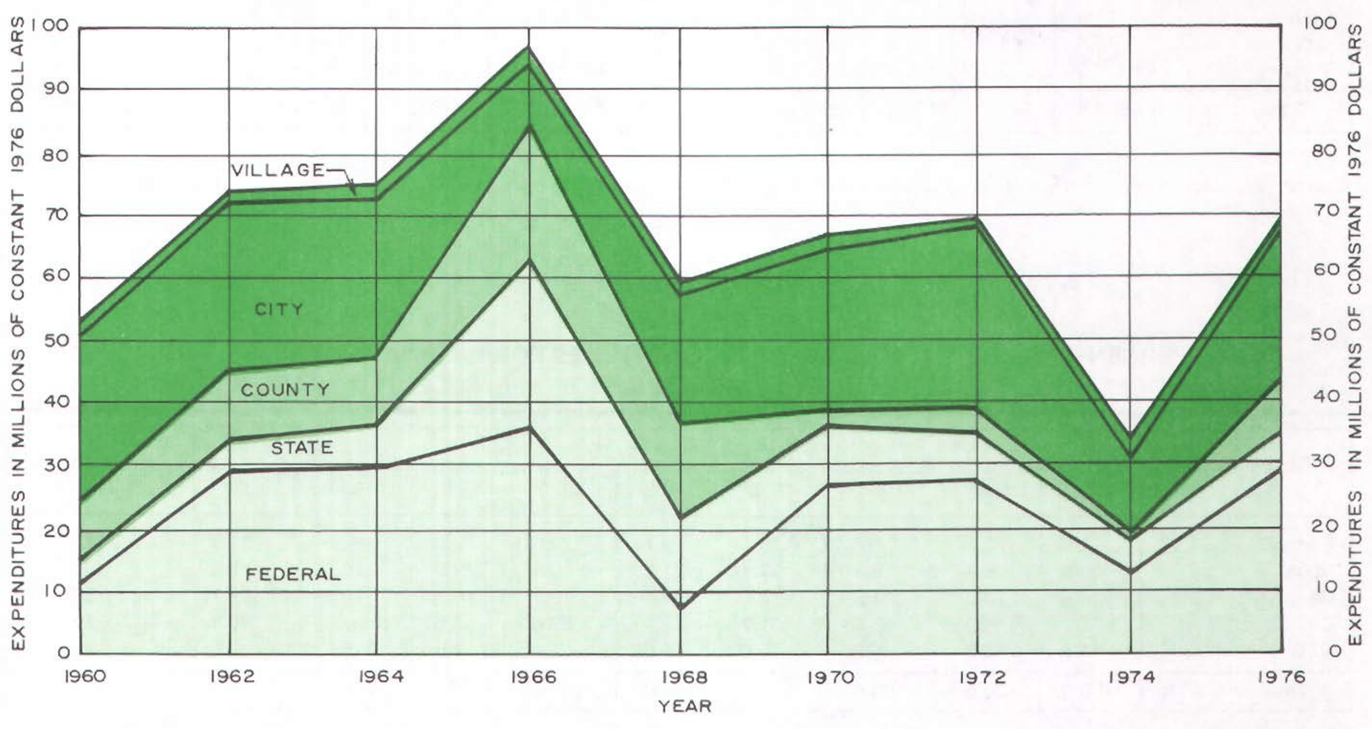
Government Type	Total Capital Expenditures (in millions of constant 1976 dollars)									Change 1960-1976	
	1960	1962	1964	1966	1968	1970	1972	1974	1976	Absolute	Percent
Federal.	$10.9	$29.4	$29.3	$36.1	$ 8.6	$27.4	$27.5	$13.3	$28.8	$17.9	164.2
State	4.6[a]	4.4	6.9	26.7	13.2	8.5	7.3	5.0	6.0	1.4	30.4
County.	8.9[a]	11.8	10.5	21.6	14.2	2.7	3.9	1.2	8.4	0.5	5.6
City.	26.1[a]	25.4	26.1	8.9	21.8	26.2	28.9	10.9	23.0	- 3.1	- 11.9
Village	1.9[a]	2.0	1.8	2.9	1.6	1.9	1.1	2.8	1.2	0.7	36.8
Total	$52.4[a]	$73.0	$74.6	$96.2	$59.4	$66.7	$68.7	$33.2	$67.4	$15.0	28.6

[a] *Estimates expenditures.*

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; Wisconsin Department of Transportation; and SEWRPC.

Figure 11

CAPITAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN MILWAUKEE COUNTY BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976



Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; Wisconsin Department of Transportation; and SEWRPC.

Table 39

PERCENT DISTRIBUTION OF CAPITAL EXPENDITURES FOR HIGHWAYS, STREETS, AND BRIDGES IN MILWAUKEE COUNTY BY GOVERNMENT TYPE: SELECTED YEARS 1960-1976

Government Type	Percent of Total Capital Expenditures									Percent Change 1960-1976
	1960	1962	1964	1966	1968	1970	1972	1974	1976	
Federal	20.8	40.3	39.3	37.5	14.5	41.1	40.0	40.1	42.7	21.9
State	8.8	6.0	9.2	27.8	22.2	12.7	10.6	15.1	8.9	0.1
County	17.0	16.2	14.1	22.5	23.9	4.1	5.7	3.6	12.5	- 4.5
City	49.8	34.8	35.0	9.2	36.7	39.3	42.1	32.8	34.1	- 15.7
Village	3.6	2.7	2.4	3.0	2.7	2.8	1.6	8.4	1.8	- 1.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	- -

Source: Wisconsin Department of Revenue, Bureau of Municipal Audit; Wisconsin Department of Transportation; and SEWRPC.

tion Administration (UMTA), for over $17 million to fund 80 percent of the cost of acquiring the physical assets of the privately owned local transit system and purchasing 100 new buses. The UMTA is a major financial resource to the Region today and provides, through specific authorizations, funding for both the capital and the operational needs of public transit services. Transit services are also funded under specific authorization by the State of Wisconsin, Department of Transportation. These federal and state monies combined provide the bulk of public transit capital and operating funds.

These funding sources, however, rarely provide 100 percent of the monies needed for transit projects, and local "matching" funds are generally required to obtain either federal or state financial assistance.

Federal Transit Assistance

The Urban Mass Transportation Act (UMT Act) of 1964, as amended, provides in Section 3, Section 5, and Section 16 funds to urban areas for property acquisition, capital improvements, and the day-to-day operation of public mass transportation services. Section 3 of the UMT Act provides for the discretionary funding of capital-intensive transit projects by the UMTA. Section 5 provides a population and population density-based formula grant allocation to urbanized areas for the day-to-day operations of, and/or capital improvements to, urban transit systems. Section 16 (Sub-Section b, paragraph 2) provides for the capital funding of specialized transit vehicles to meet the special transportation needs of elderly and handicapped people.

The National Mass Transportation Assistance Act of 1974 established an $11.8 billion, six-year (fiscal year 1975 through fiscal year 1980) public transportation program of both capital and operating assistance. Of the $11.8 billion approved by the Act, $7.825 billion was authorized for mass transit capital improvement projects (Section 3) and $3.975 billion was authorized for expenditure under the formula grant program (Section 5) that gave urbanized areas the option of using the monies either to defray operating costs on a 50 percent maximum federal and 50 percent minimum nonfederal matching basis or to fund capital improvement projects on an 80 percent federal and 20 percent matching basis. The monies authorized by Congress for public transit capital improvement projects are distributed to transit systems throughout the country at the discretion of the UMTA in response to individual capital grant applications from transit operators. The formula grant program apportioned monies to urbanized areas under a formula based 50 percent on 1970 population and 50 percent on 1970 population density as determined by the U. S. Bureau of the Census. Under Section 16(b)(2), funding was made available to cover 80 percent of the cost of vehicle and equipment purchases for private, nonprofit providers of specialized transportation service for elderly and handicapped people.

Title III of the Surface Transportation Assistance Act of 1978 established a new $15.16 billion five-year—1978 through 1983—federal public transit assistance program. Included in this amount is $7.48 billion in discretionary grant assistance for public transit capital improvement projects eligible for federal funding under Section 3 of the Urban Mass Transportation Act of 1964, as amended, and $6.525 billion in formula grant assistance for public transit operating assistance and routine capital acquisitions—primarily bus purchases—eligible for federal funding under Section 5 of the UMT Act.

Section 3 funds for capital and planning assistance will continue to be distributed at the discretion of the U. S. Secretary of Transportation through the UMTA on an 80 percent federal, 20 percent nonfederal matching basis. These funds are potentially available to any public transit operation in an urban area of 50,000 population or greater. Section 3 funds may be used for the construction of new fixed guideway systems and extensions; the acquisition, construction, and reconstruction of public transit facilities and equipment; and the introduction of new technology into public service. In addition, for the first time, Section 3 funds may be used for joint development and urban initiatives which enhance coordination between modes of transportation and economic development.

Section 5 urbanized-area capital and operating assistance (formula funds) will continue to be distributed to designated eligible recipients in urbanized areas on a 50 percent federal, 50 percent local matching basis, and will be available to provide capital assistance to eligible projects on an 80 percent federal, 20 percent nonfederal matching basis. The total annual apportionment of Section 5 funds to the State for urbanized areas of less than 200,000 population and directly to urbanized areas of more than 200,000 population is derived by summing the amounts allocated to each recipient from four separate categories of funds provided under Section 5: 1) base allocation funds, 2) second tier allocation funds, 3) commuter rail/fixed guideway allocation funds, and 4) bus capital allocation funds. The base allocation fund category is substantially greater than the other three categories of funds, which are considered supplementary to the base allocation.

The base allocation is determined 50 percent on population and 50 percent on population density, and may be used either for operating assistance or for routine capital acquisition. This allocation is developed according to a specific formula wherein one-half of the total base allocation for each urbanized area is apportioned on the basis of the ratio of that area's population to the total population of all urbanized areas. The other half of the total base allocation is apportioned according to the product of population and population density. Each urbanized area's share is proportional to the ratio of the product of population and population density for that area to the product of population and population density for all the urbanized areas.

The second tier allocation is based on the same apportionment formula that the base allocation is based on. However, the funds in this allocation are not divided evenly, but rather are divided into two parts—with 85 percent of the total apportionment earmarked for urbanized areas of more than over 750,000 population and 15 percent for urbanized areas of less than 750,000 population.

The commuter rail/fixed guideway allocation is apportioned on a commuter rail train-mile and route-mile formula basis and on a fixed guideway route-mile formula basis. Commuter rail/fixed guideway funds are available only for operating support. One-third of the total amount of this allocation is apportioned according to the number of fixed guideway route miles in each urbanized area. Each urbanized area's share is proportional to the ratio of the fixed guideway route miles (excluding commuter rail) within the area to the total of all fixed guideway route miles in all urbanized areas. However, no single state may receive more than 30 percent of the total amount allocated.

The remaining two-thirds of the allocation is apportioned to the commuter rail service serving each urbanized area. However, as with the fixed guideway allocation, no single state may receive more than 30 percent of the total. In addition, no state may receive less than one-half of 1 percent of the total amount allocated for commuter rail operating support. One-third of the total commuter rail/fixed guideway allocation is apportioned according to commuter rail route miles. Each urbanized area's share is proportional to the ratio of commuter rail route miles serving the urbanized area to the total of all commuter rail route miles serving all the urbanized areas. The other one-third is apportioned according to commuter rail train miles, where each urbanized area's share is proportional to the ratio of the commuter rail train miles serving an urbanized area to the total of all commuter rail train miles serving all the urbanized areas.

Like the base and second tier allocations, the bus capital allocation is based 50 percent on population and 50 percent on population density. However, the bus capital allocation may not be used for operating expenses, but only for routine capital acquisitions related to bus purchases.

Within the Milwaukee urbanized area, Milwaukee, Ozaukee, Washington, and Waukesha Counties have been designated as eligible recipients of UMTA assistance. In the Racine and Kenosha urbanized areas the Cities of Racine and Kenosha have been designated as eligible recipients of UMTA assistance. Tables 40 through 51 summarize the federal grant activity in the urbanized areas of the Region from 1975 to 1979 by county and grant program. Figures 11A and 11B summarize Milwaukee area public transit operating assistance and capital assistance through UMTA Section 3 and Section 5 grants from 1975 through 1979. Figure 11C shows the trend in the transit operating subsidy per ride in the Milwaukee urbanized area over the same period.

Table 40

SUMMARY OF UMTA SECTION 3 GRANT ACTIVITY IN MILWAUKEE COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-03-0005	1975	$17,140,400	Milwaukee County	Acquisition of privately owned transit system Purchase of 100 new 49- to 53-passenger buses with lifts for handicapped Purchase and installation of 105 communication radios in buses and establishment of a radio base station
WI-03-0005-1	1977	$1,134,116	Milwaukee County	Purchase of five supervisory cars Purchase and installation of 430 communication radios Fabrication and installation of 80 bus shelters
WI-03-0025	1978	$ 219,032	Milwaukee County	Preparation of master site development plan for Kinnickinnic Avenue bus garage facilities Preparation of final plans for Kinnickinnic Avenue operator's building Demolition and removal of existing Kinnickinnic Avenue operator's building Purchase of five supervisory cars
WI-03-0035	1978	$18,978,832	Milwaukee County	Purchase of 150 new 49- to 53-passenger buses with lifts for handicapped Purchase of 30 new 15- to 30-passenger buses with lifts for handicapped Purchase and installation of 100 communication radios Purchase of five supervisory cars Fabrication and installation of 80 bus shelters Purchase of miscellaneous office and garage equipment and vehicles
WI-03-0025-1	1979	$ 7,279,216	Milwaukee County	Design of and improvements to the Kinnickinnic Avenue bus garage facilities
Total	- -	$44,751,596	- -	- -

Source: SEWRPC.

Table 41

SUMMARY OF UMTA SECTION 5 GRANT ACTIVITY IN THE MILWAUKEE URBANIZED AREA: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-05-4003	1976	$ 1,515,546	Milwaukee County	Operation of transit system—1975
WI-05-4010	1977	3,521,105	Milwaukee County	Operation of transit system—1976
WI-05-4026	1978	5,345,682	Milwaukee County	Operation of transit system—1977
WI-05-4037	1978	8,373,952	Milwaukee County	Operation of transit system—1978
WI-05-4006	1979	10,078,089	Milwaukee County	Operation of transit system—1979
WI-05-0010	1979	2,689,912	Milwaukee County	Purchase of 22 new 45- to 53-passenger buses with lifts for handicapped
Subtotal	- -	$31,524,286	- -	- -
WI-05-4017	1977	$ 48,770	Waukesha County	Operation of transit system—1977
WI-05-4036	1978	68,126	Waukesha County	Operation of transit system—1978
WI-05-4043	1979	90,900[a]	Waukesha County	Operation of transit system—1979
Subtotal	- -	$ 207,796	- -	- -
Total	- -	$18,964,081	- -	- -

[a] *Represents original unaudited grant request approved by the U. S. Department of Transportation, Urban Mass Transportation Administration.*

Source: SEWRPC.

State of Wisconsin Transit Assistance

Direct State financial assistance, in the form of an operating assistance financial aid program, was established in 1973 under Chapter 85.05 of the Wisconsin Statutes. Funding was provided at an annual level of $3.5 million per year through fiscal year 1977, the same year in which monies from the State Highway (now Transportation) Fund were first used. The 1977 State Budget Act greatly increased state support of public transportation, as can be seen in Table 51, and additionally, under Chapter 85.08, provided state support for elderly and handicapped transportation services. State operating assistance funds (85.05) are generally applied as part of the required nonfederal share to leverage additional federal dollars and to assist urban areas in developing and maintaining quality public transit systems. The available state and federal aids, when combined with appropriate amounts of local revenues, have historically provided the resources to meet the cost of public transportation improvements. Tables 52 through 54 summarize the resources applied to such improvements in the Milwaukee, Racine, and Kenosha urbanized areas.

SUMMARY

Inventories of population, economic activity, and public financial resources are complementary basic studies, essential to sound land use and transportation planning. This chapter has presented a brief description of the historical and current trends in the demographic, economic, and public financial resource bases of the Region, particularly as they relate to transportation planning for the Milwaukee area primary transit system alternatives analysis.

The 1850 federal census of population was the first to include what is now the Southeastern Wisconsin Region. The population of the Region has increased every decade since then. According to the 1970 federal census, the resident population of the Region totaled approximately 1,756,100 people, or about 1 percent of the total population of the nation and about 40 percent of the population of the State. Population growth was especially pronounced in the period from 1940 to 1970. From 1940 to 1950, the resident population of the

Table 42

SUMMARY OF UMTA SECTION 16(b)(2) GRANT ACTIVITY IN MILWAUKEE COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-16-0001	1975	$ 7,544	American Cancer Society	Purchase of two station wagons
WI-16-0001	1975	$ 48,389	Curative Workshop	Purchase of three 15-passenger vans with lifts for handicapped Purchase of two 15-passenger vans Purchase of one 18-passenger bus with lift for handicapped Purchase and installation of radio equipment
WI-16-0001	1975	$ 16,861	Elder Care Lines	Purchase of two 12-passenger vans Purchase of two 5-passenger vans Purchase and installation of radio equipment
WI-16-0001	1975	$ 16,956	Jewish Vocational Service	Purchase of two 15-passenger vans Purchase of one 15-passenger van with lift for handicapped Purchase and installation of radio equipment
WI-16-0001	1975	$ 39,082	Goodwill Industries	Purchase of one 12-passenger van Purchase of one 28-passenger bus Purchase of one 40-passenger bus Purchase of one 40-passenger bus with lift for handicapped Purchase and installation of radio equipment
WI-16-0001	1975	$ 20,943	Project Involve	Purchase of two 12-passenger vans Purchase of one 18-passenger bus with lift for handicapped Purchase and installation of radio equipment
WI-16-0003	1977	$ 94,366	Goodwill Industries	Purchase of six 40-passenger buses with lifts for handicapped Purchase and installation of radio equipment
Total	- -	$244,141	- -	- -

Source: SEWRPC.

Table 43

SUMMARY OF UMTA SECTION 3 GRANT ACTIVITY IN RACINE COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-03-0019	1975	$1,827,056	City of Racine	Acquisition of privately owned transit system Purchase of 25 new 41-passenger buses Construction of bus storage shed

Source: SEWRPC.

Table 44

SUMMARY OF UMTA SECTION 5 GRANT ACTIVITY IN RACINE COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-05-4004	1975	$ 98,233	City of Racine	Operation of transit system—1975
WI-05-0002	1976	92,800	City of Racine	Fabrication and installation of 20 bus shelters Rehabilitation of bus garage facilities
WI-05-4005	1976	266,465	City of Racine	Operation of transit system—1976
WI-05-4020	1977	359,604	City of Racine	Operation of transit system—1977
WI-05-4033	1978	401,906	City of Racine	Operation of transit system—1978
WI-05-4044	1979	506,652[a]	City of Racine	Operation of transit system—1979
Total	- -	$1,725,660	- -	- -

[a] *Represents original, unaudited grant request approved by the U. S. Department of Transportation, Urban Mass Transportation Administration.*

Source: SEWRPC.

Table 45

SUMMARY OF UMTA SECTION 16(b)(2) GRANT ACTIVITY IN RACINE COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-16-0001	1975	$19,067	Lincoln Lutheran Specialized Transportation	Purchase of one 28-passenger bus with lift for handicapped Purchase of one 15-passenger van with lift for handicapped

Source: SEWRPC.

Table 46

SUMMARY OF UMTA SECTION 3 GRANT ACTIVITY IN KENOSHA COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-03-0007	1974	$1,515,197	City of Kenosha	Construction of bus storage garage and bus maintenance facilities Purchase of 24 45-passenger buses

Source: SEWRPC.

Table 47

SUMMARY OF UMTA SECTION 5 GRANT ACTIVITY IN KENOSHA COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-05-4009	1975	$ 145,136	City of Kenosha	Operation of transit system—1975
WI-05-4015	1976	210,475	City of Kenosha	Operation of transit system—1976
WI-05-4025	1977	300,561	City of Kenosha	Operation of transit system—1977
WI-05-0006	1978	166,936	City of Kenosha	Retrofitting of 12 buses with lifts for handicapped
WI-05-4034	1978	384,760	City of Kenosha	Operation of transit system—1978
WI-05-4041	1979	443,674	City of Kenosha	Operation of transit system—1979
Total	- -	$1,651,542	- -	- -

Source: SEWRPC.

Table 47A

SUMMARY OF UMTA SECTION 16(b)(2) GRANT ACTIVITY IN KENOSHA COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-16-0003	1977	$71,814	Kenosha Achievement Center	Purchase of two 24-passenger buses with lifts for handicapped Purchase of two 40-passenger buses with lifts for handicapped Purchase and installation of radio equipment

Source: SEWRPC.

Table 48

SUMMARY OF UMTA SECTION 16(b)(2) GRANT ACTIVITY IN WALWORTH COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-16-0001	1975	$ 8,355	Fairhaven Corporation	Purchase of one 15-passenger van with lift for handicapped
WI-16-0001	1975	6,187	Christian League for the Handicapped	Purchase of one 15-passenger van with lift for handicapped
Total	- -	$14,542	- -	- -

Source: SEWRPC.

Table 49

SUMMARY OF UMTA SECTION 16(b)(2) GRANT ACTIVITY IN OZAUKEE COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-16-0001	1975	$6,662	Portal Programs	Purchase of one 15-passenger van with lift for handicapped

Source: SEWRPC.

Table 50

SUMMARY OF UMTA SECTION 16(b)(2) GRANT ACTIVITY IN WASHINGTON COUNTY: 1975-1979

Grant Number	Year Awarded	Grant Amount	Grantee	Major Supported Activities
WI-16-0001	1975	$44,805	The Threshold	Purchase of one 15-passenger van with lift for handicapped Purchase of two 24-passenger buses with lifts for handicapped Purchase of one 36-passenger bus with lift for handicapped
WI-16-0003	1977	$32,666	The Threshold	Purchase of one 36-passenger bus with lift for handicapped Purchase of one 24-passenger bus with lift for handicapped

Source: SEWRPC.

Table 51

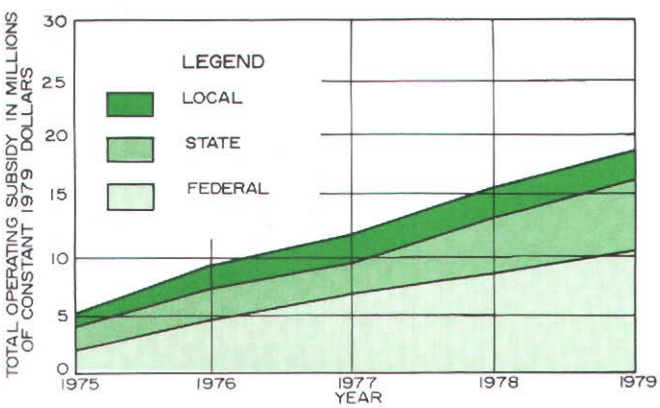
STATE URBAN TRANSIT AID APPROPRIATIONS: FISCAL YEARS 1976-1979

Program	Transit Aid Appropriations			
	Fiscal Year 1976	Fiscal Year 1977	Fiscal Year 1978	Fiscal Year 1979
Operating Assistance	$3,237,600	$3,241,200	$8,139,200	$9,360,100
Elderly and Handicapped	- -	- -	$1,300,000	$1,300,000

Source: Wisconsin Department of Transportation.

Figure 11A

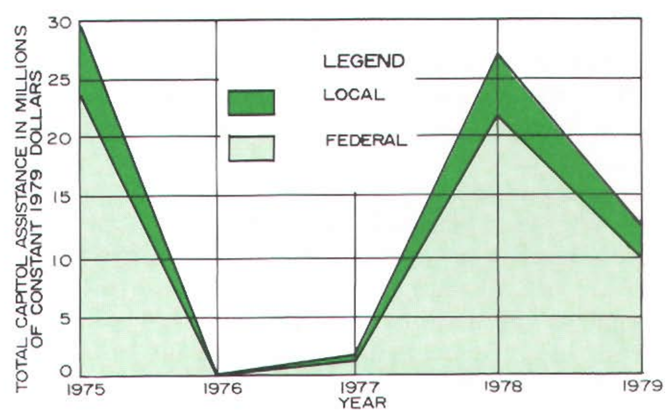
PUBLIC TRANSIT OPERATING SUBSIDIES IN THE MILWAUKEE URBANIZED AREA: 1975-1979



Source: SEWRPC.

Figure 11B

PUBLIC TRANSIT CAPITAL ASSISTANCE IN THE MILWAUKEE URBANIZED AREA: 1975-1979



Source: SEWRPC.

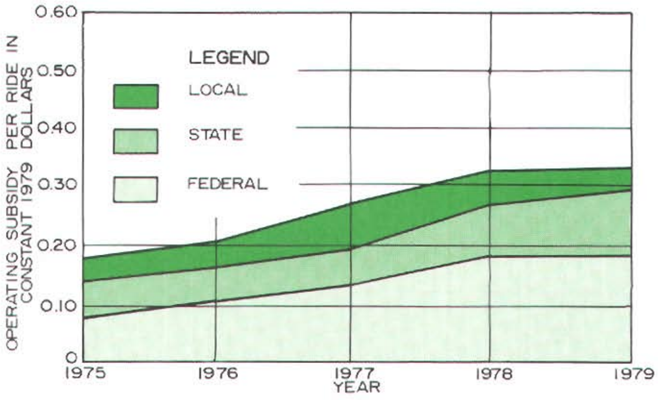
Region increased by about 173,000 people. From 1950 to 1960, the population increased by about 333,000 people, an historic peak, while from 1960 to 1970, the population increased by about 182,000 people. These large increases were primarily a function of large natural increases in the population.

Since 1970, however, population growth within the Region has virtually halted. By 1978 the resident population of the Region was estimated at 1,770,500 people, only 14,400, or 1 percent, more people, than there were in the Region in 1970. General fertility declines partially account for the reduced rates of population growth noted. However, since 1970, and particularly since 1975, net out-migration has become a significant component of population change in the Region. Between 1970 and 1978, net out-migration has offset approximately 75 percent of the population change attributable to natural increase.

From 1900 to 1930, the highest rates of population increase occurred in the three urban counties of Milwaukee, Kenosha, and Racine. Since 1930, however, the outlying counties, notably Ozaukee, Washington, and Waukesha, have experienced the

Figure 11C

PUBLIC TRANSIT OPERATION SUBSIDY PER RIDE IN THE MILWAUKEE URBANIZED AREA: 1975-1979



Source: SEWRPC.

highest rates of population increase. From 1960 to 1970, the proportion of the total regional population in the three urban counties—Kenosha, Milwaukee, and Racine—decreased about 5 percent—from 81 percent in 1960 to 76 percent in 1970. Despite the lack of any significant population growth at the regional level between 1970 and 1978, the Milwaukee County portion of the total regional population decreased about 6 percent—from about 60 percent in 1970 to about 54 percent in 1978.

With respect to characteristics of the resident population, it has been noted that the age structure of the population has been changing toward that of an older, more mature population. This has particularly been the case since 1960. At the same time, the racial composition of the population has been changing toward a greater proportion of nonwhites, although whites still comprise approximately 90 percent of the total regional population. In Milwaukee County nonwhites comprise about 13 percent of the total population.

The number of households in the Region continues to grow at a greater rate than does the resident population, leading to an overall decrease in the number of persons per household. From 1950 to 1960, the number of households in the Region increased by 111,400, or 31 percent. Between 1960 and 1970, the number of households increased by 70,600, or 15 percent. The number of persons per household declined from 3.36 in 1950 to 3.20 in 1970. The results of special censuses taken in some civil divisions in the Region since 1970 indicate that these trends are continuing.

Total regional personal income increased nearly 17 percent from 1960 to 1970, measured in constant 1967 dollars. This increase, however, was less than the national and state increase during this period, and less than the regional increase of 93.5 percent from 1950 to 1960, as measured in constant 1967 dollars, when the rate of personal income growth in the Region exceeded both the state and national increases.

Between 1950 and 1970, the Region's labor force increased from about 540,100 people to about 744,500 people—an overall increase of 204,400 people, or about 38 percent. Between 1970 and 1978, the labor force increased to 891,700 people—an increase of about 147,200 people, or 20 percent. Labor force participation has been increasing since 1950. The labor force participation rate in 1950 was about 57 percent and by 1970 had reached 59 percent. Over this same period, female labor force participation increased from 32 percent to 43 percent, while male participation decreased from 82 percent to 76 percent.

Between 1950 and 1970, the number of jobs in the Region increased by 188,900, or 34 percent, over the 1950 level of 552,700 jobs. Between 1970 and 1978, the number of jobs increased by 110,200, or 15 percent, over the 1970 level of 741,600 jobs, despite the fact that the population of the Region increased only 1 percent between 1970 and 1978. The increase in jobs has seemingly been accommodated by increased female labor force participation, an apparent trend toward individuals holding more than one job, and a changing age structure within the Region's population, wherein a larger proportion of the total population is in the working age groups.

Like population, jobs have shown a trend toward decentralization. In 1960, 75 percent of the economic activity of the Region, as measured by jobs, was located in Milwaukee County. By 1970, the proportion of the economic activity of the Region located in Milwaukee County had declined to 69 percent, and by 1978 to 66 percent. Waukesha County has experienced the largest increase in the proportion of regional jobs—from 5 percent in 1960 to 9 percent in 1970 to about 11 percent in 1978.

Table 52

PUBLIC MASS TRANSIT OPERATING ASSISTANCE FOR THE MILWAUKEE URBANIZED AREA: 1975-1979

Recipient	Amount of Assistance				
	1975	1976	1977	1978	1979[a]
Milwaukee County Transit System					
Federal	$1,453,874	$3,656,462	$5,457,176	$ 7,240,099	$10,078,089
State	1,501,749	1,875,307	2,197,907	3,703,467	5,966,518
Local	763,764	1,429,252	1,832,274	1,847,477	2,320,312
Subtotal	$3,719,387	$6,961,021	$9,487,357	$12,791,043	$18,364,919
City of Waukesha					
Federal	- -	- -	- -	- -	- -
State	- -	- -	- -	- -	- -
Local	- -	6,000	- -	- -	- -
Subtotal	- -	$ 6,000	- -	- -	- -
Waukesha County					
Federal	- -	- -	$ 48,770	$ 68,050	$ 90,900
State	- -	- -	16,860	45,367	56,356
Local	- -	- -	31,910	22,683	34,364
Subtotal	- -	- -	$ 97,540	$ 136,100	$ 181,800
Ozaukee County					
Federal	- -	- -	- -	- -	- -
State	- -	12,000	10,430	7,299	- -
Local	- -	12,024	33,680	14,599	- -
Subtotal	- -	$ 24,024	$ 44,110	$ 21,898	- -
Total Urbanized Area					
Federal	$1,453,874	$3,656,462	$5,505,946	$ 7,548,000	$10,168,989
State	1,501,749	1,887,307	2,225,197	3,972,087	6,023,054
Local	763,764	1,447,276	1,897,864	1,996,992	2,354,676
Total	$3,719,387	$6,991,045	$9,629,007	$13,517,410	$18,546,719

[a] *1979 figures are pre-audit.*

Source: SEWRPC.

The structure of the regional economy has been heavily concentrated in manufacturing, although this concentration is diminishing over time. In 1960 about 276,600 of the Region's 647,900 jobs—about 43 percent—were in manufacturing. By 1970, the number of manufacturing jobs had decreased slightly to approximately 251,000 jobs, while the total number of regional jobs increased to 741,600 jobs. In 1970 manufacturing comprised about 34 percent of all regional jobs, a decline of about 9 percentage points since 1960. By 1978, the number of manufacturing jobs had increased slightly to 257,800 jobs, but only about 30 percent of the total 1978 regional employment was represented by manufacturing jobs.

While the relative importance of manufacturing as a regional employer has declined, wholesale trade, retail trade, private services, and government services and education have grown significantly

Table 53

PUBLIC MASS TRANSIT OPERATING ASSISTANCE FOR THE RACINE URBANIZED AREA: 1975-1979

Recipient	Amount of Assistance				
	1975	1976	1977	1978	1979[a]
The Belle Urban System					
Federal	$ 98,233	$266,465	$359,773	$387,104	$490,196
State	60,886	167,925	149,550	258,069	290,221
Local.	35,006	97,065	210,223	129,034	103,951
Total	$194,125	$531,455	$719,546	$774,207	$884,369

[a] *1979 figures are pre-audit.*

Source: SEWRPC.

Table 54

PUBLIC MASS TRANSIT OPERATING ASSISTANCE FOR THE KENOSHA URBANIZED AREA: 1971-1979

Recipient	Amount of Assistance								
	1971	1972	1973	1974	1975	1976	1977	1978	1979
Kenosha Transit Commission									
Federal . .	$37,739[a]	$174,380[a]	$149,543[a]	- -	$146,000	$209,000	$302,000	$341,764	$443,674
State. . . .	- -	- -	- -	130,500	97,661	126,830	92,712	144,438	209,753
Local . . .	- -	- -	- -	65,250	48,000	82,500	97,305	155,027	97,121
Total	$37,739	$174,380	$149,543	$195,750	$291,661	$418,330	$492,017	$641,229	$750,548

[a] *The Kenosha Transit Commission received state and federal aid from a grant obtained under the Federal Emergency Employment Act between September 1971 and November 1973.*

Source: SEWRPC.

since 1960. Private services in particular has experienced rapid growth, and by 1978 represented approximately 26 percent of total regional employment compared to 18 percent in 1960. The trends being experienced in the Region are similar to changes taking place in the national economy over the same time period. Both nationally and regionally, the economy has become less manufacturing-oriented and more service-oriented.

Total public revenues of local governments in the Region have increased steadily from about $0.93 billion in 1960 to about $1.91 billion in 1976—an overall increase of $0.99 billion, or 107 percent, measured in constant 1976 dollars. Since 1960, the property tax levy has consistently been the major source of revenue for local governments in the Region. However, it should be noted that the per capita property tax rate has declined since 1972, when the per capita rate peaked at about $443 per capita. The full or equalized value of all taxable real and personal property has increased from $16.15 billion in 1960 to $25.75 billion in 1976—an overall increase of $9.6 billion, or 59 percent, when measured in constant 1976 dollars.

The public financial revenues for the municipal units of governments within Milwaukee County increased by more than $290 million, or 60 percent, between 1960 and 1976—from $484 million to $774 million. During this same period, property revenues collected by municipal units of government in Milwaukee County declined in relative importance from providing over 49 percent of total revenues in 1960 to just over 40 percent of total revenues in 1976. Debt receipts also declined within Milwaukee County, from a 1960 level of over $66 million to a 1976 level of just under $60 million—a decrease of about 11 percent.

A growing portion of local government revenue is comprised of state-collected taxes and fees which are returned to local units of government and school districts. While state-returned monies to local units of government in the Region have grown over time—from $301 million, or 25 percent of total local revenues, in 1964, to $737 million, or over 38 percent of total local revenues, in 1976, measured in constant 1976 dollars—not all forms of these returned revenues have increased uniformly. Money returned to local governments in the form of transportation aids have declined from their peak of over $22 million in 1968 to about $15 million in 1976, a decrease of $7 million, or about 32 percent. The percentage of monies collected by the State and returned to local units of government in the Region has also increased—from about 52 percent in 1964 to about 68 percent in 1976. However, the percentage of state-collected monies returned to the Region has consistently been lower than the average percentage of monies returned by the State, with only Milwaukee County of the seven counties in the Region receiving a higher percentage, 24 percent, of state payments than the statewide average for such payments of about 11 percent.

Between 1960 and 1976, the combined expenditures for all counties, cities, villages, towns, and public and vocational school districts within the Region increased by about $956 million, or 103 percent—from $924 million in 1960 to $1,880 million in 1976, when measured in constant 1976 dollars. The three largest categories of expenditure by governments in the Region in 1976 were education; health, sanitation, and welfare; and the protection of persons and property. In 1976 these three categories accounted for expenditures of $1,313 million, or 70 percent of all governmental expenditures. Expenditures by all general-purpose units of government in the Region for the construction and operation and maintenance of highways, streets, and bridges totaled about $190 million in 1976, or 10 percent of total local expenditures, compared to $160 million, or 17 percent of total local governmental expenditures, in 1960, as measured in constant 1976 dollars.

The public financial expenditure pattern for the municipal units of government in Milwaukee County shows an overall increase in total expenditures between 1960 and 1976. Expenditures increased from about $469 million in 1960 to $787 million in 1976—an increase of about $318 million, or about 68 percent. Expenditures for highway construction, operation, and maintenance by Milwaukee County municipal units of government also increased by about 68 percent—from over $80 million in 1960 to over $135 million in 1976—thus keeping pace with the increase in total expenditures. Capital expenditures for the construction of highways, streets, and bridges by the municipal units of government in Milwaukee County showed a much smaller percentage increase between 1960 and 1976. Expenditures rose from over $52 million in 1960 to over $67 million in 1976—an increase of $15 million, or only about 29 percent. Thus, most of the increases in highway-related expenditures in Milwaukee County were for operation and maintenance and not for capital construction.

Federal and state capital and operating assistance are major financial resources to the Region's public mass transit system today. Through grants from the U. S. Department of Transportation, Urban Mass Transportation Administration, and the Wisconsin Department of Transportation, the bulk of the Region's public transit capital and operating financial needs are being met. Federal and state funds are used in the acquisition, operation, and maintenance of the transit fleet. Funds are also used in the purchase of specialized vehicles for use by not-for-profit organizations in the provision of service for the transportation handicapped. However, the extent to which federal and state monies can be relied upon to fund future transit development projects depends upon the Region's ability to develop local matching funds.

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Chapter III

LAND USE

INTRODUCTION

One of the central concepts underlying areawide land use-transportation planning is that land use and transportation are closely interrelated. The type, intensity, and spatial distribution of land uses determine the number and variety of trips generated by each subarea of the Region. A complete inventory of existing land use is, therefore, essential to any areawide transportation planning effort so that the quantitative relationships existing between land use and travel can be established and used to test alternative transportation system plans. Such a complete inventory of land use in southeastern Wisconsin was first conducted in 1963 in order to facilitate the preparation of the regional land use plan and transportation system plan formally adopted by the Commission in 1966. An inventory of historical development patterns within the Region was also conducted during the Commission's initial land use-transportation study. The inventory of historical growth patterns in conjunction with the 1963 inventory of land use provided a sound basis for analyzing urban development activity and determining feasible future land use patterns as part of the initial land use planning effort. The methodology and findings of the 1963 land use inventory, as well as of the inventory of historical growth, are fully documented in previous Commission publications.[1]

Southeastern Wisconsin has experienced relatively rapid urbanization since the initial land use inventory in 1963. An analysis of changing development patterns was, therefore, particularly important in the reevaluation of the initial regional land use and transportation system plans, which began in the early 1970's. One of the first steps in this plan reevaluation was the updating of the original 1963 inventory of land use in southeastern Wisconsin to the year 1970. The 1970 inventory of land use provides important information concerning existing land development in southeastern Wisconsin. This information allows for a quantitative description of the changes in the regional land use pattern that have taken place since 1963. Based on this description, the relationships existing between land use and transportation can be reviewed, and the conformance or departure of recent development trends from the original regional land use plan can be evaluated.

This chapter describes, from these land use inventories, the land use information most relevant to the primary transit system alternatives analysis process. It includes a discussion of the type, intensity, and spatial distribution of land uses within the Region as of 1970, and a review of the historical changes in land development patterns within the Southeastern Wisconsin Region. In addition, this chapter discusses land use development trends in southeastern Wisconsin since 1970.

HISTORIC GROWTH OF SOUTHEASTERN WISCONSIN

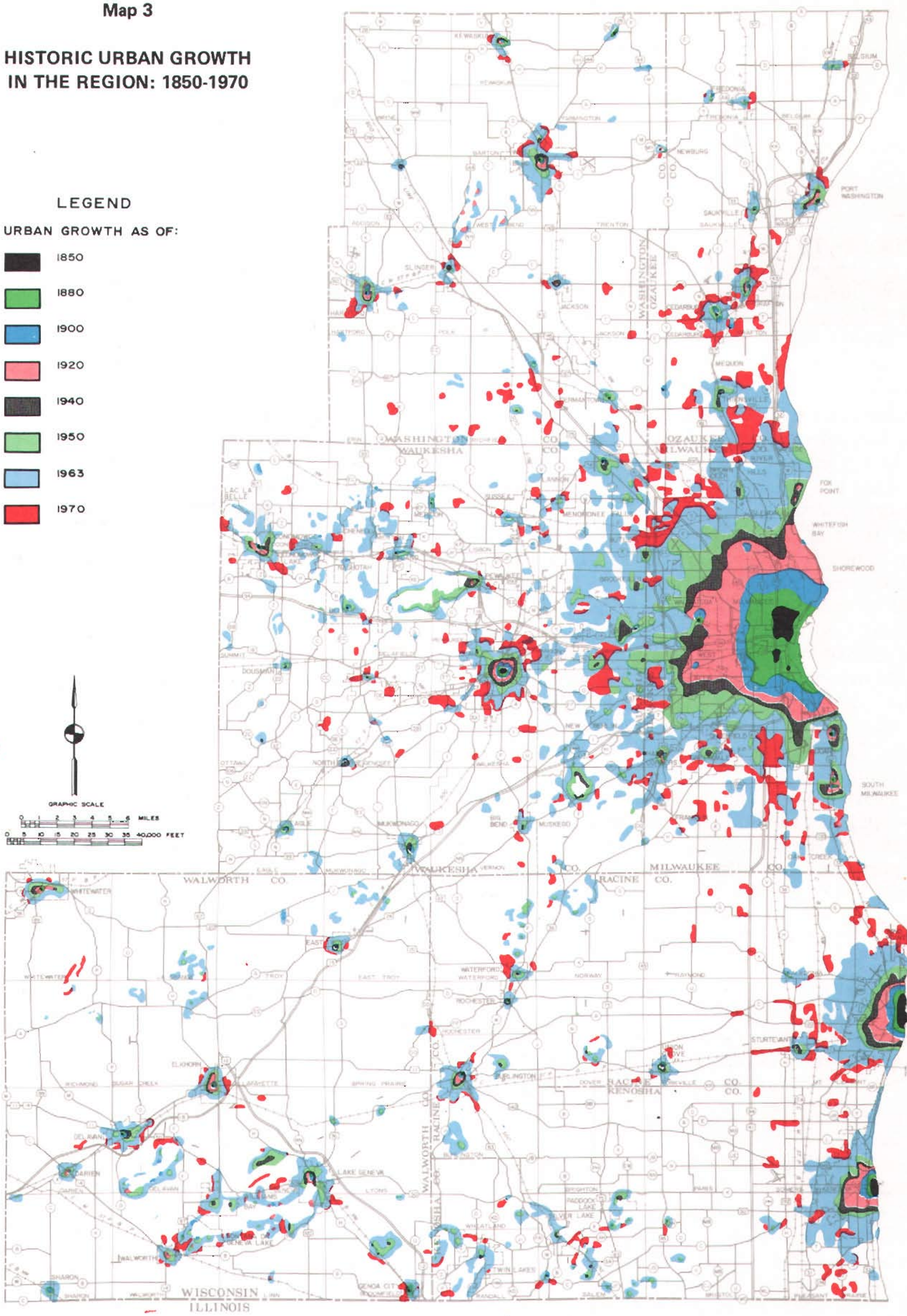
The first permanent European settlement in the Region was a trading post established in 1795 on the east side of the Milwaukee River, just north of what is now Wisconsin Avenue in the City of Milwaukee. The movement of European settlers into the Region was well underway by 1830, and most of the cities and villages within the Region can trace their origins to trading posts established in the early nineteenth century. The completion of the U. S. Public Land Survey in the Region by 1836, and subsequent sale of public lands, brought many settlers from New England, Germany, Austria, and Scandinavia.

By 1850 there were more than 113,000 people in the Region. The accompanying historic development map (see Map 3) indicates the many scattered developments existing in the Region at that

[1] *A detailed description of the methodology and classification scheme utilized in the 1963 regional land use inventory is contained in SEWRPC Procedural Manual No. 5, Land Use Inventory. The findings of the 1963 regional land use inventory, as well as the methodology and findings of the inventory of historical development within the Region, have been documented in SEWRPC Planning Report No. 7, The Regional Land Use-Transportation Study, Volume One, Inventory Findings.*

Map 3

HISTORIC URBAN GROWTH IN THE REGION: 1850-1970



Urban development within the Region occurred in a fairly dense and compact pattern until about 1950, with new urban development occurring at relatively high densities in concentric rings contiguous to, and outward from, the existing urban areas and long-established mass transit, utility, and community facility systems. Soon after World War II, however, the character of urban growth in the Region began to change to a much more diffused pattern of development, with relatively low densities and widespread proliferation of clusters of noncontiguous development. Between 1963 and 1970, 57 square miles of land were converted from rural to urban use within the Region, a rate of approximately eight square miles per year. The continuation of this sprawl pattern of land use development threatens further destruction of prime agricultural lands and the creation of scattered enclaves of urban development in otherwise rural areas that will be difficult to serve economically, if at all, with necessary public utilities and services, including mass transit services.

Source: SEWRPC.

time. In addition to being evident in the larger urban centers of Burlington, Kenosha, Milwaukee, Racine, Waukesha, and West Bend, traces of this early development are evident in many of the smaller communities that exist in the Region today. Many of these communities did not incorporate until after 1900, and did not show signs of widespread development until after 1920.

Historic Growth Patterns

Urban development[2] in the Region increased significantly between 1850 and 1880, between 1890 and 1920, and between 1950 and 1970. Although the 1920 to 1930 decade exhibited the second largest increase in the history of the Region, urban development did not increase markedly between 1920 and 1940, which included a severe national depression and slow recovery, nor between 1940 and 1950, which was too early to fully reflect the post-World War II housing boom. The 20-year period from 1950 to 1970 shows the most dramatic increase in urban development. The pattern of development occurring around the existing communities of the Region during this period is referred to as "urban sprawl." While the urban population of the Region increased by 47 percent during this period, the amount of land devoted to urban uses increased by 188 percent.

The conversion of land to urban uses occurred at the rapid rate of 15.5 square miles per year between 1950 and 1963. Since the initial regional land use inventory in 1963, urban development has continued at a somewhat slower rate of 8.1 square miles per year. It should be recognized that the increase in urban development—17 percent—exceeded the increase in the urban population—6 percent—between 1963 and 1970.

[2] *For the purposes of this report, urban development is defined as those areas of the Region wherein houses or other buildings have been constructed in relatively compact groups or where a closely spaced network of minor streets has been constructed, thereby indicating a concentration of residential, commercial, industrial, governmental, or institutional land uses. The continuity of such development is considered interrupted if a quarter-mile or more of nonurban-type land uses, such as agriculture, woodlands, or wetlands, prevails and the above conditions are generally absent.*

The 1970 inventory of land use revealed that approximately 57 square miles of land were converted from rural to urban use within the Region between 1963 and 1970. Map 3 indicates that the diffused nature of urban development which began to manifest itself in the 1950's continued into the 1960's. Between 1963 and 1970, urban development in the Milwaukee metropolitan area continued to increase in what were once considered remote rural communities. Thus, to the north and west, considerable urban development occurred in the Mequon, Cedarburg, Grafton, Germantown, Menomonee Falls, Brookfield, New Berlin, and Waukesha areas. To the south, substantial urban development occurred in the communities of Greendale, Franklin, and Oak Creek in Milwaukee County as well as in the Town of Caledonia in Racine County, which is subject to the outward spread of urban development from two metropolitan centers, Milwaukee and Racine. Along the Lake Michigan shoreline, considerable urban development occurred both north and south of the Kenosha, Milwaukee, and Racine areas.

The historic growth map for the Region reveals that transportation routes have not been as strong an influence on urban development patterns in the Region as they have been in other large metropolitan areas. Although the influence of certain major highway routes, such as STH 15, 24, 30, and 36 and USH 18, 41, and 141, on the spatial location of urban development is evident in more recent development, the historical influence of the steam railway and electric interurban railway networks is much less evident than in other large metropolitan regions; and urban growth appears to have occurred more by accretion than by axial expansion. Where the latter has occurred, it has apparently been centered on automotive transportation and been closely followed by interstitial development. The 1920 growth ring for the Milwaukee urban area, however, does approximate both the outer limits of the highest population densities of the Region and the outer limits of the highest level of public transit service provided within the Region by the then-existing local street railway network.

The historical development map indicates that the spatial location of urban development in the Region has been as strongly influenced by resource amenities as by transportation facilities and services. This is evidenced by the lineal development existing around the many inland lakes, along the Lake Michigan shore, and along the stream valleys of the Region. It appears that, although transportation routes did have some influence on urban development within the Region, that influence was modified by the location and quality of the resource amenities. Utility service availability was also a factor. It also appears, however, that the influence of transportation routes on urban development has become more marked since the introduction of the high-speed, all-weather highway.

Historic Density Trends

The change in population density within the Region between 1850 and 1970 is presented in Tables 55 and 56. During this 120-year period, the regional population increased more than 15-fold, from 113,389 to 1,756,086 persons. As a result, the overall population density of the Region increased steadily from 42 persons per square mile in 1850 to 653 persons per square mile in 1970. Population densities within urban areas of the Region, however, have followed a quite different trend. The population density of the urban area of the Region increased from 7,156 persons per square mile in 1850 to its highest level of 11,346 persons per square mile in 1920. After 1920, the population density of the urban area of the Region began a steady decline. By 1950, the urban population density in the Region had declined to 8,544 persons per square mile. By 1963, the urban population density had dropped to 4,807 persons per square mile, a substantial reduction from the 1920 peak and significantly lower than the 1950 level. The change in urban population density which occurred in the Region during the period from 1950 to 1963 amounted to an annual reduction of about 288 persons per square mile, or a decrease of about 3 percent per year. After the initial land use inventory in 1963, the urban population density continued to decline to about 4,355 persons per square mile in 1970.

The rate of decline in urban population density has, however, slowed to an annual reduction of about 65 persons per square mile, or a decrease of about 1 percent per year. The initial regional land use plan adopted in 1966 recommended the stabilization of the urban population density so that by 1990, the design year of that plan, the overall urban population density within the Region would approximate 4,353 persons per square mile, about the same as the actual 1970 urban population density of the Region.

Table 55

POPULATION DENSITY TRENDS IN THE REGION: SELECTED YEARS 1850-1970

Year	Urban Population		Rural Population		Total Population	Area (square miles)		Persons per Square Mile	
	Number	Percent of Total	Number	Percent of Total		Urban	Total	Urban	Total
1850	28,623	25.2	84,766	74.8	113,389	4	2,689	7,155.8	42.2
1880	139,509	50.3	137,610	49.7	277,119	18	2,689	7,750.5	103.1
1900	354,082	70.6	147,726	29.4	501,808	37	2,689	9,569.8	186.6
1920	635,376	81.1	148,305	18.9	783,681	56	2,689	11,346.0	291.4
1940[a]	991,535	92.9	76,164	7.1	1,067,699	90	2,689	11,017.1	397.1
1950[a]	1,179,084	95.0	61,534	5.0	1,240,618	138	2,689	8,544.1	461.4
1963[a]	1,634,200	97.6	40,100	2.4	1,674,300	340	2,689	4,806.5	622.6
1970[a]	1,728,949	98.5	27,137	1.5	1,756,086	397	2,689	4,355.0	653.1

[a] *The "rural-nonfarm" population is included in the urban total.*

Source: U. S. Bureau of the Census and SEWRPC.

Table 56

ESTIMATED POPULATION DENSITY TRENDS IN THE MILWAUKEE, RACINE, AND KENOSHA URBAN DEVELOPMENT AREAS: SELECTED YEARS 1850-1970

Year	Milwaukee			Racine			Kenosha		
	Population	Area (square miles)	Persons per Square Mile	Population	Area (square miles)	Persons per Square Mile	Population	Area (square miles)	Persons per Square Mile
1850	24,000	2.1	11,430	5,600	0.7	8,000	3,500	0.2	17,500
1880	126,000	13.0	9,690	17,000	1.2	14,167	6,000	0.5	12,000
1900	314,000	29.1	10,790	31,000	2.7	11,482	13,000	1.3	10,000
1920	530,000	42.0	12,619	62,000	4.8	12,917	41,000	3.1	13,226
1940	748,000	65.9	11,350	73,000	7.2	10,139	53,000	4.7	11,277
1950	850,000	94.0	9,043	84,000	8.6	9,767	63,000	6.4	9,844
1963	1,140,000	194.6	5,858	106,000	27.6	3,841	82,000	20.4	4,020
1970	1,204,000	255.8	4,707	122,000	32.1	3,800	88,000	21.9	4,018

Source: SEWRPC.

As indicated in Table 56, similar decreases in population densities occurred in the three major urban development areas[3] of the Region—Kenosha, Milwaukee, and Racine—between 1920 and 1963. Between 1963 and 1970, however, the population densities in the Racine and Kenosha urban development areas remained relatively stable because of similar rates of increase in urban land area and urban population levels during this time. In the Milwaukee metropolitan area, however, the amount of land in urban uses increased by 61.2 square miles, or 31 percent, during this period, while the population in the urban development area increased by only 64,000 persons, or about 6 percent. Accordingly, the population density of the Milwaukee urban area decreased from 5,858 persons per square mile in 1963 to 4,707 persons per square mile in 1970.[4]

[3] *The urban areas of Kenosha, Milwaukee, and Racine are defined as areas of contiguous urban development in and around the Cities of Kenosha, Milwaukee, and Racine. The continuity of an urban development area was considered interrupted if a quarter-mile or more of nonurban land uses prevailed and urban development was generally absent.*

[4] *Increases in the size of the Kenosha, Milwaukee, and Racine urban areas between 1963 and 1970 generally consisted of land actually developed for urban purposes during this period, but additionally may include areas of urban development that were "linked" to the urban centers by land development which occurred between 1963 and 1970, despite the fact that such areas had been removed as urban development areas.*

The increases in the size of the population and developed area and the decreases in urban population density have been accompanied by significant changes in the way of life within the Region. Widespread urban development in the rural-urban fringe areas of the Region well beyond the historic central cities and their suburbs is a fairly recent phenomenon. In these outlying areas residents can enjoy many of the amenities of rural life, yet also avail themselves of a wide variety of urban services, including employment in urban industries. The extent to which this form of diffused urban development continues will be a prime determinant of future environmental conditions within the Region, as well as of transportation and public facility needs.

Factors contributing to the diffusion of urban development and the associated decline in urban population densities include the widespread availability of electric power and telephone service; the practicality of an onsite sewage disposal and water supply made possible by the septic tank and electrically powered well; the development of high-speed, all-weather highway facilities and the attendant widespread availability and use of the automobile for transportation; and the apparent desirability with which the American public regards low-density residential development and the premium which that public places on space in the vicinity of its residence. Before the widespread availability of the automobile, limited transportation facilities served to constrain, to some extent, the spread of residential development and other forms of urban land use. Increasingly quick and convenient automobile travel, however, has effectively made large amounts of land accessible for development, thereby reducing the need for the intensive urban land development patterns of the past. It must be recognized, however, that the rapid expansion of urban land development is not consistent with judicious use of the limited fiscal and physical resources of the Region as recommended in the adopted regional land use plan.

EXISTING LAND USE OF SOUTHEASTERN WISCONSIN

Less than 20 percent of the total area of southeastern Wisconsin was devoted to urban land uses in 1970, as indicated by the regional land use inventory conducted in 1970. For regional planning purposes, urban land has been defined as lands devoted to residential, commercial, industrial, governmental and institutional, transportation, and recreational uses. Nonurban land has been defined as lands devoted to agricultural uses and open lands, consisting of woodlands, wetlands, and unused lands.[5] The spatial distribution of land uses in the Region in 1970 is shown on Map 4.

[5] *Unused lands are lands which are neither developed, cropped, tilled, grazed, or used as a place of storage.*

As indicated in Table 57, agricultural land was the largest single type of land use in the Region in 1970, occupying 1,040,121 acres, or 60 percent of the total area of the Region. The next largest land use category was open lands, consisting of woodlands, water, wetlands and unused lands. Open lands occupied 353,136 acres, or 21 percent of the Region, in 1970. Thus, 1,393,257 acres of land, representing 81 percent of the total area of the Region, were still devoted to nonurban land uses—agricultural and open lands—in 1970.

Of the types of land use considered to be urban, residential land use occupied the greatest area in the Region, accounting for 156,266 areas, or 9 percent of the total area of the Region, in 1970. A close second were transportation, communication, and utility uses, which accounted for 109,407 acres, or 6 percent of the total area. This category reflects the vast areas of land devoted to airports, parking lots, rights-of-way for streets and highways, railroads, and utility lines in 1970. A very small amount of land was devoted to urban economic activities within the Region in 1970. The total land area devoted to commercial and industrial functions within the Region amounted to only 16,556 acres, or 1 percent of the total area of the Region, yet this small area provided the basis for more than 81 percent of the jobs in southeastern Wisconsin in 1970.

Table 57

DISTRIBUTION OF EXISTING LAND USE IN THE REGION BY TYPE: 1970

County	Major Land Use Category																	
	Residential[a]		Commercial		Industrial[b]		Transportation[c]		Governmental[d]		Recreational		Agriculture		Open Lands[e]		Total	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Kenosha	13,477	7.5	504	0.3	811	0.5	8,927	5.0	1,324	0.7	2,672	1.5	113,930	64.0	36,455	20.5	178,100	100.0
Milwaukee	45,632	29.4	2,875	1.9	4,899	3.2	35,431	22.9	7,490	4.8	9,924	6.4	28,607	18.4	20,206	13.0	155,064	100.0
Ozaukee	12,321	8.2	330	0.2	444	0.3	8,054	5.4	940	0.6	1,657	1.1	100,491	67.0	25,776	17.2	150,013	100.0
Racine	16,625	7.6	575	0.3	1,099	0.5	12,442	5.7	1,744	0.8	2,585	1.2	147,207	67.7	35,284	16.2	217,561	100.0
Walworth	13,408	3.6	593	0.2	827	0.2	12,020	3.3	1,192	0.3	4,275	1.2	261,744	70.8	75,923	20.4	369,982	100.0
Washington	11,525	4.1	299	0.1	434	0.2	11,286	4.1	919	0.3	1,664	0.6	186,466	66.9	66,141	23.7	278,734	100.0
Waukesha	43,278	11.6	1,341	0.4	1,525	0.4	21,247	5.7	3,009	0.8	6,219	1.7	201,676	54.3	93,351	25.1	371,646	100.0
Region	156,266	9.1	6,517	0.4	10,039	0.6	109,407	6.3	16,618	1.0	28,996	1.7	1,040,121	60.4	353,136	20.5	1,721,100	100.0

[a] *Includes all residential areas developed and under development.*

[b] *Includes all manufacturing, wholesaling, and storage.*

[c] *Includes off-street parking areas of more than 10 spaces.*

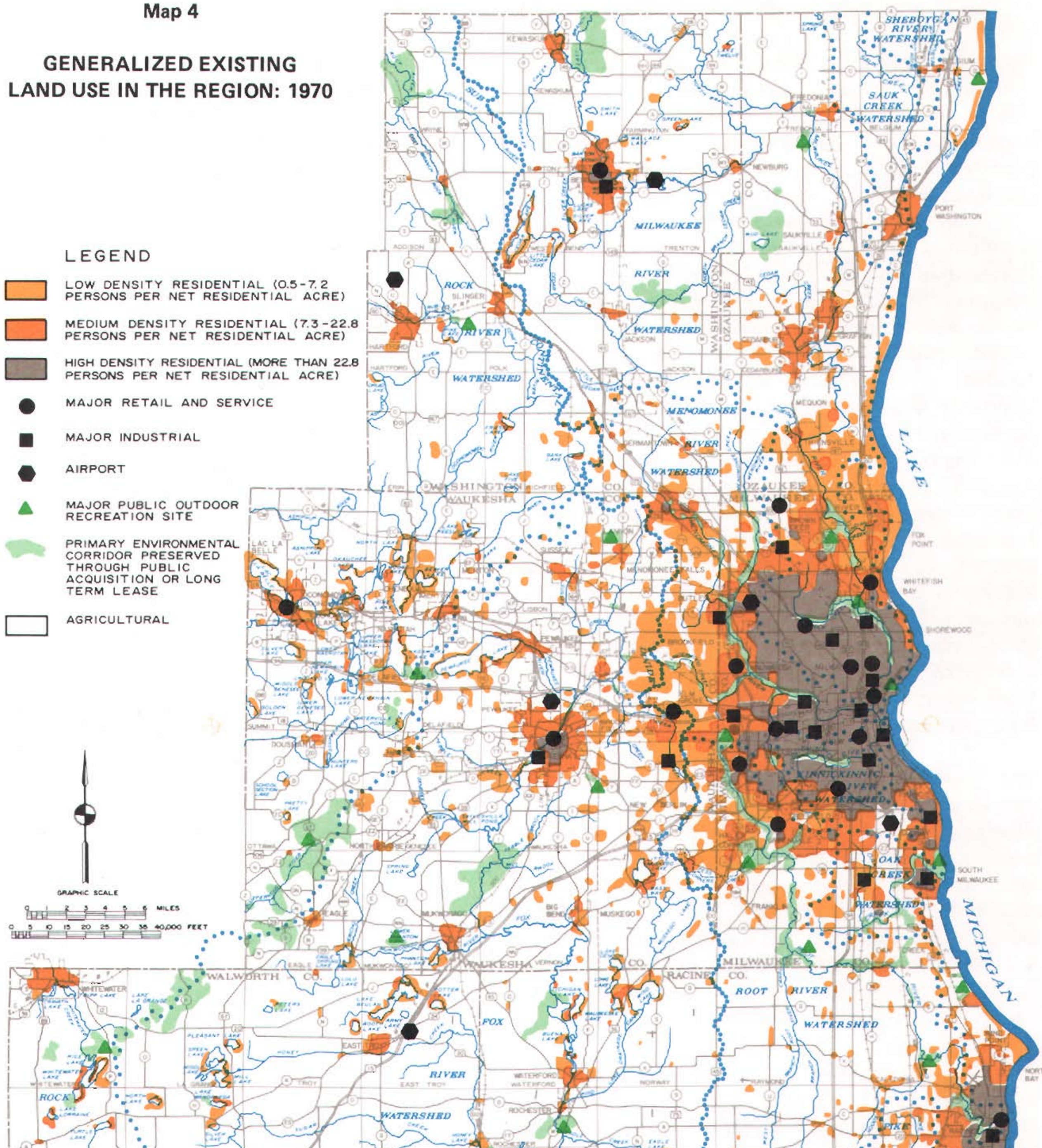
[d] *Includes institutional land uses.*

[e] *Includes woodlands, quarries, water, and wetlands, as well as unused and other open lands.*

Source: SEWRPC.

Map 4

GENERALIZED EXISTING LAND USE IN THE REGION: 1970



This map summarizes the spatial distribution of various land uses existing within the Region as of April 1970. Although southeastern Wisconsin is a highly urbanized region, less than 20 percent of its total area is presently devoted to urban land uses. Agriculture, while declining in economic importance within the Region, still occupies 60 percent of the total land use in the Region, with the remaining 20 percent occupied by water, woodlands, and wetlands.

Source: SEWRPC.

Approximately 80 percent, or about the regional average, of the land area in each county in the Region except Milwaukee County was devoted to nonurban uses in 1970. Less than 32 percent of the land area in Milwaukee County was in agricultural and open uses.

Residential Land Use

Residential land use includes both land actually occupied by a residence and vacant land either under development for residential use or immediately available for such use, such as vacant building sites between existing residences and improved but still vacant residential subdivisions. As shown on Map 5 and in Table 58, Milwaukee and Waukesha Counties together accounted for about 57 percent of the Region's total land area devoted to residential use of 156,266 acres. In addition, a nearly equal amount of land was devoted to residential use in Milwaukee and Waukesha Counties. Kenosha and Ozaukee Counties each accounted for 8 percent of the Region's total residential land area, Racine County accounted for 11 percent, and Walworth and Washington Counties accounted for about 9 and 7 percent, respectively.

Over 56 percent of all residential development in the Region in 1970 was low-density residential development, as shown in Table 58.[6] Medium-density residential land represented 28 percent of all residential development, while high-density residential land accounted for the remaining 16 percent. High-density residential development in southeastern Wisconsin was concentrated in Milwaukee County, which contained 20,876 acres of high-density residential land, or 82 percent of the regional total. Milwaukee County also contained the most medium-density residential lands—13,140 acres, or 30 percent of the regional total. Low-density residential development predominated in the other six counties of the Region, representing half or more than half of all residential land within each of these counties.

Further insight into the residential land use pattern of the Region can be obtained through an analysis of the existing housing stock. There were about 556,900 housing units intended for year-round occupancy in the Region in 1970. Of that total about 327,600, or about 59 percent, were single-family units; about 120,600, or about 22 percent, were two-family units; and about 108,700, or 19 percent, were multiple-family units (see Table 59). Milwaukee County accounted for 63 percent of all housing units in the Region in 1970, including 51 percent of all single-family units, 79 percent of all units in two-unit structures, and 82 percent of all units in structures containing three or more units. Thus, of the total stock of 349,600 units in Milwaukee County, 47 percent were single-family units, 27 percent two-family units, and 26 percent multiple-family units.

As indicated in Table 60, almost one-half of all year-round housing units in the Region in 1970 were constructed prior to 1940. About 59 percent of all occupied housing units in structures containing two or more units were constructed prior to 1940. In contrast, only 37 percent of all occupied single-family housing units in the Region in 1970 were constructed prior to 1940. Of the seven counties in the Region, Milwaukee County contained the largest number of housing units built prior to 1940—about 172,300 housing units, or about two-thirds of all such housing units in the Region and 50 percent of all housing units in Milwaukee County. At the other extreme, Ozaukee County contained only about 5,200 housing units that had been constructed prior to 1940, representing about one-third of its total existing housing stock.

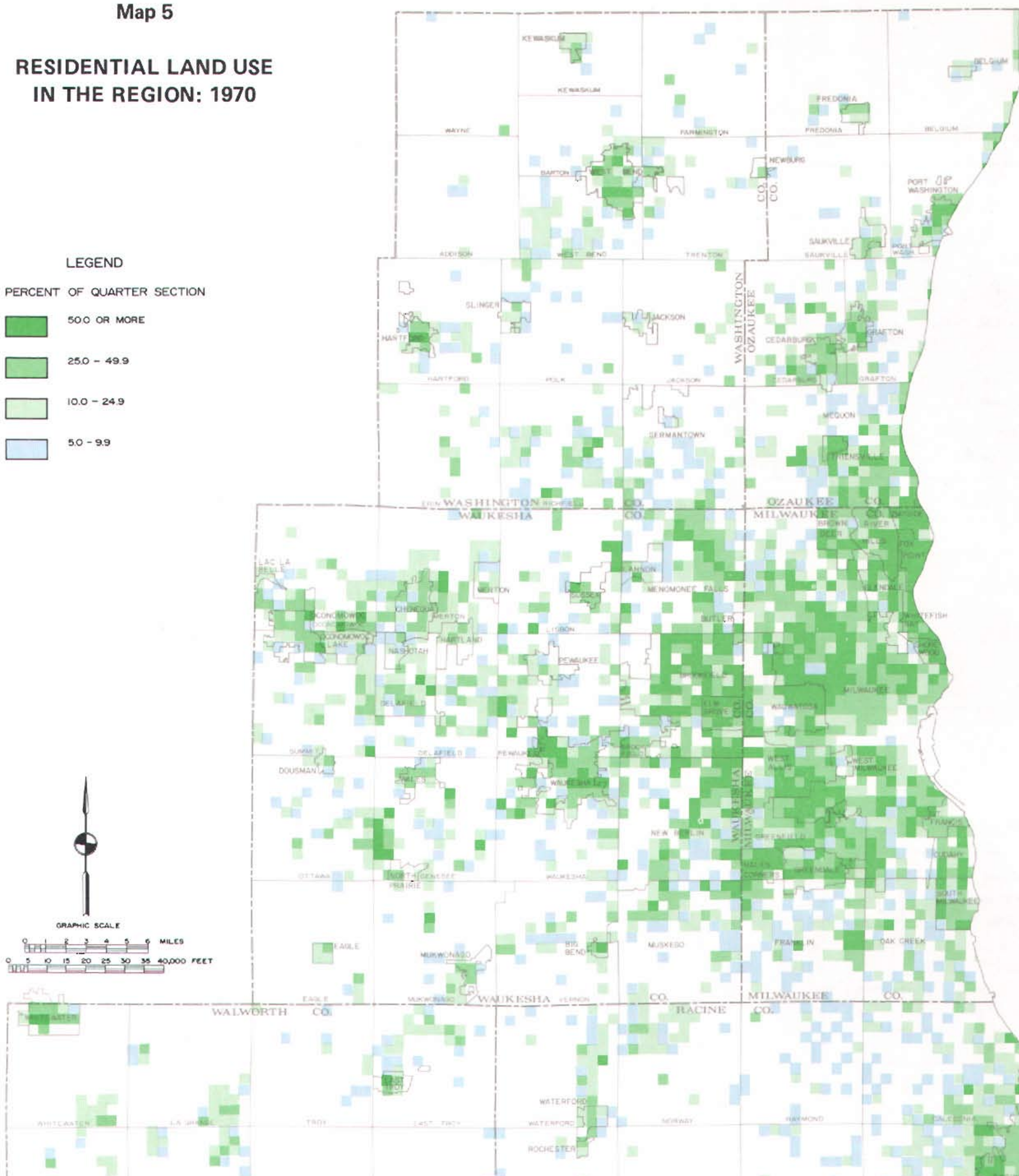
There has been a significant increase in the regional housing stock since 1970. A total of 103,200 residential building permits were authorized by local units of government in the Southeastern Wisconsin Region between 1970 and 1978, including about 49,100 permits for single-family housing units; 6,800 permits for two-family units; and 47,300 for multiple-family units (see Table 61). It should be noted, however, that new construction

[6] *Low-, medium-, and high-density residential classifications may be defined in terms of net or gross area. Net residential area includes only land actually devoted to residential use, excluding all supporting land uses such as local streets, neighborhood parks and playgrounds, elementary schools, and neighborhood institutional and commercial uses. The following residential density classifications are used by the Commission:*

Residential Density Classification	*Dwelling Units per Net Acre*	*Dwelling Units per Gross Square Mile*
Low	*0.2- 2.2*	*105-1,108*
Medium	*2.3- 6.9*	*1,109-3,066*
High	*7.0-17.9*	*3,067-7,599*

Map 5

RESIDENTIAL LAND USE IN THE REGION: 1970



About 156,000 acres, or 48 percent of the total area devoted to urban use within the Region, and 9 percent of the total area of the Region, were developed for residential use in 1970. Single-family detached residences represented the predominant type of residential use, with land devoted to such use comprising about 78 percent of all residential land in the Region, down slightly from 81 percent in 1963. The heavy concentration of residential land use in the Milwaukee, Kenosha, and Racine metropolitan areas is evident on this map. Scattered concentrations of residential use are also apparent in and around long-established urban centers in the outlying areas of the Region, and around the many inland lakes of the Region.

Source: SEWRPC.

Table 58

DISTRIBUTION OF RESIDENTIAL DEVELOPMENT WITHIN THE REGION BY DENSITY CLASSIFICATION: 1970

County	Low-Density		Medium-Density		High-Density	
	Acres	Percent	Acres	Percent	Acres	Percent
Kenosha	6,780	50	5,202	38	1,495	12
Milwaukee	11,616	25	13,140	29	20,876	46
Ozaukee	9,788	79	2,480	20	53	1
Racine.	9,371	56	5,153	31	2,101	13
Walworth.	7,793	58	5,540	41	75	1
Washington	8,029	70	3,362	29	134	1
Waukesha.	34,258	79	8,353	19	667	2
Region	87,635	56	43,230	28	25,401	16

Source: SEWRPC.

Table 59

HOUSING UNITS BY STRUCTURE TYPE IN THE REGION BY COUNTY: 1970

County	Occupied and Vacant Year-Round Housing Units by Structure Type							
	Single-Family[a]		Two-Family		Multiple-Family		Total	
	Number	Percent of Region	Number	Percent of Region	Number	Percent of Region	Number	Percent of Region
Kenosha	27,137	8.3	6,173	5.1	3,854	3.5	37,164	6.7
Milwaukee . . .	165,950	50.6	94,804	78.6	88,912	81.8	349,666	62.8
Ozaukee	12,678	3.9	1,551	1.3	1,051	1.0	15,280	2.7
Racine	36,576	11.2	9,185	7.6	6,305	5.8	52,066	9.4
Walworth. . . .	17,604	5.4	1,866	1.6	1,728	1.6	21,198	3.8
Washington . .	14,087	4.3	2,571	2.1	1,220	1.1	17,878	3.2
Waukesha . . .	53,521	16.3	4,503	3.7	5,668	5.2	63,692	11.4
Region	327,553	100.0	120,653	100.0	108,738	100.0	556,944	100.0

[a] *Includes mobile homes as well as conventional single-family housing.*

Source: U. S. Bureau of the Census.

during this time has been offset by housing unit demolitions. The City of Milwaukee accounts for the majority of residential demolitions which occur within the Region.[7] About 9,500 housing units were demolished in the City of Milwaukee between 1970 and 1978.

Commercial Land Use

Commercial land use includes all retail and service commercial uses, including both local and regional shopping centers, highway-oriented commercial centers, and professional and executive offices, but excluding off-street parking of more than 10 spaces. At the time of the land use inventory in 1970, 6,517 acres of land were devoted to commercial land uses in southeastern Wisconsin. Almost two-thirds of this total was located in Milwaukee and Waukesha Counties (see Table 57). From Map 6, it is evident that commercial development is dependent upon accessibility as well as population concentration. The axial pattern of commercial land use closely approximates the pattern of certain highways as well as of major concentrations of residential land.

[7] *The City of Milwaukee accounted for about 90 percent of all housing unit demolitions in the Region between 1960 and 1969.*

Table 60

HOUSING UNITS BY STRUCTURE TYPE AND AGE IN THE REGION BY COUNTY: 1970

County	Occupancy Status	Structure Type	Year-Round Housing Units by Year of Construction									
			Before 1940		1940-1949		1950-1959		1960-1970		Total	
			Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Kenosha	Occupied	Single-Family	10,064	38.7	3,123	12.0	6,759	26.0	6,077	23.3	26,023	100.0
		Two-or-More Unit. .	6,863	72.7	663	7.0	552	5.8	1,367	14.5	9,445	100.0
	Vacant	--[a]	847	49.9	335	19.8	254	15.0	260	15.3	1,696	100.0
		Total	17,774	47.8	4,121	11.1	7,565	20.4	7,704	20.7	37,164	100.0
Milwaukee	Occupied	Single-Family	64,174	39.2	23,126	14.1	53,687	32.8	22,856	13.9	163,843	100.0
		Two-or-More Unit. .	101,300	58.0	16,650	9.5	23,000	13.2	33,812	19.3	174,762	100.0
	Vacant	--[a]	6,855	62.0	735	6.6	893	8.1	2,578	23.3	11,061	100.0
		Total	172,329	49.3	40,511	11.6	77,580	22.2	59,246	16.9	349,666	100.0
Ozaukee	Occupied	Single-Family	3,450	28.1	1,040	8.4	3,664	29.8	4,140	33.7	12,294	100.0
		Two-or-More Unit. .	1,500	61.0	157	6.4	277	11.3	525	21.3	2,459	100.0
	Vacant	--[a]	211	40.0	41	7.8	44	8.4	231	43.8	527	100.0
		Total	5,161	33.8	1,238	8.1	3,985	26.1	4,896	32.0	15,280	100.0
Racine	Occupied	Single-Family	13,548	38.3	4,399	12.4	9,189	26.0	8,250	23.3	35,386	100.0
		Two-or-More Unit. .	9,418	65.4	886	6.1	726	5.0	3,380	23.5	14,410	100.0
	Vacant	--[a]	1,325	58.4	370	16.3	233	10.2	342	15.1	2,270	100.0
		Total	24,291	46.6	5,655	10.9	10,148	19.5	11,972	23.0	52,066	100.0
Walworth	Occupied	Single-Family	8,456	55.2	1,693	11.0	2,526	16.5	2,656	17.3	15,331	100.0
		Two-or-More Unit. .	2,170	67.5	157	4.9	167	5.2	719	22.4	3,213	100.0
	Vacant	--[a]	1,376	51.8	453	17.1	402	15.2	423	15.9	2,654	100.0
		Total	12,002	56.6	2,303	10.9	3,095	14.6	3,798	17.9	21,198	100.0
Washington	Occupied	Single-Family	5,403	39.3	1,136	8.3	3,100	22.5	4,109	29.9	13,748	100.0
		Two-or-More Unit. .	2,418	66.5	275	7.5	257	7.1	687	18.9	3,637	100.0
	Vacant	--[a]	230	46.6	27	5.5	64	13.0	172	34.9	493	100.0
		Total	8,051	45.0	1,438	8.1	3,421	19.1	4,968	27.8	17,878	100.0
Waukesha	Occupied	Single-Family	13,176	25.1	4,615	8.8	17,509	33.4	17,131	32.7	52,431	100.0
		Two-or-More Unit. .	4,199	44.2	607	6.4	1,301	13.7	3,397	35.7	9,504	100.0
	Vacant	--[a]	649	36.9	212	12.1	207	11.8	689	39.2	1,757	100.0
		Total	18,024	28.3	5,434	8.5	19,017	29.9	21,217	33.3	63,692	100.0
Region	Occupied	Single-Family	118,271	37.1	39,132	12.3	96,434	30.2	65,219	20.4	319,056	100.0
		Two-or-More Unit. .	127,868	58.8	19,395	8.9	26,280	12.1	43,887	20.2	217,430	100.0
	Vacant	--[a]	11,493	56.2	2,173	10.6	2,097	10.3	4,695	22.9	20,458	100.0
		Total	257,632	46.3	60,700	10.9	124,811	22.4	113,801	20.4	556,944	100.0

[a] *The U. S. Bureau of the Census does not provide data classifying vacant housing units simultaneously by age and by structure type.*

Source: U. S. Bureau of the Census.

Table 61

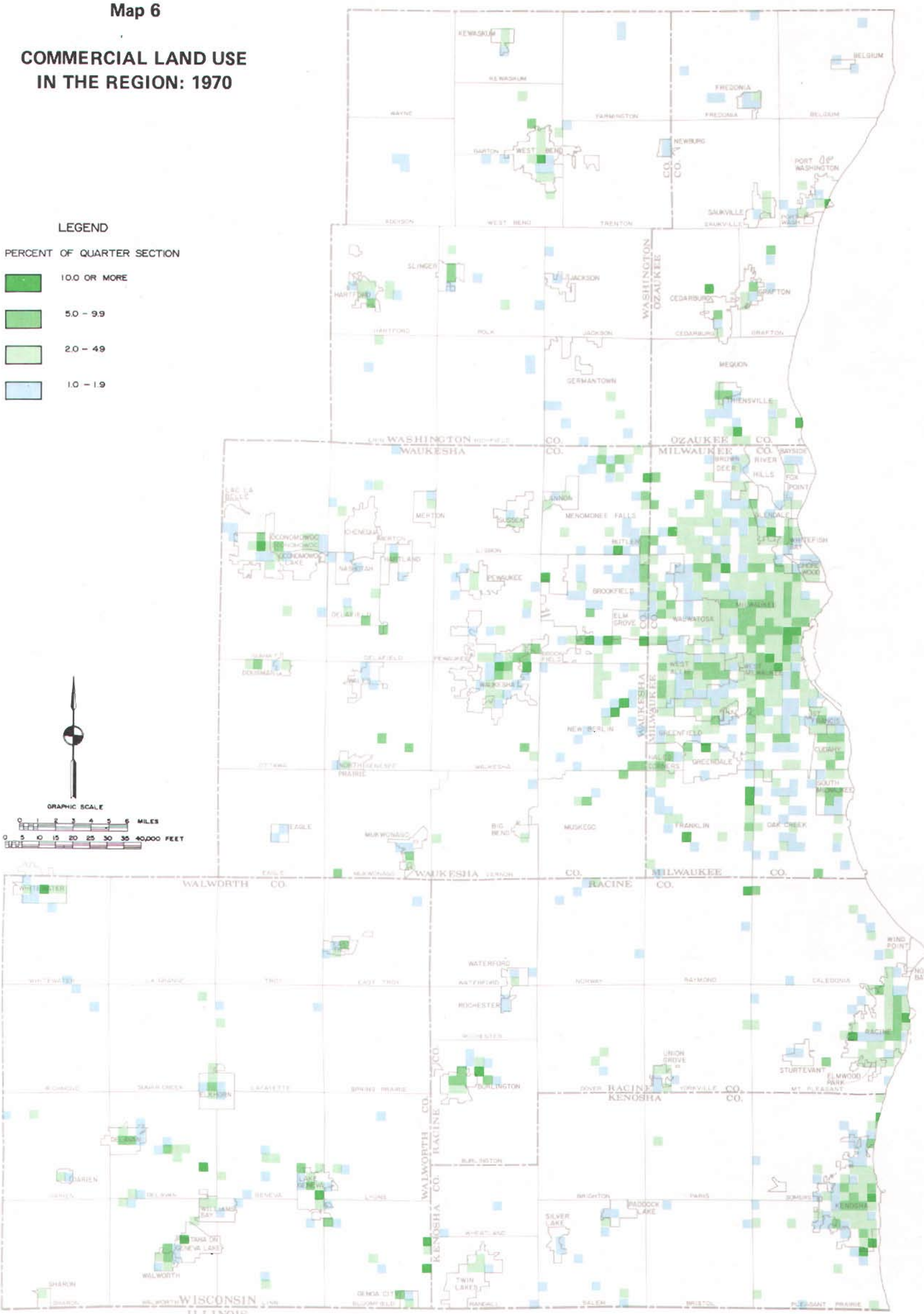
HOUSING UNITS AUTHORIZED FOR CONSTRUCTION BY MINOR CIVIL DIVISIONS IN THE REGION: 1970-1978

County	Authorized Housing Units by Structure Type							
	Single-Family		Two-Family		Multiple-Family		Total	
	Number	Percent of Region	Number	Percent of Region	Number	Percent of Region	Number	Percent of Region
Kenosha	4,460	9.1	390	5.7	3,630	7.7	8,480	8.2
Milwaukee . . .	9,390	19.1	2,740	40.4	26,430	55.8	38,560	37.4
Ozaukee	3,860	7.9	630	9.3	2,200	4.7	6,690	6.5
Racine	5,810	11.8	610	9.0	3,600	7.6	10,020	9.7
Walworth. . . .	3,810	7.8	190	2.8	2,150	4.5	6,150	6.0
Washington . .	5,650	11.5	540	8.0	2,420	5.1	8,610	8.3
Waukesha . . .	16,110	32.8	1,680	24.8	6,910	14.6	24,700	23.9
Region	49,090	100.0	6,780	100.0	47,340	100.0	103,210	100.0

Source: Allied Construction Employers Association, U. S. Bureau of the Census, and SEWRPC.

Map 6

COMMERCIAL LAND USE IN THE REGION: 1970



There were about 6,500 acres of land devoted to commercial uses in southeastern Wisconsin in 1970, or about 2 percent of the total area devoted to urban use and about 0.4 percent of the total area of the Region. This relatively small amount of commercial land serves the needs of a resident population of about 1.8 million persons. About 44 percent of the total of all commercial land in the Region is located in Milwaukee County, with an additional 20 percent located in Waukesha County. From an examination of the above map, it is clear that the location of commercial development is dependent upon proximity to population concentration. The pattern of commercial land use closely approximates the pattern of major concentrations of residential land use.

Source: SEWRPC.

The major retail and service centers of the Region form an important element of commercial land use in the Region, as they support and serve, and may often generate and stimulate, urban development and represent, as a consequence, special transportation needs. Major retail and service centers as defined by the Commission are those retail and service lands within designated community central business districts, strip shopping districts, and shopping centers which meet at least five of the following six criteria: 1) two or more department stores; 2) 10 or more additional retail and service establishments; 3) a combined average annual sales totaling $30 million or more; 4) a combined net site area of 20 acres or more; 5) the attraction of 3,000 shopping trips or more on an average weekday; and 6) accessibility to a population of at least 100,000 in a radius of 10 miles, or within 20 minutes one-way travel time. Of the 12 major retail and service centers in the Region in 1970, eight were located within Milwaukee County.

Industrial Land Use

The industrial land use category includes all manufacturing activities, wholesaling offices, and warehouse and storage areas, but excludes related off-street parking of more than 10 spaces. In 1970 10,039 acres of land were devoted to industrial uses in the Region. Although industrial development constitutes only 0.6 percent of the total area of the Region, the spatial distribution of this land use category is of major importance, since almost 40 percent of the Region's labor force finds employment in these industrial areas. Almost one-half of all industrial land area in southeastern Wisconsin is located in Milwaukee County (see Map 7). According to the map, this concentration is located particularly along the highly industrialized Menomonee River Valley. Concentrations of industrial land are also evident in and around the Cities of Kenosha and Racine and in many outlying communities.

Major industrial centers form an important element of the industrial land use in the Region. Major industrial centers are those which comprise selected contiguous U. S. Public Land Survey quarter sections having 250 acres or more of net industrial land or a minimum of 3,500 industrial employees. Because of their size, these centers have special transportation needs. Twelve of the 17 major industrial centers existing in 1970 in the Region were located in Milwaukee County.

Governmental and Institutional Land Use

In 1970, 16,618 acres of land in southeastern Wisconsin were devoted to governmental and institutional uses, representing 1 percent of the total area of the Region. Governmental and institutional land with a local service orientation, that is, directed toward serving a single community or neighborhood, comprised 5,479 acres, or 33 percent of this land use category. The large balance of governmental and institutional land had a regional orientation; that is, it was directed toward serving more than one community. Such regional uses include colleges and universities, high schools, large central libraries, museums, hospitals, nursing homes, county courthouses, welfare agencies, and military installations. Local uses include elementary schools, churches, branch libraries, and fire stations, as well as city, village, and town halls. The widespread dispersion of governmental and institutional land uses throughout the Region is apparent on Map 8.

Transportation, Communication, and Utility Land Use

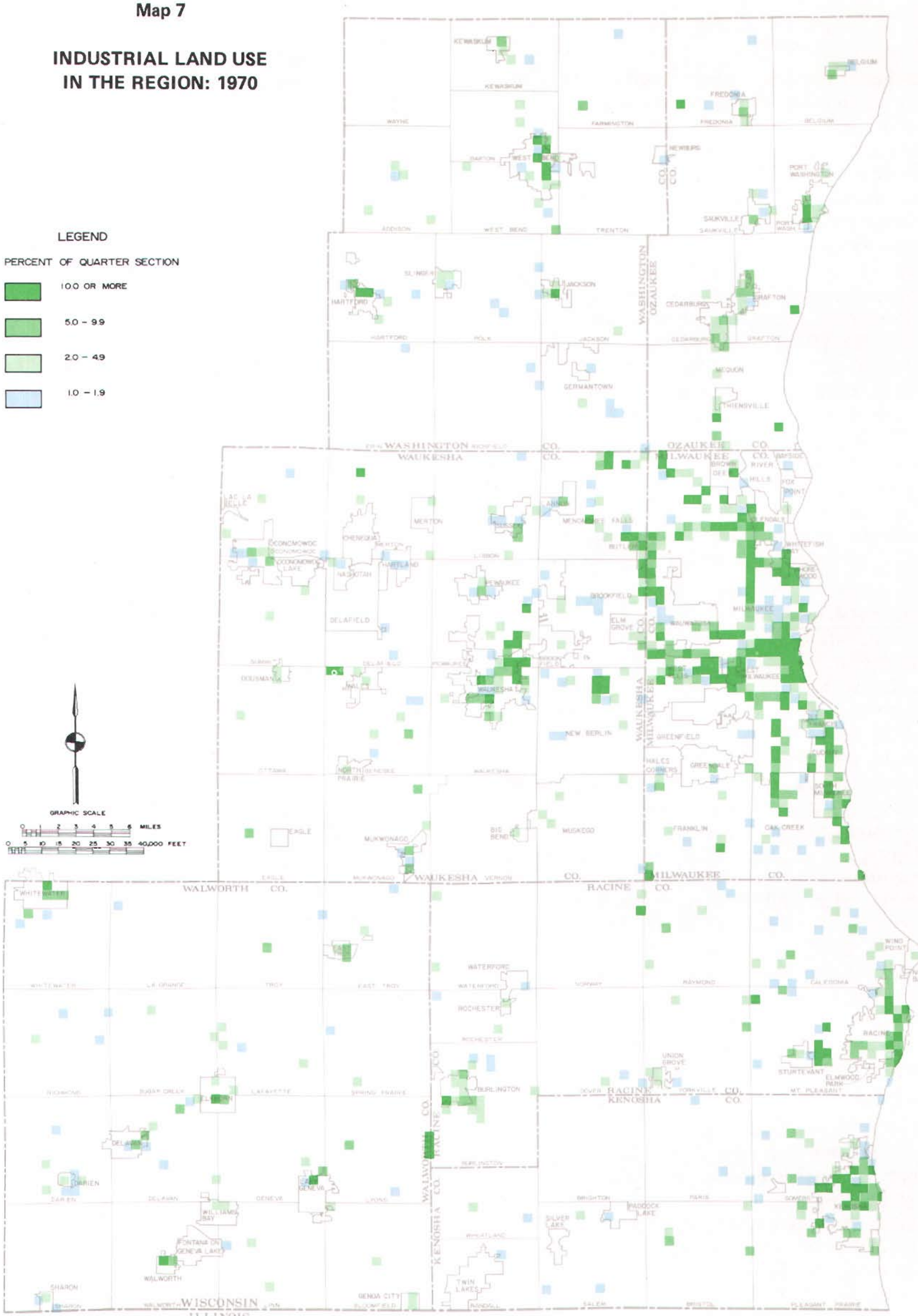
Transportation, communication, and utility land uses include all street and highway rights-of-way; railroad rights-of-way and yards; airport, rail, ship, bus, and truck terminals; communication facilities, such as radio or television stations and transmission towers; utility rights-of-way and plants, such as sewage disposal and water treatment and storage facilities; and off-street parking areas containing more than 10 parking spaces.

Transportation and related activities are inherently large consumers of land. Next to the residential land use category, the transportation, communication, and utility land use category represents the most extensive amount of urban development in the Region. At the time of the regional land use inventory in 1970, a total of 109,407 acres, representing 6 percent of the total land area of the Region, were devoted to transportation, communication, and utility uses. The magnitude of this land use category ranged from a low of 8,054 acres in Ozaukee County to a high of more than 35,000 acres in Milwaukee County (see Table 57).

Because of their supportive nature, lands devoted to transportation, communication, and utility uses are closely associated with urban development, with the greatest concentration occurring in the urban centers. Thus, a relatively large proportion of the land within the largest cities of the Region has been developed for transportation and related

Map 7

INDUSTRIAL LAND USE IN THE REGION: 1970

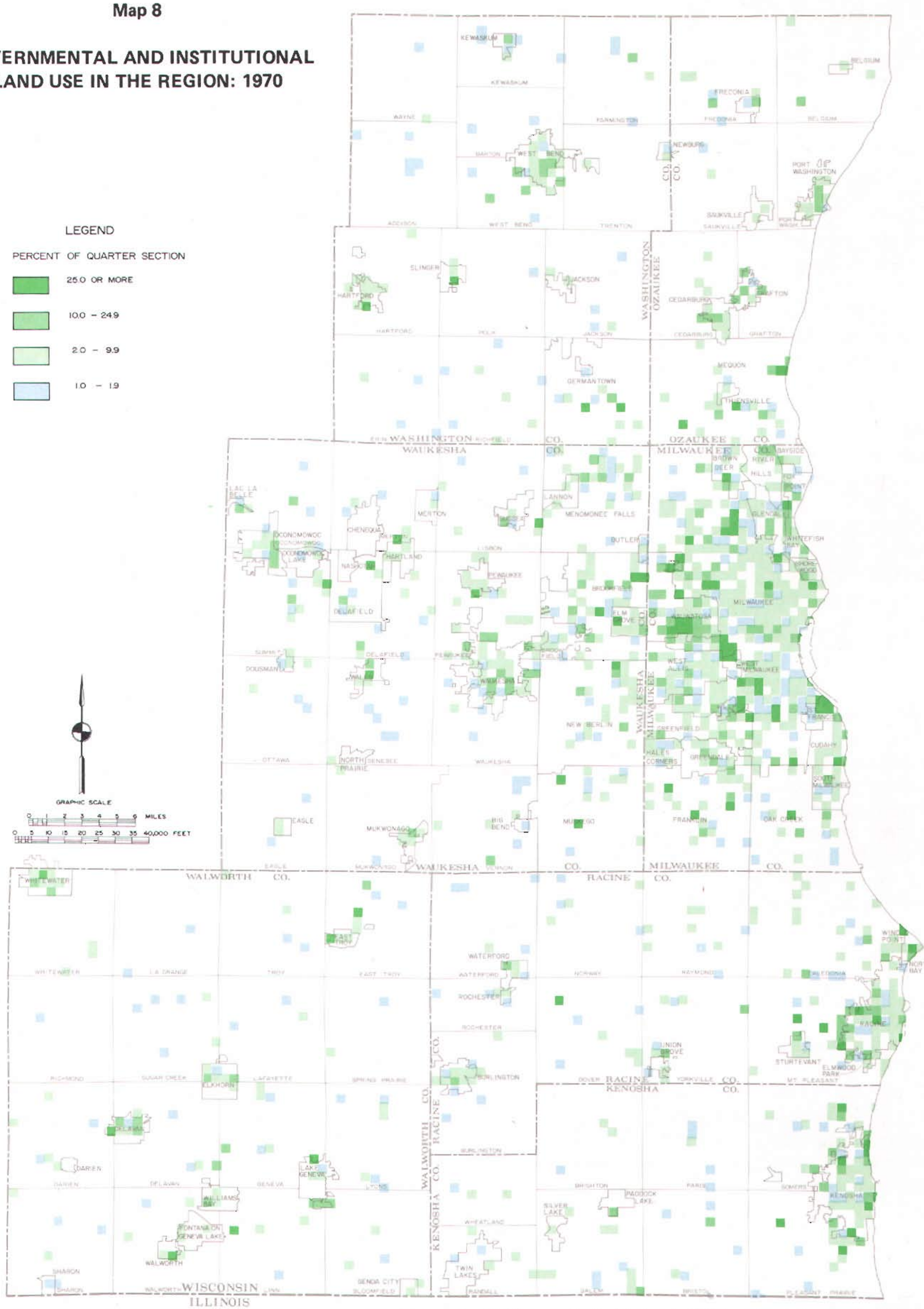


About 10,000 acres of land, or about 3 percent of the total land area devoted to urban use and about 0.6 percent of the total area of the Region, were devoted to industrial land use in 1970. Such uses include manufacturing activities, wholesaling, warehouses, and storage yards. Nearly one-half of all industrial land in the Region is located in Milwaukee County. About 40 percent of the regional labor force in 1970 found employment in the establishments occupying this industrial land.

Source: SEWRPC.

Map 8

GOVERNMENTAL AND INSTITUTIONAL LAND USE IN THE REGION: 1970



Lands devoted to governmental and institutional uses accounted for about 16,600 acres in the Region in 1970, or about 5 percent of the total land area devoted to urban use and about 1 percent of the total area of the Region. While there is a heavy concentration of governmental and institutional land in the major population centers of the Region, the diffused patterns evidenced on the above map indicate that such uses are common in outlying rural portions of the Region as well.

Source: SEWRPC.

purposes: Milwaukee, 32 percent; Racine, 30 percent; and Kenosha, 23 percent. The concentration of transportation, communication, and utility land use in the urban centers of the Region is apparent on Map 9.

Recreational Land Use

Recreational land uses considered as urban lands include playgrounds, parks, golf courses, zoos, campgrounds and picnic areas, and marinas.

The 1970 regional land use inventory reported a total of 28,996 acres of recreational lands in southeastern Wisconsin, representing 2 percent of the total area of the Region. Public recreational areas comprised 13,373 acres, or 46 percent of this total. As indicated on Map 10, major concentrations of recreational lands were located in the Kenosha, Milwaukee, and Racine metropolitan areas as well as in many of the Region's smaller urban centers in 1970. Concentrations of active recreation land are also evident around many lakes, streams, and woodland areas in the outlying parts of the Region.

LAND USE DEVELOPMENT TRENDS SINCE 1970

Urban growth and land use development trends in southeastern Wisconsin since 1970 can be established for residential land use to the year 1978 through the Commission's annual inventory of residential subdivision development platting activity, and for all urban land use growth in the Region to the year 1975 through the Commission's most recently conducted comprehensive inventory of land use in the Region.

Residential Land Development Trends Since 1970

Residential lands represent the largest proportion of all urban land uses, accounting for about 156,300 acres of urban land, or nearly 50 percent of all urban land in the Region, in 1970 and almost 10 percent of all urban and rural land in the Region. Residential land use development trends, therefore, provide a good indication of the trends in all urban development. The Commission's continuing historic residential land subdivision activity inventory,[8] which consists of an annual accounting of residential subdivision tract development plats required under state law to be filed by all developers, provides a sound basis for evaluating recent residential land development trends in the Region.

The Commission's inventories indicate that between 1970 and 1978, a total of about 29,500 acres of land in the Region, or about 46 square miles, were platted for future residential use. These platted lands represent a gross residential area including, in addition to the lots for residential use, all land to be developed in residential subdivisions, along with collector and local streets; drainageways; and neighborhood parks. The eventual development of the residential subdivisions platted between 1970 and 1978 will result in a significant increase in the supply of residential and other urban lands in the Region.

As indicated in Table 62, of the 29,495 acres of land platted for residential use in the Region between 1970 and 1978, 12,452 acres, or 42 percent, were proposed to be served by public centralized sanitary sewerage facilities, while the balance of 17,043 acres, or 58 percent, was proposed to be unsewered. Because of the higher density inherent in sewered development, the number of sewered lots proposed on the platted lands exceeded the number of unsewered lots. Thus, 25,002 lots, or 70 percent of the 35,745 lots created through subdivision platting in the Region between 1970 and 1978, were proposed to be sewered.

As shown in Table 62 and on Map 11, of the seven counties in the Region, the highest level of residential subdivision platting activity between 1970 and 1978 occurred in Waukesha County, where almost 16,400 acres of land were platted for residential development. The heaviest concentration of platting activity was located in the southwestern quadrant of the County. Only 31 percent of the subdivision area platted in the County, or 5,074 acres, was platted for sewered development which, as already noted, generally provides a higher density of development than does unsewered development. The new sewered development was almost exclusively located in the eastern half of Waukesha County, adjacent to Milwaukee County.

In Washington County, more than 4,000 acres of land use were platted for residential development between 1970 and 1978. The vast majority of this new development, 80 percent, was proposed to be unsewered and was widely scattered throughout the County.

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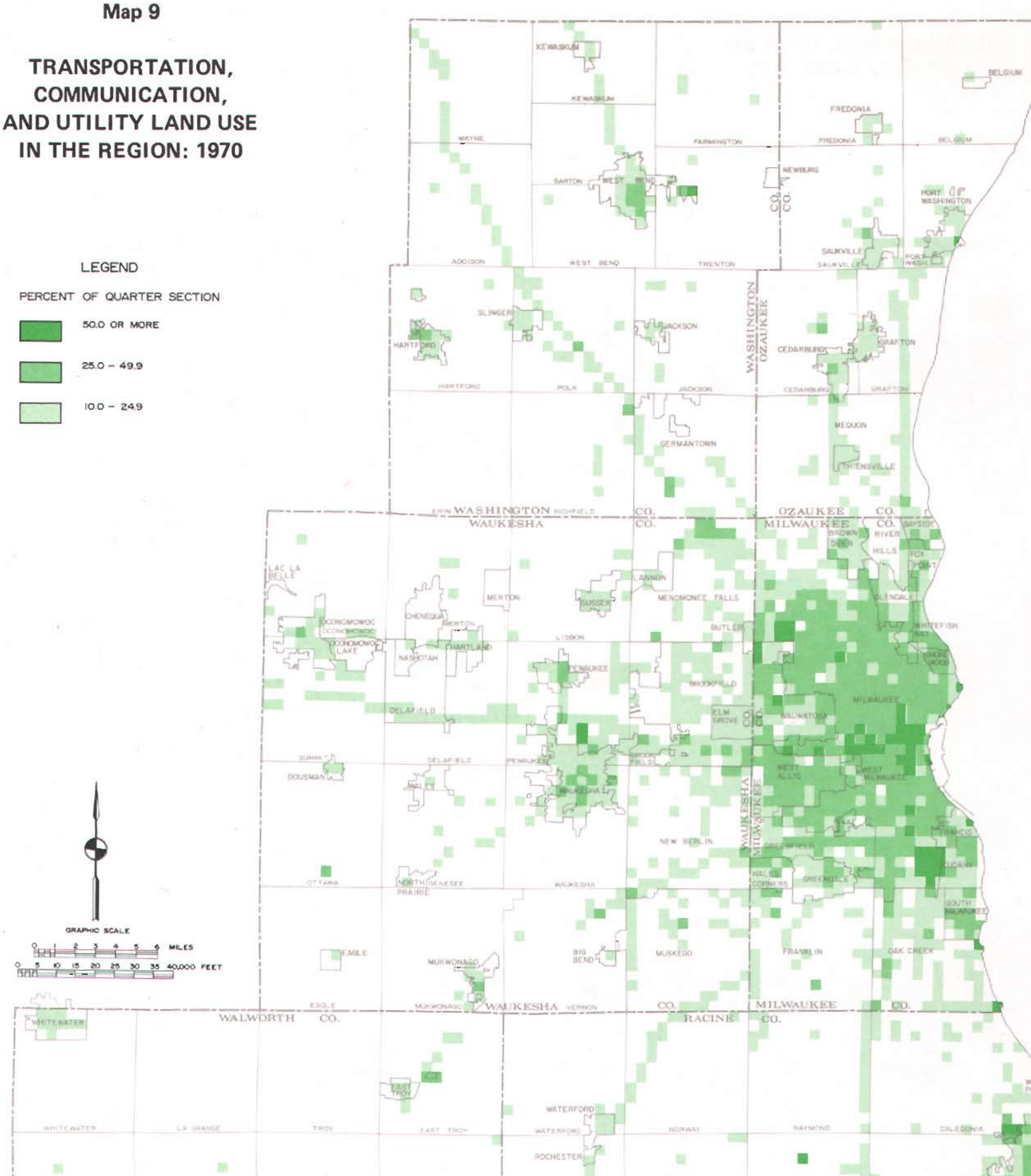
[8] *See SEWRPC Technical Report No. 9, Residential Land Subdivision in Southeastern Wisconsin, 1971.*

Map 9

TRANSPORTATION, COMMUNICATION, AND UTILITY LAND USE IN THE REGION: 1970

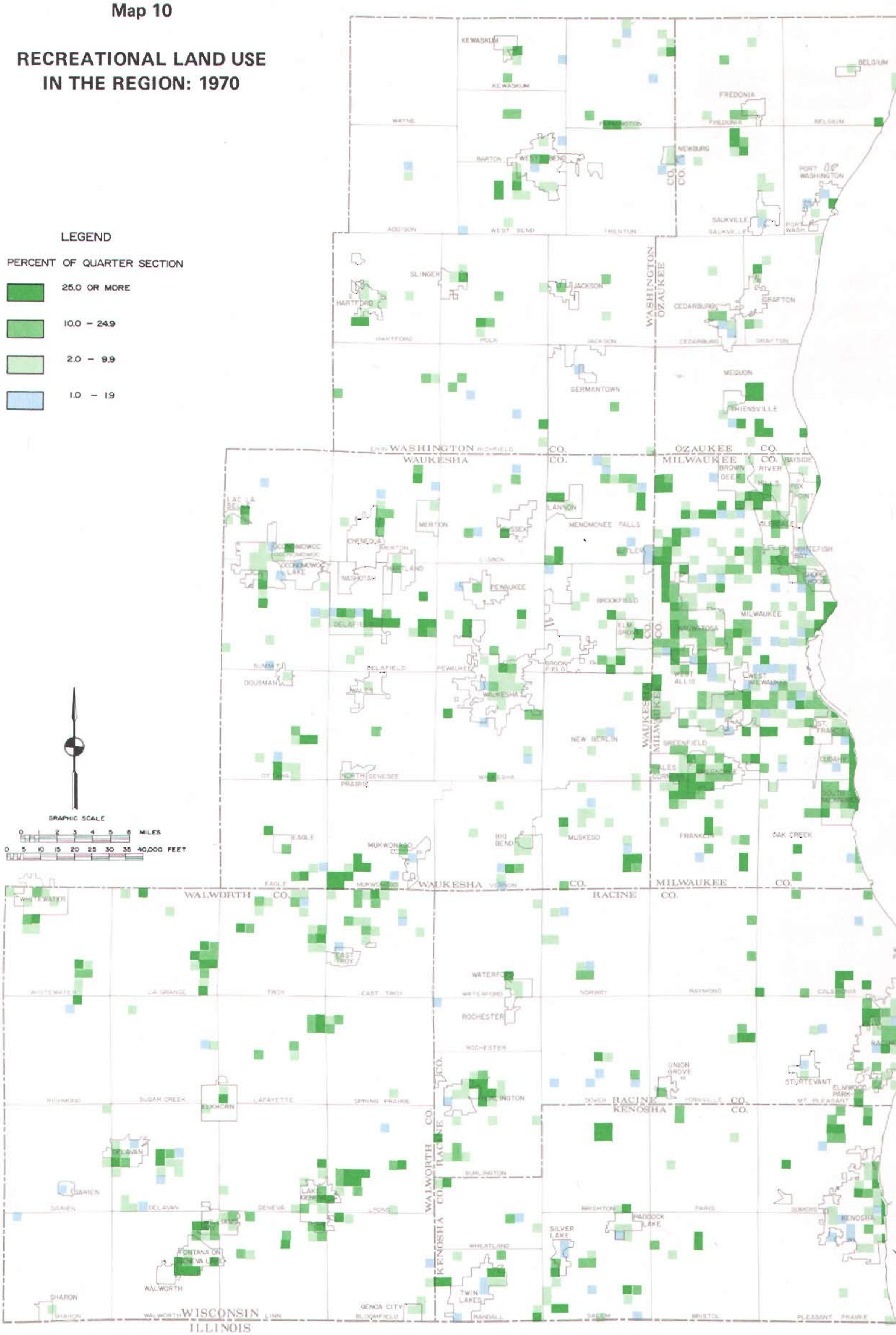


Transportation and related land uses are inherently large consumers of land. Next to the residential land use category, the transportation, communication, and utility land use category represents the most extensive amount of urban development in the Region. At the time of the regional land use inventory in 1970, about 109,400 acres of land, representing about 33 percent of the total land area devoted to urban use and about 6 percent of the total area of the Region, were devoted to transportation, communication, and utility uses. Because of their supportive nature, lands devoted to transportation, communication, and utility uses are closely associated with other urban land uses, with the greatest concentration occurring in the urban centers of the Region.

Source: SEWRPC.

Map 10

RECREATIONAL LAND USE IN THE REGION: 1970



There were about 29,000 acres of land devoted to active recreational use within the Region in 1970. This represents nearly 2 percent of the total area of the Region. Major concentrations of active recreational land are found in the Kenosha, Milwaukee, and Racine metropolitan areas, as well as in many of the Region's smaller urban centers. Concentrations of active recreational land are also evident around and along many lakes and streams and the outlying, more rural portions of the Region.

Source: SEWRPC.

Table 62

RESIDENTIAL PLATTING ACTIVITY IN THE REGION BY COUNTY: 1970-1978

County	Total Subdivisions 1970-1978			Subdivision Area 1970-1978[a]						Total Lots					
				Sewered		Unsewered		Total		Sewered		Unsewered		Total	
	Sewered	Unsewered	Total	Acres	Percent	Acres	Percent	Acres	Percent	Number	Percent	Number	Percent	Number	Percent
Kenosha	64	8	72	809	81	185	19	994	100	1,957	92	160	8	2,117	100
Milwaukee . . .	249	3	252	2,951	99	40	1	2,991	100	6,292	99	76	1	6,368	100
Ozaukee	73	10	83	979	73	355	27	1,334	100	1,847	91	193	9	2,040	100
Racine	97	7	104	1,532	86	237	14	1,769	100	3,153	94	191	6	3,344	100
Walworth. . . .	30	54	84	275	15	1,560	85	1,835	100	622	37	1,065	63	1,687	100
Washington . .	51	94	145	832	20	3,347	80	4,179	100	1,960	49	2,017	51	3,977	100
Waukesha . . .	182	225	407	5,074	31	11,319	69	16,393	100	9,171	57	7,041	43	16,212	100
Region	746	401	1,147	12,452	42	17,043	58	29,495	100	25,002	70	10,743	30	35,745	100

[a] *Includes all residential subdivision acreage, including local streets, utilities, and open space.*

Source: SEWRPC.

In Milwaukee County, almost 3,000 acres of land were platted for future residential use. Virtually all of these platted lands were proposed to be sewered. Most of the proposed subdivisions were located in the extreme northern and southern portions of the County. Subdivisions platted in Milwaukee County were typically small in area, reflecting the fact that many subdivisions are of an "in-fill" nature, providing for the development of the remaining parcels of vacant land within a highly developed urban area.

More than 1,800 acres were platted within Walworth County, all primarily for unsewered residential development scattered throughout the County, but generally concentrated in the northern part of the County. In Ozaukee County, the residential platting activity was primarily centered on existing municipalities having public centralized sanitary sewerage facilities. Consequently, more than 70 percent of all land platted for residential development in the County between 1970 and 1978 was proposed to be sewered. In Kenosha County about 800 acres of sewered residential development were platted from 1970 to 1978, principally around the fringes of the City of Kenosha. About 200 acres of unsewered residential development were platted in the same period in the far southwestern portion of the County. In Racine County about 1,500 acres of sewered residential development were platted from 1970 to 1978 on the northern fringe of the City of Racine and in small communities in the western portion of the County. Unsewered residential development in Racine County since 1970 was limited to about 200 acres in the far western portion of the County.

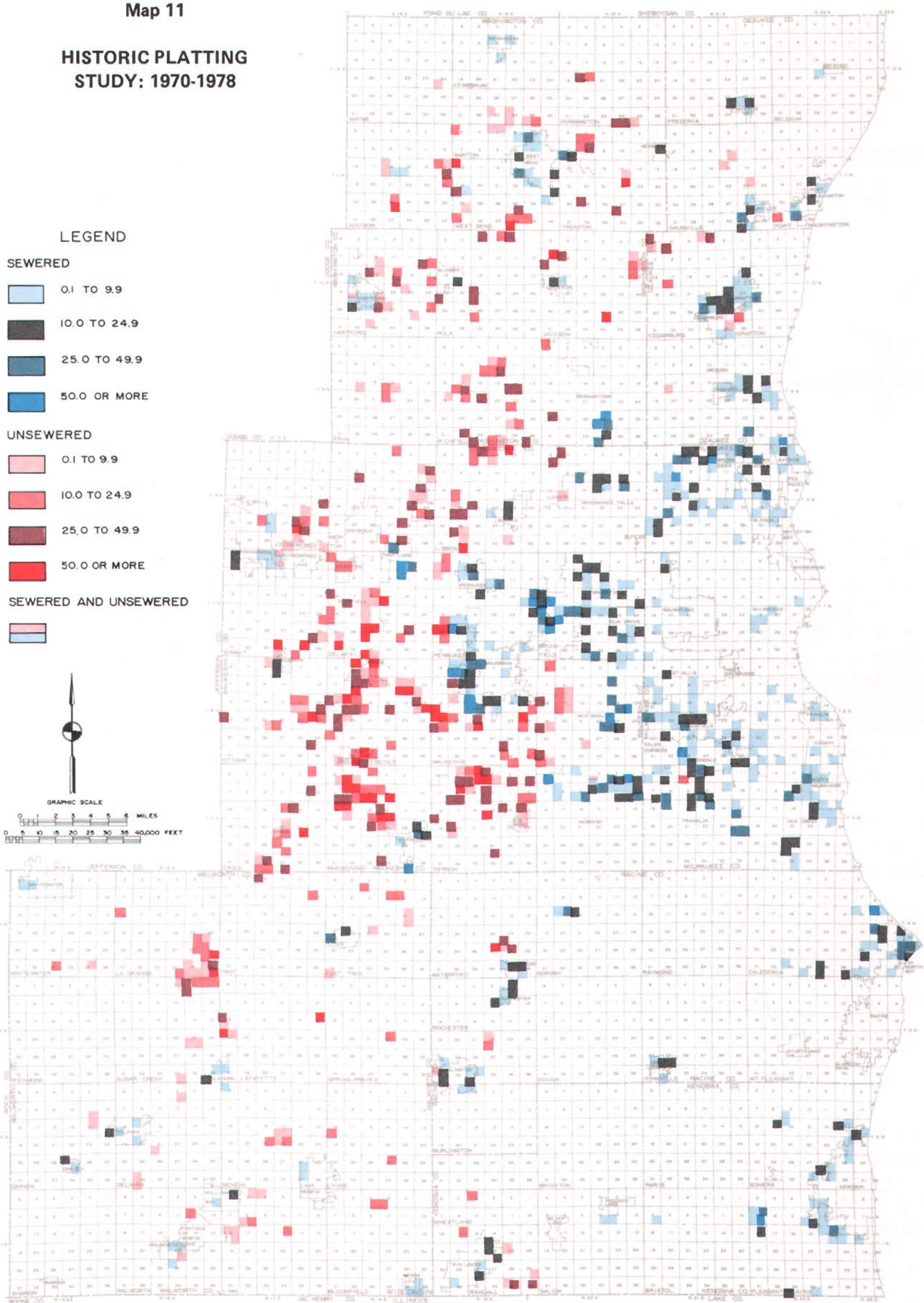
In order to further assess the recent trend in residential subdivision platting activity in the Region, the record of platting activity for the period from 1970 to 1978 was compared with the record for the period from 1957 to 1969 (see Table 63). The pattern in residential subdivision platting activity between 1970 and 1978 shows significant differences from the pattern observed between 1957 and 1969. While similar amounts of land were platted for residential development during the respective periods, the rate of platting activity—expressed as the average land area platted for residential use each year—differs. Thus, between 1957 and 1969, an average of 2,300 acres were platted per year, compared to a rate of 3,300 acres per year from 1970 to 1978. Moreover, the proportion of the platted land area proposed to be served by public sanitary sewerage facilities declined from 60 percent between 1957 and 1969 to 42 percent between 1970 and 1978. Similarly, the proportion of platted lots proposed to be sewered declined from 78 percent between 1957 and 1969 to 70 percent between 1970 and 1978. Based upon this comparison, it may be concluded that the development of lands platted between 1970 and 1978 will contribute to the proliferation of scattered unsewered residential development which occurred in the Region prior to 1970.

Historic Urban Growth

Since 1970, urban development has occurred both in locations adjacent to existing urban development and in outlying rural areas, considerably removed from existing urban centers. Scattered low-density residential development between 1970 and 1975 was especially prevalent in Waukesha County.

Map 11

HISTORIC PLATTING STUDY: 1970-1978



Of the seven counties in the Region, the highest level of residential subdivision platting activity between 1970 and 1978 occurred in Waukesha County, where almost 16,400 acres of land were platted for residential development. The platting activity in Washington County, 4,000 acres between 1970 and 1978, was widely scattered throughout the County. In Milwaukee County, almost 3,000 acres of land were platted for future residential use. Subdivisions platted in Milwaukee County were typically small in area, reflecting the fact that many subdivisions are of an "in-fill" nature, providing for the development of the remaining parcels of vacant land within a highly developed urban area. Within Walworth County, more than 1,800 acres were platted. In Ozaukee County, the residential platting activity was primarily centered on existing municipalities. In Kenosha County, about 800 acres of residential development were platted, principally around the fringes of the City of Kenosha. In Racine County, about 1,500 acres of residential development were platted on the northern fringe of the City of Racine. It may be concluded from this map that the development of lands platted between 1970 and 1978 will contribute to the proliferation of scattered unsewered residential development throughout much of the Region.

Source: SEWRPC.

Table 63

RESIDENTIAL PLATTING ACTIVITY IN THE REGION: 1957-1969 AND 1970-1978

Time Period	Total Subdivisions			Subdivision Area						Total Lots					
				Sewered		Unsewered		Total		Sewered		Unsewered		Total	
	Sewered	Unsewered	Total	Acres	Percent	Acres	Percent	Acres	Percent	Number	Percent	Number	Percent	Number	Percent
1957-1969	1,205	412	1,617	18,005	60	12,046	40	30,051	100	44,804	78	12,782	22	57,586	100
1970-1978	746	401	1,147	12,452	42	17,043	58	29,495	100	25,002	70	10,743	30	35,745	100

Source: SEWRPC.

The overall trend established within the Region in the 1950's of diffused, low-density urban development and attendant declining overall urban population densities appears to be continuing, although at a substantially reduced rate. The continued decline in the urban population density may be attributed in part to the decline being experienced in the resident population of Milwaukee County at a time when the amount of land devoted to urban use continues to increase and in part to continued low-density development in some outlying areas of the Region.

SUMMARY

This chapter has presented information concerning historical land development in the Region, and on the type, intensity, and spatial distribution of existing land use development within southeastern Wisconsin relevant to transit system planning. The information presented is particularly important to the study because of the relationship which exists between land use and transportation.

Population growth and urban development within the Region dramatically increased in the 20-year period from 1950 to 1970, and has taken on a highly diffused pattern spreading outward from the older central cities into the area's once far-removed rural communities. Between 1963 and 1970, the amount of land devoted to urban use within the Region increased by 17 percent, significantly exceeding the 6 percent increase in urban population over the same period. This increased urban development was accompanied by a marked reduction in the population density of the developed older cities of the Region. This trend was strongest during the period from 1950 to 1963, when the population density of the developed urban areas of the Region declined from 8,544 persons per square mile to 4,807 persons per square mile. The annual decline in urban population density over this period approximated 3 percent, or about 288 persons per square mile. Since 1963 the rate of decline has slowed to an annual reduction of about 1 percent, or about 65 persons per square mile. The population density of the developed urban area of the Region had declined to 4,355 persons per square mile by 1970.

In 1970 the urban land use type occupying the greatest area was residential land, which accounted for approximately 156,266 acres, or 9 percent of the total area of the Region. This land accommodated a total of about 557,000 year-round housing units in the Region in 1970. Land uses for transportation, communications, and utilities accounted for 109,407 acres, or 6 percent of the total area. Total land area devoted to commercial and industrial uses amounted to only 16,566 acres, or 1 percent of the total area of the Region, yet supported over 80 percent of the jobs in the Region. Recreational land uses accounted for 28,996 acres in 1970, or 2 percent of the total area of the Region. And finally, governmental and institutional land uses occupied 16,618 acres in 1970, or 1 percent of the total area of the Region. Approximately 1.4 million acres, or the remaining 81 percent of the total area of the Region, were devoted to nonurban land uses in 1970.

Between 1970 and 1978, a total of 29,500 acres of land in the Region, or about 46 square miles, were platted for future residential use. Nearly 58 percent of the land platted was proposed to be unsewered. Over one-half of the land platted was located in Waukesha County and nearly 70 percent of this residential land was proposed to be unsewered. In Milwaukee County, almost 3,000 acres of land were platted for future residential use. Virtually all of these lands were proposed to be sewered, and most of the proposed subdivisions were located in the extreme northern and southern portions of the County. Subdivisions platted in Milwaukee County were typically small in area, reflecting the fact that many subdivisions are of an "in-fill" nature, providing for the development of the remaining parcels of vacant land within a highly developed urban area.

In order to further assess the recent trend in residential subdivision platting activity in the Region, the record of platting activity for the period from 1970 to 1978 was compared with the record for the period from 1957 to 1969. This comparison indicates that substantial development of lands platted between 1970 and 1978 will contribute to, and perhaps accelerate, the diffusion of unsewered, low-density residential development which occurred in the Region prior to 1970.

Since 1970, actual urban development has occurred both in locations adjacent to existing urban development and in outlying rural areas, considerably removed from existing urban centers. Scattered low-density residential development was especially evident between 1970 and 1975 in Waukesha County. The overall regional trend established in the 1950's of declining urban population density appears to have leveled off substantially from a rate of 3 percent per year, or about 288 persons per square mile per year, between 1950 and 1963, to a rate of 1 percent per year, or about 65 persons per square mile per year, between 1963 and 1970. An estimated slight decline in the regional average urban density may be attributed to the decline in population in Milwaukee County at a time when the amount of land devoted to urban use continues to increase. Urban population densities within the other six counties of the Region remained basically unchanged or actually increased slightly between 1970 and 1975.

Chapter IV

THE NATURAL RESOURCE AND PUBLIC UTILITY BASE OF THE REGION

INTRODUCTION

The natural resources of an area are vital to its economic development and its ability to provide a pleasant and habitable environment for human life. Natural resources not only condition, but are conditioned by, regional growth and development. Any meaningful regional land use and transportation planning effort must, therefore, recognize the existence of a limited natural resource base to which urban and rural development must be properly adjusted if serious environmental problems are to be avoided.

The principal elements of the natural resource base of the Region are the climate, air, physiography, geology, soils, mineral and organic resources, surface water resources and associated shorelands and floodlands, groundwater resources and associated recharge areas, woodlands, wetlands, and fish and wildlife habitat areas. Existing and potential scenic, historic, and recreational-related open space sites, while not strictly a part of the natural resource base, are closely linked to the underlying resource base, and are therefore considered in this chapter along with that base.

Without a proper understanding and recognition of these elements and of the interrelationships which exist between them, human use and alteration of the natural environment proceeds at the risk of excessive costs in terms of both monetary expenditures and environmental degradation. The natural resource base is subject to grave misuse through improper land use and transportation facility development. Such misuse may lead to severe environmental problems which are difficult and costly to correct, and to the deterioration and destruction of the natural resource base itself. Intelligent selection of the most desirable transportation plan from among the alternatives available must, therefore, be based in part upon a careful assessment of the effects of each plan upon the supporting natural resource base.

Public utility systems are one of the most important and permanent elements influencing regional growth and development. Moreover, certain utility facilities are closely linked to the surface water and groundwater resources of the Region and may, therefore, affect the overall quality of the regional natural resource base. This is particularly true of sanitary sewerage, water supply, and storm water drainage facilities, which are in a sense modifications of, or extensions to, the natural lake, stream, and watercourse system of the Region and of the underlying groundwater reservoir. Knowledge of the location and capacities of these utilities is, therefore, essential to intelligent land use and transportation planning. Because the public utility systems are so closely linked to the natural resource base, these systems are considered together with that base.

The necessary inventories of the natural resource and public utility base of the Region have been conducted under various Commission planning programs, and the methodology and findings of these inventories are fully documented in previous Commission publications.[1] This chapter presents in summary form the findings of these inventories pertinent to land use and primary transit system planning.

[1] *See SEWRPC Planning Reports No. 5, The Natural Resources of Southeastern Wisconsin, No. 6, The Public Utilities of Southeastern Wisconsin, No. 7, The Regional Land Use-Transportation Study, No. 8, Soils of Southeastern Wisconsin, No. 9, A Comprehensive Plan for the Root River Watershed, No. 12, A Comprehensive Plan for the Fox River Watershed, No. 16, A Regional Sanitary Sewerage System Plan for Southeastern Wisconsin, No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, No. 26, A Comprehensive Plan for the Menomonee River Watershed, No. 27, A Regional Park and Open Space Plan for Southeastern Wisconsin: 2000, and No. 32, A Comprehensive Plan for the Kinnickinnic River Watershed; SEWRPC Technical Reports No. 1, Potential Parks and Related Open Spaces, No. 2, Water Law in Southeastern Wisconsin, No. 4, Water Quality and Flow of Streams in Southeastern Wisconsin, No. 17, Water Quality of Lakes and Streams in Southeastern Wisconsin: 1964-1975, and No. 21, Sources of Water Pollution in Southeastern Wisconsin: 1975; and SEWRPC Planning Guides No. 5, Floodland and Shoreland Development Guide, and No. 6, Soils Development Guide.*

CLIMATE[2]

Climate, especially the extreme variations in the three principal elements of climate—temperature, precipitation, and snow cover—directly affects the growth and development of an area. Climate determines to a large extent the recreational interests and pursuits that can be followed by residents of an area and has important economic implications. Rainfall, temperature, and snow cover affect the design of transit vehicles, guideways, and appurtenant structures such as stations and shelters, and the cost of operating transit facilities. These factors also affect the use of transit facilities and services, and the need for and type of feeder service required to access primary facilities.

General Climatic Conditions

Wisconsin's mid-continent location, far removed from the moderating effect of the oceans, gives the Region a typical continental-type climate characterized primarily by a continuous progression of markedly different seasons and a large range in annual temperature. Low temperatures during the long, cold winter are accentuated by prevailing frigid northwesterly winds, while summer high temperatures are reinforced by the warm southwesterly winds common during that season.

The Southeastern Wisconsin Region is positioned astride cyclonic storm tracks along which low pressure centers move from the west and southwest. The Region also lies in the path of high pressure centers moving in a generally southeasterly direction. This location at the confluence of major migratory air masses results in the Region as a whole being influenced by a continuously changing pattern of different air masses having alternately low and high pressure centers, and results in frequent weather changes being superimposed on the aforementioned large annual range in weather characteristics, particularly in winter and spring when distinct weather changes normally occur at least once every two or three days. These temporal weather changes consist of marked temperature variations, as well as variations in the type and amount of precipitation, relative humidity, wind magnitude and direction, and cloud cover.

Because of its proximity to Lake Michigan, the Region also exhibits spatial variations in weather, particularly during the spring, summer, and fall when the temperature differential between the lake water and the land air masses tends to be the greatest. During these periods, the presence of the lake tends to moderate the climate of the eastern border of the Region.

Temperature

Data for six selected temperature observation stations in southeastern Wisconsin, three of which—Port Washington, Milwaukee, and Kenosha—are located at the Lake Michigan shoreline and three of which—West Bend, Waukesha, and Lake Geneva—are located at least 15 miles inland, are presented in Table 64 and in Figure 12. These data, which encompass periods of record ranging from 10 to 30 years for the various observations, indicate the temporal and spatial variations in temperature and the temperature ranges which may be expected to occur within the Region. The temperature data also illustrate how regional air temperatures lag approximately one month behind summer and winter solstices during the annual cycle, with the result being that July is the warmest month in southeastern Wisconsin and January the coldest.

The effects of Lake Michigan are also indicated by these data when comparisons are made between inland and shoreland observation stations that have the same latitude; that is, are generally located along the same east-west line so as to eliminate temperature effects attributable to latitude. It is also possible to identify latitudinal temperature effects by comparing data for observation stations generally located along the same longitudinal, or north-south, line.

Precipitation

Precipitation within the Region takes the form of rain, sleet, hail, and snow. It ranges from gentle showers of trace quantities to destructive thunderstorms, as well as major rainfall-snowmelt events causing property and crop damage, inundation of poorly drained areas, and stream flooding.

Precipitation and snowfall data for six representative precipitation observation stations in southeastern Wisconsin located on the Lake Michigan shoreline at Port Washington, Milwaukee,

[2] *Unless otherwise indicated, climatic and weather descriptions and data presented herein are based on information extracted from publications of the National Weather Service, U. S. Department of Commerce, formerly known as the Weather Bureau, U. S. Department of Commerce.*

Table 64

TEMPERATURE CHARACTERISTICS AT SELECTED LOCATIONS IN THE REGION

	Observation Station[a]																			
	Lakeshore Location									Inland Location										
	Port Washington Period of Record: 1961-1970			Milwaukee Period of Record: 1931-1960			Kenosha Period of Record: 1945-1959			West Bend Period of Record: 1930-1959			Waukesha Period of Record: 1930-1959			Lake Geneva Period of Record: 1945-1959			Regional Summary			
Month	Average Daily Maximum[b]	Average Daily Minimum[b]	Mean[c]	Average Daily Maximum[b]	Average Daily Minimum[b]	Mean[c]	Average Daily Maximum[b]	Average Daily Minimum[b]	Mean[c]	Average Daily Maximum[b]	Average Daily Minimum[b]	Mean[c]	Average Daily Maximum[b]	Average Daily Minimum[b]	Mean[c]	Average Daily Maximum[b]	Average Daily Minimum[b]	Mean[c]	Average Daily Maximum[d]	Average Daily Minimum[d]	Mean[e]	Month
January	26.1	10.1	18.1	28.3	12.8	20.6	31.4	14.9	23.2	28.6	11.7	20.2	29.0	12.3	20.7	29.8	13.2	21.5	28.9	12.5	20.7	January
February . . .	30.5	14.0	22.3	30.2	14.6	22.4	34.2	18.0	26.2	31.0	13.5	22.3	31.6	14.5	23.1	33.2	16.4	24.8	31.8	15.2	23.5	February
March	39.1	24.2	31.7	38.8	23.2	31.0	42.8	26.6	34.7	39.9	23.0	31.5	40.8	23.4	32.1	42.6	24.5	33.6	40.7	24.2	32.4	March
April	50.4	34.3	42.4	53.1	34.1	43.6	55.7	36.8	46.2	54.9	34.6	44.8	56.0	34.7	45.4	58.6	36.4	47.5	54.8	35.2	45.0	April
May	60.8	42.9	51.9	63.9	42.9	53.4	66.4	45.1	55.8	67.5	45.4	56.5	68.2	44.8	56.5	69.6	45.9	57.8	66.1	44.5	55.3	May
June	71.0	52.1	61.6	73.9	52.6	63.3	77.1	55.7	66.4	77.4	55.8	66.6	78.6	55.2	66.9	79.2	56.8	68.0	76.2	54.7	65.5	June
July	76.7	59.2	68.0	78.9	58.4	68.7	81.9	62.3	72.1	82.9	60.7	71.8	84.1	60.1	72.1	84.0	61.9	73.0	81.4	60.4	71.0	July
August	76.7	58.3	67.5	77.7	57.8	67.8	81.5	62.3	71.9	80.8	59.5	70.2	82.6	59.0	70.8	82.6	61.3	72.0	80.3	59.7	70.0	August
September . .	69.1	51.7	60.4	70.7	49.9	60.3	74.0	53.8	63.9	72.4	51.3	61.9	74.1	50.6	62.4	74.1	52.4	63.3	72.4	51.6	62.0	September
October. . . .	59.3	41.8	50.6	60.1	39.9	50.0	64.2	44.2	54.2	60.8	41.1	51.0	62.3	40.2	51.3	63.7	42.7	53.2	61.7	41.7	51.7	October
November . .	45.3	30.4	37.9	44.1	27.5	35.8	47.3	30.2	38.8	44.1	27.8	36.0	44.8	27.9	36.4	45.0	28.7	36.9	45.1	28.8	37.0	November
December . .	28.9	15.3	22.1	32.0	17.1	24.6	35.6	19.5	27.6	32.0	16.7	24.4	32.4	17.4	24.9	33.2	18.6	25.9	32.4	17.4	24.9	December
Year	52.8	36.2	44.5	54.3	35.9	45.1	57.7	39.1	48.4	56.0	36.8	46.4	57.0	36.7	46.9	58.0	38.2	48.1	56.0	37.2	46.6	Year

[a] Observation stations were selected both on the basis of the length of record available and geographic location within the Southeastern Wisconsin Region. Port Washington, Milwaukee, and Kenosha are representative of areas with temperatures influenced by Lake Michigan, whereas West Bend, Waukesha, and Lake Geneva are typical of inland areas having temperatures that are not generally influenced by Lake Michigan. Kenosha and Lake Geneva are representative of southerly areas in the Region, whereas Port Washington and West Bend typify northern locations.

[b] The monthly average daily maximum temperature and the monthly average daily minimum temperature are obtained by using daily measurements to compute an average for each month in the period of record, the results are then averaged for all the months in the period of record.

[c] The monthly mean temperature is the mean of the average daily maximum temperature and the average daily minimum temperature for each month.

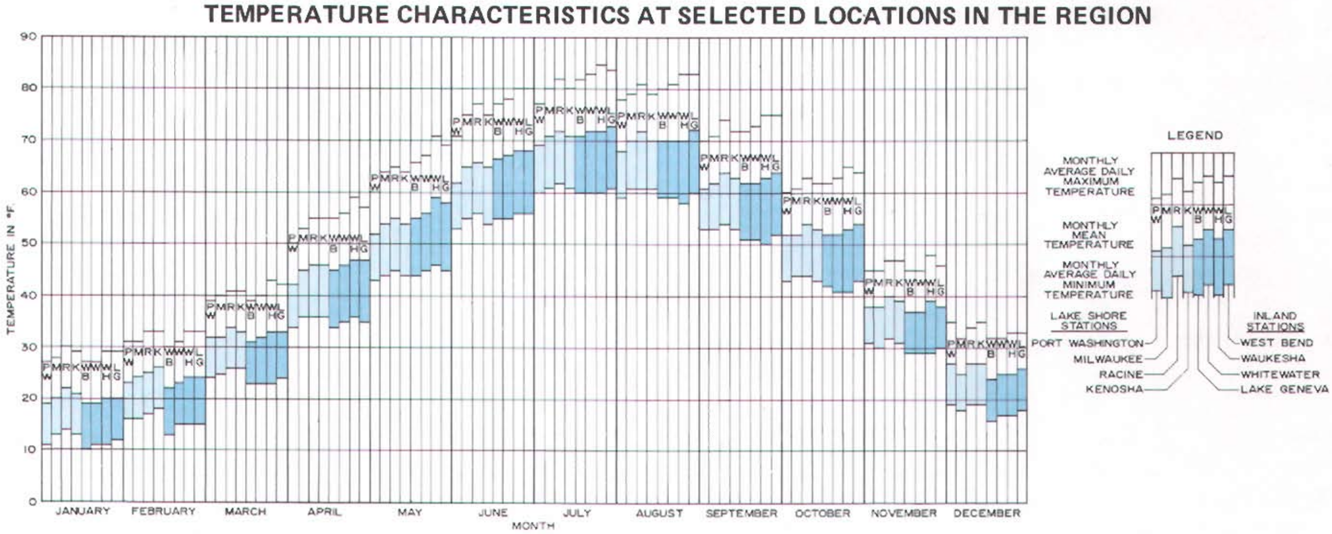
[d] The monthly average daily maximum and minimum temperatures for the Region as a whole were computed as averages of the corresponding values for the six observation stations.

[e] The monthly mean for the Region as a whole is the mean of the regional monthly average daily maximum and average daily minimum, which is equivalent to the average of the monthly means for the six observation stations.

Source: Wisconsin Statistical Reporting Service, National Weather Service, and SEWRPC.

Figure 12

TEMPERATURE CHARACTERISTICS AT SELECTED LOCATIONS IN THE REGION



Source: Wisconsin Statistical Reporting Service and National Weather Service.

and Kenosha and inland at West Bend, Waukesha, and Lake Geneva are presented in Table 65 and Figure 13. These data, which encompass periods of record ranging from 15 to 65 years for the various observation stations, illustrate the temporal and spatial variations in the type and amount of precipitation that normally occur within the Region.

Precipitation data indicate that Lake Michigan does not have as pronounced an effect on precipitation within the Region as it does on temperature. A minor Lake Michigan effect is evidenced by the fact that rainfall is up to 0.5 inch less per month in late spring and summer in the eastern areas of the Region than in the western areas. The influence of Lake Michigan as a source of moisture is

Table 65

PRECIPITATION CHARACTERISTICS AT SELECTED LOCATIONS IN THE REGION

Month	Observation Station[a]												Regional Summary		Month
	Lakeshore Location						Inland Location								
	Port Washington		Milwaukee		Kenosha		West Bend		Waukesha		Lake Geneva				
	Period of Record 1896-1960[b]		Period of Record 1931-1960		Period of Record 1945-1959		Period of Record 1930-1959		Period of Record 1930-1959		Period of Record 1945-1959				
	Average Total Precipitation	Average Snow and Sleet	Average Total Precipitation	Average Snow and Sleet	Average Total Precipitation	Average Snow and Sleet	Average Total Precipitation	Average Snow and Sleet	Average Total Precipitation	Average Snow and Sleet	Average Total Precipitation	Average Snow and Sleet	Average Total Precipitation	Average Snow and Sleet	
January. . . .	1.61	11.5	1.83	12.7	1.56	11.9	1.68	12.3	1.70	11.8	1.73	11.0	1.69	11.9	January
February . . .	1.56	10.2	1.40	8.0	1.08	12.1	1.36	8.1	1.26	6.6	1.26	5.5	1.32	8.4	February
March.	2.21	8.0	2.31	9.3	2.29	7.3	2.01	10.5	2.16	10.7	2.55	10.1	2.26	9.3	March
April	2.73	1.9	2.53	1.2	3.19	1.4	2.54	1.2	2.52	1.1	3.24	1.1	2.79	1.3	April
May.	3.37	0.1	3.16	0.0	3.49	0.2	2.98	0.4	3.46	0.4	3.69	0.1	3.36	0.2	May
June	3.32	0.0	3.64	0.0	4.05	0.0	3.96	0.0	3.72	0.0	4.46	0.0	3.86	0.0	June
July.	2.79	0.0	2.95	0.0	3.23	0.0	3.34	0.0	3.31	0.0	4.18	0.0	3.30	0.0	July
August	2.92	0.0	3.06	0.0	3.08	0.0	2.89	0.0	3.06	0.0	3.60	0.0	3.10	0.0	August
September . .	3.20	0.0	2.72	0.0	2.19	0.0	3.16	0.0	2.93	0.0	1.98	0.0	2.70	0.0	September
October . . .	2.30	0.2	2.10	0.0	1.85	0.1	2.21	0.1	2.09	0.0	2.13	0.0	2.11	0.1	October
November . .	2.06	3.0	2.18	2.5	1.96	2.5	2.13	2.9	2.30	3.5	2.16	4.5	2.13	3.2	November
December . .	1.55	7.2	1.63	9.8	1.89	9.7	1.50	7.8	1.56	7.7	2.12	10.8	1.71	8.8	December
Year	29.62	42.1	29.51	43.5	29.86	45.2	29.76	43.3	30.07	41.8	33.10	43.1	30.33	43.2	Year

[a] *Observation stations were selected both on the basis of the length of record available and geographic location within the Southeastern Wisconsin Region. Port Washington, Milwaukee, and Kenosha are representative of areas where precipitation would be influenced by Lake Michigan, whereas West Bend, Waukesha, and Lake Geneva are typical of inland areas having precipitation that is not generally influenced by Lake Michigan. Kenosha and Lake Geneva are representative of southerly areas in the Region, whereas Port Washington and West Bend typify northern locations.*

[b] *Snow and sleet data for Port Washington is based on the 56 year period 1894 through 1950.*

Source: Wisconsin Statistical Reporting Service, National Weather Service, and SEWRPC.

reflected by the slightly higher seasonal snowfalls for the entire Region relative to inland areas lying west of the Region.

Snow Cover

Snow depth as measured in Milwaukee for the 70-year period of 1900 through 1969 and published in Snow and Frost in Wisconsin, a 1970 Wisconsin Statistical Reporting Service report, is summarized and presented in Table 66. It should be emphasized that the tabulated data pertain to snow depth on the ground as measured at the place and time of observation, and are not a direct measure of average snowfall. Recognizing that snowfall and temperatures, and therefore snow accumulation on the ground, vary spatially within the Region, the Milwaukee area data presented in Table 66 should be considered only as an approximation of conditions that would be encountered in other parts of the Region. As indicated by the data, snow cover is most likely during the months of December, January, and February, during which at least a 0.40 probability exists of having one inch or more of snow cover in Milwaukee. Furthermore, at least a 0.30 probability exists of having one inch or more of snow on the ground during the first half of January, while the probability of having that much snow cover diminishes to 0.07 by the middle of February.

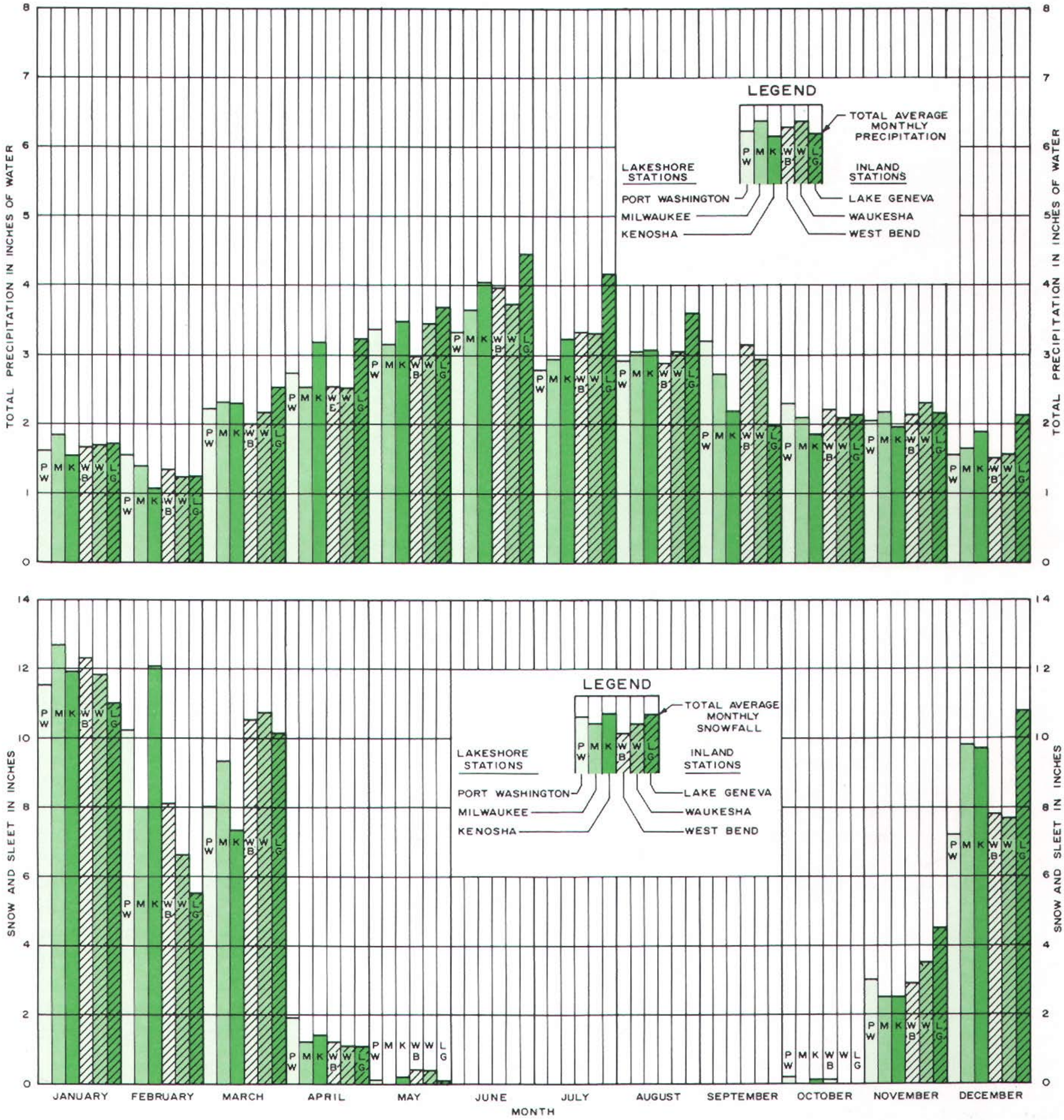
AIR QUALITY

Air Quality Resources

Air is one of the most important natural resources. Air not only is a particularly important determinant of the overall quality of the environment for life, but is essential to life itself. The earth's atmosphere provides the vital blend of oxygen and other gases needed to support terrestrial animal and plant life. Pure air, consisting only of this vital

Figure 13

PRECIPITATION CHARACTERISTICS AT SELECTED LOCATIONS IN THE REGION



Source: Wisconsin Crop Reporting Service, National Weather Service, and SEWRPC.

blend of gases necessary for life, is not known to exist in nature. Air always contains foreign matter in the form of smoke, soot, dust, fly ash, fumes, mists, odors, pollens, and spores, in addition to uncombined water vapor. Some of this foreign particulate and gaseous matter is contributed by such natural sources as volcanic activity, windstorms, and lightening-caused fires. Added to this naturally occurring foreign matter are contaminants contributed by man from land cultivation,

Table 66

SNOW COVER PROBABILITIES IN MILWAUKEE BASED ON DATA FOR THE PERIOD 1900-1970

Date		Snow Cover[a]									
		1.0 Inch or More		5.0 Inches or More		10.0 Inches or More		15.0 Inches or More		Average (Inches)	
Month	Day	Number of Occurrences[b]	Probability of Occurrence[c]	Number of Occurrences[b]	Probability of Occurrence[c]	Number of Occurrences[b]	Probability of Occurrence[c]	Number of Occurrences[b]	Probability of Occurrence[c]	Per Occurrence[d]	Overall[e]
November	15	5	0.07	0	0.00	0	0.00	0	0.00	1.2	0.09
	30	12	0.17	1	0.01	1	0.01	0	0.00	2.8	0.49
December	15	33	0.47	10	0.14	0	0.00	0	0.00	3.3	1.54
	31	32	0.46	9	0.13	1	0.01	0	0.00	3.6	1.66
January	15	43	0.61	17	0.24	4	0.06	2	0.03	4.9	2.94
	31	48	0.69	22	0.31	9	0.13	4	0.06	6.2	4.26
February	15	44	0.63	23	0.33	7	0.10	3	0.04	6.0	3.69
	28	27	0.39	8	0.11	3	0.04	1	0.01	4.5	1.69
March	15	23	0.33	6	0.09	4	0.06	0	0.00	3.9	1.21
	31	5	0.07	1	0.01	1	0.01	0	0.00	3.4	0.24

[a] *Data pertain to snow depth on the ground as it was measured at the time and place of observation, and are not a direct measure of average snowfall.*

[b] *Number of occurrences is the number of times during the 70-year period of record when measurements revealed that the indicated snow depth was equaled or exceeded on the indicated date.*

[c] *Probability of occurrence for a given snow depth and date is computed by dividing the number of occurrences by 70, and is defined as the probability that the indicated snow cover will be reached or exceeded on the indicated date.*

[d] *Average snow cover per occurrence is defined as the sum of all snow cover measurements in inches for the indicated date divided by the number of occurrences for that date, that is, the number of times in which 1.0 inch or more of snow cover was recorded.*

[e] *Overall average snow cover is defined as the sum of all snow cover measurements in inches for the indicated date divided by 70, that is, the number of observation times.*

Source: Wisconsin Statistical Reporting Service, National Weather Service, and SEWRPC.

waste burning, heat and power generation, industrial processes, and transportation movements. Those foreign particulate and gaseous materials which are contributed to the atmosphere through the activities of man and which have a deleterious effect on either the use of the air or the contribution which air makes to the overall quality of the environment are defined as air pollutants.

Urbanization tends to intensify the contribution of air pollutants from human activities because it tends to concentrate commercial and industrial activities, transportation movements, waste burning, power generation, and space heating. When the rate at which pollutants are contributed by human activities exceeds the natural absorptive, diffusive, and dispersive capacity of the earth's atmosphere, and when the concentration of pollutants becomes so severe as to seriously and adversely affect health and property, an air pollution problem exists.

Comprehensive land use planning can be an extremely effective means of managing the air resources of an area. Alternative regional land use patterns can result in different air quality levels, and those land use patterns that serve to minimize air pollution should be encouraged. The density and spatial distribution of residential, commercial, and industrial land uses, major transportation terminals, agricultural areas, and environmental corridors can affect the overall air quality of the Region, and should be explicitly considered in the development of regional plans. Similarly, comprehensive transportation planning can be an extremely effective means of managing the air resources of an area. Alternative configurations of transportation systems and the relative use of alternative modes of transportation can both have important effects on air quality.

Major Air Pollutants

There are five major pollutants which have been identified as having significant adverse effects on human health or property: particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, and ozone. A sixth pollutant, gaseous hydrocarbons, must also be considered in air quality planning. Although direct adverse effects of this pollutant on human health have not been demonstrated to date, hydrocarbons, under certain atmospheric conditions, contribute to the formation of ozone, which has been demonstrated to have an adverse effect on human health and property.

Accordingly, these six major pollutants are of prime consideration in the Commission's regional air quality attainment and maintenance planning program.[3] The Commission's regional air quality attainment and maintenance plan sets forth actions proposed to be taken in southeastern Wisconsin to assure that federally prescribed air quality standards are met and maintained within the Region.

The federal air quality standards for these pollutants have been established by the U. S. Environmental Protection Agency and are applicable on a nationwide basis. These air quality standards, also called criteria, are founded on a body of laboratory, epidemiological, and toxicological data on air pollution and its observed effects on human, plant, and animal life. The six air pollutants for which standards have been promulgated are: 1) particulate matter, 2) sulfur oxides measured as sulfur dioxide, 3) carbon monoxide, 4) nitrogen dioxide, 5) hydrocarbons, and 6) ozone. The air quality standards for each of these six pollutant species are presented in Table 67. For each of the six pollutant species there is a primary, or health-related, standard, and a secondary, or general welfare-related, standard. In some cases the primary and secondary standards are the same. In the case of particulate matter, sulfur dioxide, and carbon monoxide, air quality standards have been established for more than one averaging time in order to prevent excessive short-term exposures to harmful pollutant levels, as well as to prevent the occurrence of harmful effects which have been found to be associated with long-term exposures to pollutant concentrations at generally lower average levels.

It should be recognized that the development of air quality standards is a dynamic process, with new data on the effects of air pollutants being continually gathered and assimilated into the existing body of knowledge. Therefore, revisions to the ambient air quality standards may be expected to be forthcoming in future years. Such revisions may, accordingly, require revisions in the regional air quality attainment and maintenance plan. In addition, the U. S. Environmental Protection Agency may promulgate air quality standards for additional pollutant species.

Particulate Matter

Particulate matter is a term for a large variety of substances that have the ability to remain suspended in ambient air for indefinite periods of time. Natural sources of particulate matter include bacteria, viruses, fungi, molds, yeasts, pollen, and spores from live and decaying plant and animal life, as well as particles caused by wind erosion, volcanic activities, and forest fires. Human-caused particulate matter includes soot, dust, and fly ash caused by combustion, industrial processes, agricultural activities, and transportation movements.

Particulate matter can be harmful to human health either through absorption or inhalation into the body of a chemically or physically toxic particle, or through interference with cleansing mechanisms in the human respiratory tract. Particulate matter enters the human body principally through breathing. Excessive levels of particulate matter can also have adverse effects on animals, vegetation, and materials. For example, vegetation damage may occur as particles are deposited on plant leaves, which in moisture develop into a hard crust on the surface of leaves. In addition, materials can erode because of the acid nature of particles.

Both primary and secondary long-term and short-term ambient air quality standards have been set for particulate matter. On an annual basis the primary standard for particulate matter—that is, the maximum level permissible to protect human health—has been set at 75 micrograms per cubic meter ($\mu g/m^3$). The secondary standard has been established at 60 ug/m^3, and is designed to prevent damage to plants, animals, and materials. The 24-hour primary standard has been established at 260 $\mu g/m^3$, and the secondary standard at 150 $\mu g/m^3$ (see Table 67).

Existing Monitored Particulate Matter Levels: In 1977 measured ambient air quality levels exceeding the primary standard for particulate matter were observed at three monitoring stations in Milwaukee and at two monitoring stations in Waukesha County. Violations of the secondary standard were found at 14 monitoring stations—six in Milwaukee County, two in Kenosha County, two in Racine County, one in Walworth County, and three in Waukesha County. Based on these monitoring data,

[3] *See SEWRPC Planning Report No. 28, A Regional Air Quality Attainment and Maintenance Plan for Southeastern Wisconsin: 2000.*

Table 67

SUMMARY OF NATIONAL AMBIENT AIR QUALITY STANDARDS ISSUED APRIL 30, 1971 AND REVISED SEPTEMBER 15, 1973 AND FEBRUARY 8, 1979[a]

Pollutant	Period of Measurement or Calculation	Concentration (weight of pollutant per cubic meter of ambient air corrected to 25°C and 760 millimeters of mercury)	
		Primary Standard	Secondary Standard
Particulate Matter (PM)	Annual (geometric mean) 24 hour	75 micrograms 260 micrograms[b]	60 micrograms 150 micrograms[b]
Sulfur Oxides (SO_x) (measured as sulfur dioxide)	Annual (arithmetic mean) 24 hour 3 hour	80 micrograms (0.03 part per million) 365 micrograms (0.14 part per million)[b] - -	- - - - 1,300 micrograms (0.5 part per million)[b]
Carbon Monoxide (CO)	8 hour 1 hour	10 milligrams (9 parts per million)[b] 40 milligrams (35 parts per million)[b]	Same as Primary Same as Primary
Hydrocarbons (HC) (nonmethane measured as methane)	3 hour (6 a.m. to 9 a.m.)	160 micrograms (0.24 part per million)[b]	Same as Primary
Nitrogen Dioxide (NO_2)	Annual (arithmetic mean)	100 micrograms (0.05 part per million)	Same as Primary
Ozone[c] (O_x)	1 hour	235 micrograms (0.12 part per million)[d]	Same as Primary

[a] *Ambient air quality standards for a seventh pollutant, lead, were promulgated by the Administrator of the U. S. Environmental Protection Agency on October 5, 1978. More detailed ambient air quality monitoring will be needed to determine whether the standard for this pollutant species is being exceeded in the Region and whether, in fact, a plan need be prepared to ensure the attainment and maintenance of the lead ambient air quality standard.*

[b] *Concentration not to be exceeded more than once per year.*

[c] *Formerly expressed as photochemical oxidants.*

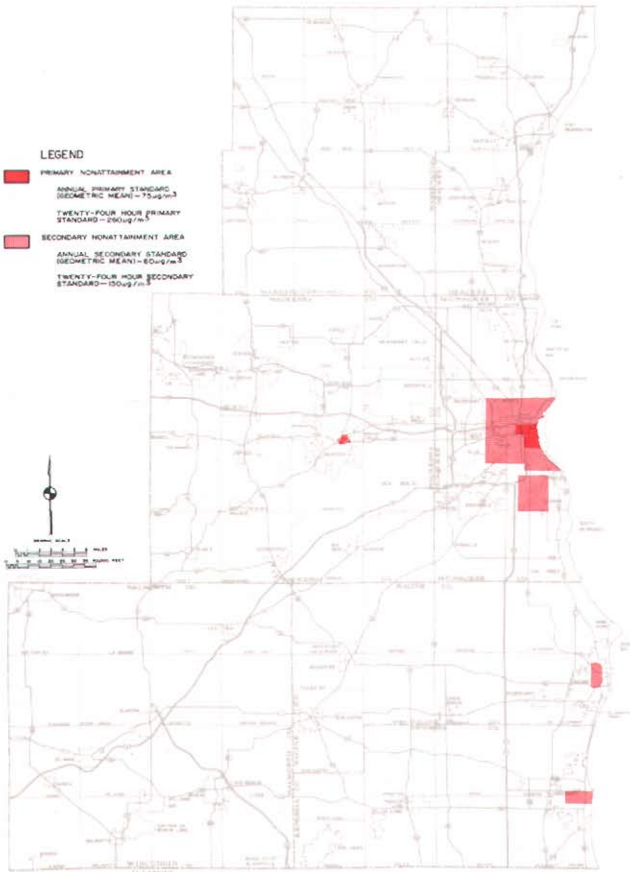
[d] *Concentration not to be exceeded more than one hour averaged over any consecutive three-year period.*

Source: Code of Federal Regulations Title 40, Part 50, 1973.

the U. S. Environmental Protection Agency has formally designated primary and secondary nonattainment areas for particulate matter in the Region (see Map 12). There are two designated primary nonattainment areas—one in the Menomonee River Valley portion of the City of Milwaukee and one in the City of Waukesha—and five secondary nonattainment areas—one each sur-

Map 12

DESIGNATED PRIMARY AND SECONDARY PARTICULATE MATTER NONATTAINMENT AREAS IN THE REGION



This map indicates the location of the primary and secondary particulate matter nonattainment areas in the Region as designated by the Wisconsin Department of Natural Resources in 1978. As may be seen on this map, there are two primary particulate matter nonattainment areas in the Region: one over a three-square-mile area in and around the heavily industrialized portion of the Menomonee River Valley in the City of Milwaukee comprising an estimated resident population of 16,500 persons, and one over a less than one-square-mile area in the northeast portion of the City of Waukesha comprising an estimated resident population of 3,700 persons. In addition, there are five secondary particulate matter nonattainment areas in the Region: one each surrounding the primary nonattainment areas in the Cities of Milwaukee and Waukesha, one in and around General Mitchell Field in Milwaukee County, and one each in the Cities of Kenosha and Racine. In total, these secondary particulate matter nonattainment areas encompass an area of approximately 38.4 square miles and an estimated resident population of 335,300 persons.

Source: U. S. Environmental Protection Agency and Wisconsin Department of Natural Resources.

rounding the primary nonattainment areas in the Cities of Milwaukee and Waukesha, one centered on General Mitchell Field in Milwaukee County, and one each in the Cities of Kenosha and Racine.

About three square miles in the Region have been designated as primary nonattainment areas and about 38 square miles have been designated as secondary nonattainment areas. A total of about 355,500 persons reside in these designated particulate matter nonattainment areas. Of these 355,500 persons, about 20,200 reside within the primary nonattainment areas.

Sources of Particulate Matter: About 30,500 tons of particulate matter were released into the atmosphere over the Region from all identified sources in 1977. About 18,600 tons, or 61 percent, were attributable to area sources of emissions. Point sources, including major industrial facilities and fuel-burning installations, accounted for about 7,400 tons, or about 24 percent, and line or transportation-related sources accounted for only about 4,400 tons, or 15 percent. The estimated distribution of particulate matter emissions by county and source category is set forth in Table 68. Particularly important area sources of particulate matter emissions are industrial fugitive dust and agricultural tilling operations, while the majority of emissions from point sources are attributable to large fuel-burning installations such as electric power generating stations.

Simulation of Existing Air Quality—Particulate Matter: The particulate matter emissions as obtained from the foregoing inventory were assessed for their impact on ambient air quality in the Region using the Wisconsin Atmospheric Diffusion Model under prevailing meteorological conditions for the base year 1977. As shown on Map 13, the modeling effort indicated that about a five-square-mile area of Milwaukee County and about a 12-square-mile area of Waukesha County exceeded the primary standard for particulate matter in 1977. This effort also indicated that an additional 24-square-mile area in Milwaukee County, a 23-square-mile area in Waukesha County, and a very small area—less than one square mile—in Racine County exceeded the secondary standard. A comparison of Maps 12 and 13 indicates that a large area in Waukesha County exceeds the primary particulate matter standard, and that areas in Milwaukee, Racine, and Waukesha Counties exceed the secondary standard. All of these areas lie outside presently designated nonattainment areas. These areas generally correspond to locations of major quarrying activity in the Region, which are presently not subject to monitoring. About 65,700 persons, or about 4 percent of the total

Table 68

SUMMARY OF PARTICULATE MATTER EMISSIONS IN THE REGION BY MAJOR SOURCE CATEGORY: 1977

County	Point Sources			Line Sources			Area Sources			Total	
	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Region
Kenosha	49	0.7	3.3	368	8.3	24.6	1,078	5.8	72.1	1,495	4.9
Milwaukee . . .	6,095	82.0	47.2	2,056	46.5	15.9	4,768	25.6	36.9	12,919	42.4
Ozaukee	536	7.2	33.3	224	5.1	13.9	848	4.5	52.7	1,608	5.3
Racine	293	4.0	11.1	420	9.5	15.8	1,932	10.4	73.0	2,645	8.7
Walworth. . . .	127	1.7	5.4	264	6.0	11.3	1,946	10.4	83.3	2,337	7.6
Washington . .	10	0.1	0.6	272	6.1	16.1	1,407	7.6	83.3	1,689	5.5
Waukesha . . .	322	4.3	4.1	820	18.5	10.5	6,663	35.7	85.4	7,805	25.6
Region	7,432	100.0	24.4	4,424	100.0	14.5	18,642	100.0	61.1	30,498	100.0

Source: SEWRPC.

regional population, live in those areas of the Region indicated by the modeling results to exceed the primary particulate standard. Taken together, the results of the air quality monitoring and air quality simulation work for the year 1977 indicated that it was necessary to prepare a plan to ensure the near-term attainment of the particulate matter ambient air quality standards.

The particulate matter pollution control plan consists of four basic measures: imposition of control measures on existing sources of emissions; imposition of control measures on new sources of emissions; the conduct of an intensive ambient air quality monitoring effort; and the conduct of a pilot vacuum street sweeping program in Milwaukee County. Analyses conducted under the study indicate that if these actions are carried out, significant progress toward the attainment and maintenance of the particulate matter standards may be expected, with the possibility that the standards will be met and maintained as controls of upwind air pollution sources are implemented.

Sulfur Dioxide

Sulfur dioxide is a nonflammable, nonexplosive, colorless gas with a pungent, irritating odor. Sulfur dioxide in the atmosphere comes primarily from the burning of coal having sulfur or sulfur-bearing components.

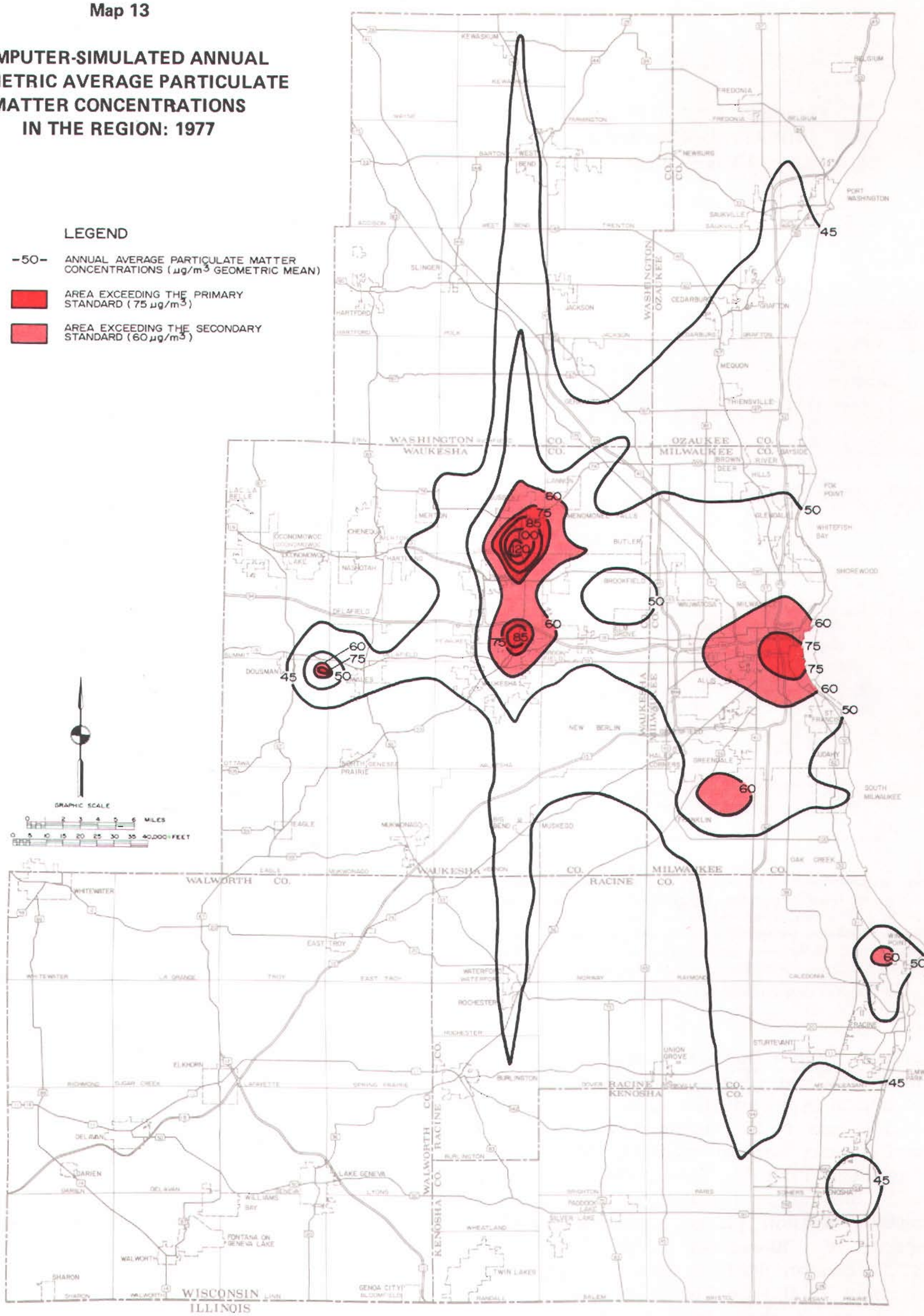
Excessive concentrations of sulfur dioxide in the ambient air represent a threat to human health. Inhaling sulfur dioxide can cause a constriction in human bronchial tubes. Sulfur dioxide can also accentuate symptoms in persons with chronic respiratory diseases and has been associated with increased morbidity of elderly persons having heart diseases. Animals, vegetation, and materials have been found to tolerate higher sulfur dioxide concentrations than those acceptable to humans.

Primary long-term and short-term ambient air quality standards have been set for sulfur dioxide. The primary annual average standard is 80 micrograms per cubic meter ($\mu g/m^3$) and the primary 24-hour average standard is 365 $\mu g/m^3$. Average annual and 24-hour average secondary standards were deemed unnecessary because of the greater tolerance of animals, vegetation, and materials to sulfur dioxide concentrations. In order to prevent short-term exposure to sulfur dioxide, however, a three-hour secondary standard was established at 1,300 $\mu g/m^3$ (see Table 67).

Existing Monitored Sulfur Dioxide Levels: In 1976 no violations of the annual, 24-hour, or three-hour average sulfur dioxide standards were recorded at the network of monitoring stations in Milwaukee and Racine Counties. In 1977 and 1978, however, violations of the 24-hour average sulfur dioxide standard were recorded at two monitoring stations in Milwaukee County. Based upon these violations, the Wisconsin Department of Natural Resources (DNR) has proposed to the U. S. Environmental Protection Agency (EPA) that an approximately 7.4-square-mile area in Milwaukee County be designated as a nonattainment area for sulfur dioxide (see Map 14). For the purpose of the regional air quality study, this designation was accepted as a committed action, although the EPA has yet to approve the designation. About 62,500 persons reside in the single proposed sulfur dioxide nonattainment area.

Map 13

COMPUTER-SIMULATED ANNUAL GEOMETRIC AVERAGE PARTICULATE MATTER CONCENTRATIONS IN THE REGION: 1977

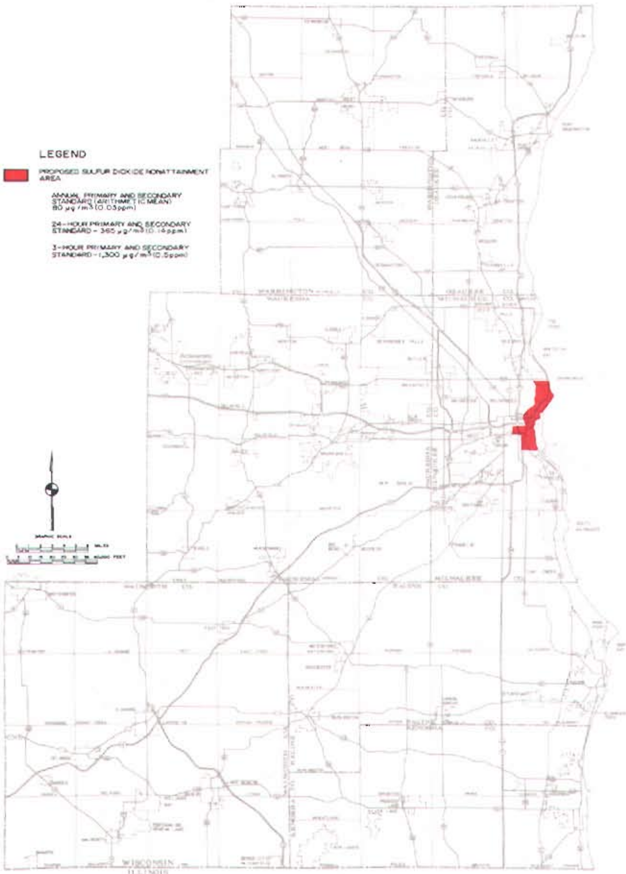


The above map presents annual geometric average particulate matter concentration values resulting from regional point, line, and area sources of emissions derived from 1977 inventory data. The primary annual average air quality standard of 75 micrograms per cubic meter ($\mu g/m^3$) is estimated to have been exceeded over a 5-square-mile area in Milwaukee County and a 12-square-mile area in Waukesha County. The secondary annual average standard of 60 $\mu g/m^3$ is estimated to have been exceeded over a 24-square-mile area in Milwaukee County, a 23-square-mile area in Waukesha County, and a 0.1-square-mile area in Racine County. An estimated 294,500 persons resided in the area impacted by particulate matter concentrations in the ambient air greater than the primary, or health-related, and secondary, or welfare-related, standards.

Source: Air Quality Modeling Group, University of Wisconsin-Madison; and SEWRPC.

Map 14

PROPOSED SULFUR DIOXIDE NONATTAINMENT AREA IN THE REGION



This map identifies the 7.4-square-mile area in Milwaukee County which the Wisconsin Department of Natural Resources in 1979 proposed be designated as a sulfur dioxide nonattainment area based upon monitored violations of the 24-hour average sulfur dioxide ambient air quality standard in 1977 and 1978. An estimated resident population of 62,500 persons reside within the boundaries of this proposed sulfur dioxide nonattainment area.

Source: Wisconsin Department of Natural Resources.

Sources of Sulfur Dioxide: About 249,900 tons of sulfur dioxide were released into the atmosphere of the Region by identified sources in 1976. About 236,700 tons, or 95 percent, were attributable to point sources located primarily in Milwaukee County (see Table 69). These point sources are primarily fuel-burning installations, such as electric power generation plants, having a heat input capacity of 100 million British Thermal Units (BTU's) or more per hour. Area sources accounted for about 11,400 tons of sulfur dioxide, or less than 5 percent of the total. Sulfur dioxide emissions from area sources are primarily generated by the combustion of fossil fuel in residential, small industrial, and commercial-institutional boilers and furnaces. Line sources contribute only about 1,800 tons of the total sulfur dioxide emissions, or less than 1 percent of the total.

Simulation of Existing Air Quality—Sulfur Dioxide: The sulfur dioxide emissions in the Region as obtained from the foregoing inventory were assessed for their impact on ambient air quality in the Region, using the Wisconsin Atmospheric Diffusion Model under prevailing meteorological conditions for the base year 1976. The three averaging periods—annual, 24-hour, and three-hour—corresponding to the sulfur dioxide ambient air quality standards were considered in this modeling effort. The results of the simulation modeling effort for the annual average period are shown on Map 15. As may be seen on this map, the maximum sulfur dioxide concentration isopleth has a value of 50 ug/m^3, expressed as an annual arithmetic average, and is centered in and around the central business district of the City of Milwaukee. This 50 ugm/m^3 isopleth value is about 63 percent of the primary annual average standard of 80 ug/m^3. Simulation modeling results for the 24-hour average and three-hour average sulfur dioxide concentrations in the Region also indicated that the ambient air quality standards for these averaging periods—365 ug/m^3 and 1,300 ug/m^3, respectively—were not exceeded in the Region during 1976. Although the modeling effort for 1976 is supported by the available sulfur dioxide monitoring data for that year, violations of the 24-hour average sulfur dioxide standard did occur at two stations in Milwaukee County during 1977 and 1978.[4] Based upon these inventory data, a need to prepare an attainment plan for sulfur dioxide was recognized.

Carbon Monoxide

Carbon monoxide is a colorless, odorless, and tasteless gas. It is the most widely distributed and most commonly occurring of the air pollutants,

[4] *It should be noted that certain groups, including the Wisconsin Electric Power Company, have questioned the need to designate a nonattainment area for sulfur dioxide within the Region based upon the monitoring data. However, no data have been advanced as part of the claim specifying the inaccuracy of the monitoring data, and the Wisconsin Department of Natural Resources has not changed its proposed designation of part of Milwaukee County as a sulfur dioxide nonattainment area.*

Table 69

SUMMARY OF SULFUR DIOXIDE EMISSIONS IN THE REGION BY COUNTY AND BY MAJOR SOURCE CATEGORY: 1976

County	Point Sources			Line Sources			Area Sources			Total	
	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Region
Kenosha	392	0.17	26.2	180	10.0	12.0	925	8.1	61.8	1,497	0.6
Milwaukee . . .	184,788	78.09	96.8	768	42.9	0.4	5,444	47.6	2.9	191,000	76.4
Ozaukee	51,136	21.60	98.8	112	6.3	0.2	502	4.4	0.9	51,750	20.7
Racine	208	0.09	11.6	180	10.0	10.0	1,400	12.3	78.3	1,788	0.7
Walworth. . . .	32	0.01	4.7	124	6.9	18.3	522	4.6	77.0	678	0.3
Washington . .	8	--[a]	0.9	120	6.7	13.3	775	6.8	85.8	903	0.4
Waukesha . . .	84	0.04	3.7	308	17.2	13.7	1,857	16.2	82.6	2,249	0.9
Region	236,648	100.00	94.7	1,792	100.0	0.7	11,425	100.0	4.6	249,865	100.0

[a] *Less than 0.01 percent.*

Source: SEWRPC.

accounting by weight for more total atmospheric pollution than all the other pollutants combined. Carbon monoxide is formed primarily by the incomplete combustion of carbonaceous fuels used for motor vehicles, space heating, and industrial processes. Natural sources of carbon monoxide include volcanoes, lightning-caused forest fires, and the photodissociation of carbon dioxide in the upper atmosphere.

Carbon monoxide is the agent responsible for most of the poisoning deaths that occur in the United States each year. It is readily absorbed into the lungs and reacts with protein in the blood to reduce the oxygen-carrying and -exchange mechanism in the circulatory system. The result, if sufficient concentrations of carbon monoxide are inhaled, is mortality by suffocation.

The air quality standards for carbon monoxide are intended to limit the buildup of this pollutant species in the blood stream. Since this buildup occurs rapidly during early exposures, and since it reaches an equilibrium after about eight hours, a one-hour average and an eight-hour average primary ambient air quality standard have been established. These primary standards, 40 milligrams per cubic meter (mg/m^3) and 10 mg/m^3 for the one-hour average and eight-hour average periods, respectively, are thought to be sufficient to protect the public health with an adequate margin of safety. Carbon monoxide has been shown not to have a detrimental effect on vegetation or materials at levels presently found in the ambient air. The secondary ambient air quality standards for carbon monoxide have, therefore, been established at the same level as the primary standards (see Table 67).

Existing Monitored Carbon Monoxide Levels: In 1977 there were eight monitoring stations measuring carbon monoxide levels in the Region: five in Milwaukee County, two in Racine County, and one in Waukesha County. The highest one-hour average carbon monoxide concentration recorded during 1977 was 25.8 mg/m^3—measured at 606 W. Kilbourn Avenue in the City of Milwaukee. This level is approximately 65 percent of the 40 mg/m^3 ambient air quality standard. All five carbon monoxide monitoring sites in Milwaukee County and the monitoring site in Waukesha County recorded maximum carbon monoxide concentrations in excess of the 10 mg/m^3 eight-hour average ambient air quality standard. The highest eight-hour average carbon monoxide concentration monitored during 1977—17.3 mg/m^3—was recorded at 3716 W. Wisconsin Avenue in the City of Milwaukee. Based upon these monitoring data, supplemented with data from 1976 and 1978, the Wisconsin Department of Natural Resources has designated an 85-square-mile area in Milwaukee County as a carbon monoxide nonattainment area (see Map 16). An estimated 693,500 persons reside in this nonattainment area.

Sources of Carbon Monoxide: About 598,800 tons of carbon monoxide were released into the atmosphere over the Region from all identified sources in 1977. About 519,800 tons, or nearly 87 per-

Map 15

COMPUTER-SIMULATED ANNUAL ARITHMETIC AVERAGE SULFUR DIOXIDE CONCENTRATIONS IN THE REGION: 1976

LEGEND

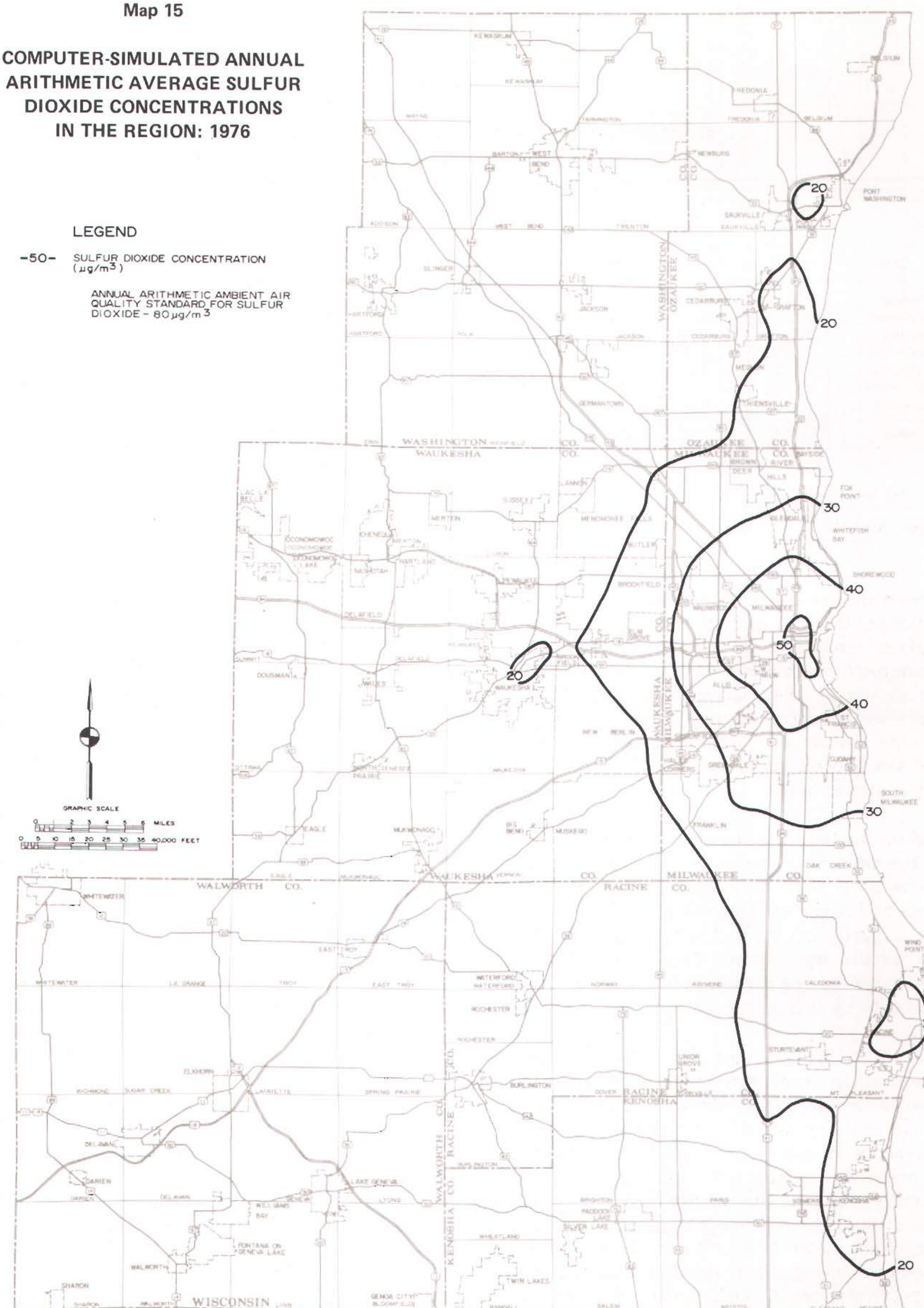
-50- SULFUR DIOXIDE CONCENTRATION ($\mu g/m^3$)

ANNUAL ARITHMETIC AMBIENT AIR QUALITY STANDARD FOR SULFUR DIOXIDE - 80 $\mu g/m^3$

GRAPHIC SCALE

0 1 2 3 4 5 6 MILES

0 5 10 15 20 25 30 35 40,000 FEET

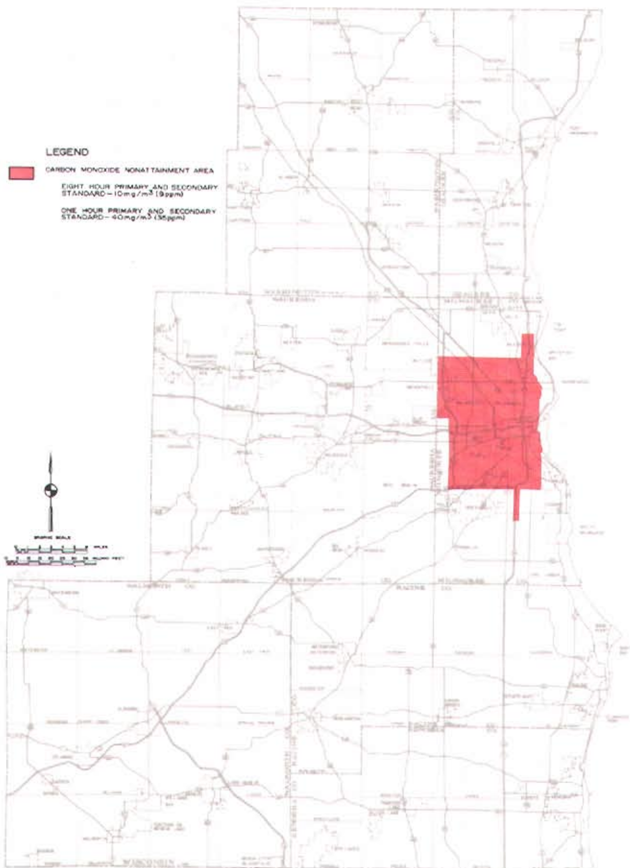


This map illustrates the composite impact of point, line, and area sources of sulfur dioxide emissions on ambient air quality in the Region during 1976 as determined using the Wisconsin Atmospheric Diffusion Model. The computer-simulated sulfur dioxide concentrations shown on this map were calibrated to available ambient air quality monitoring data for the year 1976, and adjusted to reflect the influence of long-range transport, unidentified local emission sources, and naturally occurring levels of sulfur dioxide in the ambient air. The highest sulfur dioxide concentration in the Region in 1976 as determined by this modeling effort was 50 micrograms per cubic meter ($\mu g/m^3$), expressed as an annual arithmetic average, and was located in and around the central business district of the City of Milwaukee. The 50 $\mu g/m^3$ sulfur dioxide concentration isopleth is approximately 63 percent of the annual arithmetic average sulfur dioxide ambient air quality standard of 80 $\mu g/m^3$. It may, therefore, be concluded that this standard was not exceeded in the Region during 1976.

Source: Air Quality Modeling Group, University of Wisconsin-Madison; and SEWRPC.

Map 16

CARBON MONOXIDE NONATTAINMENT AREA IN THE REGION



This map identifies that portion of Milwaukee County which was designated by the U. S. Environmental Protection Agency in March 1978 as a nonattainment area for carbon monoxide. Ambient air quality monitoring data from stations located within this designated nonattainment area indicate that the eight-hour average carbon monoxide ambient air quality standard has been violated on one or more occasions each year since monitoring for this pollutant species was initiated in 1973. The designated carbon monoxide nonattainment area encompasses approximately 85 square miles and an estimated resident population of 730,600 persons.

Source: SEWRPC.

cent, were attributable to line sources of emissions—that is, automobiles and trucks. Area sources accounted for about 70,500 tons, or nearly 12 percent, and point sources accounted for only about 8,600 tons, or slightly more than 1 percent. The estimated distribution of carbon monoxide emissions by county and source category is shown in Table 70.

Simulation of Existing Air Quality—Carbon Monoxide: The carbon monoxide emissions in the Region as obtained from the foregoing inventory were assessed for their impact on ambient air quality in the Region using the Wisconsin Atmospheric Diffusion Model under meteorological conditions least favorable to pollutant dispersion. The results of this effort are shown on Map 17 for the one-hour average carbon monoxide concentrations and on Map 18 for the eight-hour carbon monoxide concentrations during 1977. As may be seen on Map 17, the maximum one-hour average carbon monoxide level indicated for the Southeastern Wisconsin Region is 35 mg/m^3—a level approximately 12 percent below the 40 mg/m^3 standard—and occurs in the vicinity of the Marquette Interchange in Milwaukee County. This finding is supported by available monitoring data which indicate that the one-hour average carbon monoxide ambient air quality standard was not exceeded during 1977.

As shown on Map 18, however, the eight-hour average carbon monoxide standard of 10 mg/m^3 was exceeded over a 20.7-square-mile area in Milwaukee County under "worst case" meteorological conditions. An estimated 267,800 persons reside in this 20.7-square-mile area. The air quality simulation modeling results thus support the findings of the ambient air quality monitoring data that an attainment plan is required to ensure safe levels of carbon monoxide throughout the Region.

The recommended plan to accelerate the attainment of the eight-hour average carbon monoxide standard in the Region to the year 1982 is presented with the recommended hydrocarbon/ozone plan because of the commonality of emission sources and because many control actions—particularly transportation-related control actions—have an influence on both carbon monoxide and hydrocarbon emissions.

Nitrogen Dioxide

Nitrogen dioxide, a reddish-brown gas with a characteristic pungent odor, is one member of a family of nitrogen-oxygen compounds found in the atmosphere. From a standpoint of air pollution, however, nitric oxide (NO) and nitrogen dioxide (NO_2) are the most important of the various oxides of nitrogen. Under the high temperature conditions accompanying the burning of fossil fuel, NO and, to a much lesser extent, NO_2 are formed when air is used as the oxidizing agent. Nitrogen dioxide is normally formed in the atmosphere when two molecules of nitric oxide react with oxygen in the ambient air.

Table 70

SUMMARY OF CARBON MONOXIDE EMISSIONS IN THE REGION BY COUNTY AND BY MAJOR SOURCE CATEGORY: 1977

County	Point Sources			Line Sources			Area Sources			Total	
	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Region
Kenosha	32	0.4	0.08	37,694	7.2	87.1	5,565	7.9	12.9	43,291	7.2
Milwaukee . . .	6,840	79.8	2.30	273,936	52.7	90.3	22,484	31.9	7.4	303,260	50.6
Ozaukee	380	4.4	1.50	20,659	4.0	84.0	3,552	5.1	14.4	24,591	4.1
Racine	33	0.4	0.06	46,639	9.0	85.8	7,670	10.9	14.1	54,342	9.1
Walworth. . . .	506	5.9	1.50	24,947	4.8	74.5	8,053	11.4	24.0	33,506	5.6
Washington . .	292	3.4	0.84	26,584	5.1	76.9	7,695	10.9	22.3	34,571	5.8
Waukesha . . .	490	5.7	0.47	89,329	17.2	84.9	15,437	21.9	14.7	105,256	17.6
Region	8,573	100.0	1.40	519,788	100.0	86.8	70,456	100.0	11.8	598,817	100.0

Source: SEWRPC.

Although nitric oxide produces adverse health effects, the concentrations at which such effects are observed are many times the level at which it is found to occur in the ambient air. However, long-term exposures to concentrations of nitrogen dioxide at levels commonly found in the ambient air have been associated with impaired respiratory functioning in elementary school-age children and an increase in the frequency of acute respiratory illness in family groups. Also, long-term exposure of laboratory animals has shown that inhalation of nitrogen dioxide increases susceptibility to bacterial pneumonia and influenza infections and may lead to pulmonary emphysema. Based upon the available laboratory, toxicological, and epidemiological data, therefore, a primary annual average nitrogen dioxide ambient air quality standard has been established by the federal government at 100 micrograms per cubic meter (ug/m^3). The secondary annual average standard for nitrogen dioxide has been established at the same level as the primary standard, since this pollutant species was found to have adverse effects on animal and plant life, and cause damage to materials at concentrations in excess of that level harmful to humans.

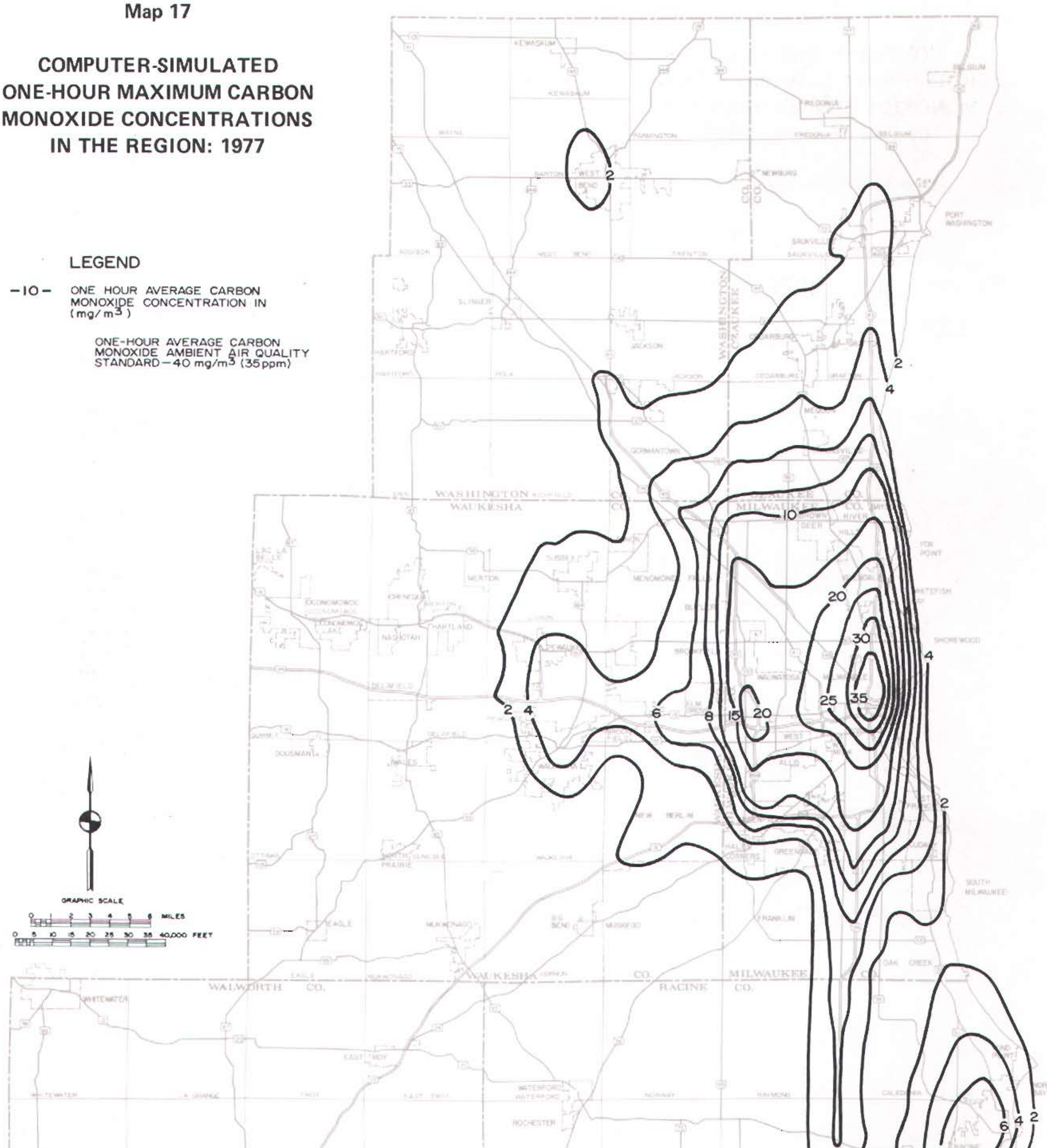
Existing Monitored Nitrogen Dioxide Levels: In 1977 there were four monitoring sites in the Region, all in the City of Milwaukee, which monitored for ambient levels of nitrogen dioxide. The highest annual average concentration reported during 1977—70 µg/m^3 at 711 W. Wells Street—was well below the standard of 100 µg/m^3. Thus, based upon available monitoring data, existing nitrogen dioxide levels in the Region do not pose a threat to the health of the regional population.

Sources of Nitrogen Oxides: About 114,300 tons of nitrogen oxide emissions were released into the atmosphere over the Region from all identified sources in 1977. About 47,700 tons, or nearly 42 percent, were attributable to line sources of emissions. Point sources, principally major fuel-burning installations, accounted for approximately 46,300 tons, or more than 40 percent, of the nitrogen oxide emissions, with area sources accounting for about 20,300 tons, or about 18 percent. The distribution of nitrogen oxide emissions by county and source category is shown in Table 71.

Simulation of Existing Air Quality—Nitrogen Oxides: The nitrogen oxide emissions in the Region, as obtained from the foregoing inventory, were assessed for their impact on the ambient air quality in the Region using the Wisconsin Atmospheric Diffusion Model under prevailing meteorological conditions, and in the assumed absence of photochemical reactions, for the base year 1977. It should be noted that this modeling effort was conducted only to provide a generalized depiction of the areas having high relative concentrations of nitrogen oxide compounds, since this pollutant species is chemically reactive in the presence of sunlight and since the rate of conversion of nitric oxide to nitrogen dioxide varies according to prevailing meteorological conditions. This modeling effort, however, does provide an indication of whether the ambient air quality monitoring data are representative of the area demonstrating the peak nitrogen dioxide concentrations in the Region.

Map 17

COMPUTER-SIMULATED ONE-HOUR MAXIMUM CARBON MONOXIDE CONCENTRATIONS IN THE REGION: 1977



This map illustrates the composite impact of point, line, and area sources of emissions on one-hour average carbon monoxide concentrations in the Region during 1977. This simulation modeling effort was conducted under emission conditions representative of the peak morning travel hour, from 7:00 a.m. to 8:00 a.m., and under meteorological conditions least favorable to pollutant dispersion. Under these "worst case" conditions, the maximum carbon monoxide concentration isopleth has a value of 35 milligrams per cubic meter (mg/m^3), expressed as a one-hour arithmetic average, and is located in the area of the Marquette Interchange. Thus, the simulation modeling results, in agreement with available monitoring data, indicate that the one-hour average carbon monoxide ambient air quality standard of 40 mg/m^3 was not exceeded in the Region during 1977.

Source: Air Quality Modeling Group, University of Wisconsin-Madison; and SEWRPC.

Map 18

COMPUTER-SIMULATED EIGHT-HOUR MAXIMUM CARBON MONOXIDE CONCENTRATIONS IN THE REGION: 1977

LEGEND

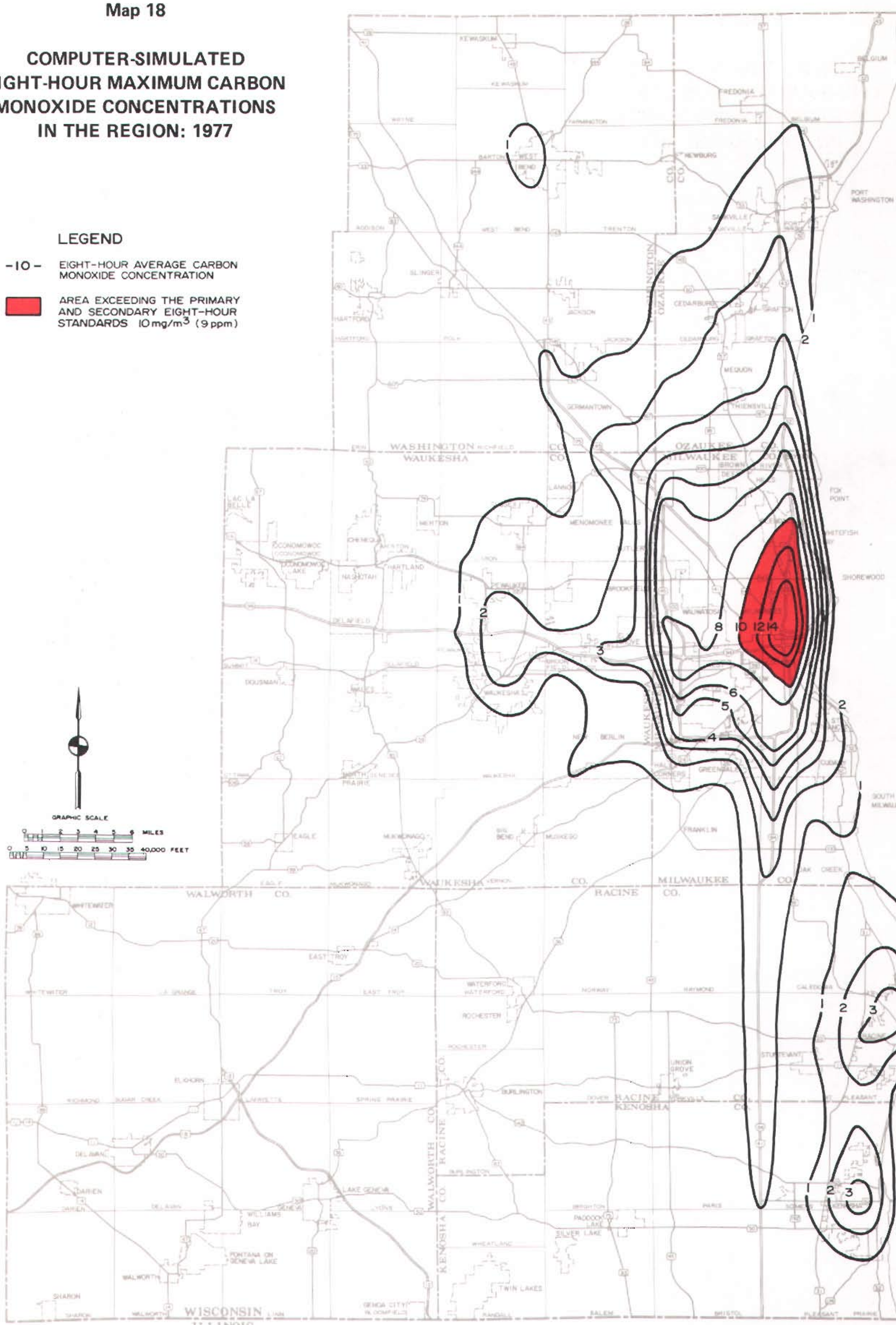
-10- EIGHT-HOUR AVERAGE CARBON MONOXIDE CONCENTRATION

AREA EXCEEDING THE PRIMARY AND SECONDARY EIGHT-HOUR STANDARDS 10 mg/m^3 (9 ppm)

GRAPHIC SCALE

0 1 2 3 4 5 6 MILES

0 5 10 15 20 25 30 35 40,000 FEET



This map illustrates the composite impact of point, line, and area sources of emissions on eight-hour average carbon monoxide concentrations in the Region during 1977. This simulation modeling effort was conducted under emission conditions representative of a period of heavy traffic flow, from 5:00 a.m. to 1:00 p.m. on a weekday, and under meteorological conditions least favorable to pollutant dispersion. Under these "worst case" conditions, the eight-hour average carbon monoxide ambient air quality standard of 10 milligrams per cubic meter (mg/m^3) is estimated to have been exceeded over a 21-square-mile area in Milwaukee County during 1977. This area has an estimated resident population of 267,800 persons.

Source: Air Quality Modeling Group, University of Wisconsin-Madison; and SEWRPC.

Table 71

SUMMARY OF NITROGEN OXIDE EMISSIONS IN THE REGION BY COUNTY AND BY MAJOR SOURCE CATEGORY: 1977

County	Point Sources			Line Sources			Area Sources			Total	
	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Region
Kenosha	267	0.58	4.4	4,116	8.6	68.1	1,663	8.2	27.5	6,046	5.3
Milwaukee . . .	38,884	83.99	55.8	21,459	45.0	30.8	9,308	45.8	13.4	69,651	60.9
Ozaukee	6,355	13.73	63.4	2,569	5.4	25.6	1,092	5.4	10.9	10,016	8.8
Racine	342	0.74	4.7	4,646	9.8	64.0	2,275	11.2	31.3	7,263	6.4
Walworth. . . .	192	0.41	4.2	2,893	6.1	63.1	1,503	7.4	32.8	4,588	4.0
Washington . .	23	0.05	0.5	2,975	6.2	62.0	1,800	8.8	37.5	4,798	4.2
Waukesha . . .	233	0.50	2.0	9,010	18.9	75.5	2,684	13.2	22.5	11,927	10.4
Region	46,296	100.00	40.5	47,668	100.0	41.7	20,325	100.0	17.8	114,289	100.0

Source: SEWRPC.

The modeling effort for nitrogen dioxide, as shown on Map 19, indicates that the maximum concentration for this pollutant species in the Region is 300 ug/m^3, expressed as an annual arithmetic average, and is located in the area of the Marquette Interchange. Since monitoring data near the Marquette Interchange indicate that the nitrogen dioxide ambient air quality standard has not been exceeded, it may be concluded from the modeling results that this standard was not exceeded anywhere in the Region during 1977.

Hydrocarbons and Ozone

Hydrocarbons are compounds whose molecules consist of hydrogen and carbon atoms only. Hydrocarbons of themselves have no direct effect on human health at levels found in the atmosphere. They do, however, enter into and promote the formation of photochemical oxidants, the most important of which is ozone. Hydrocarbons react with oxygen atoms, ozone molecules, and certain additional oxidation products generated by the action of sunlight on other compounds in the atmosphere, particularly nitrogen dioxide. Sunlight alone has no appreciable effect on hydrocarbons in the ambient air. Without such reaction products as ozone, hydrocarbons would not be involved in photochemical air pollution.

Ozone in particular appears to cause substantial damage to the respiratory tract. Being chemically active, ozone may react with the mucus and tissue layers in all compartments of the respiratory tract, causing deterioration of the cellular lining and consequently a restriction of normal pulmonary functions. Ozone is also known to deteriorate materials, particularly rubber and certain textile fibers.

In order to protect the public health and welfare from the deleterious effects of ozone, a maximum one-hour average ozone standard has been established at a level of 235 micrograms per cubic meter (μg/m^3), which is equivalent to 0.12 part per million (ppm). In addition, since ozone is not directly emitted into the atmosphere, but rather is formed in the ambient air from the reaction of sunlight with precursor compounds, a hydrocarbon ambient air quality standard was promulgated as a guideline for achieving the ozone standard. The hydrocarbon standard has been established at 160 μg/m^3 for a three-hour, 6:00 a.m. to 9:00 a.m., averaging period, since a strong correlation has been observed between early morning hydrocarbon concentrations and maximum ozone concentrations during the afternoon (see Table 67).

Existing Monitored Hydrocarbon and Ozone Levels: To date, there is only a limited amount of ambient air quality monitoring data available on regional hydrocarbon levels. One special monitoring study for hydrocarbons was conducted at the Kenosha Airport between August 4 and September 30, 1976. Of the 58 monitoring days, 43 recorded violations of the three-hour average ambient air quality standards for hydrocarbons. The highest level recorded was 553 μg/m^3, measured on September 19, 1976—a level approximately 250 percent above the established standard.

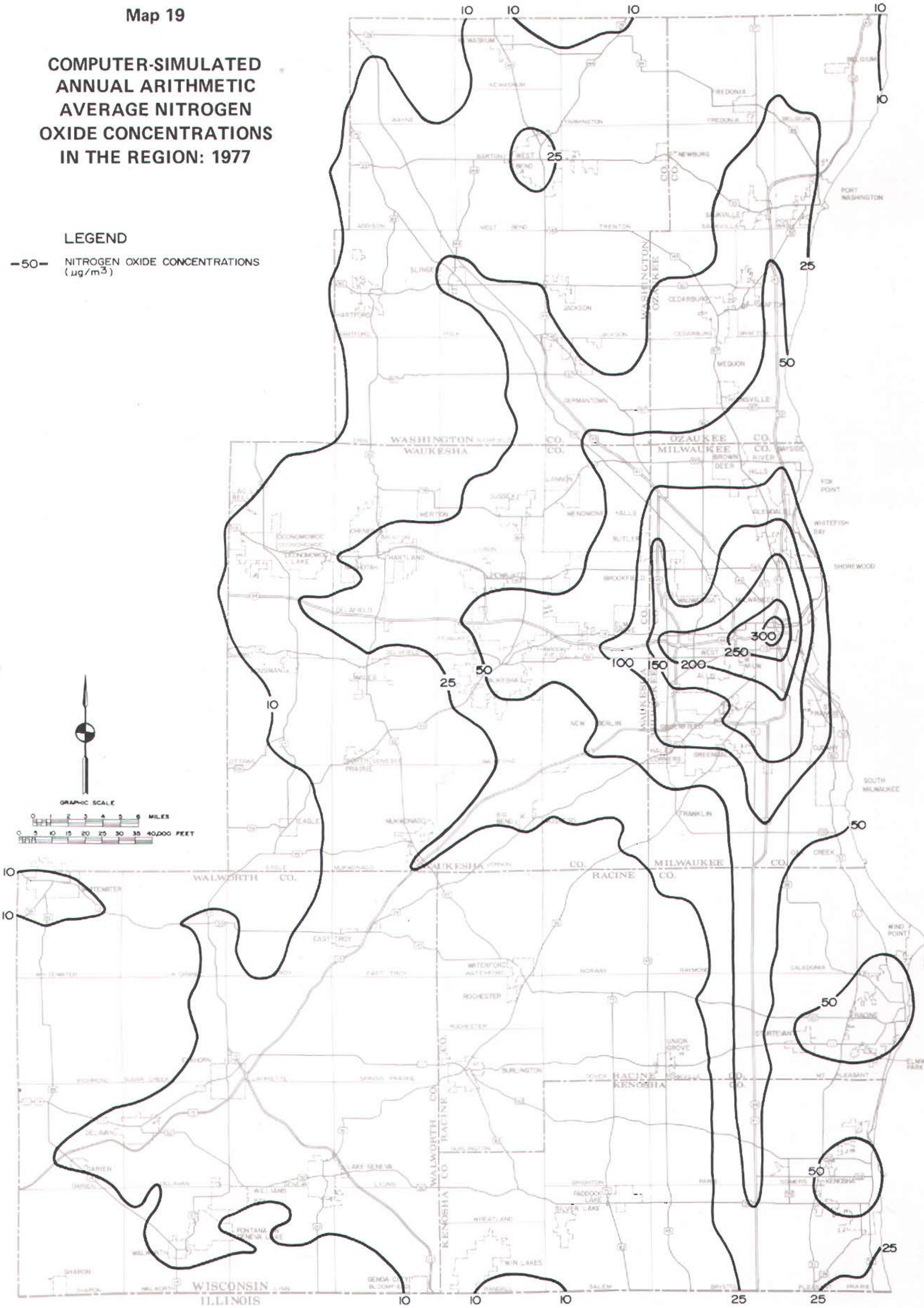
During the summer of 1977, there were 10 ambient air quality monitoring sites in the Region recording ozone levels: five in Milwaukee County, two in Racine County, and one each in Kenosha, Ozaukee, and Waukesha Counties. With the exception of one station in Racine County, all of these monitoring sites recorded maximum hourly average ozone

Map 19

COMPUTER-SIMULATED ANNUAL ARITHMETIC AVERAGE NITROGEN OXIDE CONCENTRATIONS IN THE REGION: 1977

LEGEND

—50— NITROGEN OXIDE CONCENTRATIONS ($\mu g/m^3$)



This map indicates the composite impact of point, line, and area sources of nitrogen oxide emissions on ambient air quality in the Region during 1977. The maximum nitrogen oxide isopleth has a value of 300 micrograms per cubic meter ($\mu g/m^3$), expressed as an annual arithmetic average, and is located in and around the central business district of the City of Milwaukee. Although this simulation modeling effort was conducted in the assumed absence of photochemical reactions in the atmosphere leading to the conversion of nitric oxide to nitrogen dioxide and thus may not be related directly to the standard, available nitrogen dioxide monitoring data indicate that the air quality standard for this pollutant species was not exceeded in the Region during 1977.

Source: Air Quality Modeling Group, University of Wisconsin-Madison; and SEWRPC.

concentrations in excess of the ambient air quality standard of 0.12 ppm. The highest maximum hourly average ozone concentration monitored during 1977 was 0.204 ppm, recorded at 2114 E. Kenwood Boulevard in the City of Milwaukee. This level exceeds the established standard by about 70 percent.

On the basis of available monitoring data recorded between 1973 and 1977, the Wisconsin Department of Natural Resources has designated Kenosha, Milwaukee, Ozaukee, Racine, and Waukesha Counties as an ozone nonattainment area. Because ambient air quality monitoring for ozone levels in Walworth and Washington Counties has not been conducted to date, these two counties are unclassified. In total, therefore, approximately 1,675 square miles, or more than 62 percent of the total area of the Region, are included within the designated ozone nonattainment area, as shown on Map 20. Approximately 1,629,000 persons, or about 92 percent of the total regional population, reside within the five counties of this nonattainment area.

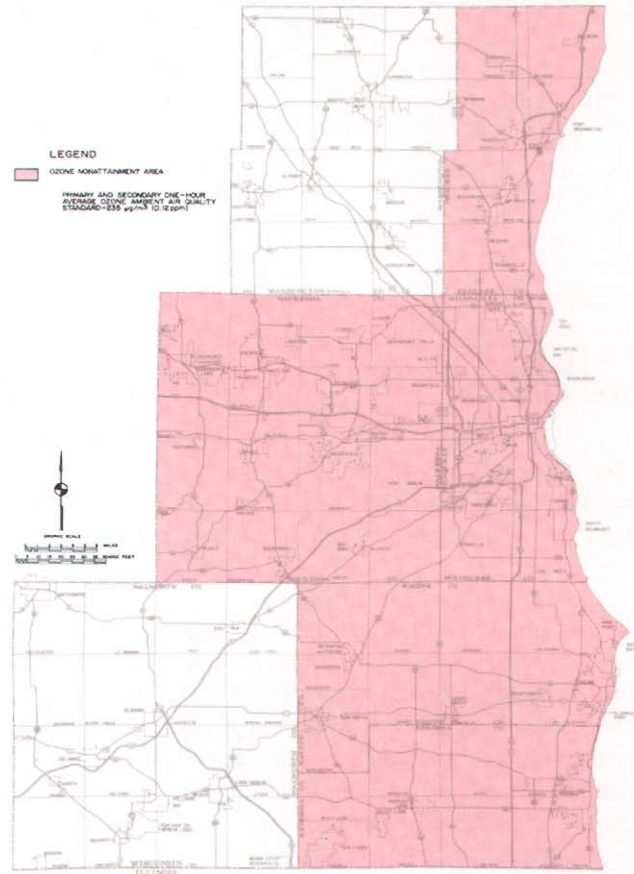
Sources of Hydrocarbons: About 132,400 tons of total hydrocarbon emissions were released into the atmosphere over the Region from all identified sources in 1977. Approximately 52,400 tons, or slightly less than 40 percent, were attributable to area sources of emissions, such as fuel combustion and solvent use. Line sources accounted for about 47,900 tons, or about 36 percent, and point sources, including surface coating operations and petroleum marketing, accounted for about 32,100 tons, or about 24 percent. The estimated distribution of total hydrocarbon emissions by county and source category is shown in Table 72.

It should be noted that not all hydrocarbon compounds are equally reactive nor contribute uniformly to the formation of ozone in the ambient air. Those hydrocarbon compounds figuring most significantly in the photochemical process are termed volatile organic compounds. It has been estimated that of the 132,400 tons of total hydrocarbons emitted in the Region in 1977, only about 102,200 tons, or about 77 percent, were volatile organic compounds that contributed to the ozone problem in the Region during the summer months. Major sources of volatile organic compounds include motor vehicles, petroleum product marketing and storage, and surface coating operations.

Simulation of Existing Air Quality—Hydrocarbons and Ozone: Because ozone is a photochemically reactive pollutant species which forms in the atmosphere, the nonreactive modeling techniques that have been used to evaluate nonreactive pollutant species are not applicable. The technique recommended by the U. S. Environmental Protection Agency (EPA) for evaluating ozone levels in the ambient air, and the effectiveness of alternative controls, is the Empirical Kinetics Modeling Approach (EKMA). The results of the EKMA model are stated as a reduction in volatile organic compound emissions from local sources required to reduce the maximum ozone concentrations to a level below the established standard. The results of the EKMA simulation modeling effort for

Map 20

OZONE NONATTAINMENT AREA IN THE REGION



As may be seen on the above map, five counties in the Region—Kenosha, Milwaukee, Ozaukee, Racine, and Waukesha—were designated in 1978 by the U. S. Environmental Protection Agency as a nonattainment area for ozone. Walworth and Washington Counties are presently designated as "unclassifiable" with respect to the attainment of the ozone ambient air quality standard because there are no monitoring data for these two counties. The designated five-county ozone nonattainment area encompasses approximately 1,675 square miles, or about 62 percent of the total area of the Region, and a resident population of about 1,629,000 persons, or about 92 percent of the total regional population.

Source: SEWRPC.

Table 72

SUMMARY OF HYDROCARBON EMISSIONS IN THE REGION BY COUNTY AND BY MAJOR SOURCE CATEGORY: 1977

County	Point Sources			Line Sources			Area Sources			Total	
	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Source Total	Percent of County Total	Emissions (tons)	Percent of Region
Kenosha	3,857	12.0	34.7	3,527	7.4	31.7	3,738	7.1	33.6	11,122	8.4
Milwaukee . . .	22,200	69.1	30.5	24,922	52.0	34.2	25,680	49.0	35.3	72,802	55.0
Ozaukee	938	2.9	19.1	1,935	4.0	39.4	2,039	3.9	41.5	4,912	3.7
Racine	1,801	5.6	15.9	4,325	9.0	38.2	5,186	9.9	45.8	11,312	8.6
Walworth. . . .	654	2.0	10.9	2,339	4.9	38.9	3,023	5.8	50.2	6,016	4.5
Washington . .	1,054	3.3	15.8	2,520	5.3	37.8	3,085	5.9	46.3	6,659	5.0
Waukesha . . .	1,623	5.1	8.3	8,340	17.4	42.5	9,641	18.4	49.2	19,604	14.8
Region	32,127	100.0	24.3	47,908	100.0	36.2	52,392	100.0	39.5	132,427	100.0

Source: SEWRPC.

volatile organic compound emissions in the Region in 1977 indicated that the 102,200 tons of emissions in that year would have to be reduced by 62 percent at a minimum, 74 percent at a maximum, to achieve the ambient air quality standard for ozone. The volatile organic compound emission rate in the Region, therefore, should not exceed about 38,800 tons in any year, and ideally should not exceed 26,600 tons in any year. The attainment and maintenance of the ambient air quality standard for ozone, therefore, may be evaluated against the achievement of the maximum permissible volatile organic compound emission rate.

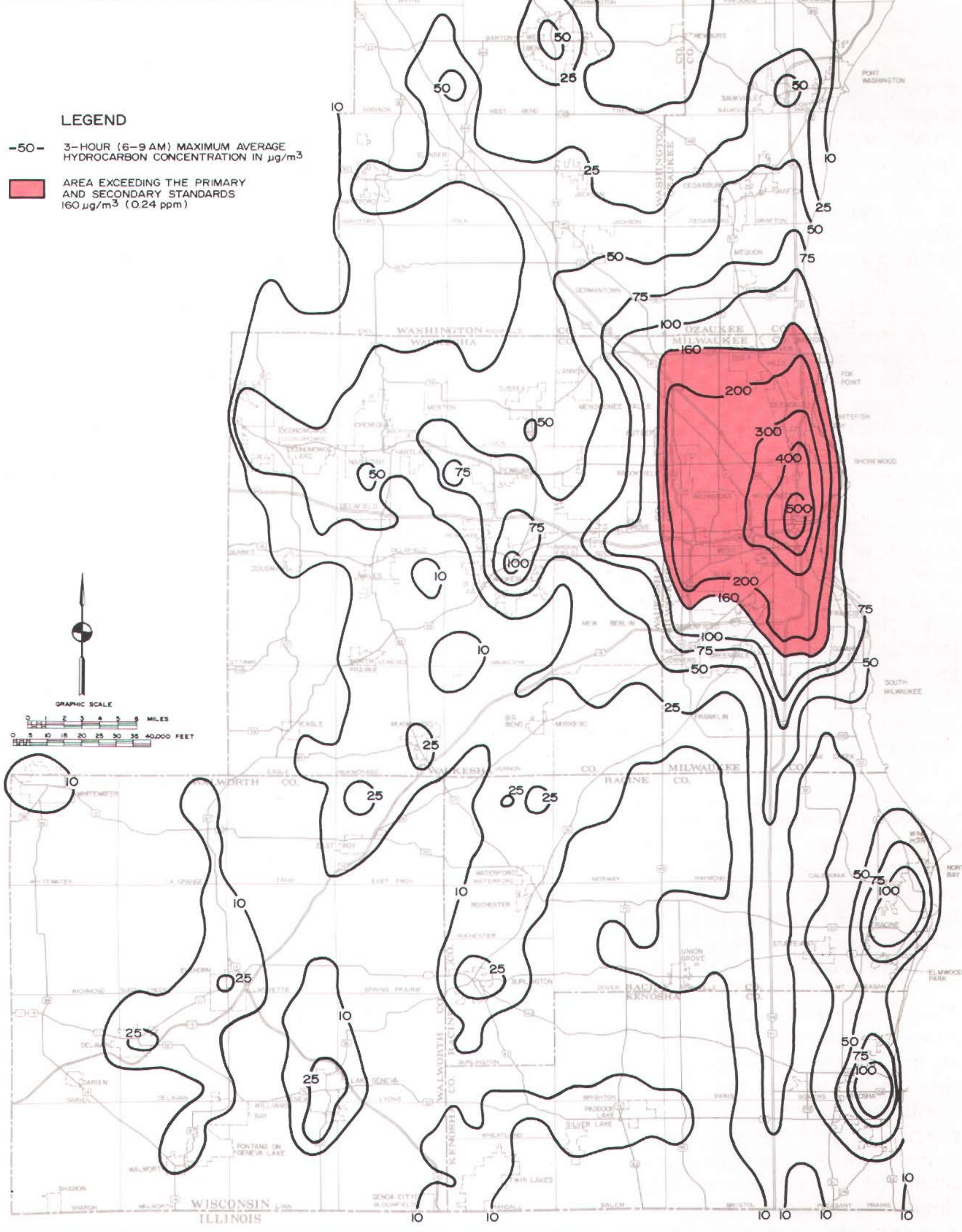
In order to depict the area which has the greatest potential for reductions in volatile organic compound emissions, the Wisconsin Atmospheric Diffusion Model was used to simulate the total hydrocarbon emissions inventory in the Region during 1977 in the assumed absence of photochemical reactions. The results of this modeling effort are shown on Map 21. As may be seen on this map, the most intensive hydrocarbon concentrations are located in Milwaukee County, where it is indicated that an area of approximately 90 square miles exceeds the maximum three-hour, or average, hydrocarbon standard of 160 $\mu g/m^3$.

As noted earlier, the recommended plan for carbon monoxide is treated jointly with the hydrocarbon/ozone plan because of the commonality of emission sources and the corresponding influence that many control actions—particularly transportation-related control actions—have on carbon monoxide and hydrocarbon emissions. The recommended carbon monoxide pollution control plan is based essentially on actions related to transportation pollutants, since nearly 87 percent of all carbon monoxide emissions are due to line sources. The recommended hydrocarbon/ozone plan calls for controlling volatile organic compound emissions from both stationary and mobile sources. Both the carbon monoxide and hydrocarbon/ozone plans consist of committed actions—that is, actions presently mandated by either the U. S. Environmental Protection Agency or the Wisconsin Department of Natural Resources—and additional measures recommended to supplement the committed actions.

For carbon monoxide emissions from industrial sources, the committed actions include only the continued enforcement of existing state regulations. For hydrocarbon emissions, or, more specifically, volatile organic compound emissions, from industrial sources, the committed actions include the application of Reasonably Available Control Technology to certain major industrial sources and processes. The committed actions for both carbon monoxide and volatile organic compounds also include the continued implementation of the federal motor vehicle emissions control program. To supplement these committed actions, the recommended carbon monoxide and hydrocarbon/ozone plan recommends continued efforts toward implementation of the regional transportation plan, most importantly including the recommended transportation systems management actions; establishment of an inspection and maintenance program for automobiles and light-duty trucks; and a prohibition on the use of cutback asphalt as a paving material in the Region. An important element of the recommended transportation systems management actions is the short-

Map 21

MAXIMUM THREE-HOUR (6:00 A.M. TO 9:00 A.M.) AVERAGE HYDROCARBON CONCENTRATIONS IN THE REGION: 1977



This map represents a generalized depiction of the maximum three-hour average, 6:00 a.m. to 9:00 a.m., hydrocarbon concentrations in the ambient air over the Region during 1977 in the assumed absence of photochemical reactions. Under this assumption, the three-hour average hydrocarbon ambient air quality standard of 160 micrograms per cubic meter (µg/m^3) is indicated to have been exceeded over a 90-square-mile area in Milwaukee County. Since hydrocarbons have no known adverse effects on human health in themselves, the hydrocarbon ambient air quality standard has been promulgated only as a surrogate measure for ozone. It has been observed that the ozone standard is generally violated during afternoon hours within and downwind of areas exhibiting high hydrocarbon concentrations in the early morning hours.

Source: SEWRPC.

and long-term improvement of public transit service, as now being considered in this alternatives analysis.

PHYSIOGRAPHY

The land forms and physical features of the Region, such as the topography and drainage pattern, are important determinants of regional growth and development. The physiography of an area must be considered in any sound land use and supporting transportation, utility, and community facility planning and development, as it contributes directly to the natural beauty and overall quality of life in an area.

Physiographic and Topographic Features

Glaciation has largely determined the physiography and topography as well as the soils of this part of the State. The physiographic features or surficial land forms of southeastern Wisconsin are shown on Map 22, and regional topography or variation in elevation is depicted on Map 23. The dominant physiographic and topographic feature is the Kettle Moraine, an interlobate glacial deposit, or moraine, formed between the Green Bay and Lake Michigan tongues, or lobes, of the continental glacier which moved in a generally southerly direction from its point of origin in what is now Canada. Topographically high points in the Kettle Moraine include areas around Lake Geneva in Walworth County, areas in southwestern Waukesha County north of Eagle, areas in central Waukesha County around Lapham Peak, and areas around Holy Hill and Hartford in southwestern and western Washington County. The Kettle Moraine, which is oriented in a general northeast-southwest direction across western Washington, Waukesha, and Walworth Counties, is a complex system of kames, or crudely stratified conical hills; kettle holes marking the site of glacial ice blocks that became separated from the ice mass and melted to form depressions; and eskers, consisting of long, narrow ridges of drift deposited in abandoned drainageways.

The remainder of the Region is covered by a variety of glacial land forms and features, including kames—ground moraine or heterogeneous material deposited beneath the ice; recessional moraines, consisting of material deposited at the forward margins of the ice sheet; lacustrine basins, or former lake sites; outwash plains formed by the action of flowing glacial meltwater; eskers, or elongated meandering ridges of crudely stratified waterlain sand and gravel deposits; and drumlins, or elongated mounds of drift molded by and parallel to the advancing glacier.

Surface Drainage

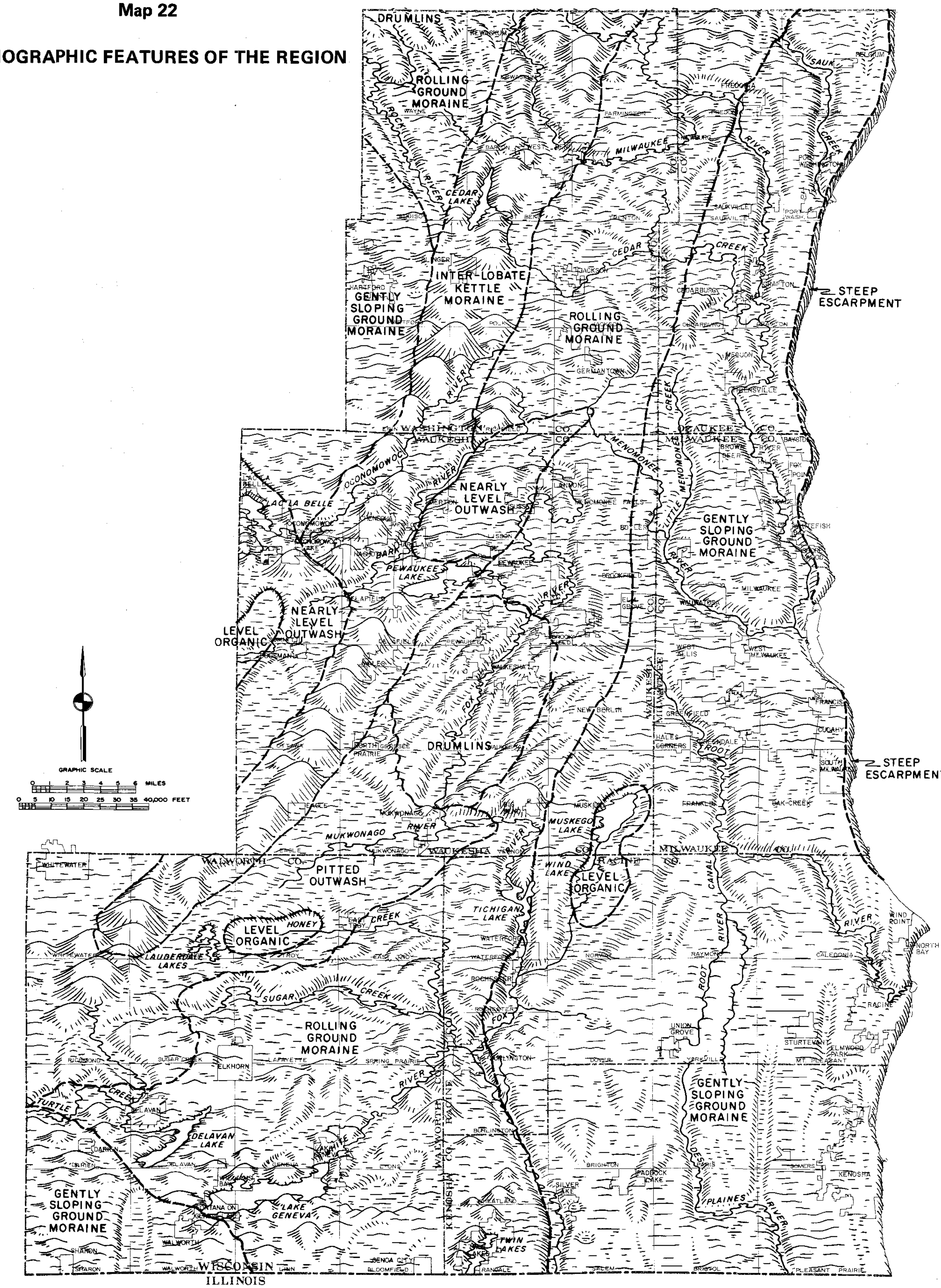
Surface drainage is poorly developed but highly diverse within the planning Region due to the effects of the relatively recent glaciation. The land surface is complex as result of being covered by glacial drift, containing thousands of closed depressions that range in size from mere pots to large areas. Significant areas of the Region are covered by wetlands, and many streams are mere threads of water through these wetlands. The 11 major watersheds of southeastern Wisconsin are depicted on Map 24, along with the surface drainage pattern of the major perennial stream system.

A major subcontinental divide, oriented in a generally northwesterly-southeasterly direction, approximately bisects the Region so that about 1,685 square miles lying west of the divide, or 63 percent of the Region, drains to the Mississippi River, while the remaining 1,004 square miles, or 37 percent, is tributary to the Great Lakes-St. Lawrence River drainage basin. The subcontinental divide not only exerts a major physical influence on the gross drainage pattern of the Region, but also carries with it certain legal constraints on the diversion of water across the divide, and thereby constitutes an important consideration in land use planning. The surface water drainage pattern of southeastern Wisconsin may be further subdivided so as to identify 11 major watersheds, five of which—the Root River, Menomonee River, Kinnickinnic River, Oak Creek, and Pike River watersheds—are wholly contained within the Region. In addition to these 11 major watersheds, there are numerous small catchment areas contiguous to Lake Michigan that drain directly to the lake via local natural watercourses and artificial drainageways. These areas together may be considered as comprising a twelfth watershed.[5]

[5] *The Commission has completed comprehensive watershed studies for the 197-square-mile Root River watershed; the 939-square-mile Fox River watershed; the 694-square-mile Milwaukee River watershed, 430 square miles of which lie in the Region; the 137-square-mile Menomonee River watershed; and the 25-square-mile Kinnickinnic River watershed. Comprehensive watershed studies have, therefore, been completed for 1,728 square miles, or 64 percent, of the 2,689-square-mile seven-county Region. The Commission is currently (1980) conducting a comprehensive planning program for the 52-square-mile Pike River watershed which, upon completion, will increase the portion of the Region included in watershed studies to 1,780 square miles, or 66 percent of the total area of the Region.*

Map 22

PHYSIOGRAPHIC FEATURES OF THE REGION

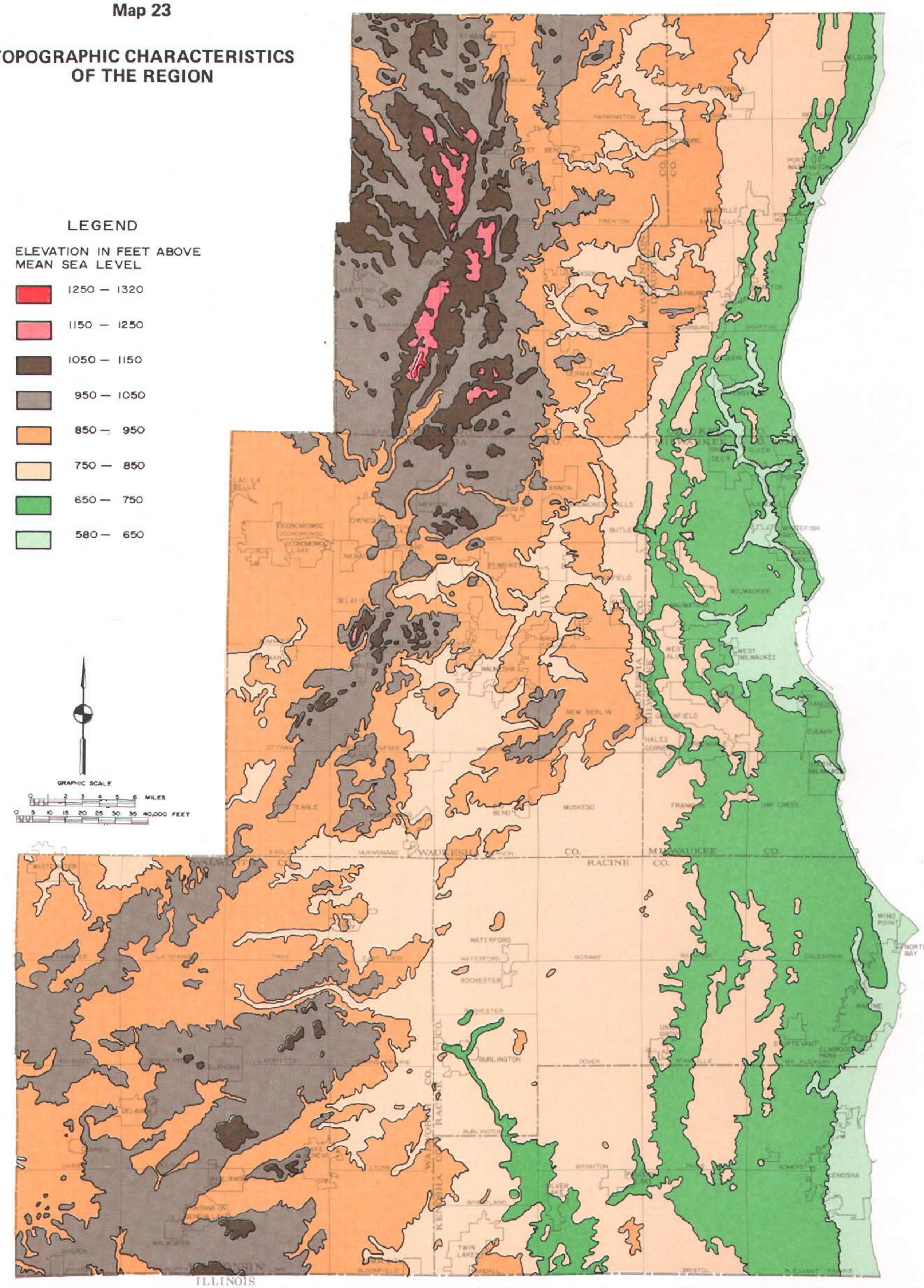


Physiographic features, or surficial land forms, throughout southeastern Wisconsin were determined largely by repeated stages of glaciation, the last of which, the Wisconsin stage, is believed to have ended about 10,000 years ago. Included in the great variety of interesting and attractive glacial land forms covering the Region are ground and recessional moraines, abandoned lake basins, outwash plains, kames, eskers, and drumlins. The dominant feature is the Kettle Moraine, an interlobate moraine lying in a northeasterly-southwesterly direction within the western part of the Region and formed by and between the Green Bay and Lake Michigan lobes of the continental glacier.

Source: SEWRPC.

Map 23

TOPOGRAPHIC CHARACTERISTICS OF THE REGION

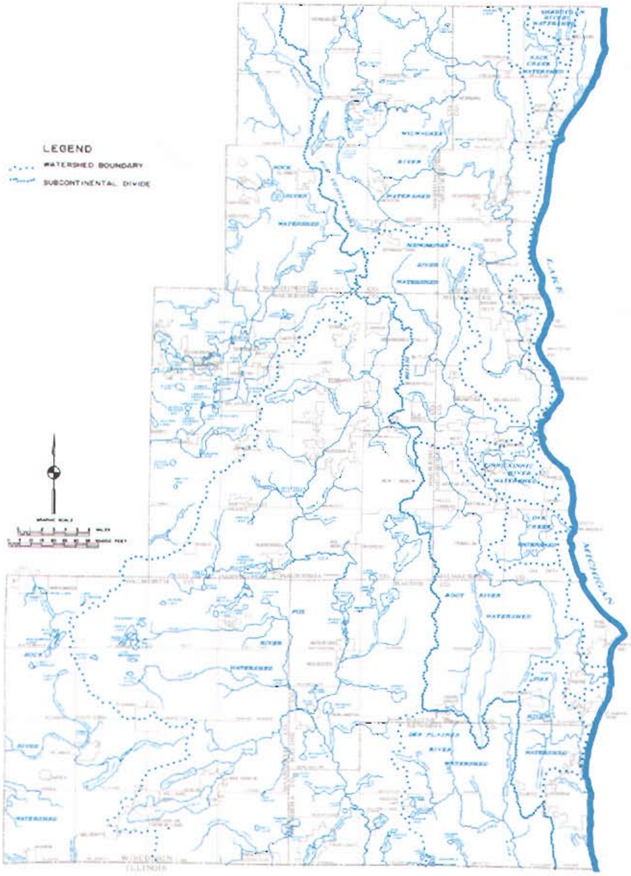


The topography, or relative elevation of the land surface throughout the Region, is determined by the configuration of the bedrock geology in combination with overlying glacial deposits. Elevations within southeastern Wisconsin range from a low of about 580 feet MSL on the Lake Michigan shore to a high of 1,320 feet MSL at Holy Hill in southwestern Washington County. Topographic highs and some of the most attractive landscapes and scenic vistas in the Region are coincident with the interlobate Kettle Moraine area in the western portion of the Region.

Source: SEWRPC.

Map 24

WATERSHEDS AND SURFACE WATER RESOURCES OF THE REGION



A subcontinental divide traverses the Southeastern Wisconsin Region. That part of the Region lying east of this divide is tributary to the Great Lakes-St. Lawrence River drainage system, while that part of the Region lying west of this divide is tributary to the Mississippi River drainage system. This subcontinental divide has certain important implications for water resources planning and management, since major diversions of water across this divide are restricted by law and interstate and international compacts. The generally dendritic surface water drainage pattern of the Region, which is the result of the glacial land forms and features, divides the Region into 11 individual watersheds, three of which—the Des Plaines, Fox, and Rock River watersheds—lie west of the subcontinental divide. In addition to the 11 watersheds, there are numerous small catchment areas along the Lake Michigan shoreline that drain directly to the lake, which areas together may be considered to comprise a twelfth watershed.

Source: SEWRPC.

GEOLOGY

Knowledge of bedrock and the surficial deposits overlying the bedrock is important to land use and transportation planning, as they directly affect the construction costs related to initial urban improvements such as residential developments and street and highway facilities and the extension of public utilities, particularly those involving extensive trenching or tunneling. In addition, the placement of urban improvements in relation to the bedrock and surficial deposits may directly or indirectly affect the quality and quantity of the groundwater resources of the Region.

Bedrock

The bedrock formations underlying the unconsolidated surficial deposits of southeastern Wisconsin consist of Cambrian through Devonian period rocks of the Paleozoic era that attain a thickness in excess of 1,500 feet along the eastern limits of the Region, which are in turn underlain by older, predominantly crystalline rocks of the Precambrian era. The bedrock geology of the Region is shown in Figure 14 by means of a map of the surface of the bedrock supplemented with a representative vertical section.

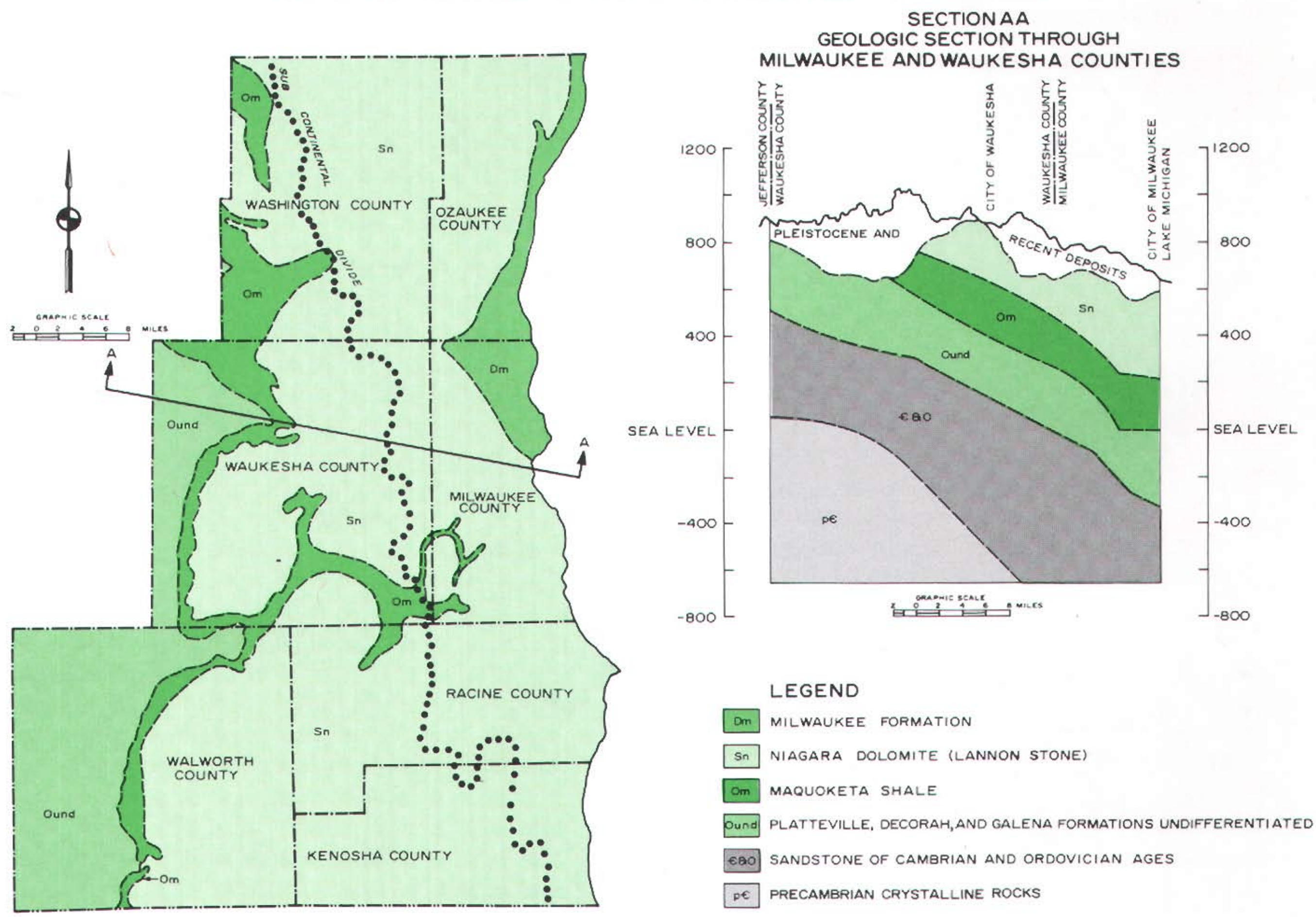
A stratigraphic column including a description of the lithologic characteristics of bedrock formation beginning with those dating back to the Ordovician period and of glacial deposits is presented in Table 73. Bedrock formations in the Region dip gently down toward the east at an average slope of about 20 feet per mile, with the result being that the bedrock lying immediately beneath the unconsolidated surficial deposits in the western extremities of the Region includes older rocks of the Ordovician period, whereas in the east along Lake Michigan younger rocks of the Silurian and Devonian periods lie immediately beneath the surficial deposits.

Surficial Deposits

The bedrock of the Region is, for the most part, covered by deep, unconsolidated glacial deposits, attaining a thickness in excess of 500 feet in some buried preglacial valleys. Bedrock lies within 20 feet of the ground surface within certain areas of the Region that together total only about 150 square miles in extent, and in a few localized areas the bedrock is actually exposed at the surface. These shallow drift areas and rock outcrops tend to occur in Washington and Waukesha Counties along a northeasterly-southwesterly alignment generally paralleling the interolobate Kettle Moraine, and reflect the presence of a preglacial ridge. Map 25 depicts the spacial variation of the thickness of surficial deposits overlying the bedrock that may be generally expected within the Region.

Figure 14

MAP AND CROSS SECTION OF BEDROCK GEOLOGY IN THE REGION



Source: SEWRPC.

SOILS

Soil properties exert a strong influence on the manner in which man uses land. Soils are an irreplaceable resource, and mounting pressures upon land are constantly making this resource more and more valuable. A need exists, therefore, in any comprehensive land use-transportation planning program to examine not only how land and soils are presently used, but also how they can be best used and managed. This requires an areawide soil suitability study which maps the geographic locations of various kinds of soils; identifies their physical, chemical, and biological properties; and interprets these properties for land use and public facilities planning. The resulting comprehensive knowledge of the character and suitability of the soils can be extremely valuable in every phase of the planning process. Soils information can comprise a prime input into the preparation of planning standards; the analysis of existing land uses; plan synthesis, testing, and evaluation; and, perhaps most important of all, plan implementation.

For planning application, the necessary soils studies must be designed to permit careful assessment of the engineering, agricultural, and nonagricultural plant material properties of soils, and the relationship of wildlife population to soils. These assessments can then serve as the basis for the selection of desirable spatial distribution patterns for residential, commercial, industrial, agricultural, and recreational land use development, and for the selection of highway, railroad, airport, pipeline, and other transportation facility locations.

Table 73

STRATIGRAPHIC COLUMN OF BEDROCK AND GLACIAL DEPOSITS IN THE REGION

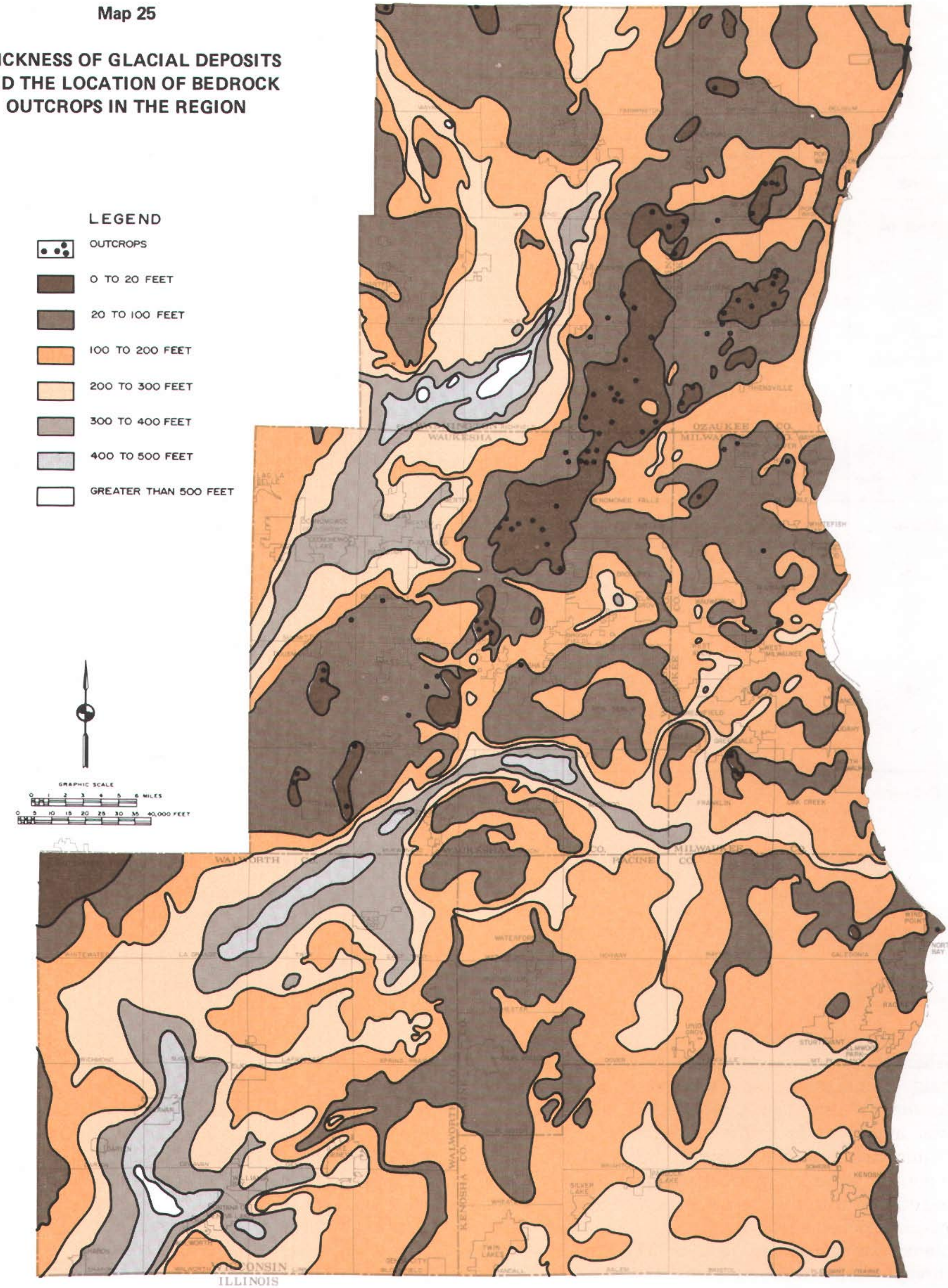
System	Series	Formation	Lithologic Description
Quaternary		Recent Deposits	Soils, muck, peat, alluvium, beach sand, and gravel. 0 to 5 feet thick.
		Pleistocene Deposits	Till and outwash sand and gravel. 0 to 430 feet thick.
		Kenwood	Shale, black, carbonaceous. Fossiliferous. No outcrops. Found in City of Milwaukee intake tunnel—Lake Michigan. Approximately 55 feet thick.
Devonian		Milwaukee	Shale, shaly limestone; lower 1/3 dolomite. Fossiliferous. Approximately 130 feet thick.
	Middle Erian	Thiensville	Dolomite, thick to thin-bedded. Some fossils. Small amounts of bitumen. Approximately 65 feet thick.
		Lake Church	Dolomite, thick to thin-bedded. Fossiliferous. Pyritic in places. Approximately 27 feet thick.
Silurian	Cayugan	Waubakee	Dolomite, thin-bedded, hard and brittle. Fossils scarce. Approximately 30 feet thick.
		Racine	Dolomite, fine to coarsely crystalline. Thick- to thin-bedded. Barren to fossiliferous. Approximately 100 feet thick.
	Niagaran	Manistique	Dolomite—lower part thin-bedded. Fossils. Upper—fairly thin-bedded, cherty. Many corals. Approximately 150 feet thick.
		Burnt Bluff	Dolomite, thick-bedded or thin-bedded. Lower part, a few fossils. Upper part, semilithographic. No fossils. Approximately 110 feet thick.
	Alexandrian	Mayville	Dolomite, thick-bedded, compact to coarsely crystalline. Brecciated in places, cherty, many reef structures. Approximately 175 feet thick.
Ordovician	Cincinnatian	Meda	Red-brown oolitic iron ore and nonoolitic ore. Missing in Racine, Milwaukee, Ozaukee, Door, and Dodge Counties. In lenses up to approximately 55 feet thick.
		Maquoketa	Shale, dolomitic and beds of dolomite. Fossiliferous. 90 to 225 feet thick.
	Champlainian	Salena	Dolomite, thick- to thin-bedded, fine to coarsely crystalline. Cherty. Shaly and sandy in places; some fossils. Approximately 227 feet thick.

Source: SEWRPC.

When the Southeastern Wisconsin Regional Planning Commission was created, a very limited amount of useful data on the soils of the Region was available. In order to fulfill the soils data requirements of the Commission's initial regional planning program, a cooperative agreement was negotiated with the Soil Conservation Service under which detailed operational soil surveys were completed for the entire Region. The results of the survey were published under the initial regional land use-transportation study in SEWRPC Planning Report No. 8, Soils of Southeastern Wisconsin. In addition to detailed information on the physical, chemical, and biological properties of the soils mapped, the report contains interpretations of these data for planning purposes. These interpretations include suitability ratings for potential intensive and extensive residential, commercial, industrial, transportation, natural and developed recreational, and agricultural uses. Suitability ratings are also included for specific uses, such as onsite soil absorption sewage disposal, building foundations, earthwork, road subgrade, lawns, and golf courses, and for the soil as a source of material for backfill, topsoil, and water reservoir embankments and linings. All of the data and interpretations are summarized in tabular form suitable for ready use in planning and engineering analyses.

Map 25

THICKNESS OF GLACIAL DEPOSITS AND THE LOCATION OF BEDROCK OUTCROPS IN THE REGION



Most of the Region is covered by unconsolidated glacial drift deposited by continental glaciers. This drift attains a thickness in excess of 500 feet in some preglacial valleys. Dolomitic bedrock lies within 20 feet of the surface or is actually exposed as outcrops in areas totaling about 150 square miles. The northeasterly-southwesterly alignment of the rock outcrop sites indicates the presence of a buried preglacial bedrock ridge which is an important consideration in planning for and construction of septic tank systems, public sewerage systems, and other public works projects that involve extensive trenching and excavation.

Source: T. O. Friz, Man and the Materials of Construction, How They Interrelate in the Seven Counties of Southeastern Wisconsin, Ph.D. Dissertation, University of Wisconsin, Madison, Wisconsin, 1969.

Map 26 shows, in generalized form, the major soil relationships existing within the Region, based upon seven broad suitability associations. The soils designated on this map as Group "A," which cover about 29 percent of the Region, are generally well suited for both agricultural use and urban development. These soils are not only very productive as cropland, but have good drainage and foundation characteristics for all types of urban development. This soils group generally occurs in a belt lying between the present westerly limits of intensive urban development and the easterly limits of the Kettle Moraine. It is interesting to note that this broad soils group does not occur at all in Milwaukee County, and occurs to only a very limited extent in Ozaukee, Kenosha, and Racine Counties.

The soils designated as Group "B" generally have a sandy-gravelly subsurface, and are well suited to both agricultural use and urban development with septic tank sewage disposal systems. Approximately 14 percent of the Region is covered by this general soils group, which occurs in the Kettle Moraine and the recessional moraine areas of the Region and to a limited extent along the Lake Michigan shore.

The soils designated as Group "C" are fairly to poorly suited for agricultural use. Their suitability for urban development is limited by characteristically steep slopes. These soils are suitable for very large lot residential development which does not disturb the natural topography. Approximately 8 percent of the Region is covered by this soils group, which is prevalent in the Kettle Moraine and the recessional moraine areas of the Region.

The soils designated as Group "D" are generally well suited for agricultural use but generally unsuited for urban development requiring the use of onsite septic tank sewage disposal systems. Urban development on these soils generally requires a high level of municipal improvements and careful attention to storm water drainage. Nearly 31 percent of the Region is covered by this general soils group, which occurs primarily between the Lake Michigan shore and the westerly limits of present urban development. Much of the existing urban development in the Region has occurred on the soils in this group.

The soils designated as Group "E" are generally not well suited for either cropland or urban development. Bedrock normally occurs within four feet of the surface, and bedrock outcrops are common. Good gravel and rock deposits, which are suitable for commercial development, occur in this group. Approximately 1 percent of the Region is covered by this group, which occurs primarily in isolated pockets throughout the Region.

The soils designated as Group "F" are generally poorly drained, have a high water table, and are interspersed with areas of peat, muck, and other organic soils. Approximately 11 percent of the Region is covered by this group, which generally occurs along streams and watercourses of the Region. For this reason, the soils in this group are commonly subject to flooding. These characteristics generally preclude their use for nearly all forms of development except limited agricultural wetland, forest, wildlife conservation, and recreational uses.

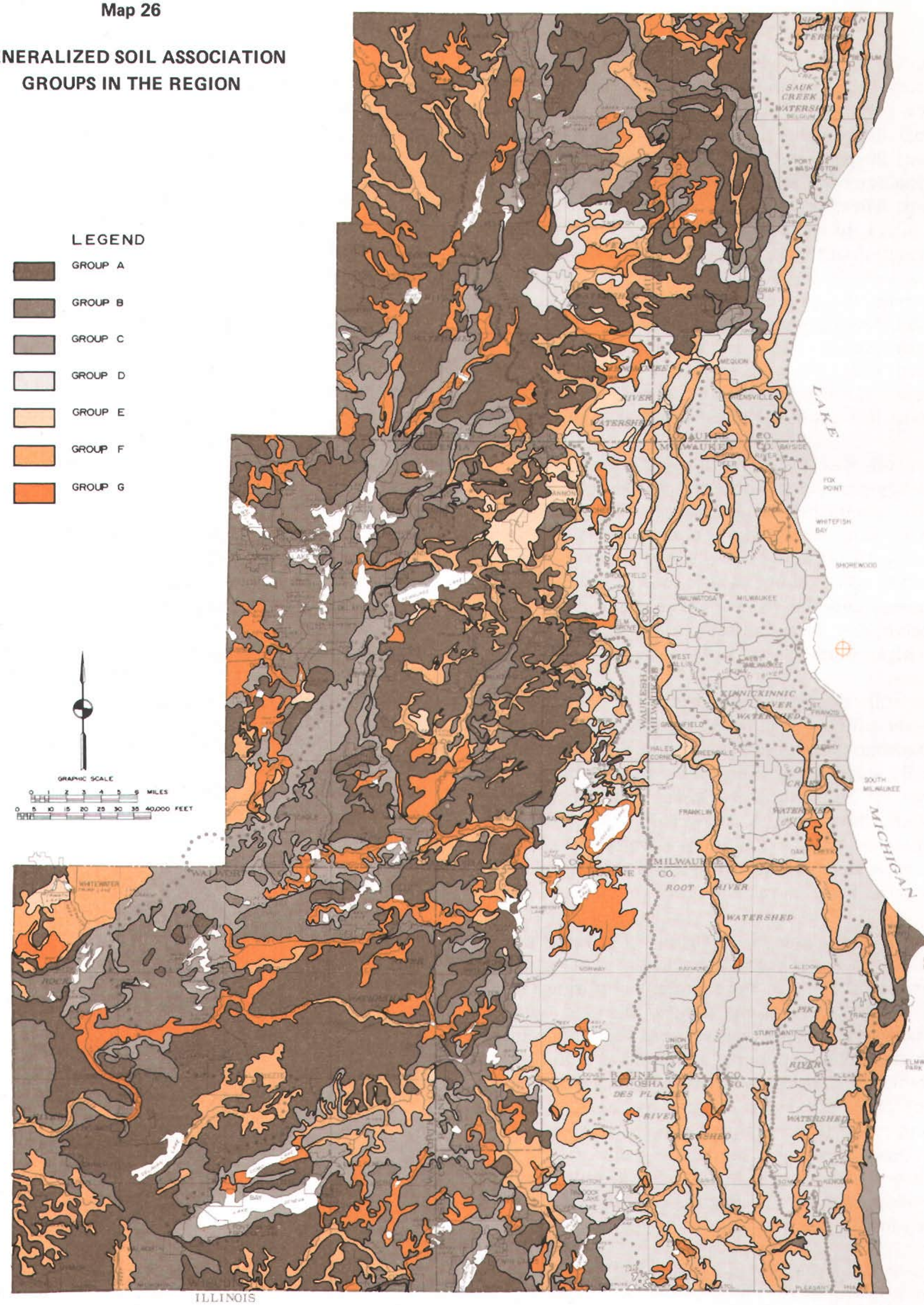
The soils designated as Group "G" are peat and muck soils and are generally unsuited for urban development of any kind. These areas, when left in a natural state, are ideally suited for wildlife habitat and, if properly drained, are suitable for certain types of agricultural use. Approximately 6 percent of the Region is covered by this soils group, which occurs in scattered corridors and pockets throughout the Region.

Proper location of new urban development in relation to the soils of the Region is particularly important because, irrespective of the generalized groupings described above, analysis of the detailed soil survey data to date indicates that many soils have questionable characteristics for urban development, especially residential development in suburban and rural locations utilizing onsite sewage disposal systems. Approximately 40 percent of the estimated 125 soils series[6] occurring within the Region have been found to be troublesome in this respect. Urban development undertaken in disregard of these soil conditions has actually created severe environmental problems within the Region, with the result being that the state health authorities have placed restrictions on the development of new subdivision plats in certain areas of the Region and have issued orders for the installation of public sanitary sewer facilities in other areas originally developed with onsite soil absorption sewage disposal systems.

[6] *A soil series is defined as a group of soils developed from a common parent material and having horizons with similar characteristics except for the texture of the surface soil.*

Map 26

GENERALIZED SOIL ASSOCIATION GROUPS IN THE REGION



As shown on this generalized soil map of the seven-county Southeastern Wisconsin Region, nearly one-half of the 2,689 square mile Region is covered by soils in groups D, E, F, or G which are generally poorly suited for development with onsite soil absorption sewage disposal systems. The detailed soil survey completed for the Region in 1966 provides more definitive soils data for use in local, as well as regional, planning and development.

Source: U. S. Soil Conservation Service and SEWRPC.

It should also be noted that soils poorly suited or unsuited for urban development even if served by public sewer are also widespread throughout the Region. Urban development on such soil types is expensive not only to construct initially but also to maintain. Again, it should be stressed that the widespread occurrence of soils having questionable characteristics for certain types of urban development, coupled with the highly complex soil relationships, indicates the need for basing regional and local development plans on the results of the detailed soil surveys rather than on any generalized soils data.

Detailed Soil Suitability Interpretations

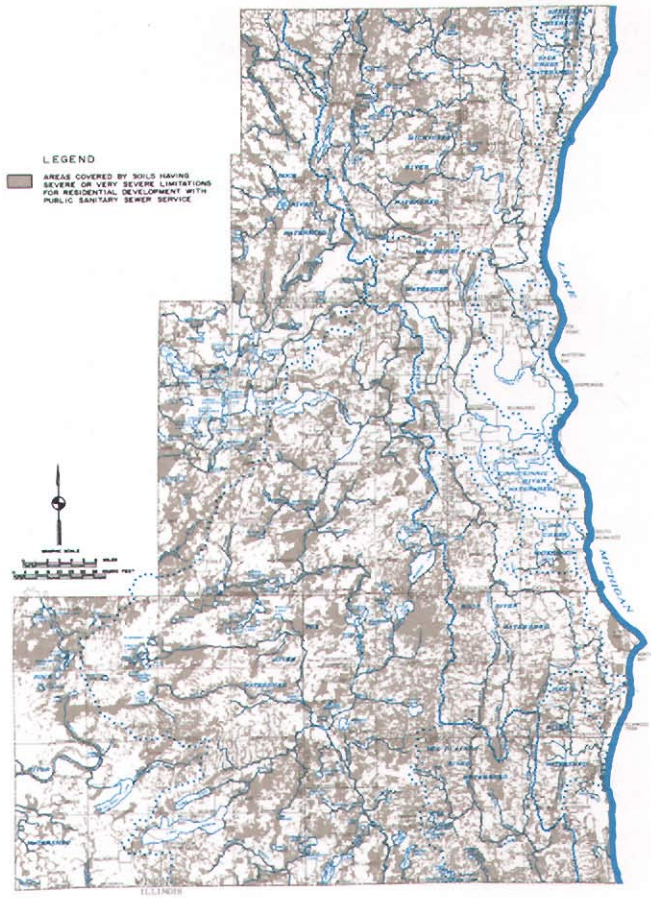
Soil suitability interpretations for specified types of urban development, especially residential development, are important to regional land use planning. These specified types of urban development include: residential development with public sanitary sewer service, residential development without public sanitary sewer service, residential development without public sanitary sewer service on lots smaller than one acre in size, and residential development without public sanitary sewer service on lots one acre or larger in size. Some of the more important considerations in determining soil suitability for urban development include depth to bedrock, depth of water table, likelihood of flooding, soil permeability, and slope.

On the basis of the detailed soil surveys, it is evident that much of the Southeastern Wisconsin Region exhibits severe or very severe limitations for specific types of urban development. As shown on Map 27, approximately 716 square miles, or about 27 percent of the area of the Region, are covered by soils which are poorly suited for residential development with public sanitary sewer service, or stated differently, poorly suited for residential development of any kind. Approximately 1,637 square miles, or about 61 percent of the area of the Region, are, as shown on Map 28, covered by soils which are poorly suited for residential development without public sanitary sewer service on lots smaller than one acre in size. As shown on Map 29, approximately 1,181 square miles, or about 44 percent of the area of the Region, are covered by soils poorly suited for residential development without public sanitary sewer service on lots one acre or larger in size. It should be noted that the use suitability ratings on which these maps are based are empirical, being based upon the performance of similar soils elsewhere for the specified uses as well as upon the performance of such physically observed conditions as high water table, slow permeability, high shrink-swell potential, low bearing capacity, frost heave, and frequent flood overflow.

It should be noted that in May 1975, the Wisconsin Department of Health and Social Services, Division of Health, approved for use throughout Wisconsin three new types of "package" onsite soil absorption sewage disposal systems commonly known as "mound" systems, designed to overcome natural soil limitations relative to impermeability, high groundwater, and shallow bedrock.

Map 27

SUITABILITY OF SOILS IN THE REGION FOR RESIDENTIAL DEVELOPMENT WITH PUBLIC SANITARY SEWER SERVICE

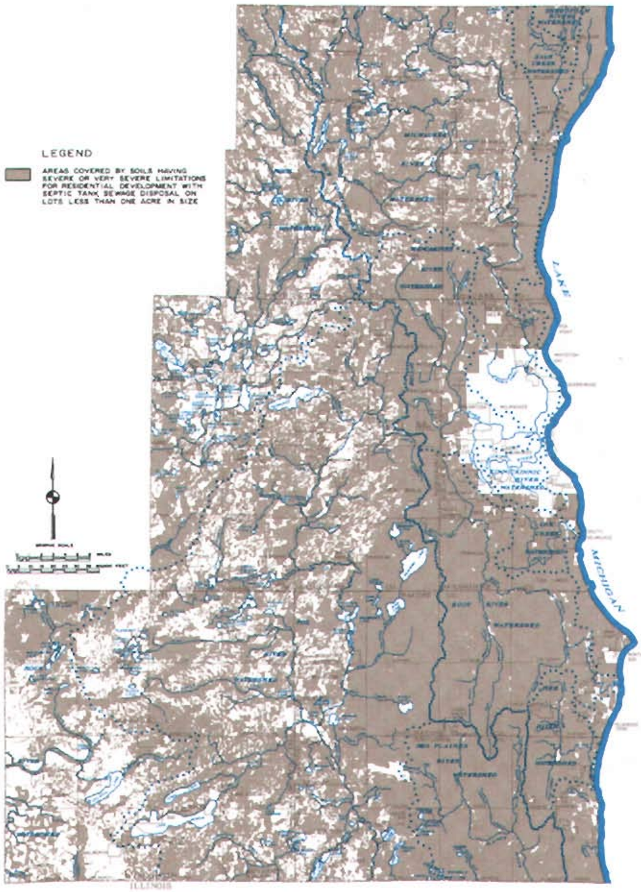


A recognition of the limitations inherent in the soil resource base is essential to the sound urban and rural development of the Region. About 716 square miles, or 27 percent of the area of the Region, are covered with soils which are poorly suited for residential development with public sanitary sewer service, or, more precisely, residential development of any kind. These soils, which include wet soils having a high water table or poor drainage, organic soils which are poorly drained and provide poor foundation support, and soils which have a flood hazard, are especially prevalent in the riverine areas of the Region.

Source: U. S. Soil Conservation Service and SEWRPC.

Map 28

SUITABILITY OF SOILS IN THE REGION FOR SMALL LOT RESIDENTAL DEVELOPMENT WITHOUT PUBLIC SANITARY SEWER SERVICE



Approximately 1,637 square miles, or about 61 percent of the area of the Region, are covered by soils poorly suited for residential development on lots having an area smaller than one acre and not served by public sanitary sewerage facilities. Reliance on septic tank sewage disposal systems in these areas, which are covered by relatively impervious soils or are subject to seasonally high water tables, can only result in eventual malfunctioning of such systems and the consequent intensification of water pollution and public health problems in the Region.

Source: U. S. Soil Conservation Service and SEWRPC.

While the rules adopted by the Division of Health currently restrict the applicability of the mound systems, it is likely that if the mound systems prove to be operational on a widespread basis, all restrictions relating to such use will be lifted. Similarly, it is highly likely that the additional package systems to be developed will be designed to overcome nearly all natural soil limitations that currently inhibit or restrict the utilization of onsite sewage disposal systems. As a net result of these developments, soil limitations for onsite sewage disposal would no longer serve as a constraint on regional settlement patterns, thereby permitting substantial additional areas to be developed for urban use without centralized sanitary sewerage systems. Map 29 identifies that additional area of the Region which could be subject to urban development with mound-type septic tank systems if the current restrictions on the application of the mound system are lifted and the additional package systems now being developed are introduced. This area totals approximately 465 square miles, or about 17 percent of the area of the Region. In effect, only those soils currently unsuitable even for residential development with public sanitary sewer service would remain undevelopable.

WATER RESOURCES

Surface water resources, consisting of lakes, streams, and associated floodlands, form the singularly most important element of the natural resource base of the Region. Their contribution to the economic development, recreational activity, and aesthetic quality of the Region is immeasurable. The groundwater resources of southeastern Wisconsin are closely interrelated with the surface water resources inasmuch as they sustain lake levels and provide the base flow of streams. The groundwater resources, along with Lake Michigan, constitute the major sources of supply for domestic, municipal, and industrial water users.

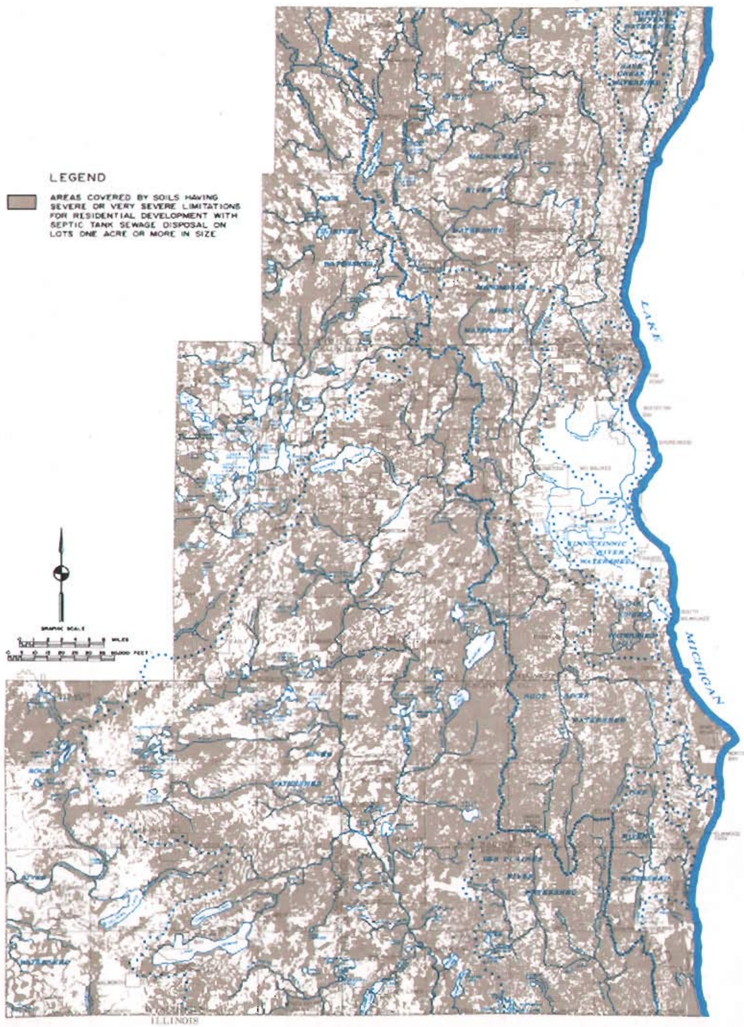
Surface Water Resources

Lakes and streams constitute an extremely valuable part of the natural resource base of southeastern Wisconsin. Inasmuch as they are focal points for water-related recreational activities popular with the inhabitants of the Region, they provide extremely attractive sites for properly planned residential development and, when viewed in the context of open space areas, greatly enhance the aesthetic aspects of the environment. It is important to note that, in addition to being valued highly by the urban and rural population of the Region, lakes and streams are extremely susceptible to deterioration through the activities of that population. Water quality can degenerate as a result of excessive nutrient loads from malfunctioning or improperly placed septic tank systems, inadequate operation of waste treatment facilities, careless agricultural practices, and inadequate soil conservation practices. Lakes and streams are also adversely affected by the excessive development of lakeshore and riverine areas in combination with the filling of peripheral wetlands, which removes valuable nutrient and sediment traps while adding nutrient and sediment sources. The regional surface water

Map 29

SUITABILITY OF SOILS IN THE REGION FOR LARGE LOT RESIDENTIAL DEVELOPMENT WITHOUT PUBLIC SANITARY SEWER SERVICE

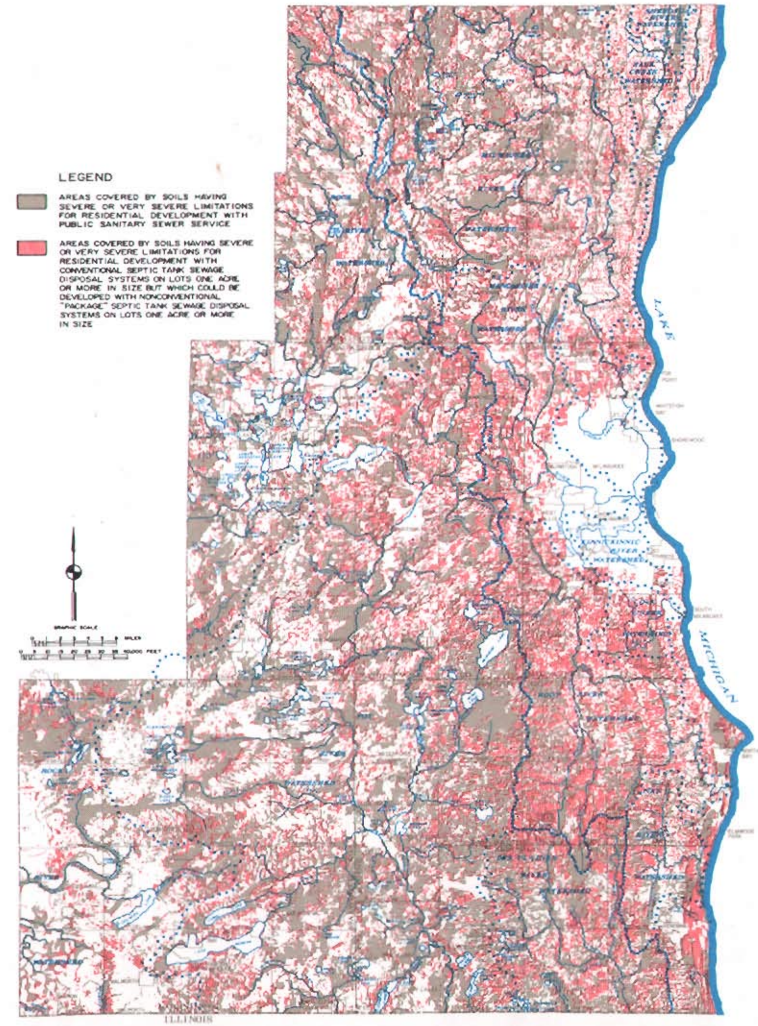
Suitability Assuming Conventional Septic Tank System



Approximately 1,181 square miles, or about 44 percent of the area of the Region, are covered by soils poorly suited for residential development on lots having an area of one acre or more and not served by public sanitary sewerage facilities. The inherent limitations of these soils for septic tank sewage disposal systems cannot be overcome simply by the provision of larger lots, and the use of such systems on these soils which cannot absorb the sewage effluent ultimately results in surface ponding and runoff of partially treated wastes into nearby watercourses.

Source: U. S. Soil Conservation Service and SEWRPC.

Suitability Assuming Nonconventional "Package" Septic Tank System



The above map identifies those areas of the Region which, while naturally unsuited for residential development with onsite soil absorption septic tank sewage disposal systems on large lots, could eventually be subject to such development assuming widespread use of the new "package" septic tank sewage disposal systems. Through the construction of artificial mounds and the utilization of mechanical dosing, the new systems overcome natural soil limitations relative to impermeability, high groundwater, and shallow bedrock. These additional areas amount to approximately 465 square miles, or about 17 percent of the area of the Region. Utilization of the new mound systems would require at least a one-acre parcel for a typical single-family home.

Source: SEWRPC.

resources must be properly managed to adjust man's uses to the quantity and quality of surface waters that are available, and to achieve a reasonable balance between public and private use and enjoyment of those surface water resources.

Lakes: Major lakes are defined herein as those having 50 or more acres of surface water area, a size capable of supporting reasonable recreational use with relatively little degradation of the resource. There are 100 major lakes within the Region, the location and relative sizes of which are shown on Map 24. A tabular summary[7] by county, of the surface water resources of southeastern Wisconsin is presented in Table 74. Major lakes in the Region have a combined surface water area of 57 square miles, or about 2 percent of the area of the Region, and provide a total of 448 miles of shoreline. Lake Geneva is by far the largest lake in southeastern Wisconsin, having a surface area of 5,262 acres, and is more than twice as large as Pewaukee Lake, which, with an area of 2,493 acres, is the second largest lake in the Region.

Streams: As noted earlier and as shown on Map 24, the surface drainage system of southeastern Wisconsin may be viewed as existing within 11 individual watersheds, five of which—the Root River, Menomonee River, Kinnickinnic River, Oak Creek, and Pike River watersheds—are contained entirely within the Region. In addition to the 11 watersheds, numerous small catchment areas immediately adjacent to the Lake Michigan shoreline drain directly to the lake via local natural streams and artificial drainageways, and these tributary areas together may be considered to comprise a twelfth watershed.

One of the most interesting, variable, and occasionally unpredictable features of each watershed is its river and stream system in its ever changing, sometimes widely fluctuating, discharges and stages. The stream systems of the Region receive a relatively uniform flow of groundwater from the shallow aquifer underlying the Region. This groundwater discharge constitutes the base flow of the streams. The streams also periodically intercept surface water runoff from rainfall and snowmelt, which is superimposed on the base flow and sometimes causes the streams to leave their channels and occupy the adjacent floodlands. The volume of water drained annually from southeastern Wisconsin by the stream system is equivalent to seven to eight inches of water spread over the seven-county Region, which amounts to about one-fourth of the average annual precipitation.

Major streams are defined herein as perennial streams which maintain, at a minimum, a small, continuous flow throughout the year except under unusual drought conditions. Within the Region, there are approximately 1,148 miles of such major streams, as summarized by county in Table 74. Water quality conditions and long-term trends in such conditions were analyzed by the Commission from data obtained at 87 sampling stations located at strategic points on the stream networks of the major watersheds of the Region from 1964 through 1975. Such sampling data permitted water quality conditions to be ascertained for a total of 459 miles of perennial streams in the Region. For the Region as a whole, no major shift in water quality conditions over the study period was found. A slight decline in water quality was noted despite improvements observed at sampling stations below points of improved or reduced effluent discharges from sewage treatment plants, indicating that attention to the abatement of pollution from point sources alone will not be enough to meet the water use objectives and supporting water quality standards. Of the total network of 459 miles of perennial streams studied, only 88 miles, or 19 percent, met the adopted state water quality standards in 1975, compared to 164 miles, or 36 percent, in 1964. If phosphorus levels are also taken into account, there being no state phosphorus standard at the present time, only about nine miles of streams in 1975 met Commission-recommended standards.

Floodlands: The floodlands of a river or stream are the wide, gently sloping areas contiguous with, and usually lying on both sides of, a river or stream channel. Rivers and streams occupy their channels

[7] *See Appendix C of SEWRPC Planning Guide No. 5, Floodland and Shoreland Development Guide, for a detailed tabulation, by county, of lakes and ponds in southeastern Wisconsin. This report indicates the location of each lake and pond, and summarizes pertinent morphometric parameters for major lakes which have been revised under the Commission's Fox and Milwaukee River watershed studies published as SEWRPC Planning Reports No. 12, A Comprehensive Plan for the Fox River Watershed, Volumes One and Two, and No. 13, A Comprehensive Plan for the Milwaukee River Watershed, Volumes One and Two.*

Table 74

LAKES AND STREAMS IN THE REGION BY COUNTY

County		Lakes[a]						Lakes[a]			
		Major[b]						Minor[c]			
			Total Surface Area			Largest Lake			Total Surface Area		
Name	Area (Square Miles)	Number	Square Miles	Percent of County	Total Shoreline Length (Miles)	Name	Area (Acres)	Number	Square Miles	Percent of County	Total Shoreline Length (Miles)
Kenosha	278.28	15	5.06	1.82	48.62	Elizabeth Lake	637.80	9	0.27	0.10	5.85
Milwaukee . . .	242.19	--	--	--	--	--	--	40	0.26	0.11	14.99
Ozaukee	234.49	2	0.47	0.20	4.75	Mud Lake	245.40	36	0.63	0.27	25.40
Racine.	339.87	10	5.48	1.61	59.52	Wind Lake	936.20	7	0.17	0.05	4.59
Walworth. . . .	578.08	25	19.52	3.38	131.40	Lake Geneva	5,262.40	9	0.35	0.06	9.10
Washington . .	435.50	15	4.22	0.97	40.59	Big Cedar	932.00	43	0.70	0.16	24.32
Waukesha. . . .	580.66	33	22.07	3.80	162.89	Pewaukee	2,493.00	84	1.62	0.28	57.08
Region	2,689.07	100	56.82	2.11	447.77	--	10,506.80	228	4.00	0.15	141.33

County		Lakes[a]				Major Streams[d]			
		Total							
			Total Surface Area					Total Surface Area	
Name	Area (Square Miles)	Number	Square Miles	Percent of County	Total Shoreline Length (Miles)	Number	Total Length (Miles)	Square Miles	Percent of County
Kenosha	278.28	24	5.33	1.92	54.47	19	106.40	0.73	0.03
Milwaukee . . .	242.19	40	0.26	0.11	14.99	15	102.99	0.62	0.03
Ozaukee	234.49	38	1.10	0.47	30.15	29	112.20	1.25	0.05
Racine.	339.87	17	5.65	1.66	64.11	14	100.55	0.96	0.01
Walworth. . . .	578.08	34	19.87	3.44	140.50	29	173.00	0.58	0.01
Washington . .	435.50	58	4.92	1.13	64.91	38	219.80	1.03	0.02
Waukesha. . . .	580.66	117	23.69	4.08	219.97	50	333.30	1.31	0.02
Region	2,689.07	328	60.82	2.26	589.10	194	1,148.24	6.48	0.02

[a] *Appendices B, C, and D to SEWRPC Planning Guide No. 5, Floodland and Shoreland Development Guide, contain detailed tabulations, by county, of all streams, lakes, and ponds in the Southeastern Wisconsin Region. These appendices indicate the location of each stream, lake, and pond and summarize pertinent morphometric parameters. Surface areas and shoreline lengths for some of the major lakes have been revised under the Commission Fox and Milwaukee River watershed studies, documented in SEWRPC Planning Report No. 12, A Comprehensive Plan for the Fox River Watershed; Volumes 1 and 2, and SEWRPC Planning Report No. 13, A Comprehensive Plan for the Milwaukee River Watershed, Volumes 1 and 2. Entries in this table reflect the revised figures for major lakes.*

[b] *A major lake is defined as one having 50 acres or more of surface water area.*

[c] *A minor lake is defined as one having less than 50 acres of surface water area.*

[d] *A major stream is defined as one which maintains, at a minimum, a small, continuous flow throughout the year except for unusual drought conditions.*

Source: Wisconsin Department of Natural Resources and SEWRPC.

most of the time. However, during even minor flood events, stream discharges increase markedly such that the channel is not able to convey all the flow. As a result, stages increase and the river or stream spreads laterally over the floodlands. The periodic flow of a river onto its floodlands is a normal phenomenon, and in the absence of major, costly structural flood control works, will occur regardless of whether or not urban development occurs on the floodlands.

For planning and regulatory purposes, floodlands are normally defined as the areas, excluding the channel, subject to inundation by the 100-year recurrence interval flood event. This is the event that, on the average, would be reached or exceeded in severity once every 100 years. Stated another way, there is a 1 percent chance that this event will be reached or exceeded in severity in any given year. Commission studies indicate that about 6 to 10 percent of the total land area of any given watershed will be within the 100-year floodlands of the Region's rivers and streams. Obviously, the 100-year recurrence interval floodland contains within its boundaries the areas inundated by floods of less severe but more frequent occurrence such as the 50-, 25-, and 5-year recurrence interval events.

Floodland areas are generally not well suited to urban development because of flood hazards, high water tables, and inadequate soils. These floodland areas are, however, generally prime locations for much needed park and open space areas. Therefore, within the context of regional land use planning, every effort should be made to discourage indiscriminate urban development in floodlplains while encouraging open space uses.

Flood hazard data on the numerous streams of the Southeastern Wisconsin Region, and particularly data on the limits of the natural floodlands of the streams for a flood of a specific recurrence interval, are important inputs to the regional planning process. The Commission, as an integral part of its comprehensive watershed studies, provides definitive data, including a delineation of the limits of the floodplains, on the 10- and 100-year recurrence interval floods for most of the perennial streams in each watershed.

The status of existing flood hazard data in the Region as of 1978 is summarized on Map 30. The Commission has completed comprehensive watershed studies for the Root, Fox, Milwaukee, Menomonee, and Kinnickinnic River watersheds resulting in the delineation of floodlands for about 631 miles of major stream channels, not including stream channels in the Milwaukee River watershed lying outside the Region in Sheboygan and Fond du Lac Counties. Both 10- and 100-year recurrence interval floodplain limits have been established by the Commission for the indicated stream reaches in these watersheds. It is important that a flood used to delineate floodlands for land use planning as well as land use regulation purposes have a specified recurrence interval so that the benefits and costs, and the advantages and disadvantages, of various combinations of land use regulation, public acquisition, and public construction for flood damage abatement and prevention can be fully analyzed.

While the Commission is the only agency that has developed flood hazard data for the Region on the basis of comprehensive watershed studies, other federal and local agencies have developed flood hazard data for additional stream reaches within the Region. These are also indicated on Map 30.

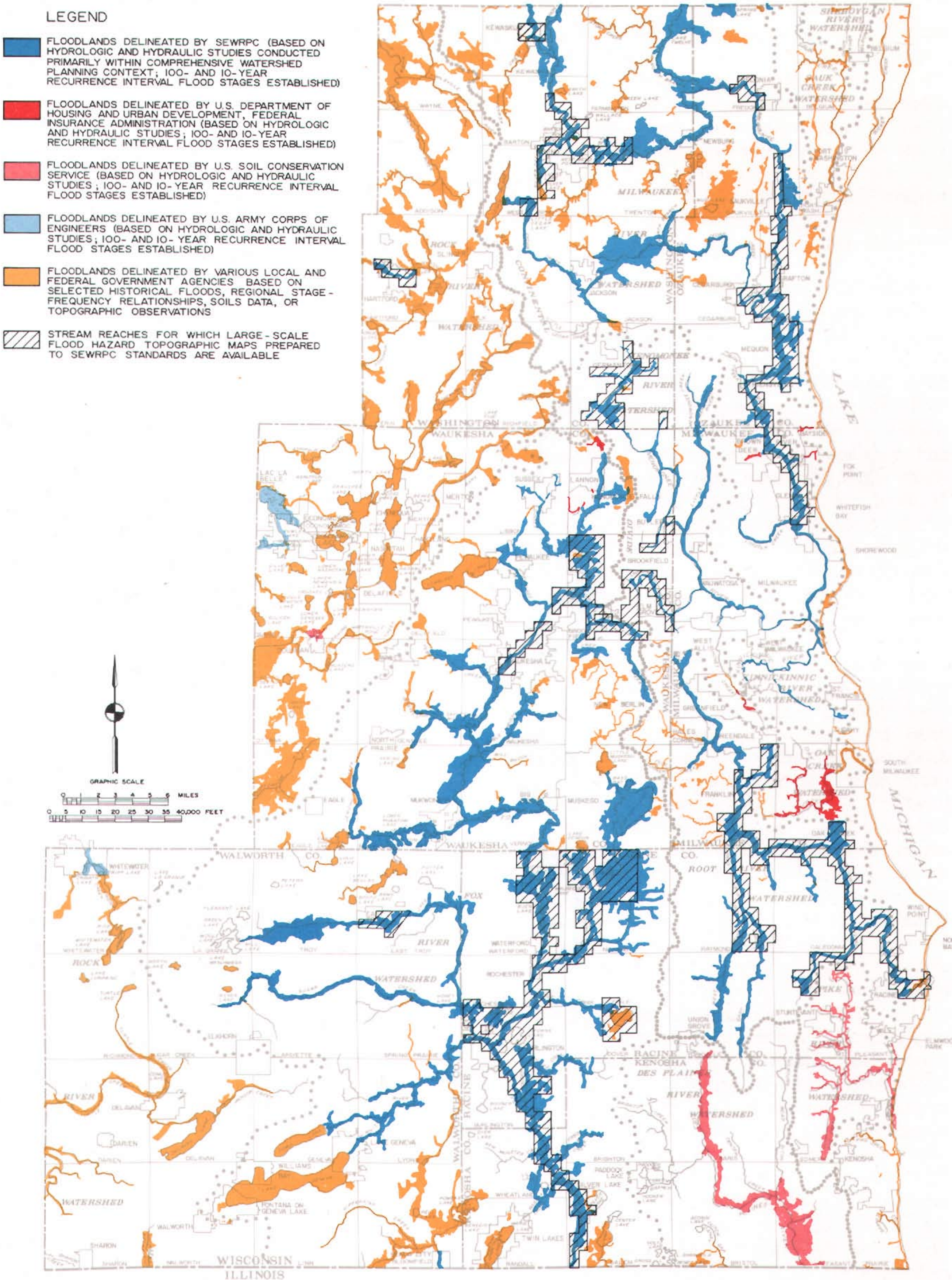
Groundwater Resources

Groundwater resources constitute an extremely valuable element of the natural resource base of southeastern Wisconsin. The groundwater reservoir not only sustains lake levels and provides the base flow of the streams in the Region, but comprises a major source of water supply for domestic, municipal, and industrial water users. Like surface water, groundwater is susceptible to depletion in quantity and to deterioration in quality. An important consideration in land use and transportation facility development, therefore, is the protection of the quantity and quality of this valuable resource.

The seven-county Region is richly endowed with groundwater resources. Continuous, relatively uniform discharge from groundwater storage provides for the base flow of the major streams within the Region. In 1970, groundwater was the source of water supply for 46 public water utilities, or 69 percent of the 67 public water utilities within the Region. Together these 46 utilities served a resident population of about 190,000 persons, or about 11 percent of the total resident population of the Region and 14 percent of the population of the Region served by public water utilities. In addition, many major industries within the Region utilize groundwater as a source of supply.

The rock units within the Region differ widely in the yield of stored water. Rock units that supply water in usable amounts to pumping wells and in important amounts to lakes and streams are called aquifers. The aquifers of southeastern Wisconsin

Map 30
FLOODLANDS IN THE REGION



Delineation of the floodlands of southeastern Wisconsin is extremely important for sound local as well as regional planning and development. The above map summarizes the status of floodland data in the Region as of the end of 1978. The Commission itself, as an integral part of its comprehensive watershed studies, provides definitive data on the 10- and 100-year recurrence interval floods for most of the perennial streams in each watershed studied. In addition to identifying the stream reaches for which existing flood hazard data in the Region are available and the agency from which the data are available, the above map shows those stream reaches for which detailed, large-scale flood hazard maps are available from the Commission. These maps are available at scales of 1" = 100' with 2' contour intervals, or 1" = 200' with 2'-4' contour intervals, and enable precise delineations of the floodplains to be accomplished.

Source: SEWRPC.

extend to great depths, attaining a thickness in excess of 1,500 feet in the eastern portions of the Region. An enormous reservoir of groundwater, therefore, lies beneath the Region. Three major aquifers exist within the seven-county Region. From land surface downward, they are: 1) the sand and gravel deposits in the glacial drift; 2) the shallow dolomite strata in the underlying bedrock; and 3) the deeper sandstone, dolomite, siltstone, and shale strata.

Because of their relative nearness to the land surface, and because of the hydraulic interconnection, the first two aquifers are commonly referred to collectively as the "shallow aquifer," while the latter is referred to as the "deep aquifer." Wells tapping these aquifers are referred to as shallow or deep wells, respectively. The shallow and deep aquifers are separated by the Maquoketa shale, which forms a relatively impermeable barrier between the two aquifers. The spatial distribution of the unconsolidated surficial material and the thickness and orientation of the bedrock strata are depicted on Figure 14, and lithologic descriptions of the surficial deposits and the bedrock are provided in Table 73.

Some water is recharged to the deep sandstone aquifer underlying the Region by vertical movement through wells open to both the shallow and deep aquifers and by some vertical movement downward through the Maquoketa shale. The principal source of recharge to the deep aquifer, however, is precipitation percolating downward through glacial deposits into the deep aquifer which, as shown in Figure 14, is exposed beneath the glacial deposits only in the western one-half of Walworth County and the western one-quarter of Waukesha County. The deep aquifer recharge area for southeastern Wisconsin is a long narrow zone oriented in a generally north-south direction. It is bounded on the east by the Maquoketa shale and on the west by a groundwater divide—the separation between eastward and westward groundwater movements— that is located along the western edge of Waukesha and Walworth Counties. Groundwater in the deep aquifer beneath the Region moves in a generally easterly direction from the primary western recharge areas toward Lake Michigan. Thus, most of the water withdrawn from the deep sandstone aquifer by communities and industries in the seven-county Region originally entered the aquifer via the Waukesha and Walworth County recharge areas.

Whereas the primary source of recharge for the deep sandstone aquifer is located partly outside southeastern Wisconsin, the shallow aquifer, composed of the glacial drift and interconnected dolomitic bedrock, is recharged locally through the downward percolation of precipitation and surface water. The direction of water movement in the shallow aquifer is much more viable and complex than that in the deep aquifer. Movement occurs from local recharge areas toward multiple points of discharge such as streams, lakes, marshes, and wells. Relative to the deep aquifer, the shallow aquifer is more susceptible to pollution by wastewater because it is nearer, both in terms of distance and time, to potential pollution sources, thus minimizing the potential for dilution, filtration, and other natural processes that tend to reduce the potential detrimental effects of pollutants.

The current quality of groundwater in both the shallow and deep aquifers throughout the Region is generally good although it is very hard, containing high concentrations of calcium, magnesium, sulfate, and other dissolved solids; therefore, softening is required for almost all water uses.

VEGETATION

Presettlement Vegetation

Historically, vegetational patterns in the Region have been influenced by climate, glacial deposits, soil, fire, topography, and natural drainage characteristics. Historical records, including the original U. S. Public Land Survey carried out within the Region in 1836, indicate that frequent fires set by the Indians or initiated by natural causes maintained large portions of southeastern Wisconsin either as open-level plains containing orchard-like stands of oak or as prairies dominated by big bluestem grass and colorful prairie forbs. Other portions of the Region that were protected from fire by the drainage pattern or local relief developed into mixed hardwood forests. The upland timber for the most part consisted of the hardwood species: sugar maple, oak, elm, ash, hickory, beech, linden, walnut, and ironwood, and one coniferous species, white pine. Common species found in the lowland forests included black ash, elm, willow, cedar, tamarack, aspen, and soft maple.

Woodlands

Woodlands in the Region have much value beyond monetary return for their forest products. In addition to contributing to clean air and water, the maintenance of woodlands within the Region can contribute to the maintenance of a diversity of plant and animal life in association with human life. The existing woodlands of the Region, which required a century or more to develop, can, however, be destroyed through mismanagement within a comparatively short time. Woodlands can and should be maintained for their total values: scenic, wildlife, open space, educational, recreational, and watershed protection, as well as for their forest products. Primarily located on ridges and slopes, along lakes and streams, and in wetlands, woodlands provide an attractive natural resource of immeasurable value.

An inventory of woodlands within the Southeastern Wisconsin Region was conducted by the Commission as part of the 1963 and 1970 land use inventories. As indicated in Table 75 and on Map 31, woodlands in the Region in 1970 covered a total combined area of about 125,300 acres, or approximately 7 percent of the total area of the Region, with over 91,700 acres, or 73 percent, located in Walworth, Washington, and Waukesha Counties. Milwaukee County, with about 3,200 acres, had the smallest amount of woodlands of any county in the Region.

Wetlands

Water and wetland areas probably provide the singularly most important landscape feature within the Region, and can serve to enhance all proximate uses. Their contribution to resource conservation and recreation within the Region is immeasurable, and they contribute both directly and indirectly to the regional economy. Recognizing the many environmental attributes of wetland areas, continued efforts should be made to protect this resource by discouraging costly—both in monetary and environmental terms—wetland draining, filling, and urbanization.

Wetlands represent a variety of stages in the natural filling of lake and pond basins as well as floodplain areas. Wetlands are considered herein as areas with a water table at or near the land surface; they are generally unsuited or poorly suited for most

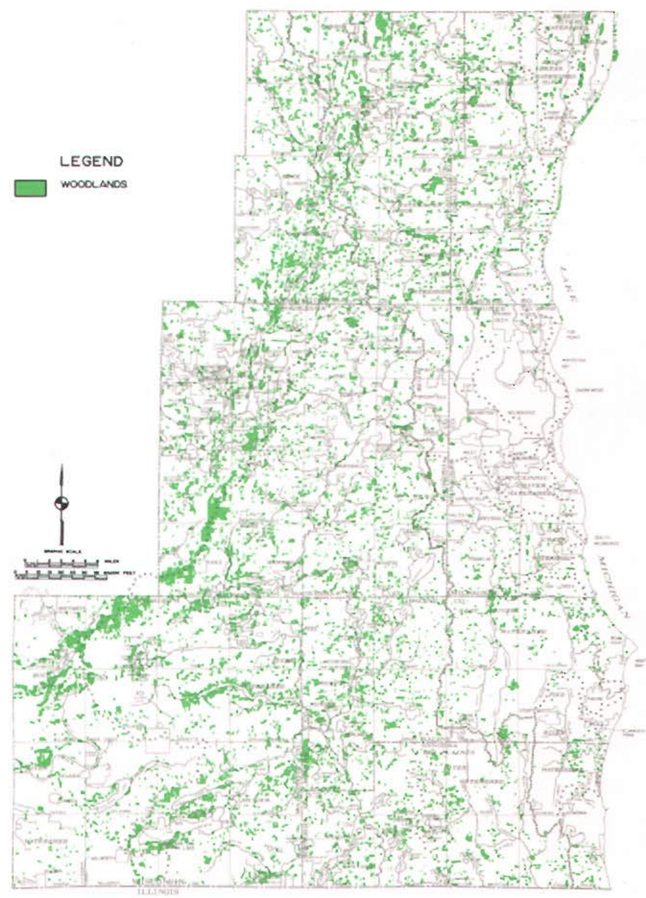
Table 75

WOODLANDS IN THE REGION BY COUNTY: 1970

County	Woodlands 1970	
	Acres	Percent
Kenosha	9,112	7.3
Milwaukee	3,213	2.6
Ozaukee	8,272	6.6
Racine	12,927	10.3
Walworth	31,755	25.3
Washington	27,410	21.9
Waukesha	32,597	26.0
Region	125,286	100.0

Map 31

WOODLANDS IN THE REGION: 1970



Woodlands currently occupy about 125,000 acres, or about 7 percent of the total land area of the Region. Woodlands have much value beyond monetary return for forest products. The maintenance of woodlands contributes to clean air and water and to the maintenance of a diversity of plant and animal life. Woodlands also provide an attractive natural resource of immeasurable value. Significant concentrations of woodlands are located in the Kettle Moraine State Forest and in several major stream valley areas in Walworth and Waukesha Counties. Together, these areas contain about 64,000 acres of woodland, representing slightly over one-half of the remaining woodlands in the Region.

Source: SEWRPC.

agricultural or urban development purposes. Wetlands, however, have important ecological value in a natural state: Wetlands contribute to flood control and stream purification, since such areas naturally serve to store excess runoff temporarily, and thereby tend to reduce peak flood flows. It has been found that except during exceptional periods of high runoff following prolonged drought, concentrations of nutrients in waters leaving such areas are considerably lower than in waters entering the wetlands.

Inventories of water and wetlands within the Southeastern Wisconsin Region were conducted by the Commission as part of the 1963 and 1970 land use inventories. The water and wetland land use category includes all inland lakes, excluding Lake Michigan; all streams, rivers, and canals more than 50 feet in width; and open lands that are intermittently covered with water or that are wet due to a high water table. As indicated in Table 76 and on Map 32, water and wetland areas in the Region in 1970 covered about 180,800 acres, or about 10 percent of the area of the Region, with over 124,500 acres, or 69 percent, being located in Walworth, Washington, and Waukesha Counties.

Of the total area in the water and wetland category, only 48,000 acres, or 27 percent, actually consisted of surface water in 1970. The remaining 132,800 acres consisted of swamps, marshes, and other wetland areas.

FISH AND WILDLIFE RESOURCES

Fish and wildlife are valuable assets to this Region's natural resource base. The variety and relative abundance of wildlife in the Region have provided numerous recreational pursuits and pleasures for fishermen, hunters, and nature enthusiasts. Fees collected as part of fish and game licenses have also contributed to the Region's economy. The remaining wildlife not only provide a valuable and much sought recreational resource, but also contribute both directly and indirectly to the regional economy of the Region.

Lake fisheries exist in the 100 major inland lakes within the Region and within Lake Michigan. Most of these fisheries are sustained primarily by natural spawning areas within the lakes. Presently, there are adequate shallow weedbed areas available for fish spawning within most major lakes. Other factors, however, such as deteriorating water quality, fluctuating water quality, and the lack of

Table 76

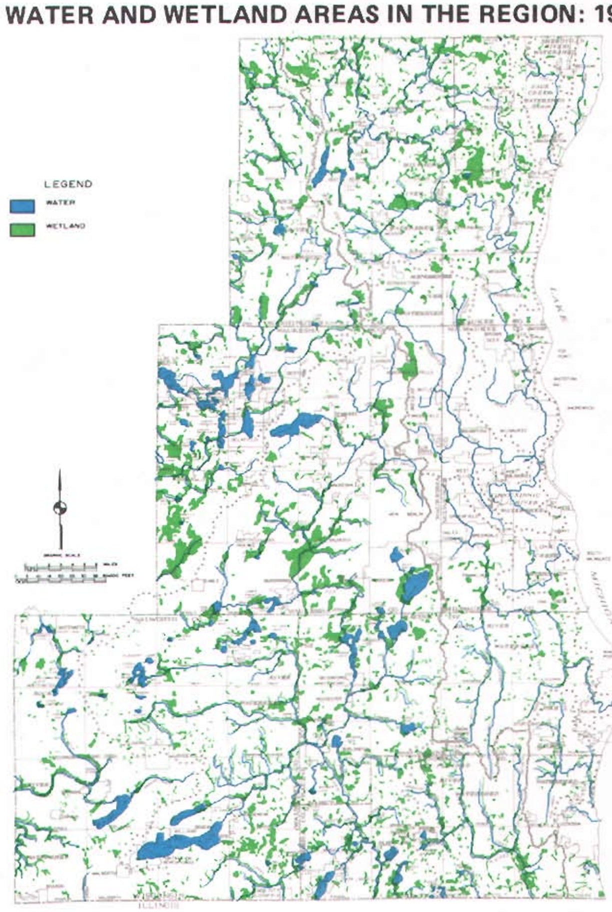
SURFACE WATER AND WETLANDS IN THE REGION BY COUNTY: 1970

County	Surface Water and Wetlands 1970 Acres	Surface Water and Wetlands 1970 Percent
Kenosha	19,445	10.8
Milwaukee	4,207	2.3
Ozaukee	14,879	8.2
Racine.	17,712	9.8
Walworth.	39,160	21.7
Washington	35,638	19.7
Waukesha.	49,789	27.5
Region	180,830	100.0

Source: SEWRPC.

Map 32

WATER AND WETLAND AREAS IN THE REGION: 1970



About 180,800 acres, or approximately 10 percent of the area of the Region, were covered by water and wetlands in 1970. These wetlands constitute a valuable resource, supporting wide varieties of desirable forms of plant and animal life; assisting in reducing storm water runoff, stabilizing streamflows, and enhancing stream water quality by functioning as nutrient and sediment traps; and providing aesthetically pleasing vistas on the landscape.

Source: Wisconsin Department of Natural Resources and SEWRPC.

adequate boating regulations to protect spawning areas tend to limit the effectiveness of these areas for natural spawning. In many instances, therefore, lake fisheries must be sustained by fish stocking procedures.

Only limited-quality stream fisheries are found within the Region. The Commission's Fox and Milwaukee River watershed studies, for example, found that stream fisheries were generally limited in that only some of the relatively large streams in these two watersheds are capable of supporting self-sustaining populations of walleye, smallmouth bass, northern pike, or panfish. Very few streams presently support trout populations. It is recognized that not every stream in the Region can, or should, be of such quality that it can support walleye, smallmouth bass, or trout. These species are, however, important indicators of environmental quality, and should be maintained or restored in selected streams throughout the area.

Wildlife Habitat Areas

Wildlife in southeastern Wisconsin is composed primarily of small upland game such as rabbit and squirrel; some predators such as fox and raccoon; game birds, including water fowl; and pan and game fish. Deer are also found in some areas, but the herds are small when compared with those of other regions of the State.

Inventories of land and inland water in the Region known to be inhabited by various forms of wildlife were carried out cooperatively by the Wisconsin Department of Natural Resources and the SEWRPC in 1963 and 1970. As indicated in Table 77 and on Map 33, wildlife habitat areas in 1970 covered approximately 259,800 acres, or 15 percent of the total area of the Region. The overwhelming majority of this area, over 192,500 acres, or 74 percent, was found to be located in Walworth, Washington, and Waukesha Counties. It should be noted that 76 percent, or more than 77,900 acres, of the total high-value wildlife habitat areas and 75 percent, or more than 70,000 acres, of the total medium-value wildlife habitat areas are located in these counties as well.

Significant concentrations of high-value wildlife habitat are located in the Kettle Moraine area in northwestern Walworth County, western Waukesha County, and Washington County, and in a band 12 to 16 miles wide along the Fox River in eastern Walworth County and western Racine and Kenosha Counties.

The destruction of wildlife habitat areas is overwhelmingly a result of urbanization. While some wildlife habitat areas are lost due to widening or

Table 77

WILDLIFE HABITAT AREAS IN THE REGION BY VALUE RATING[a] AND COUNTY: 1963 AND 1970

County	Value[a]	1970	
		Acres	Percent
Kenosha	High	10,083	44.0
	Medium	6,136	26.8
	Low	6,683	29.2
	Total	22,902	100.0
Milwaukee	High	0	0.0
	Medium	1,225	68.9
	Low	553	31.1
	Total	1,778	100.0
Ozaukee	High	6,033	38.1
	Medium	8,310	52.4
	Low	1,512	9.5
	Total	15,855	100.0
Racine	High	8,945	33.4
	Medium	8,015	30.0
	Low	9,803	36.6
	Total	26,763	100.0
Walworth	High	26,890	42.7
	Medium	20,775	32.9
	Low	15,368	24.4
	Total	63,033	100.0
Washington	High	19,340	37.2
	Medium	21,414	41.2
	Low	11,240	21.6
	Total	51,994	100.0
Waukesha	High	31,710	40.9
	Medium	28,255	36.5
	Low	17,542	22.6
	Total	77,507	100.0
Region	High	103,001	39.6
	Medium	94,130	36.3
	Low	62,701	24.1
	Total	259,832	100.0

[a] *High-value wildlife habitat areas have a high diversity of species. The territorial requirements of the major species are met in that minimum population levels are possible. The structure and composition of the vegetation provide for nesting, travel routes, concealment, and modification of weather impact. Also, such areas have experienced little or no disturbance as a result of man's activities and are located in close proximity to other wildlife habitat areas.*

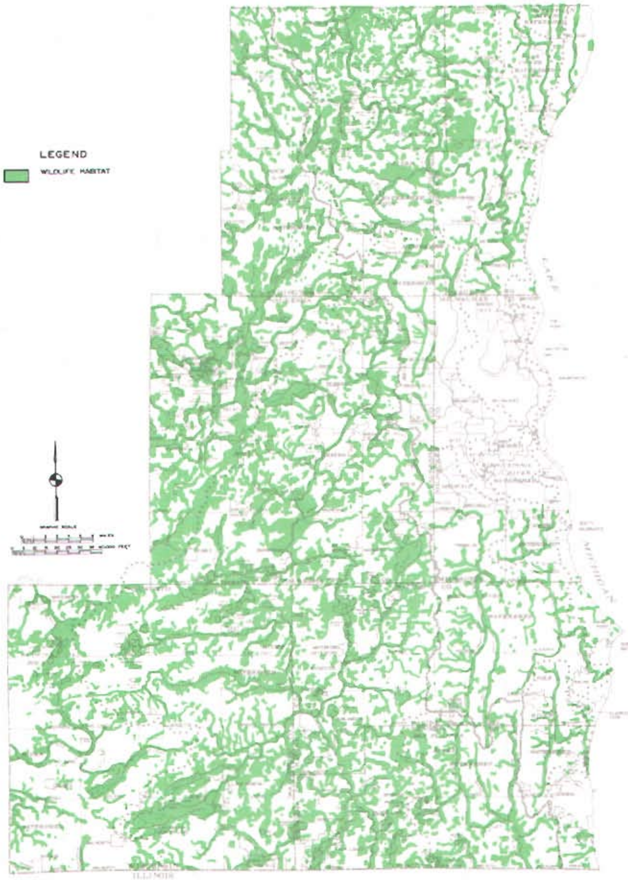
Medium-value wildlife habitat areas maintain all of the criteria described for a high-value habitat, but at a lower level. The species diversity may not be as high as in the high-value areas. The territorial requirements of the major species may not be adequately met in that minimum population levels are not possible or are just barely met. The structure and composition of the vegetation may not adequately provide for nesting, travel routes, concealment, or modification of weather impact. The areas may have undergone disturbance as a result of man's activities, and also may not be located in the close proximity to other wildlife habitat areas.

Low-value wildlife habitat areas are of a supplemental or remnant nature. They are usually considerably disturbed but are included in the inventory since they provide the only available range in the vicinity, supplement areas of a higher quality, or provide corridors linking higher habitat areas.

Source: Wisconsin Department of Natural Resources and SEWRPC.

Map 33

WILDLIFE HABITAT IN THE REGION: 1970



The remaining wildlife habitat areas and the wildlife therein provide an important recreational resource and constitute a valuable aesthetic asset of southeastern Wisconsin. As of 1970, approximately 260,000 acres, or 15 percent of the area of the Region, were identified as wildlife habitat.

Source: Wisconsin Department of Natural Resources and SEWRPC.

new construction of transportation facilities, most have been destroyed as a result of residential development. Wildlife habitat must furnish food, cover, and protection. Consequently, the highest quality and largest areas of remaining wildlife habitat occur in areas of the Region having large proportions of forest, wetland, pastureland, and cropland, and small proportions of land devoted to urban development.

PARKS, OUTDOOR RECREATIONAL AREAS, AND RELATED OPEN SPACES

In an urbanizing region, open space should serve three primary purposes. First, it should lend form to regional development by shaping urban growth and providing a desirable setting for the more intensive types of urban land uses. Second, it should serve to provide outdoor recreational opportunities to the resident population. Third, it should be utilized to conserve and enhance the natural resource base and thereby to protect important community values. When properly related to woodlands, wetlands, and prime wildlife habitat areas, open space can be used to conserve soils, fish, and game, and certain species of trees and plants and to improve surface water and groundwater quality and quantity. Open space may also be used to protect sites having scenic, historic, or scientific value.

Planning for the provision of the necessary open space in an urbanizing region requires definitive knowledge of the location and characteristics of the woodlands, wetlands, and wildlife habitat areas; of the scenic, historic, and scientific sites; and of the existing and potential park and outdoor recreation sites. Knowledge of these resources is essential and must constitute an input to the preparation of land use plans if such elements are to be protected from inadvertent destruction through poorly located urban development or transportation route location.

Woodlands, wetlands, and wildlife habitat areas were discussed in the three previous sections of this chapter. Attention in this section is focused on existing park and recreation areas, potential park and related open space sites, and sites of historical significance. Inventories of existing park and recreational areas, potential park and related open space sites, and sites of historical significance were conducted by the Commission as part of the initial regional land use-transportation study in 1963. These inventories have since been updated as part of the Commission's regional park, outdoor recreation, and related open space planning program.[8]

Existing Park, Outdoor Recreation, and Related Open Space Sites

The existing outdoor recreation sites inventory, conducted in 1973 as part of the Commission's regional park, outdoor recreation, and related open space planning program, revealed that there are 1,348 publicly and nonpublicly owned outdoor recreation sites in the Region, totaling 55,654 acres in area. The spatial distribution of the 1973 sites is shown on Map 34, and the acreage and number of sites are shown by ownership category and by county in Table 78.

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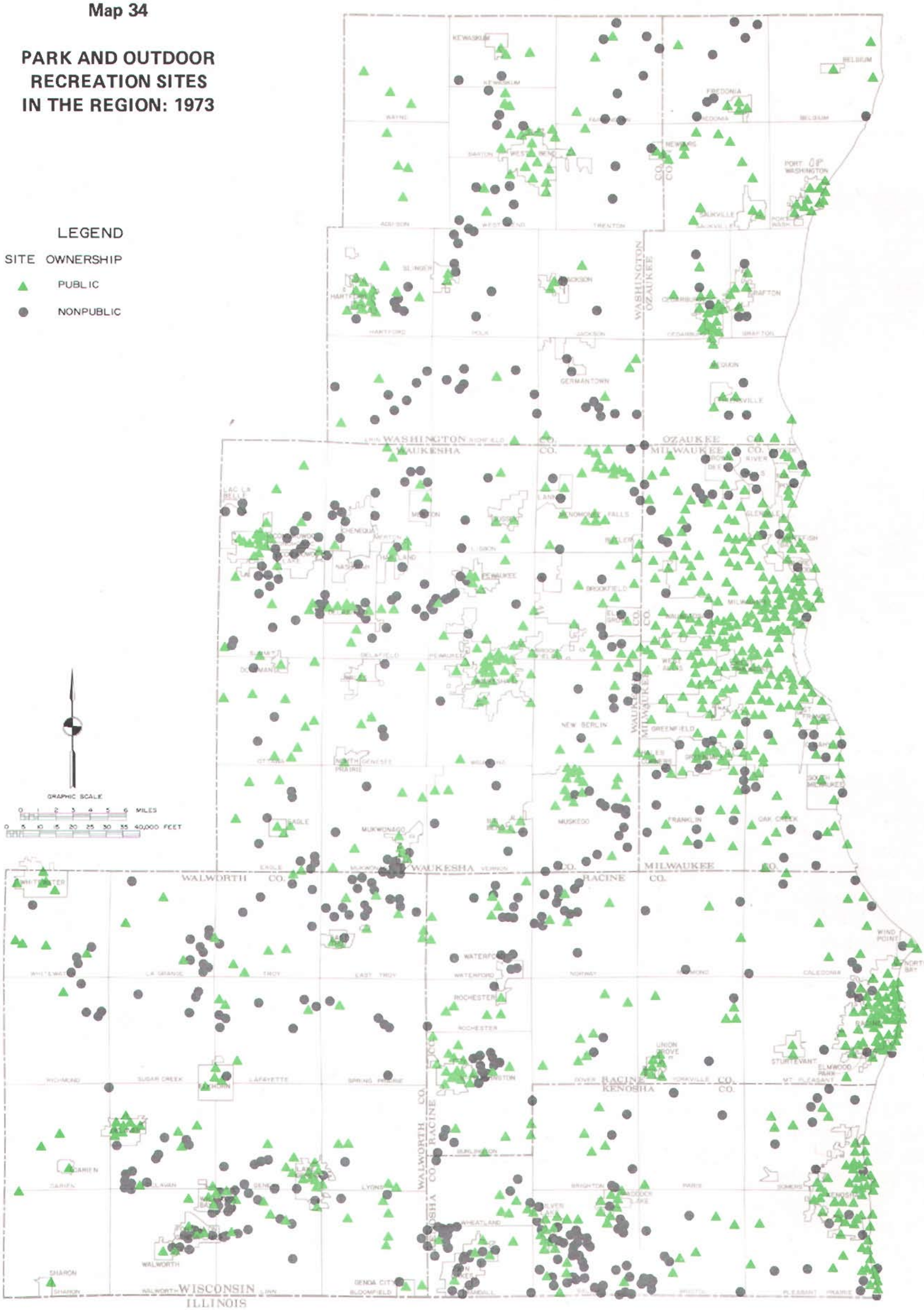
[8] *See SEWRPC Planning Report No. 27, A Regional Park and Open Space Plan for Southeastern Wisconsin: 2000, November 1977.*

Map 34

PARK AND OUTDOOR RECREATION SITES IN THE REGION: 1973



Nearly 1,350 public and nonpublic park and outdoor recreation sites existed in the Region in 1970. Together these sites comprise a total area of nearly 56,000 acres. In 1963 there were about 890 such sites totaling about 34,000 acres. Thus, there has been a significant increase in the total amount of outdoor recreation sites and acreage within the Region over the period 1963 to 1973. There were about 790 publicly owned sites in 1970 totaling nearly 29,000 acres in area, representing about 58 percent of the total sites and 52 percent of the total acreage. Milwaukee County alone owns nearly 13,000 acres of park and related open space land, representing about 47 percent of all publicly owned park and outdoor recreation land in the Region.

Source: SEWRPC.

Table 78

PARK AND OUTDOOR RECREATION SITES IN THE REGION BY COUNTY AND BY OWNERSHIP: 1973[a]

County	Public Ownership								Nonpublic Ownership					
	Federal	State	County	City	Village	Town	School District	Subtotal	Organizational	Commercial	Private	Other Nonpublic	Subtotal	Total
Kenosha														
Sites	0	4	7	36	14	26	0	87	23	39	39	1	102	189
Acres	0	169	1,302	569	37	154	0	2,231	900	1,463	895	1	3,259	5,490
Milwaukee														
Sites	0	2	123	110	25	0	2	262	10	23	21	0	54	316
Acres	0	214	13,786	497	198	0	12	14,707	101	307	1,299	0	1,707	16,414
Ozaukee														
Sites	0	3	7	33	13	0	0	56	8	6	5	1	20	76
Acres	0	636	657	318	91	0	0	1,702	421	280	857	1	1,559	3,261
Racine														
Sites	0	6	17	64	10	3	0	100	13	30	22	1	66	166
Acres	0	12	1,302	1,043	19	38	0	2,414	590	800	629	2	2,021	4,435
Walworth														
Sites	0	9	6	25	17	13	1	71	29	60	30	0	119	190
Acres	0	578	204	204	172	30	1	1,189	3,557	3,273	1,960	0	8,790	9,979
Washington														
Sites	0	8	5	26	7	3	1	50	21	32	10	0	63	113
Acres	0	709	482	413	74	9	29	1,716	2,218	1,539	546	0	4,303	6,019
Waukesha														
Sites	0	12	17	77	41	12	2	161	32	76	28	1	137	298
Acres	0	479	2,688	1,077	673	188	76	5,181	1,208	2,140	1,396	131	4,875	10,056
Region														
Sites	0	44	182	371	127	57	6	787	136	266	155	4	561	1,348
Acres	0	2,797	20,421	4,121	1,264	419	118	29,140	8,995	9,802	7,582	135	26,514	55,654

[a] *The 1973 park and outdoor recreation data differ from the data presented in SEWRPC Planning Report No. 7, The Regional Land Use-Transportation Study, Volume One, Inventory Findings, because of the availability of more detailed information since 1963 compiled as part of the Commission's regional park and open space planning program.*

Source: SEWRPC.

Publicly owned sites, in addition to providing recreational facilities, also permanently reserve lands for public use. The 787 publicly owned sites identified in 1973 totaled 29,140 acres in area. Almost half of the total sites are city owned, and over two-thirds of the total acreage is county owned. Milwaukee County alone owns 13,786 acres of park and related open space land, or about 47 percent of all publicly owned acreage in the Region.

Nonpublicly owned sites, though presently providing recreational facilities, are subject to conversion as urbanization continues, and cannot be relied upon as a permanent recreational resource. Of the 561 nonpublicly owned recreational sites, 24 percent are owned and operated by nonprofit organizations but are generally open to the public for a fee; 47 percent are commercial or privately owned and operated and open to the public for a fee; and 28 percent are private or privately owned and operated for members only, and therefore are not generally open to the public.

Milwaukee County has one of the finest park and parkway systems in the United States. The County owns more recreational acreage than any other County in the Region, and there is more land in the Milwaukee County park system than in any other category of recreation ownership in the entire Region. The Milwaukee County park sites account for nearly 68 percent of the total number of county-owned sites in the Region and 67 percent of the total county park area in the Region. The major parks are generally located along rivers and streams and the Lake Michigan shoreline. Many smaller recreational areas, however, are distributed throughout the various communities in the County in the form of neighborhood and community parks.

While Milwaukee County has a high proportion of both the total county park sites and total park-site acreage within the Region, it contains only about 23 percent of the total number of recreation sites and only about 29 percent of the total acreage of such sites. Milwaukee County contains almost

60 percent of the regional population, so the ratio of total outdoor recreational area per 1,000 resident population is well below the regional average.

In addition to the recreational lands identified in the 1973 inventory, conservation lands, the primary function of which is the preservation of significant natural resource areas in the Region for conservation, wildlife management, scientific, or educational purposes, were identified as part of the 1973 inventory. As shown in Table 79, 81 such sites totaling 39,821 acres existed in the Region in 1973. Of these, 55 sites totaling 37,528 acres were state owned, with the balance of the acreage being divided primarily among county-owned conservation lands, school-related educational areas, and organizationally owned nature areas.

The 1973 inventory also identified all recreational areas related to school facilities. Sites in this category include all school properties with developed active recreational facilities, and acreage figures represent areas of land available for outdoor recreational activity on school property. As shown in Table 80, 787 school sites totaling 8,017 acres possess outdoor recreational facilities, with almost half of these sites being located in Milwaukee County.

Historic Sites

To indicate the need for, and progress regarding, preservation of the Region's historic sites, which are an irreplaceable part of the Region's natural and cultural heritage, inventories of sites of historic significance were conducted in 1963 in conjunction with the preparation of the initial regional land use-transportation plan and in 1973 in conjunction with the Commission's regional park, outdoor recreation, and related open space planning program.

As shown in Table 81, the 1973 inventory identified 781 sites of historic significance within the Region, including 235 cultural features, 85 natural features, and 461 structures. Seventy-five percent, or 69, of the 93 marked historic cultural feature sites are located in Milwaukee, Racine, and Waukesha Counties. Most of the cultural features within the Region are sites of Indian or early white settlements or are closely related to such settlements,

Table 79

CONSERVATION LANDS IN THE REGION BY COUNTY AND BY OWNERSHIP: 1973

County	Public								Nonpublic					
	Federal	State	County	City	Village	Town	School District	Subtotal	Organizational	Commercial	Private	Other Nonpublic	Subtotal	Total
Kenosha														
Sites	0	10	0	0	1	0	2	13	2	0	0	0	2	15
Acres	0	6,324	0	0	5	0	256	6,585	217	0	0	0	217	6,802
Milwaukee														
Sites	1	0	0	0	1	0	0	2	1	0	0	0	1	3
Acres	39	0	0	0	19	0	0	58	164	0	0	0	164	222
Ozaukee														
Sites	0	4	0	0	0	0	0	4	1	0	0	0	1	5
Acres	0	1,534	0	0	0	0	0	1,534	249	0	0	0	249	1,783
Racine														
Sites	0	9	3	2	0	0	2	16	0	0	0	0	0	16
Acres	0	2,831	288	91	0	0	316	3,526	0	0	0	0	0	3,526
Walworth														
Sites	0	18	0	0	0	0	0	18	0	0	0	0	0	18
Acres	0	7,163	0	0	0	0	0	7,163	0	0	0	0	0	7,163
Washington														
Sites	0	5	0	0	1	0	1	7	0	0	0	0	0	7
Acres	0	7,507	0	0	121	0	13	7,641	0	0	0	0	0	7,641
Waukesha														
Sites	0	9	2	1	2	0	2	16	1	0	0	0	1	17
Acres	0	12,169	130	172	88	0	61	12,620	64	0	0	0	64	12,684
Region														
Sites	1	55	5	3	5	0	7	76	5	0	0	0	5	81
Acres	39	37,528	418	263	233	0	646	39,127	694	0	0	0	694	39,821

Source: SEWRPC.

Table 80

SCHOOL RECREATIONAL SITES IN THE REGION BY COUNTY AND BY OWNERSHIP: 1973

County	Public								Nonpublic					
	Federal	State	County	City	Village	Town	School District	Subtotal	Organizational	Commercial	Private	Other Nonpublic	Subtotal	Total
Kenosha														
Sites	0	1	0	0	0	0	43	44	17	0	0	0	17	61
Acres	0	747	0	0	0	0	321	1,068	157	0	0	0	157	1,225
Milwaukee														
Sites	0	1	0	0	0	0	255	256	109	0	3	0	112	368
Acres	0	25	0	0	0	0	1,588	1,613	558	0	65	0	623	2,236
Ozaukee														
Sites	0	0	0	0	0	0	23	23	11	0	0	0	11	34
Acres	0	0	0	0	0	0	285	285	43	0	0	0	43	328
Racine														
Sites	0	0	1	0	0	0	51	52	24	0	0	0	24	76
Acres	0	0	1	0	0	0	369	370	133	0	0	0	133	503
Walworth														
Sites	0	0	0	0	0	0	36	36	7	0	1	3	11	47
Acres	0	0	0	0	0	0	411	411	224	0	70	174	468	879
Washington														
Sites	0	1	0	0	0	0	33	34	14	0	0	0	14	48
Acres	0	30	0	0	0	0	342	372	49	0	0	0	49	421
Waukesha														
Sites	0	1	0	1	0	0	112	114	38	0	1	0	39	153
Acres	0	61	0	14	0	0	1,167	1,242	1,181	0	2	0	1,183	2,425
Region														
Sites	0	4	1	1	0	0	553	559	220	0	5	3	228	787
Acres	0	863	1	14	0	0	4,483	5,361	2,345	0	137	174	2,656	8,017

Source: SEWRPC.

Table 81

HISTORIC SITES IN THE REGION BY TYPE OF SITE AND BY COUNTY: 1973

Type of Site[a]	Kenosha	Milwaukee	Ozaukee	Racine	Walworth	Washington	Waukesha	Region
Cultural Features								
Marked	6	23	3	22	9	6	24	93
Unmarked . . .	11	10	19	1	11	19	71	142
Subtotal	17	33	22	23	20	25	95	235
Natural Features								
Marked	0	2	0	0	1	0	3	6
Unmarked . . .	13	0	3	19	25	6	12	78
Subtotal	13	2	3	19	26	6	15	84
Structures								
Marked	3	49	5	4	5	4	18	88
Unmarked . . .	40	71	49	55	42	33	84	374
Subtotal	43	120	54	59	47	37	102	462
Total Sites								
Marked	9	74	8	26	15	10	45	187
Unmarked . . .	64	81	71	75	78	58	167	594
Total	73	155	79	101	93	68	212	781

[a] *Marked sites are those which have been officially recognized and marked in some manner by historical groups or local, county, or state historical societies. Unmarked sites are those which: a) are being considered for marking by historical societies or groups or b) are identified as having historical significance by historical societies or groups but are not yet being considered for marking.*

Source: SEWRPC.

and include old plank roads, early trails, and burial grounds and cemeteries. Natural feature historic sites consist primarily of wetland and woodland areas, with only seven, or 8 percent, of the 85 identified natural feature sites being marked. A total of 461, or 59 percent, of all the identified historic sites are structures, the majority of which are located in the urbanized areas of the Region, particularly in Milwaukee County. Indeed, 49, or 56 percent, of the 87 marked are located in Milwaukee County. Historic homes, churches, inns, and schools predominate in this category, which also includes government buildings, mills, and museums. Map 35 shows the spatial distribution of the cultural, natural, and structural sites of historic significance identified in the 1973 inventory.

Map 35

HISTORIC SITES IN THE REGION: 1973

A total of 781 sites of historic significance were identified in the Region in 1973. Of this total, 235 are cultural features, primarily sites of Indian or early white settlements; 85 are natural features, primarily wetland and woodland areas; and 461 are structures, including historic homes, churches, inns, and schools. Of the total number of historic sites, 187 are officially recognized and marked in some manner by historical groups and societies.

Source: SEWRPC.

ENVIRONMENTAL CORRIDORS

The Corridor Concept

One of the most important tasks completed under the initial regional land use planning effort was the identification and delineation of those areas in the Region in which concentrations of natural resource and natural resource-related elements occur. It was recognized that preservation of the natural resource and natural resource-related elements, especially where these elements are concentrated in identifiable geographic areas, was essential both to the maintenance of the overall environmental quality of the Region and to the continued provision of the amenities required to maintain the quality of life for the resident population.

Seven resource elements of the natural resource base, all of which have been previously discussed in this chapter, are considered essential to the maintenance of both the ecological balance and the overall quality of life in the Region. These include: 1) lakes, rivers, and streams and their associated floodplains; 2) wetlands; 3) woodlands; 4) wildlife habitat areas; 5) rugged terrain and high relief topography; 6) significant geological formations and physiographic features; and 7) wet or poorly drained soils. In addition, there are certain other elements which, although not a part of the natural resource base per se, are closely related to or centered on that base. These elements are: 1) existing outdoor recreation sites, 2) potential outdoor recreation and related open space sites, 3) historic sites and structures, and 4) significant scenic areas and vistas.

The delineation of these natural resource and natural resource-related elements on a map of the Region results in an essentially lineal pattern encompassed in narrow elongated areas which have been termed environmental corridors by the Commission. Primary environmental corridors are those areas which encompass three or more of the aforementioned 11 environmental elements. Secondary environmental corridors are contiguous areas exhibiting one or two of the 11 elements.

It is important to point out that, because of the many interlocking and interacting relationships existing between living organisms and their environment, the destruction or deterioration of one element of the total environment may lead to a chain reaction of deterioration and destruction. The drainage of wetlands, for example, may have far-reaching effects, since such drainage may destroy fish spawning grounds, wildlife habitat, groundwater recharge areas, and the natural filtration action and flood water storage areas of interconnecting lake and stream systems. The resulting deterioration of surface water quality may, in turn, lead to a deterioration of the quality of the groundwater which serves as a source of domestic, municipal, and industrial water supply and on which low flows in rivers and streams may depend. Similarly, the destruction of forest cover, which may have taken a half a century to develop, may result in soil erosion and stream siltation and in more rapid runoff and increased flooding, as well as destruction of wildlife habitat. Although the effects of any one of these environmental changes may not in and of itself be overwhelming, the combined effects must lead eventually to the serious deterioration of the supporting resource base. The need to maintain the integrity of the remaining environmental corridors thus becomes apparent.

Primary Environmental Corridors

The primary environmental corridors of southeastern Wisconsin generally lie along major stream valleys, surround major lakes, or are found in the Kettle Moraine area, and contain almost all of the remaining high-value wildlife habitat areas and woodlands within the Region, in addition to most of the wetlands, lakes and streams, and associated floodlands. These corridors also contain many of the best remaining potential park sites. The primary environmental corridors are, in effect, a composite of the best of the individual elements of the natural resource base of southeastern Wisconsin.

Primary environmental corridors were identified within the Region in 1963 as part of the Commission's original land use-transportation planning program. The corridor delineation has since been refined, primarily as a result of the Commission watershed studies but also because of the availability of more detailed information which permitted a more definitive delineation of these lands.

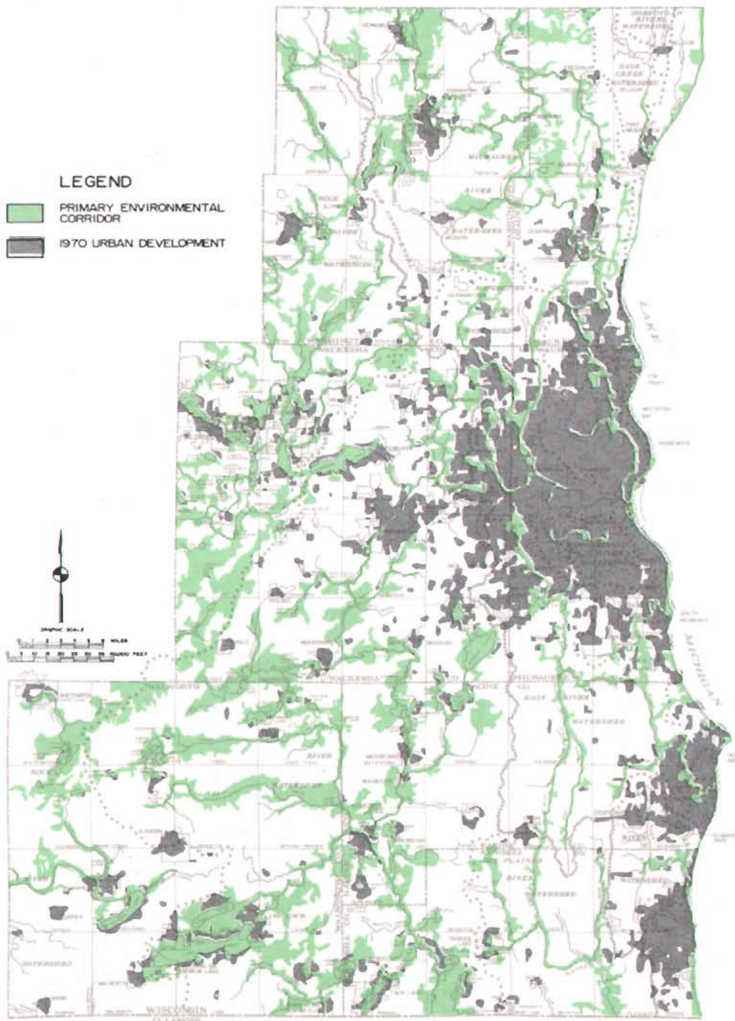
The delineation of primary environmental corridors is indicated on Map 36, and the land use components which comprise the corridor are indicated in Table 82. The gross primary environmental corridor area, defined as including all land uses, both urban and rural, within the the corridor configuration, is also indicated on Map 36. The gross primary environmental corridors totaled 341,500 acres in 1970, or about 20 percent of the total area of the Region. Net primary environmental corridor areas are defined as the gross corridor acreage minus the noncompatible urban land use acreages in the corridor. Net corridor areas, therefore, include recreational land uses, agricultural and related land uses, water, wetlands and woodland uses, and other open space land uses.

Of particular importance in future land use-transportation planning is an analysis of changing land uses within the net primary environmental corridors since 1963, and a quantification of the extent to which the corridors have been preserved. Net primary environmental corridors in 1970 totaled over 319,900 acres, or about 94 percent of the total gross corridor acreage. The majority of net corridor acreage in 1970 consisted of agricultural and related land (92,800 acres), wetlands (90,600 acres), and woodlands (64,700 acres). The 319,900 acres of net corridor in 1970 represent a decrease of 4,000 acres from the 323,900 acres of net corridor existing in the Region in 1963. Decreases in net corridor acreage in the Region were primarily due to losses in agricultural use (5,100 acres) and, to a lesser extent, to losses in woodlands (1,600 acres) and wetlands (1,500 acres). While some of the losses in agricultural, woodland, and wetland uses may have resulted in gains in recreational land use, which is also considered part of the net environmental corridor, many of these lands were lost as a result of urban encroachment, especially residential land use, which increased by 3,000 acres, and transportation uses, which increased by 700 acres. Commercial and industrial land uses in the corridor increased by only about 250 acres between 1963 and 1970.

It is interesting to note that the loss of net primary environmental corridor acreage was not uniform within all counties of the Region (see Map 37). Waukesha County experienced the largest loss of net corridor acreage, over 1,600 acres, with the loss occurring primarily as a result of a decrease in agricultural lands and wetlands. Walworth County lost almost 900 acres of net environmental corridor, primarily in agricultural lands and woodlands. Losses in net corridor acreage were less than 500 acres in the remaining five counties of the Region, with virtually no loss at all in Kenosha County. It appears that recent trends within southeastern Wisconsin have resulted in the encroachment of urban development into the primary environmental corridors. Unfortunately, unplanned or poorly planned intrusion of urban development into these corridors not only tends to destroy the very resources and related amenities sought by the development, but tends to create severe environmental problems as well.

Map 36

PRIMARY ENVIRONMENTAL CORRIDORS IN THE REGION: 1970

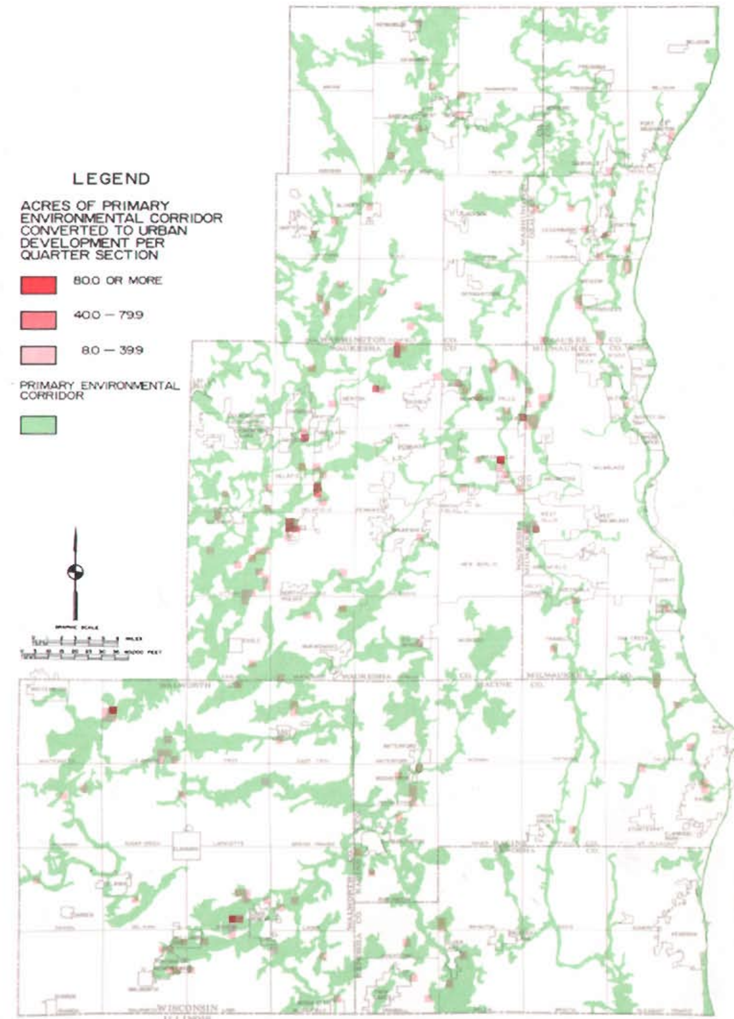


Approximately one-fifth of the Region lies within primary environmental corridors, which encompass almost all of the best remaining woodlands and wetlands, the best remaining wildlife habitat areas, almost all of the streams and lakes and associated undeveloped floodlands and shorelands, as well as many of the significant topographical, geological, and historical features remaining in the Region. The preservation of these corridors in compatible open uses is essential to maintaining the overall quality of the environment within the Region.

Source: SEWRPC.

Map 37

LOSS OF PRIMARY ENVIRONMENTAL CORRIDORS IN THE REGION: 1963-1970



Between 1963 and 1970, about 4,000 acres of primary environmental corridor lands were converted to incompatible land uses and thus lost forever. This represents a loss of about 1 percent of the approximately 324,000 acres of primary environmental corridor lands which existed in the Region in 1963, and which were recommended in the adopted regional land use plan for permanent preservation, protection, and enhancement. Most of the loss resulted from urban encroachment by residential land uses. New residential development in the primary environmental corridors of the Region totaled about 3,000 acres over the seven-year period. While such losses were distributed throughout the entire seven-county Region, losses were particularly heavy in Waukesha and Walworth Counties, where together about 2,500 acres of primary environmental corridor land were lost. The above map identifies those U. S. Public Land Survey quarter sections where losses exceed eight acres. The unplanned or poorly planned intrusion of urban development into these corridors not only contributes to the creation of severe environmental problems, but tends to destroy the very resources and related amenities sought by the development.

Source: SEWRPC.

Table 82

DISTRIBUTION OF PRIMARY ENVIRONMENTAL CORRIDOR LANDS IN THE REGION BY MAJOR LAND USE WITHIN EACH COUNTY: 1963 AND 1970

		Gross Primary Environmental Corridor													
		Total[b]		Urban Development											
				Residential		Commercial		Industrial		Transportation		Governmental and Institutional		Subtotal	
County	Year	Acres	Percent of Region	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent of Gross Corridor
Kenosha	1963	29,490	8.6	1,007	3.4	23	0.1	10	--[a]	638	2.2	105	0.4	1,783	6.0
	1970	29,490	8.6	1,072	3.6	25	0.1	15	0.1	596	2.0	112	0.4	1,820	6.2
	Change 1963-1970	0	--	65	0.2	2	--	5	0.1	- 42	- 0.1	7	--	37	0.2
Milwaukee	1963	14,779	4.3	727	4.9	48	0.3	123	0.8	1,078	7.3	176	1.2	2,152	14.5
	1970	14,779	4.3	853	5.8	101	0.7	141	1.0	1,176	7.9	206	1.4	2,477	16.8
	Change 1963-1970	0	--	126	0.9	53	0.4	18	0.2	98	0.6	30	0.2	325	2.3
Ozaukee	1963	24,648	7.2	1,215	5.0	33	0.1	23	0.1	708	2.9	12	--[a]	1,991	8.1
	1970	24,648	7.2	1,497	6.1	32	0.1	26	0.1	803	3.2	19	0.1	2,377	9.6
	Change 1963-1970	0	--	282	1.1	- 1	--	3	--	95	0.3	7	0.1	386	1.5
Racine	1963	33,750	9.9	770	2.3	16	--[a]	55	0.2	713	2.1	86	0.3	1,640	4.9
	1970	33,750	9.9	1,005	3.0	22	0.1	38	0.1	786	2.3	70	0.2	1,921	5.7
	Change 1963-1970	0	--	235	0.7	6	0.1	- 17	- 0.1	73	0.2	- 16	- 0.1	281	0.8
Walworth	1963	88,527	25.9	1,975	2.2	81	0.1	39	--[a]	1,429	1.6	148	0.2	3,672	4.1
	1970	88,527	25.9	2,630	3.0	105	0.1	47	0.1	1,615	1.8	145	0.2	4,542	5.2
	Change 1963-1970	0	--	655	0.8	24	--	8	0.1	186	0.2	- 3	--	870	1.1
Washington	1963	56,286	16.5	988	1.7	37	0.1	43	0.1	1,107	1.9	39	0.1	2,214	3.9
	1970	56,286	16.5	1,360	2.4	41	0.1	60	0.1	1,156	2.1	67	0.1	2,684	4.8
	Change 1963-1970	0	--	372	0.7	4	--	17	--	49	0.2	28	--	470	0.9
Waukesha	1963	94,051	27.6	1,815	1.9	82	0.1	191	0.2	1,896	2.0	203	0.2	4,187	4.4
	1970	94,051	27.6	3,052	3.2	116	0.1	281	0.3	2,127	2.3	225	0.3	5,801	6.2
	Change 1963-1970	0	--	1,237	1.3	34	--	90	0.1	231	0.3	22	0.1	1,614	1.8
Region	1963	341,531	100.0	8,497	2.5	320	0.1	484	0.1	7,569	2.2	769	0.2	17,639	5.1
	1970	341,531	100.0	11,469	3.4	442	0.1	608	0.2	8,259	2.4	844	0.2	21,622	6.3
	Change 1963-1970	0	--	2,972	0.9	122	--	124	0.1	690	0.2	75	--	3,983	1.2

Table 83

PRESERVATION OF PRIMARY ENVIRONMENTAL CORRIDOR IN THE REGION: 1970

		Primary Environmental Corridor Preserved												
		Permanent Preservation				Temporary Preservation							Total	
				Subtotal							Subtotal			
County	1970 Gross Primary Environmental Corridor (Acres)	Public Parks Owned (Acres)	Floodland Zoning (Acres)	Acres	Percent of Gross Corridor	Conservancy Zoning (Acres)	Private Recreation (Acres)	Park Zoning (Acres)	Exclusive Agriculture Zoning (Acres)	Country Estate Zoning (Acres)	Acres	Percent of Gross Corridor	Acres	Percent of Gross Corridor
Kenosha	29,490	3,173	6,126	9,299	31.5	243	1,162	0	581	0	1,986	6.7	11,285	38.2
Milwaukee . . .	14,779	8,470	1,072	9,542	64.6	62	581	7	0	85	735	5.0	10,277	69.6
Ozaukee	24,648	2,166	7,624	9,790	39.7	3,145	566	54	3,337	0	7,102	28.8	16,892	68.5
Racine.	33,750	4,112	13,803	17,915	53.1	751	260	76	2,604	0	3,691	10.9	21,606	64.0
Walworth. . . .	88,527	7,408	23,005	30,413	34.4	2,076	5,719	2	0	0	7,797	8.8	38,210	43.2
Washington . .	56,286	7,102	62	7,164	12.7	4,502	1,949	22	3,288	0	9,761	17.3	16,925	30.0
Waukesha. . . .	94,051	13,674	31,659	45,333	48.2	13,195	1,712	7	612	471	15,997	17.0	61,330	65.2
Region	341,531	46,105	83,351	129,456	37.9	23,974	11,949	168	10,422	556	47,069	13.8	176,525	51.7

Source: SEWRPC.

Table 82 (continued)

		Gross Primary Environmental Corridor															
				Net Primary Environmental Corridor													
		Total		Recreation		Agriculture and Related		Water		Wetlands		Woodlands		Other Open Lands		Subtotal	
County	Year	Acres	Percent of Region	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent of Gross Corridor
Kenosha	1963	29,490	8.6	1,165	4.0	9,715	32.9	3,446	11.7	9,017	30.6	2,957	10.0	1,407	4.8	27,707	94.0
	1970	29,490	8.6	1,646	5.6	9,870	33.5	3,551	12.0	8,624	29.2	2,673	9.1	1,306	4.4	27,670	93.8
	Change 1963-1970	0	--	481	1.6	155	0.6	105	0.3	- 393	- 1.4	- 284	- 0.9	- 101	- 0.4	- 37	- 0.2
Milwaukee	1963	14,779	4.3	5,186	35.1	2,668	18.0	707	4.8	1,506	10.2	1,131	7.7	1,429	9.7	12,627	85.5
	1970	14,779	4.3	5,757	39.0	2,046	13.8	761	5.1	1,449	9.8	1,079	7.3	1,210	8.2	12,302	83.2
	Change 1963-1970	0	--	571	3.9	- 622	- 4.2	54	0.3	- 57	- 0.4	- 52	- 0.4	- 219	- 1.5	- 325	- 2.3
Ozaukee	1963	24,648	7.2	835	3.4	6,705	27.2	1,513	6.1	8,888	36.1	3,770	15.3	946	3.8	22,657	91.9
	1970	24,648	7.2	903	3.7	6,380	25.9	1,540	6.3	8,803	35.7	3,675	14.9	970	3.9	22,271	90.4
	Change 1963-1970	0	--	68	0.3	- 325	- 1.3	27	0.2	- 85	- 0.4	- 95	- 0.4	24	0.1	- 386	- 1.5
Racine	1963	33,750	9.9	848	2.5	13,920	41.2	3,787	11.2	7,166	21.2	5,149	15.3	1,240	3.7	32,110	95.1
	1970	33,750	9.9	1,075	3.2	13,318	39.5	3,970	11.8	7,188	21.3	4,909	14.5	1,369	4.0	31,829	94.3
	Change 1963-1970	0	--	227	0.7	- 602	- 1.7	183	0.6	22	0.1	- 240	- 0.8	129	0.3	- 281	- 0.8
Walworth	1963	88,527	25.9	2,680	3.0	27,709	31.3	13,495	15.3	17,106	19.3	21,391	24.2	2,474	2.8	84,855	95.9
	1970	88,527	25.9	4,030	4.5	25,939	29.3	13,747	15.5	17,050	19.3	20,779	23.5	2,440	2.7	83,985	94.8
	Change 1963-1970	0	--	1,350	1.5	- 1,770	- 2.0	252	0.2	- 56	--	- 612	- 0.7	- 34	- 0.1	- 870	- 1.1
Washington	1963	56,286	16.5	629	1.1	14,819	26.3	3,414	6.1	21,585	38.4	12,574	22.3	1,051	1.9	54,072	96.1
	1970	56,286	16.5	804	1.4	14,251	25.3	3,451	6.1	21,423	38.1	12,574	22.3	1,099	2.0	53,602	95.2
	Change 1963-1970	0	--	175	0.3	- 568	- 1.0	37	--	- 162	- 0.3	--	--	48	0.1	- 470	- 0.9
Waukesha	1963	94,051	27.6	3,606	3.8	22,433	23.9	15,253	16.2	26,805	28.5	19,347	20.6	2,420	2.6	89,864	95.6
	1970	94,051	27.6	4,224	4.5	21,031	22.4	15,264	16.2	26,055	27.7	19,018	20.2	2,658	2.8	88,250	93.8
	Change 1963-1970	0	--	618	0.7	- 1,402	- 1.5	11	--	- 750	- 0.8	- 329	- 0.4	238	0.2	- 1,614	- 1.8
Region	1963	341,531	100.0	14,949	4.4	97,969	28.7	41,615	12.2	92,073	27.0	66,319	19.4	10,967	3.2	323,892	94.9
	1970	341,531	100.0	18,439	5.4	92,835	27.2	42,284	12.4	90,592	26.5	64,707	19.0	11,052	3.2	319,909	93.7
	Change 1963-1970	0	--	3,490	1.0	- 5,134	- 1.5	669	0.2	- 1,481	- 0.5	- 1,612	- 0.4	85	--	- 3,983	- 1.2

[a] *Less than 0.05 percent.*

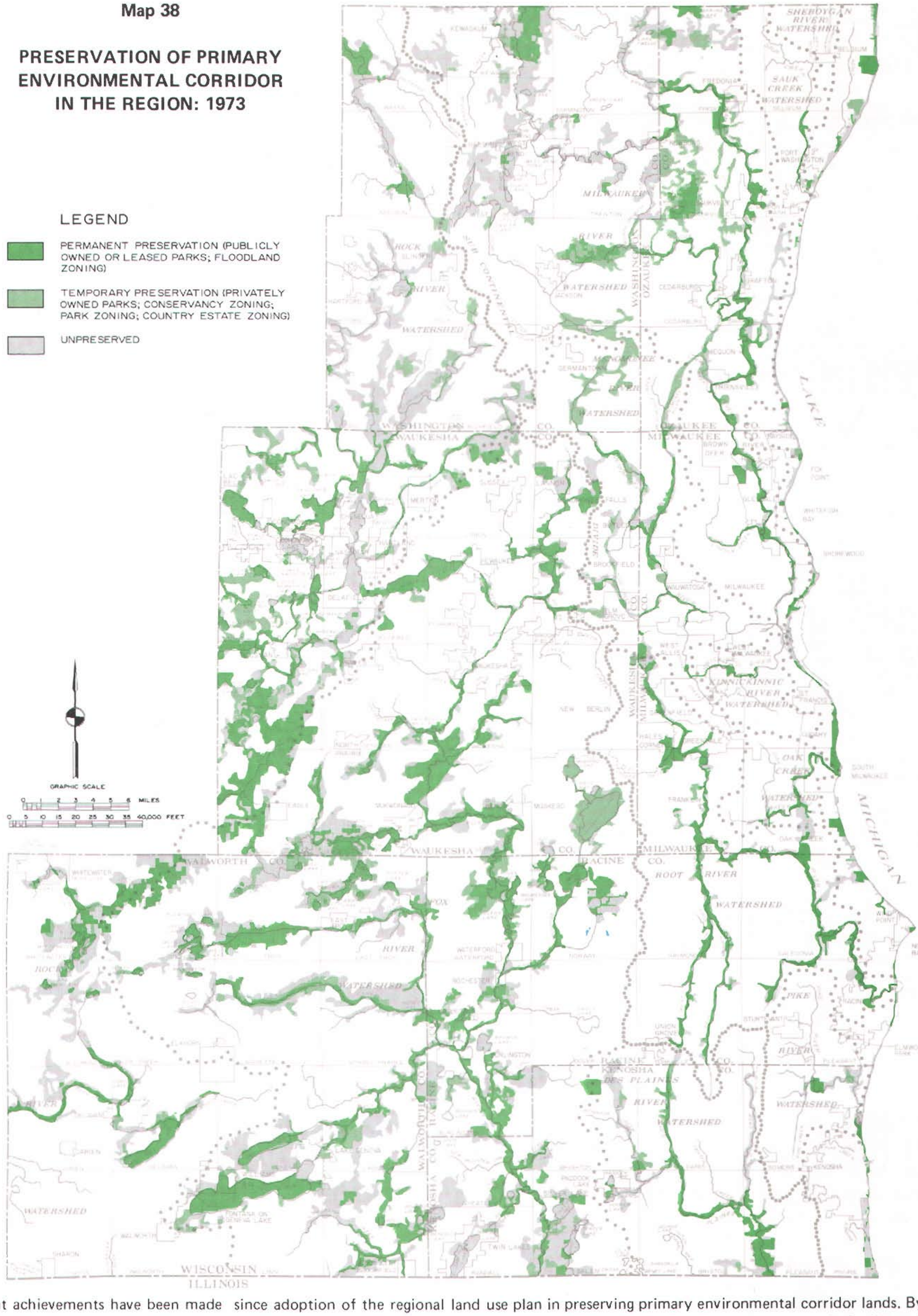
[b] *The 1963 primary environmental corridor acreage data differ from the data presented in SEWRPC Planning Report No. 7, The Land Use Transportation Study, Volume One, Inventory Findings, due to the availability of more detailed natural resource base information permitting a refinement of the primary environmental corridor delineation.*

Source: SEWRPC.

Significant achievements, however, have been made regarding the preservation of primary environmental corridors. Table 83 quantifies the amount and Map 38 indicates the spatial distribution of primary environmental corridor land preserved as of 1973. Primary environmental corridors were considered permanently preserved if they were publicly owned as park, outdoor recreation, or related open space lands; if they were publicly leased for park, outdoor recreation, or open space (long-term lease for 25 years or more); or if they were protected through a locally enacted floodland zoning ordinance which substantially carries out the Commission land use plan recommendation regarding preservation of floodland areas. Primary environmental corridors were considered temporarily preserved if they were protected through a locally enacted conservancy district zone; if they were part of a private park, outdoor recreation area, or open space area; if they were protected through a locally enacted public or private park and outdoor recreation zone, or if they were part

Map 38

PRESERVATION OF PRIMARY ENVIRONMENTAL CORRIDOR IN THE REGION: 1973



Significant achievements have been made since adoption of the regional land use plan in preserving primary environmental corridor lands. By 1973, about 129,500 acres, or 38 percent of the total primary environmental corridor acreage, had been permanently preserved; that is, such lands were either publicly owned or leased for park and outdoor recreation purposes or protected from development by a floodland zoning ordinance. An additional 47,000 acres, representing about 14 percent of the primary environmental corridor acreage, have been temporarily preserved through the enactment of conservancy or park zoning or through private park ownership. In total, about 176,500 acres, or 52 percent of the primary environmental corridor area of the Region, were either permanently or temporarily preserved by the end of 1973.

Source: SEWRPC.

of an exclusive agricultural or country estate zoning district which requires lot sizes of five acres or more per farm or dwelling unit.

As indicated in Table 83, 129,500 acres, or 38 percent, of the 341,500 gross primary environmental corridor acreage had been permanently preserved as of 1973. The majority of this area (83,400 acres) is preserved through floodland zoning. Over 47,000 acres, or 14 percent, of the gross corridor acreage has been temporarily preserved, with the majority of this area (24,000 acres) being protected through conservancy zoning districts. In total, over 176,500 acres, or 52 percent, of the gross primary environmental corridors in the Region were either permanently or temporarily preserved as of 1973.

PUBLIC UTILITY BASE

Public utility systems are one of the most important and permanent elements of urban growth and development. Urban development today is highly dependent upon these utility systems, which provide the individual land uses with power, light, communication, heat, water, and sewerage. Water supply and sanitary sewerage utilities have a particularly important interrelationship. Water supply facilities bring potable water from its sources to the user, while sanitary sewerage facilities collect the used water, convey it to a treatment plant, and after treatment return it to the natural environment from which it came.

The majority of water and sewerage utilities in the Region are organized as water and sewer departments of incorporated municipalities, and serve only those areas within the political boundaries of a municipality. Where sanitary districts have been organized, sewer and water service area limits may not be coterminous, although the individual service areas will often tend to approximate one another. Therefore, a general pattern of water and sewer service areas following political boundary lines rather than natural topographic boundaries, such as watershed boundaries, exists within the Region.

Sanitary Sewerage Utilities

Virtually all sanitary sewer service within the Region is provided by public agencies. These agencies generally take the form of a commission in the case of utilities providing areawide sewer service, a department in the case of utilities providing sewer service to incorporated municipalities, and a town sanitary or utility district board in the case of utilities providing sewer service to unincorporated areas. In 1975 a total of 95 centralized public sanitary sewerage systems were operated by utilities within the Region. These 95 systems served a total area of 353 square miles, or about 13 percent of the total area of the Region, and a total population of about 1.54 million persons, or about 86 percent of the total population of the Region. A total of 61 sewage treatment facilities were operated by the utilities owning, operating, and maintaining the 95 public sanitary sewerage systems, with many of the utilities contracting with adjacent utilities for sewage treatment. In addition, there were 67 privately owned sewage treatment plants in operation within the Region in 1975. These generally served isolated land use enclaves associated primarily with relatively large industrial, commercial, and recreational enterprises. In all, then, there were 128 sewage treatment facilities within the Region in 1975. The public sanitary sewerage service areas existing in the Region in 1975, together with the location of the sewage treatment facilities within the Region, are shown on Map 39.

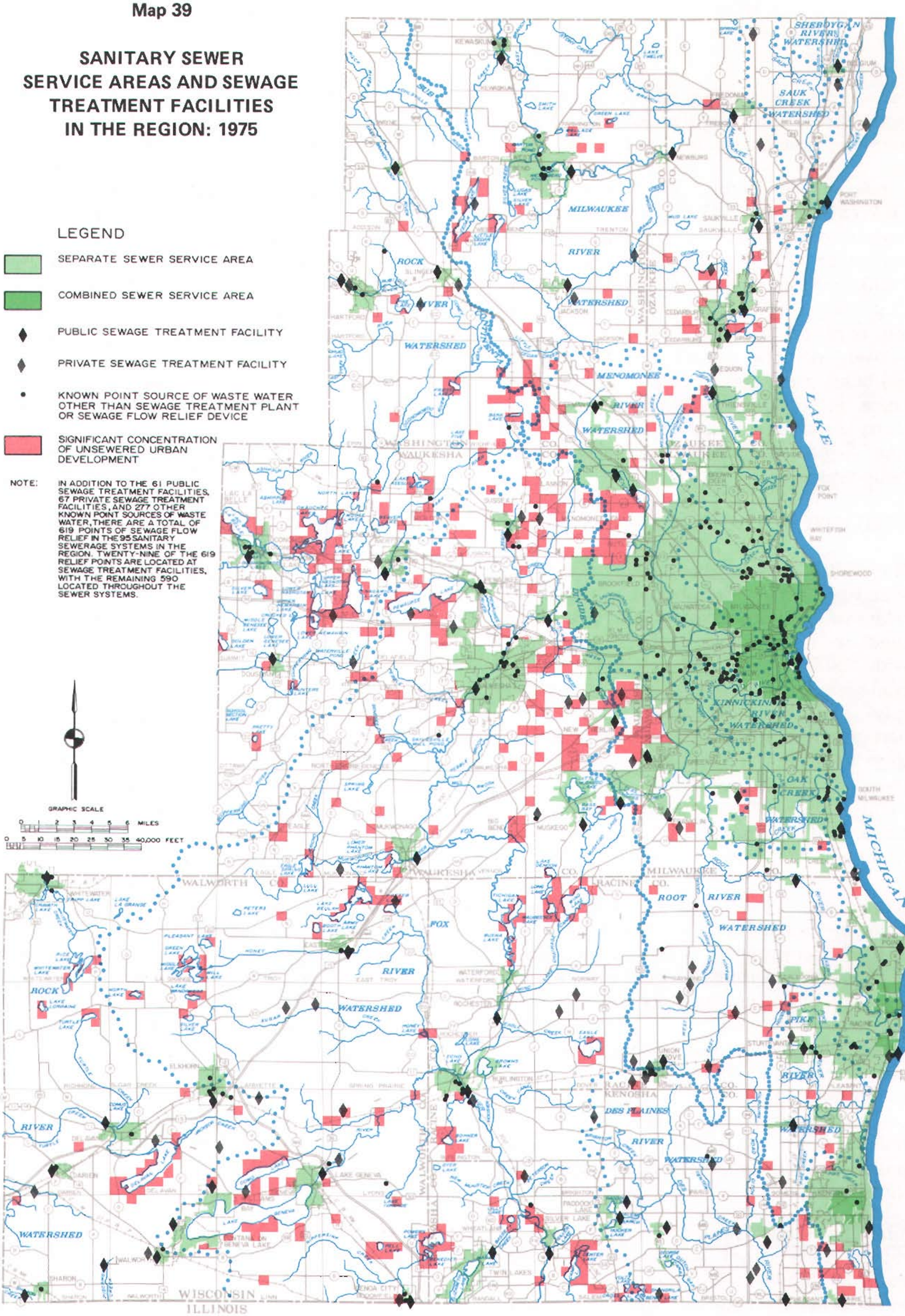
Septic Tank System Development: The construction of public sanitary sewerage facilities has not fully kept pace with the rapid urbanization of the Region, and this has been a contributing factor to the widespread use of onsite soil absorption sewage disposal systems. An estimated 246,500 persons in the Region, or about 14 percent of the total resident population, rely on such septic tank sewage disposal systems for domestic sewage disposal. About 24,000 of these persons live on farms. The remaining 222,000 persons constitute urban dwellers generally living in scattered fashion throughout the rural and rural-urban fringe areas of the Region. An estimated 28 percent of the area presently devoted to urban land uses within the Region is unserved by sanitary sewerage facilities.

Urban Storm Water Management Systems

The engineered urban storm water management systems of the Region are constructed and maintained by public agencies in the form of commissions, departments of general-purpose governments, or urban drainage district boards. In 1975, there were a total of 55 engineered urban storm water management systems within the Region consisting of a combination of piped and channelized drains and, in some cases, natural drainage channels. Systems mapping was available for such systems in 48 civil divisions. The remaining seven civil divisions are known to operate storm water drainage systems, but could not provide systems mapping.

Map 39

SANITARY SEWER SERVICE AREAS AND SEWAGE TREATMENT FACILITIES IN THE REGION: 1975



Centralized public sanitary sewer service in the Region is currently provided by 95 public sewerage systems to an area of about 353 square miles, or 13 percent of the total area of the Region. These 95 systems serve more than 1.5 million persons, or about 86 percent of the total population of the Region. About 27 square miles, primarily located in the central cities of Kenosha, Milwaukee, and Racine, are served by combined storm and sanitary sewers. Treatment for sewage generated in the Region is provided at 61 public sewage treatment facilities, which collectively discharge about 293 million gallons of sewage effluent per day. Of this total, 254 mgd, or 87 percent, are discharged directly to Lake Michigan. There are also 67 sewage treatment facilities serving isolated enclaves of urban land use development, as well as 277 known point sources of wastewater other than sewage treatment plants, which consist primarily of industrial cooling, rinse, process, and wash waters discharged directly to storm sewers or streams. While not shown on this map, there are an additional 590 known points of sewage flow relief in the Region, consisting of combined sewer overflows, relief pumping stations, crossovers from the sanitary to the storm sewer system, and gravity bypasses directly to the streams of the Region. In total, then, there are nearly 1,000 point sources of raw sewage, sewage effluent, and industrial waste discharge throughout the Region.

Source: SEWRPC.

The systems for which mapping was available serve a total area of about 183 square miles, or about 7 percent of the total area of the Region, with a total resident population of about 1.50 million persons, or about 84 percent of the total resident population of the Region. In addition to natural watercourses, improved surface drainageways, and subsurface conduits, these systems are known to include occasional pumping stations, detention-retention basins, and experimental installations for the treatment of combined sewer overflows. The location and extent of existing storm water management systems for which mapping was available within the Region as of 1975 are shown on Map 40.

Water Utilities

Most of the water supply service within the Region is provided by public water utilities. In 1975, there were a total of 72 publicly owned water utilities within the Region (see Table 84). Of these 72 utilities, all but one—the North Shore Water Utility in Milwaukee County—provide retail water service to consumers. The North Shore Water Utility provides wholesale water service only to three other water utilities—the Glendale Water Utility, the Village of Whitefish Bay Water Utility, and the Water Utility of the Village of Fox Point. Together, these 72 publicly owned water utilities serve an area of about 327 square miles, or about 12 percent of the total area of the Region, and about 1.59 million persons, or about 89 percent of the total resident population of the Region. The existing service areas of these 72 publicly owned water utilities as of 1975 are shown on Map 41.

In addition to the publicly owned water utilities, there are 79 known private or cooperatively owned water systems in operation within the Region (see Table 85). Many of these small water systems serve isolated residential enclaves. Some serve summer residents only and suspend operations during cold weather. Very few of these private systems have standby supply or storage facilities, and the majority do not keep detailed records or file annual reports with state or regulatory bodies. It is anticipated that many of these systems will eventually be absorbed into publicly owned municipal water utilities. The locations of these 79 known privately owned water utilities are shown on Map 41.

All water supplied by the publicly owned water utilities is drawn either from Lake Michigan or from the two district groundwater aquifers underlying the Region. Treated Lake Michigan water in an amount averaging 322 million gallons per day (mgd) was supplied in 1975 to an aggregate service area of about 252 square miles, or about 10 percent of the total area of the Region, and to a resident population of about 1.35 million persons, or about 76 percent of the total resident population of the Region. Twenty-one of the 72 public utilities in the Region utilize Lake Michigan as the sole source of supply. Of these 21, seven own and operate water on a wholesale basis. Generally, Lake Michigan offers an unusually good source of supply to those areas lying east of the subcontinental divide and within economic reach of this source of supply.

Well water in an amount averaging about 35 mgd was supplied in 1975 to an aggregate area of about 75 square miles, or about 3 percent of the total area of the Region, and to a population of about 235,000 persons, or about 13 percent of the total resident population of the Region. Fifty-one of the public utilities in the Region utilize groundwater as a source of supply. In general, water service from a municipal utility is, as a matter of local policy, furnished only to property within the municipal limits of that municipality. In the Southeastern Wisconsin Region, only the Cities of Kenosha, Milwaukee, and Racine provide water service beyond their corporate limits in any substantial amounts.

Gas Utilities

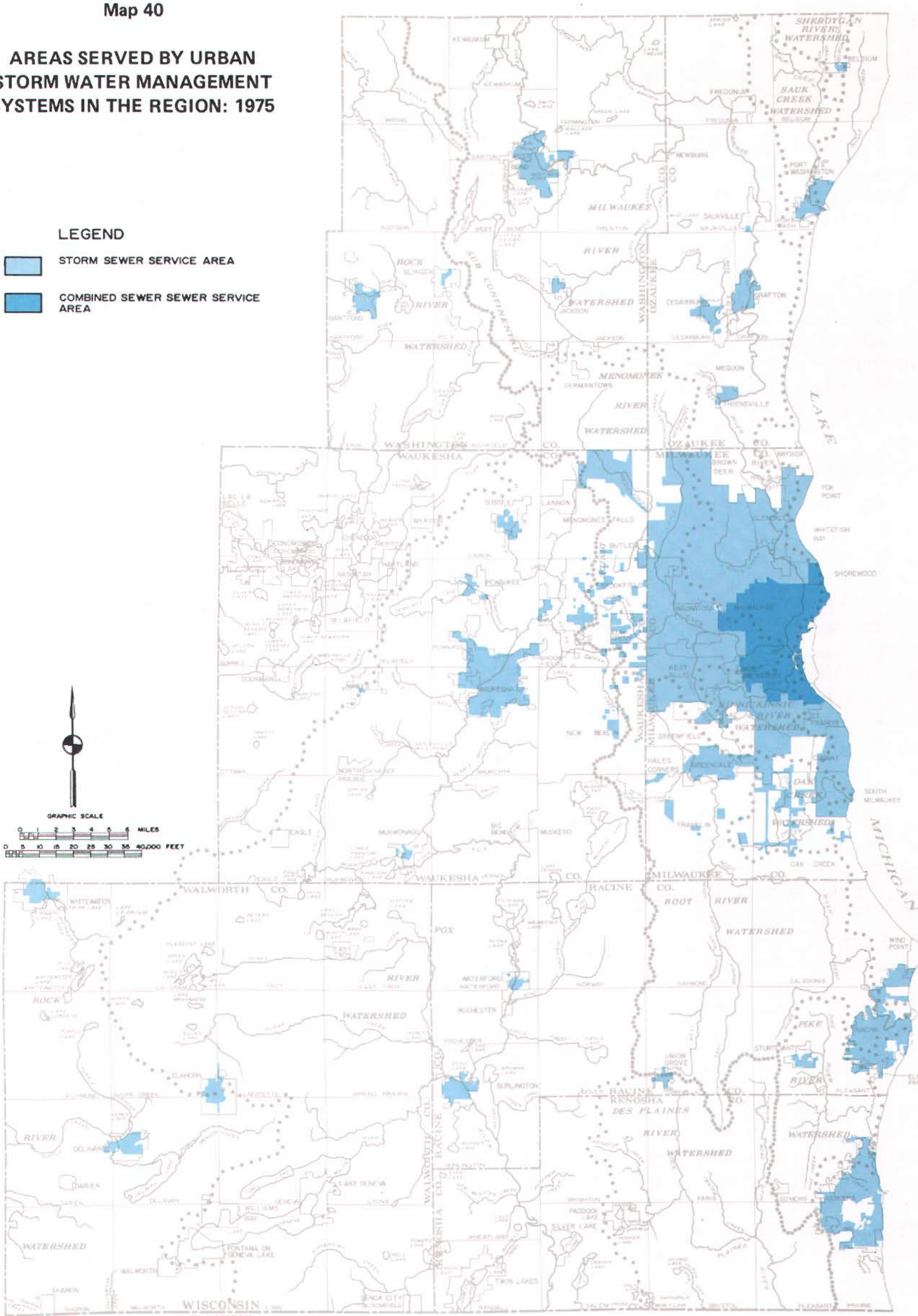
Three gas utilities are authorized to operate within the Region and provide all public gas service therein. The Wisconsin Gas Company is authorized to operate in parts of Milwaukee, Ozaukee, Washington, and Waukesha Counties. The Wisconsin Natural Gas Company is authorized to operate in parts of Kenosha, Milwaukee, Racine, Walworth, and Waukesha Counties. The Wisconsin Southern Gas Company is authorized to operate in parts of Kenosha, Racine, and Walworth Counties. Only in the Towns of Erin and Wayne, both in Washington County, is there no gas utility presently authorized to operate. Natural gas is supplied to the three gas utilities by the Michigan-Wisconsin Pipeline Company and the Natural Gas Pipeline Company of America. Gas service may be considered to be virtually ubiquitous and does not constitute a major constraint on the location and intensity of urban development in the Region.

Electric Utilities

Two major privately owned electric utilities are authorized to operate within the Region which,

Map 40

AREAS SERVED BY URBAN STORM WATER MANAGEMENT SYSTEMS IN THE REGION: 1975



A total of 55 urban storm water drainage systems consisting of piped and channelized drains and natural surface drainage channels were identified in the Region in 1975. These storm water drainage systems served just over 1,500,000 persons, or about 84 percent of the total population of the Region. System mapping was available for 48 of these 55 systems. The systems for which mapping was available serve a total area of about 183 square miles, or about 7 percent of the Region, and contain 1,358 known outfalls. During periods of wet weather, these storm water drainage systems discharge pollutants to the lakes and streams of the Region. The total runoff discharged from the outfalls in the 48 systems for which mapping was available as they existed in 1975—excluding the combined sewer system—during an average year was estimated at 22.9 billion gallons occurring in about 70 discrete events.

Source: SEWRPC.

Table 84

PUBLIC WATER UTILITIES IN THE REGION: 1975

Public Water Utility Name	Location	Area Served (square miles)	Estimated Population Served	Estimated Average Consumption (MGD)
KENOSHA COUNTY				
Kenosha Water Utility[a,b]	City of Kenosha	15.50	87,500	15.355
Paddock Lake Municipal Water Utility	Village of Paddock Lake	0.16	1,100	0.024
Pleasant Park Utility Company, Inc.[c]	Town of Pleasant Prairie - Pleasant Homes Subdivision	0.28	800	0.027
Pleasant Prairie Water Works[c]	Unincorporated Village of Pleasant Prairie	0.26	400	0.111
Sanitary District No. 1, Town of Somers[a]	Town of Somers	0.82	1,500	0.184
Town of Bristol Water Utility	Town of Bristol	0.19	500	0.039
Subtotal—Kenosha County		17.21	91,800	15.740
MILWAUKEE COUNTY				
Brown Deer Municipal Water Utility[a]	Village of Brown Deer	4.36	13,600	1.484
City of Franklin Industrial Park	City of Franklin	0.16	N/A	0.097
City of Oak Creek Water and Sewer Utility[d]	City of Oak Creek	6.67	12,000	2.347
Cudahy Water Department[a]	City of Cudahy	4.66	21,700	2.809
Glendale Water Utility[a]	City of Glendale	5.97	13,500	3.153
Milwaukee Water Works[a,e]	City of Milwaukee	147.91	882,500	239.675
North Shore Water Utility[a,f]	City of Glendale	--	--	--
Shorewood Municipal Water Utility[a]	Village of Shorewood	1.70	14,300	1.566
South Milwaukee Water Utility[a]	City of South Milwaukee	4.78	23,400	7.992
Village of Greendale Water and Sewer Utility[a]	Village of Greendale	4.90	16,800	1.453
Village of Whitefish Bay Water Utility[a]	Village of Whitefish Bay	2.13	16,200	2.031
Water Utility of the Village of Fox Point[a]	Village of Fox Point	2.88	7,900	0.920
Wauwatosa Water Works[a]	City of Wauwatosa	13.28	55,700	6.602
West Allis Water Utility[a]	City of West Allis	10.37	69,000	12.098
Subtotal—Milwaukee County		209.77	1,146,600	282.227
OZAUKEE COUNTY				
Belgium Municipal Water Utility	Village of Belgium	0.42	900	0.142
Cedarburg Light and Water Commission	City of Cedarburg	2.56	10,400	1.186
Fredonia Municipal Water and Sewer Utility	Village of Fredonia	0.56	1,300	0.124
Grafton Sewer and Water Utility	Village of Grafton	2.21	8,800	1.165
Port Washington Municipal Water Utility[a]	City of Port Washington	2.30	9,500	1.045
Saukville Municipal Water and Sewer Utility	Village of Saukville	1.06	2,400	0.696
Subtotal—Ozaukee County		9.11	33,300	4.358
RACINE COUNTY				
Burlington Water Works	City of Burlington	2.38	8,900	1.286
Caddy Vista Sanitary District	Town of Caledonia	0.31	1,000	0.052
Crestview Sanitary District	Town of Caledonia	0.80	2,500	0.239
North Cape Sanitary District	Towns of Norway and Raymond	0.06	200	0.164
North Park Sanitary District[a,g]	Town of Caledonia	1.34	5,200	0.832
Racine Water Department[a,h]	City of Racine	16.90	96,700	22.156
South Lawn Sanitary District[a]	Town of Mt. Pleasant	0.68	1,900	0.199
Sturtevant Water and Sewer Utility[a]	Village of Sturtevant	1.03	4,400	0.362
Town of Caledonia Water Utility District No. 1[a]	Town of Caledonia	1.98	1,400	N/A
Union Grove Water Department	Village of Union Grove	0.77	3,000	0.574
Waterford Water Utility	Village of Waterford	0.83	2,300	0.178
Wind Point Municipal Water Utility[a]	Village of Wind Point	1.21	2,000	0.166
Subtotal—Racine County		28.29	129,500	26.208
WALWORTH COUNTY				
Darien Municipal Water and Sewer Utility	Village of Darien	0.54	1,000	0.074
Delavan Water and Sewerage Commission	City of Delavan	2.41	5,800	0.799
East Troy Municipal Water Utility	Village of East Troy	1.17	2,200	0.607
Elkhorn Light and Water Commission	City of Elkhorn	1.98	4,300	0.523
Fontana Municipal Water Utility	Village of Fontana-on-Geneva Lake	1.75	1,800	0.334
Genoa City Municipal Water and Sewer Utility	Village of Genoa City	0.61	1,100	0.085
Lake Geneva Water Commission	City of Lake Geneva	1.91	5,600	1.044
Lyons Sanitary District No. 1	Town of Lyons	0.04	300	N/A
Town of Troy Sanitary District No. 1	Town of Troy	0.16	100	0.002
Village of Sharon Water Works and Sewer System	Village of Sharon	0.62	1,300	N/A
Walworth Municipal Water and Sewer Utility	Village of Walworth	0.85	1,700	0.243
Whitewater Municipal Water Utility	City of Whitewater	2.39	11,000	1.492
Williams Bay Municipal Water Utility	Village of Williams Bay	1.49	1,700	0.235
Subtotal—Walworth County		15.92	37,940	5.438

Table 84 (continued)

Public Water Utility: Name	Public Water Utility: Location	Area Served (square miles)	Estimated Population Served	Estimated Average Consumption (MGD)
WASHINGTON COUNTY				
Allenton Sanitary District No. 1	Town of Addison	0.33	800	0.130
City of Hartford Utilities Department	City of Hartford	1.91	7,700	0.731
City of West Bend Water Department	City of West Bend	5.53	19,300	3.344
Jackson Municipal Water Department	Village of Jackson	0.46	2,000	0.211
Kewaskum Municipal Water Department	Village of Kewaskum	0.82	2,400	0.408
Slinger Utilities	Village of Slinger	0.57	1,300	0.197
Village of Germantown Water Utility	Village of Germantown	1.41	2,800	0.241
Subtotal—Washington County		11.03	36,300	5.262
WAUKESHA COUNTY				
Butler Water Utility	Village of Butler	0.80	2,200	0.667
City of Brookfield Water Utility	City of Brookfield	4.93	4,800	0.985
City of Oconomowoc Electric and Water Departments	City of Oconomowoc	3.48	11,000	1.306
Hartland Municipal Water Utility	Village of Hartland	1.40	4,000	1.308
Mukwonago Municipal Water Utility	Village of Mukwonago	1.45	3,400	0.345
Muskego Water Utility	City of Muskego	2.36	4,800	N/A
New Berlin Water Utility	City of New Berlin	2.99	7,300	1.082
Pewaukee Water and Sewage Utility	Village of Pewaukee	1.28	4,400	0.520
Sussex Municipal Water Utility	Village of Sussex	0.96	4,100	N/A
Village of Dousman Water Utility	Village of Dousman	0.49	1,000	0.065
Village of Eagle Water Utility	Village of Eagle	0.37	900	0.046
Village of Menomonee Falls Water Utility	Village of Menomonee Falls	4.38	18,800	2.181
Waukesha Water Utility	City of Waukesha	9.96	49,000	9.141
Westbrooke Sanitary Districts Nos. 1 and 2	Town of Brookfield	0.39	1,000	0.050
Subtotal—Waukesha County		35.24	116,700	17.696
Region Total		326.57	1,592,100	356.929

NOTE: N/A indicates not applicable.

[a] *These utilities utilize Lake Michigan as the sole source of water supply.*

[b] *The Kenosha Water Utility provides retail water service to portions of the Towns of Pleasant Prairie and Somers and wholesale water service to the Town of Somers Sanitary District No. 1. The data presented in this table for the Kenosha Water Utility include the communities served on a retail basis.*

[c] *The Pleasant Park Utility Company, Inc. and the Pleasant Prairie Water Works are not public water utilities since they are privately owned. Because, however, these utilities operate in the same fashion as a public water utility and because they are capable of ready expansion much the same as a public water utility, they have been classified for analysis purposes in this study as public water utilities.*

[d] *The City of Oak Creek Water and Sewer Utility provides retail service to a portion of the City of Franklin. These data are shown under the City of Oak Creek Water and Sewer Utility totals.*

[e] *The Milwaukee Water Works provides retail water service to the Cities of Greenfield and St. Francis and the Village of West Milwaukee and a portion of the City of Franklin and provides wholesale water service to the Cities of Wauwatosa and West Allis and the Villages of Brown Deer, Greendale, and Shorewood. The data presented in this table for the Milwaukee Water Utility include the communities served on a retail basis.*

[f] *The North Shore Water Utility provides no retail water service and exists only to sell water on a wholesale basis to the City of Glendale and the Villages of Fox Point and Whitefish Bay.*

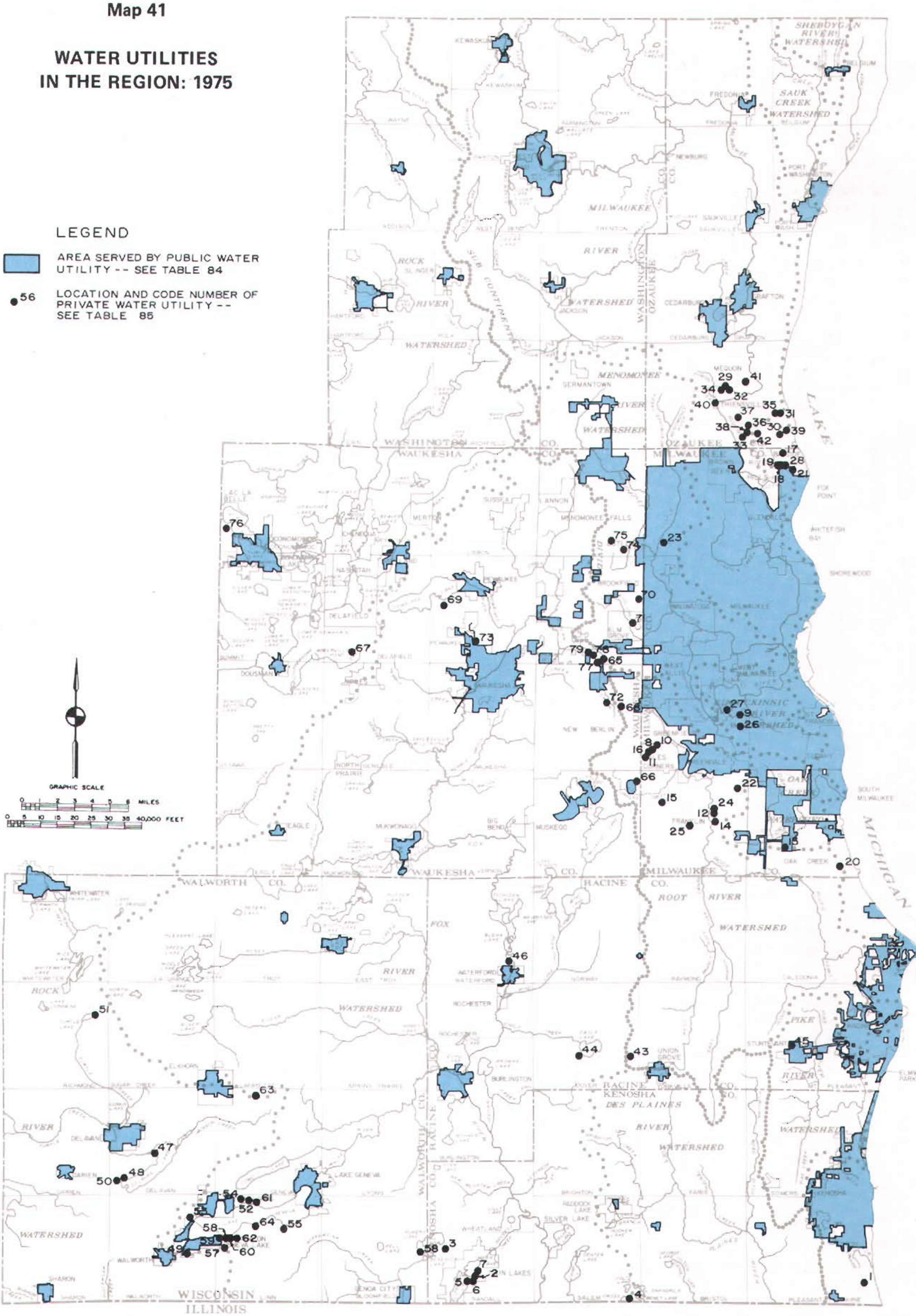
[g] *The North Park Water Utility provides water on a wholesale basis to the Wind Point Municipal Water Utility.*

[h] *The Racine Water Department provides retail water service to the Villages of North Bay and Elmwood Park and the Town of Mt. Pleasant and wholesale water service to the Village of Sturtevant, the North Park Sanitary District, the South Lawn Sanitary District, and the Town of Caledonia Utility District No. 1. The data presented in this table for the Racine Water utility include the communities served on a retail basis.*

Source: Wisconsin Public Service Commission, Wisconsin Department of Natural Resources, and SEWRPC.

Map 41

WATER UTILITIES IN THE REGION: 1975



Most of the water supply service in the Region is provided by 72 publicly owned water utilities. The service areas of these 72 utilities are shown on this map. In addition, there are 79 known private or cooperatively owned water supply systems in the Region which provide water service generally to individual subdivisions. The location of these private systems is also shown on this map. Lake Michigan is by far the most important source of water supply in the Region, with about 1.35 million persons, or 76 percent of the total Region population, currently being supplied from that source. An additional 235,000 persons, or about 13 percent of the total Region population, are supplied by public utilities relying on groundwater.

Source: SEWRPC.

Table 85

PRIVATE WATER UTILITIES IN THE REGION: 1975

Private Water Supply		
Code Number on Map 41	Name	Civil Division
	KENOSHA COUNTY	
1	Carol Beach Water Company	Town of Pleasant Prairie
2	Edgewater Subdivision	Town of Randall
3	Lake Knolls Subdivision	Town of Randall
4	Oakwood Knolls Subdivision	Town of Salem
5	Twin Lakes Park Water Company	Town of Randall
6	Van Woods Estates Water Company	Town of Randall
7	Wy-Wood Co-operative	Town of Randall
	MILWAUKEE COUNTY	
8	Blossom Heath Water Trust	Village of Hales Corners
9	Franklin Estates Subdivision	City of Franklin
10	Hales Happiness Homesites Subdivision	Village of Hales Corners
11	Hales Park Meadows	Village of Hales Corners
12	Hawthorn Glens Subdivision	City of Franklin
13	Howell Avenue Estates Subdivision	City of Oak Creek
14	Milwaukee County House of Correction	City of Franklin
15	Mission Hills Subdivision	City of Franklin
16	Monaco Heights	Village of Hales Corners
17	North Shore East Subdivision	Village of Bayside
18	Northway Co-operative No. 1	Village of Bayside
19	Northway Co-operative No. 2	Village of Bayside
20	Oakview Subdivision No. 3	City of Oak Creek
21	Pelham Heath Subdivision	Village of Bayside
22	Rawson Homes Subdivision	City of Franklin
23	Robert Williams Park	City of Milwaukee
24	Root River Water Trust[a]	City of Franklin
25	Security Acres Water Trust	City of Franklin
26	Southgate Manor Estates Subdivision	City of Greenfield
27	Town View Water Co-operative Association	City of Milwaukee
28	Vista Del Mar Water Trust	Village of Bayside
	OZAUKEE COUNTY	
29	Alberta Subdivision	Village of Thiensville
30	Apple Orchard Acres Subdivision	City of Mequon
31	Bonnie Lynn Highlands Subdivision	City of Mequon
32	Century Estates Subdivision No. 1 and Additions	Village of Thiensville
33	Lac du Cours Subdivision	City of Mequon
34	Laurel Acres Subdivision	Village of Thiensville
35	Mequon Water Trust	City of Mequon
36	North Shore Estates Subdivision	City of Mequon
37	North Shore Heights Subdivision	City of Mequon
38	Range Line Hills Subdivision	City of Mequon
39	Ravine Farm Acres	City of Mequon
40	Village Heights Co-operative	Village of Thiensville
41	Villa Du Parc	City of Mequon
42	Whitman Place Subdivision	City of Mequon
	RACINE COUNTY	
43	Center for the Developmentally Disabled (Wisconsin Southern Colony)	Town of Dover
44	Eagle Lake Manor Community Association	Town of Dover
45	St. Bonaventure Prep School[b]	Village of Mt. Pleasant
46	Waterford Woods Association	Town of Waterford
	WALWORTH COUNTY	
47	Assembly Grounds Association	Town of Delavan
48	Chicago Club	Town of Delavan
49	Country Club Estates	Town of Walworth
50	Crest View Estates Corporation	Town of Delavan
51	Crystal Bowl, Inc.	Town of Richmond
52	Elgin Club	Town of Linn
53	Gardens Association	Town of Walworth
54	Knollwood and Cisco Beach Subdivision	Town of Linn
55	Lake Geneva Beach Subdivision	Town of Linn
56	Lake Geneva Club	Town of Linn
57	Maple Hills Subdivision	Town of Linn
58	Nippersink Subdivision	Town of Bloomfield
59	Oak Shores Subdivision	Town of Linn
60	Shore Havens Association	Town of Linn
61	Sunset Hills Association	Town of Linn
62	Sybil Lane Subdivision	Town of Linn
63	Walworth County Institutions and Lakeland Nursing Corporation	Town of Geneva
64	Wooddale Lake Shore Properties	Town of Linn
	WASHINGTON COUNTY	
	None	
	WAUKESHA COUNTY	
65	Brookfield Hills Apartment Complex	City of Brookfield
66	Durham Meadows	City of Muskego
67	Ethan Allen School (Wisconsin School for Boys-Wales)	Town of Delafield
68	Glendale Park Subdivision	City of New Berlin
69	Highlands Water Co-operative	Town of Pewaukee
70	Lynwood Water Company	City of Brookfield
71	Marion Heights Terrace	Village of Elm Grove
72	Monterey Heights Subdivision	City of New Berlin
73	Northview Home and Hospital	City of Waukesha
74	River View Manors Well Association	Village of Menomonee Falls
75	Silver Springs Terrace Subdivision	Village of Menomonee Falls
76	Sunnyfield Acres Subdivision	Town of Oconomowoc
77	Westchester Water Co-operative No. 1	City of Brookfield
78	Westchester Water Co-operative No. 2	City of Brookfield
79	Westfield Co-operative Water Systems, Inc.	Town of Brookfield

[a] *Operation of the Root River Water Trust and Hawthorn Glens Subdivision wells were taken over by the City of Franklin in July 1977 and as of that date should be considered as a public water utility.*

[b] *St. Bonaventure School was connected to the Village of Sturtevant water system in 1977 and as of that date should be considered as a portion of the Village of Sturtevant public water utility.*

Source: SEWRPC.

together with five small municipal utilities, provide service to the entire Region. The Wisconsin Electric Power Company is authorized to operate throughout nearly the entire Region. The Wisconsin Power and Light Company is authorized to operate in parts of Kenosha and Walworth Counties. Municipal electric power utilities are operated by the Cities of Cedarburg, Elkhorn, Hartford, and Oconomowoc and by the Village of Slinger. Generally, an adequate supply of electric power is available throughout the Region. Residential service is available on demand anywhere within the Region, and low-voltage lines are in place along virtually every rural highway. Therefore, electric power service, like gas service, may be considered virtually ubiquitous and not a major constraint on the location and intensity of urban development in the Region.

SUMMARY

This chapter has described the natural resource and related public utility base of the Region. The natural resources and related public utilities of an area are vital to its economic development and to its ability to provide a pleasant and habitable environment. The following findings have particular significance for primary transit planning:

1. Air pollution exists in certain subareas of the Region. Federal air quality standards for particulate matter, sulfur dioxide, carbon monoxide, and hydrocarbons and ozone were estimated to have been exceeded in parts of the Region in 1977. The regional air quality attainment and maintenance plan, a part of the State Implementation Plan for air quality in Wisconsin, which is required under federal legislation, sets forth actions proposed to be taken to ensure that the federally prescribed air quality standards are met and maintained over the years. An important element of the recommended actions to achieve carbon monoxide and hydrocarbon/ozone standards is the short- and long-term improvement of public transit service in the Region.

2. The highly complex soil relationships existing within the Region and the extreme variability and intermingling of soils within even very small areas, together with the widespread occurrence of soils having questionable suitability for certain types of urban development, indicate the need for basing regional and local development plans on the results of detailed soil surveys. Analysis of detailed soil survey data revealed that severe or very severe limitations for residential development exist in the Region, particularly in Ozaukee and Milwaukee Counties and the eastern portions of Waukesha, Racine, and Kenosha Counties. Approximately 716 square miles, or about 27 percent of the area of the Region, are covered by soils which are poorly suited for residential development even with public sanitary sewer service; about 1,637 square miles, or 61 percent of the Region, are covered by soils which are poorly suited for residential development without public sanitary sewer service on lots smaller than one acre; and about 1,181 square miles, or 44 percent of the Region, are covered by soils poorly suited for residential development without public sanitary sewer service on lots one acre or larger in size.

3. There are 100 major lakes—lakes 50 acres or more in size—in the Region having a combined surface water area of 57 square miles, or about 2 percent of the total area of the Region. In addition, there are 228 lakes in the Region of less than 50 acres having a combined surface water area of four square miles, or about 0.15 percent of the area of the Region.

4. In 1970 woodlands in the Region covered a total combined area of about 125,300 acres, or 7 percent of the total area of the Region. Over 91,700 acres, or 73 percent of the total, were located in Walworth, Washington, and Waukesha Counties. Woodlands in the Region serve scenic, wildlife open space, educational, and recreational uses, and contribute to the quality of the environment as measured in terms of clean air, clean water, and scenic beauty.

5. Water and wetland areas covered 180,800 acres, or about 10 percent of the area of the Region, in 1970. Water and wetland areas contribute to resource conservation, and recreation and wetland areas are particularly important to flood control and to stream and lake water quality preservation.

6. Wildlife habitat areas covered approximately 259,800 acres, or 15 percent of the total area of the Region, in 1970. Over 103,000 acres, or 40 percent, were classified as high-

value wildlife habitat areas; 94,100 acres, or 36 percent, were classified as medium-value areas; and 62,700 acres, or 24 percent, were classified as low-value areas. Over 192,000 acres, or 74 percent of the wildlife habitat, were located in Walworth, Washington, and Waukesha Counties.

7. A total of 1,348 publicly and nonpublicly owned outdoor recreation sites totaling 55,564 acres in area existed in the Region in 1973. The 787 publicly owned sites were located primarily in the urbanized areas of the Region, while the 561 nonpublicly owned sites were located primarily in the Region's significant water resource areas. Other outdoor recreation and related open space sites existing in the Region in 1973 included 81 conservation sites comprising 39,821 acres, and 787 school facilities comprising 8,017 acres.

8. A total of 781 sites of historic significance existed in the Region in 1973. Of this total, 235, or 30 percent, were cultural features such as sites of Indian or early white settlements; 85, or 11 percent, were natural features such as woodlands or wetland areas; and 461, or 59 percent, were historic structures such as homes, churches, inns, or schools. Of the 187 marked historical sites in 1970, 74 sites, or 40 percent, were located in Milwaukee County.

9. When combined, the most important elements of the regional resource base, including the best remaining woodlands, wildlife habitat, surface water and wetlands, and historic, scenic, and recreational sites, form lineal elongated patterns termed environmental corridors by the Commission. There were 319,900 acres of net primary environmental corridor in the Region in 1970—4,000 acres less than the 323,900 acres of net corridor which existed in the Region in 1963. Much of the loss in corridor lands occurred as a result of urban encroachment, particularly residential land uses which increased by 3,000 acres, and transportation uses which increased by over 700 acres, between 1963 and 1970. Significant achievements have been made toward preserving the primary environmental corridors. A total of 176,500 acres, or 52 percent, of the gross primary environmental corridors in the Region have essentially been preserved through park, outdoor recreation, or related open space land acquisition, floodland, conservancy, or recreational district zoning, and exclusive agricultural 1 or country estate zoning.

10. In 1975, 95 public sanitary sewerage systems in the Region served an area of 353 square miles, or about 13 percent of the total area of the Region, and a population of about 1.54 million, or nearly 86 percent of the total population of the Region. The proportion of the total regional population served remained nearly constant between 1963 and 1975, despite significant gains in both the number and proportion of the total population served in several counties. Fourteen percent of the total regional population, or about 246,500 persons, rely on septic tank sewage disposal systems for domestic sewage disposal. About 222,000 of these persons are urban dwellers generally living in scattered fashion throughout the rural and rural-urban fringe areas of the Region.

11. Seventy-two publicly owned water utilities in the Region serve an area of about 327 square miles, or about 12 percent of the total area, and about 1.6 million persons, or about 89 percent of the total 1970 population of the Region. Of these 72 utilities, 21 utilize Lake Michigan as the source of supply and 51 utilize groundwater as the source of supply.

This chapter has presented data on the natural resource and related public utility bases of the Region. These data are important to the land use and transportation planning process in this primary transit system alternatives analysis because natural resources within the Region are limited and can be subject to misuse through improper land use and transportation facility development. Certain conclusions regarding the natural resource base, especially recent changes to that base which may affect the design of alternative land use and primary transit plans, are presented herein.

The residential development pattern of urban sprawl evident in the Region since 1950 has resulted in the encroachment of such development upon many important elements of the natural resource base, including woodlands, wetlands, wildlife habitat, potential park sites, and historic sites. This encroachment has in turn resulted in a general deterioration of surface water quality, potential contamination of groundwater supplies, and destruction of portions of the rural landscape and scenic topography. However, with the exception of the impact of this encroachment on surface water quality, the total impact of urban encroachment on the regional resource base remains relatively insignificant, especially when changes in individual natural resource elements are compared to the total qualitative and quantitative aspects of those resource elements within the Region. Indeed, as indicated by the significant achievements in preserving and protecting various natural resource elements through purchase, lease, or zoning, far more has been accomplished toward preservation and enhancement of that natural resource base than toward its destruction.

Based upon a growing public awareness of the need for environmental protection and enhancement, a general recognition of the important attributes of the natural resource base, and mandates from state and federal government agencies related to environmental protection, it would appear that the trend toward preservation and protection of natural resource base elements evident between 1963 and 1970 will continue. Through implementation of well-conceived land use and transportation plans and of such related plans as watershed and sanitary sewerage systems plans, the recreational, aesthetic, ecological, and cultural attributes of the natural resource base will not only be maintained but, in some cases, such as regional surface water quality, will even improve.

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Chapter V

TRAVEL HABITS AND PATTERNS

INTRODUCTION

One of the central concepts underlying any urban transportation planning effort is that personal travel is an orderly, regular, and measurable occurrence, evidenced by recognizable travel patterns. An inventory of existing personal travel is necessary to discover these patterns, along with those aspects of these patterns which demonstrate a high degree of repetitiveness. Such knowledge is a prerequisite to an understanding of likely future travel behavior and, therefore, to intelligent planning for future travel requirements. In this respect, the inventory of travel must provide a clear representation of total personal travel, while taking stock of and describing in detail each of its component parts.

Another concept underlying urban transportation planning is that land use and transportation are closely interrelated. An inventory of existing personal travel within the Region is, therefore, also necessary in order to determine the quantitative relationships existing between land use and travel, thereby providing a basis for the derivation of future travel demand from proposed land use patterns and for the determination of the distribution of that demand over existing and proposed transportation facilities and services.

Travel inventories were conducted by the Commission in 1963 for use in the preparation of its initial regional transportation system plan, and again in 1972 for use in the reevaluation and revision of that plan. The salient findings of the 1963 and 1972 regional inventories of travel are presented, respectively, in SEWRPC Planning Report No. 7, Land Use-Transportation Study, Volume One, Inventory Findings, and in SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000, Volume One, Inventory Findings.

The basic travel origin-destination surveys conducted in both the 1963 and 1972 regional travel inventories were the home interview, truck and taxi, and external cordon surveys. In 1972, five special origin-destination surveys were also conducted: the public transit user survey, public transit nonuser survey, major traffic generator survey, interregional motor bus, rail, and carferry survey, and weekend travel survey.

This chapter presents a summary of existing travel behavior in the Region as measured in the 1972 regional travel inventory. In addition, comparisons between existing travel behavior and that measured in 1963 are drawn. Some planners and engineers hold that it would be desirable to reinventory existing travel habits and patterns in the Milwaukee area for the purposes of this study. However, the U. S. Department of Transportation will no longer fund large-scale areawide travel inventories as in the past since mathematical models derived from past travel inventories can be used to simulate both existing and probable future travel habits and patterns. Such models were developed by the Commission from its 1963 inventory data and were reevaluated using its 1972 inventory data, and are available to simulate existing and probable future travel patterns, deriving such patterns from existing or proposed land use configurations. Thus, a new inventory of travel is not required for the study. Substantial evidence exists that relationships between land use and travel are reasonably stable over time, as documented in SEWRPC Planning Report No. 25, Volume Two, Alternative and Recommended Plans.

QUANTITY OF TOTAL TRAVEL IN SOUTHEASTERN WISCONSIN

In 1972 the resident population of the Region was approximately 1.81 million people—about 156,000 people, or 9 percent, more than in 1963.[1] These regional residents occupied nearly 557,300 year-round housing units and 10,400 units in group quarters,[2] for a total of nearly 568,000 occupied

[1] *These 1972 and 1963 figures do not include the approximately 20,000 persons confined in mental hospitals, prisons, invalid homes, and other such group quarters where travel is restricted.*

[2] *Group quarters are defined herein as special housing dormitories, convents, hospital staff residences, and homes for the aged.*

housing units in 1972. This figure represents an increase over the 1963 figure of about 77,000 occupied housing units, or about 16 percent.

In 1972, 4.68 million person trips[3] were made by this resident population on an average weekday—an increase of about 887,000 person trips per day, or 23 percent, since 1963. Of these 4.68 million person trips, about 4.50 million, or 96 percent, were internal person trips; that is, trips having both origin and destination within the Region. These 4.50 million internal person trips represent an increase of 902,000 trips, or 25 percent, since 1963. The average number of internal person weekday trips per capita increased from 2.2 in 1963 to 2.5 in 1972, while the average number of internal person weekday trips per household increased from 7.3 to 7.9.

The remaining 0.18 million person trips made within the Region on an average weekday in 1972 were the result of external travel; that is, trips made into, out of, or through the Region. External travel decreased by about 8 percent from 1963 to 1972, or by about 15,000 person trips per average weekday. Thus, internal travel represents the great majority of all travel within the Region on an average weekday, and, therefore, virtually the entire potential market for a primary transit system.

In 1972 approximately 3.41 million vehicle trips were made within the Region on an average weekday, principally by auto, truck, and taxi. This represents an increase of 848,000 vehicle trips, or 33 percent, since 1963. Of the 3.41 million vehicle trips, about 3.29 million, or 96 percent, were internal vehicle trips, representing an increase of 824,000 such trips, or 33 percent, since 1963. Over 88 percent of these 3.29 million internal vehicle trips were made by automobile, with 11 of the remaining 12 percent being made by trucks.

INTERNAL PERSON TRIP PRODUCTION

The number of per capita trips made on an average weekday increased from 2.2 in 1963 to 2.5 in 1972. At the same time, the number of per household trips increased from 7.3 in 1963 to 7.9 in 1972. A wide variance in these trip rates existed in geographic subareas of the Region in both 1963 and 1972. The lowest rates of person trip production in both years were found in the central areas of the larger cities and in outlying rural areas, where the average daily number of trips per household was usually less than four. The highest rates in both years were found in the suburban and rural-urban fringe areas, where the number of daily trips per household averaged 12 or more. Overall trip production increased from 1963 to 1972, particularly in many of the rural-urban fringe areas where the average number of trips per household increased from 4 to 8 trips per day to 8 to 12 trips per day, and in many of the suburban areas where trip production averages increased from 8 to 12 trips per day to 12 to 16 or more trips per day.

Relationship of Automobile Availability

A strong correlation was found to exist between person trip production and the number of automobiles available to households within the Region. As indicated in Table 86, trip production per household in the Region was found both in 1963 and in 1972 to increase sharply with increased household automobile availability. This observed relationship of automobile availability and demand for travel has important implications for transportation planning, because the number of automobiles available per resident of the Region has been increasing. The 1972 survey findings indicated that about 704,600 automobiles were available to the approximately 568,000 households within the Region, an average of 1.24 autos per household, or about 389 autos per 1,000 resident population. Approximately 527,300 automobiles were determined to be available in the Region in 1963, an average of 1.07 autos per household, or 319 autos per 1,000 resident population. Estimates of population and automobiles available in the Region in 1978 indicate that the number of automobiles available has increased to 758,900 while the number of households has increased to 595,000, resulting in an estimated 1.28 autos per household in the Region in 1978.

Relationship of Income

Another factor closely related to person trip production is annual household income. The average number of person trips made daily per household has been shown to be higher for households with higher income levels. Table 87 indicates that households having an income of less than $4,000 per year averaged about three trips per day, whereas households having an annual income of $8,000

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[3] *A person trip is defined herein as a one-way journey between a point of origin and a point of destination by a person five years of age or older traveling as an auto driver or as a passenger in an auto, taxi, truck, motorcycle, school bus, or mass transit carrier. To be considered, the trip must have been at least the equivalent of one full city block in length.*

averaged about six trips per day in 1972. Households reporting a yearly income of less than $8,000 represented 30 percent of the total households in the Region but accounted for only 15 percent of total trips, while households reporting a yearly income more than $12,000 represented 40 percent of the total households in the Region but accounted for 54 percent of total trips. These data indicate that increasing affluence and increased personal travel are directly related.

Relationship of Family Size

Person trip production within the Region is also related to the number of persons in a household. Table 88 indicates that in both 1963 and 1972, the average number of trips per household increased with household size. In 1972 the number of trips made on an average weekday per household increased by about 2.5 trips with each additional person per household, up to a household size of five.

TRAVEL MODE OF INTERNAL PERSON TRIPS

The opportunity to select a particular mode of travel, principally automobile or public transit, is not available to all residents of the Region. Many households are located in areas not served by public transit, and are thus dependent upon the automobile. Many other households do not have automobiles available because of age, income, personal disability, or choice, and are thus dependent almost entirely on public transit. The 1972 survey findings indicate that automobile travel on an average weekday accounted for the vast majority of total internal person travel within the Region, as shown in Table 89. Auto driver trips alone accounted for 64 percent of all internal person trips in 1972, up from 60 percent in 1963, while auto passenger trips accounted for an additional 27 percent of the total, about the same as in 1963. Of the remaining modes, public transit passenger trips accounted for 9 percent of total internal person trips in 1963 and 4 percent in 1972, and school bus trips accounted for 3 percent in 1963 and 4 percent in 1972. All other remaining modes together, such as taxi passenger trips, truck passenger trips and, in 1972, motorcycle driver and passenger trips accounted for 0.2 and 0.5 percent in 1963 and 1972, respectively.

Table 89 also indicates that from 1963 to 1972, auto driver trips within the Region increased by 731,000 trips, or by 34 percent, while auto passenger trips increased by 242,000 trips, or by 25 percent. The greater increase in automobile driver trips, as well as the substantial increase in both automobile driver and auto passenger trips, reflects not only the increase in population from 1963 to 1972 and the increased number of automobiles available to drivers over that same period, but also the increase in the number of multiple-automobile households within the Region. The lesser growth in auto passenger travel is reflected by a decrease in the average auto occupancy rate for the Region—from 1.45 persons per auto in 1963 to 1.42 persons in 1972.

Table 86

AVERAGE WEEKDAY INTERNAL PERSON TRIPS PER HOUSEHOLD IN THE REGION BY AUTOMOBILE AVAILABILITY: 1963 AND 1972

Autos Available	1963				1972				Person Trips per Household	
	Households		Person Trips		Households		Person Trips			
	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total	1963	1972
0	90,700	18.4	193,900	5.4	95,600	16.8	182,500	4.1	2.1	1.9
1	284,600	57.9	2,107,800	58.5	279,200	49.2	1,964,900	43.6	7.4	7.0
2	103,000	21.0	1,123,900	31.2	161,300	28.4	1,851,000	41.1	10.9	11.5
3 or More . .	13,100	2.7	177,400	4.9	31,600	5.6	506,500	11.2	13.5	16.0
Region	491,400	100.0	3,603,000	100.0	567,700	100.0	4,504,900	100.0	7.3	7.9

Source: SEWRPC.

Table 87

AVERAGE WEEKDAY INTERNAL PERSON TRIPS PER HOUSEHOLD IN THE REGION BY INCOME GROUP: 1972

Income Range	Households[a] Number	Households[a] Percent of Total	Person Trips Number	Person Trips Percent of Total	Person Trips per Household
$ 0 to 3,999	51,600	13.2	145,300	4.2	2.8
4,000 to 7,999	67,100	17.2	384,400	11.2	5.7
8,000 to 11,999	117,300	30.1	1,043,200	30.5	8.9
12,000 to 15,999	75,600	19.4	854,700	25.0	11.3
16,000 to 24,999	60,200	15.4	741,800	21.7	12.3
25,000 or More	18,200	4.7	252,300	7.4	13.9
Total Reporting Households	390,000	100.0	3,421,700	100.0	8.8

[a] *Approximately 31 percent of total households did not provide household annual income data.*

Source: SEWRPC.

Table 88

AVERAGE WEEKDAY INTERNAL PERSON TRIPS PER HOUSEHOLD IN THE REGION BY FAMILY SIZE: 1963 AND 1972

Family Size	1963 Households Number	1963 Households Percent of Total	1963 Person Trips Number	1963 Person Trips Percent of Total	1972 Households Number	1972 Households Percent of Total	1972 Person Trips Number	1972 Person Trips Percent of Total	Person Trips per Household 1963	Person Trips per Household 1972
1	60,000	12.2	114,600	3.2	98,700	17.4	234,800	5.2	1.9	2.4
2	136,300	27.7	685,000	19.0	164,200	28.9	903,200	20.1	5.0	5.5
3	87,800	17.9	668,400	18.6	92,400	16.3	762,100	16.9	7.6	8.2
4	84,000	17.1	807,100	22.4	86,600	15.3	904,700	20.1	9.6	10.4
5 or More	123,300	25.1	1,327,900	36.8	125,800	22.1	1,700,100	37.7	10.8	13.5
Region	491,400	100.0	3,603,000	100.0	567,700	100.0	4,504,900	100.0	7.3	7.9

Source: SEWRPC.

Table 89

DISTRIBUTION OF AVERAGE WEEKDAY INTERNAL PERSON TRIPS IN THE REGION BY MODE OF TRAVEL: 1963 AND 1972

Mode of Travel	Person Trips 1963 Number	Person Trips 1963 Percent of Total	Person Trips 1972 Number	Person Trips 1972 Percent of Total	Change: 1963-1972 Number	Change: 1963-1972 Percent
Auto Driver	2,165,700	60.1	2,897,000	64.3	731,300	33.8
Auto Passenger	985,100	27.4	1,227,400	27.2	242,300	24.6
Mass Transit	324,300	9.0	186,200	4.1	- 138,100	- 42.6
School Bus	119,900	3.3	173,800	3.9	53,900	45.0
Other	8,000	0.2	20,500	0.5	12,500	156.3
Total	3,603,000	100.0	4,504,900	100.0	901,900	25.0

Source: SEWRPC.

Public transit passenger trips, in contrast to auto travel trips, decreased from about 324,000 revenue passenger trips per average weekday in 1963 to about 186,000 in 1972—a decrease of about 138,000, or 43 percent (see Figure 15). In the Milwaukee transit service area,[4] the number of public transit passenger rides per year per capita decreased from 85 in 1963 to 51 in 1972; in the Racine transit service area, from 30 in 1963 to 5 in 1972; and in the Kenosha transit service area, from 26 in 1963 to 6 in 1972.

Transit travel to the Milwaukee central business district (CBD) sharply decreased from 50,500 trips per average weekday in 1963 to 29,000 trips per average weekday in 1972, a decline of 43 percent, while total travel to the CBD decreased by only 11,500 trips per day, or about 4 percent. This rate of decline in transit travel to the CBD approximates the rate of decline experienced during the period in total public transit travel within the Region. Table 90 shows the change in average weekday travel by mode for total trips entering, leaving, and made within the Milwaukee CBD between 1963 and 1972. The table shows that the proportion of total trips to the CBD represented by auto driver travel increased from 47 percent to 57 percent between 1963 and 1972, that the proportion represented by auto passenger travel increased from 16 percent to 21 percent, and that the proportion represented by public transit travel decreased from 36 percent to 22 percent.

Person trips by school bus within the Region increased substantially between 1963 and 1972—from about 120,000 in 1963 to about 174,000 in 1972, an increase of about 54,000, or 45 percent. Trips by all other modes of travel combined increased from about 8,000 in 1963 to more than 20,000 in 1972—an increase of more than 12,000 trips, or 156 percent.

Public Transit Trip Production

The total number of households in the urbanized areas of the Region making public transit trips on an average weekday decreased from approximately 110,500 in 1963 to 73,200 in 1972, a 34 percent decrease.

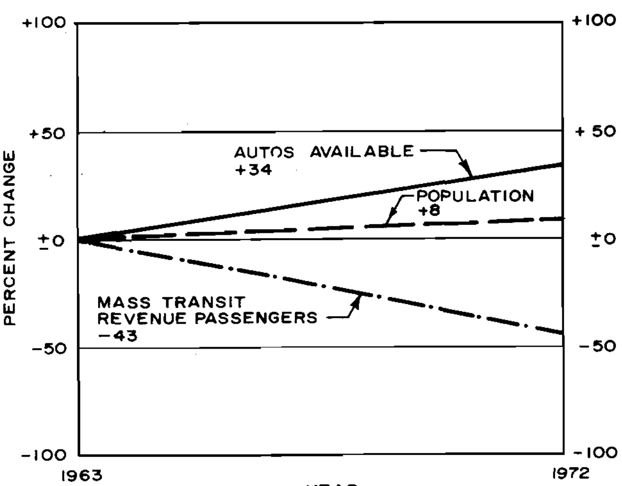
[4] *For the purpose of this report, a transit service area is defined as the area within one-quarter mile of a transit line.*

Table 91 indicates that in both the 1963 and 1972, the average number of transit trips per transit tripmaking household in the urbanized areas of the Region decreased as the number of automobiles available per household increased. The largest differences in transit tripmaking per household in 1963 is indicated between zero-auto and one-auto households; zero-auto households made 3.2 transit trips per weekday, whereas one-auto households made 2.7 transit trips per weekday. This one-auto average remains relatively steady for two-auto and three-or-more-auto households. In 1972 the largest difference is indicated between two-auto and three-or-more-auto households; two-auto households made 2.3 transit trips per weekday, whereas three-or-more auto households made 1.9 trips per weekday.

The declining transit ridership trend observed between 1963 and 1972, and for at least 10 years prior to 1963, is changing. This change can be explained in part by the increase in the quality of transit service in the three urbanized areas of the Region over the past six years due, primarily, to the effects of public ownership. New equipment, extension and expansion of service, and improvements in the frequency and speed of service have all contributed to increases in the availability and attractiveness of public transit and, as a consequence, to the increased use of transit service in

Figure 15

PERCENT CHANGE IN POPULATION, AUTOMOBILES AVAILABLE, AND MASS TRANSIT REVENUE PASSENGERS IN THE REGION: 1963-1972



Source: SEWRPC.

Table 90

INTERNAL PERSON TRIPS ENTERING, LEAVING, AND OCCURRING WITHIN THE MILWAUKEE CBD ON AN AVERAGE WEEKDAY BY MODE OF TRAVEL: 1963 AND 1972

Direction of Travel	Year	Auto Driver Trips	Auto Driver Percent	Auto Passenger Trips	Auto Passenger Percent	Mass Transit Trips	Mass Transit Percent	Other[a] Trips	Other[a] Percent	Total Trips	Total Percent
Entering the CBD	1963	58,840	47.3	20,230	16.3	44,590	35.9	650	0.5	124,310	100.0
	1972	67,500	56.6	24,790	20.8	26,350	22.1	580	0.5	119,220	100.0
Leaving the CBD	1963	59,030	47.6	19,610	15.8	44,610	35.9	850	0.7	124,100	100.0
	1972	68,030	56.9	25,350	21.2	25,410	21.3	670	0.6	119,460	100.0
Within the CBD	1963	6,220	45.1	1,390	10.1	5,960	43.2	220	1.6	13,790	100.0
	1972	6,820	56.6	2,470	20.5	2,660	22.1	90	0.8	12,040	100.0
Total	1963	124,090	47.3	41,230	15.7	95,160	36.3	1,720	0.7	262,200	100.0
	1972	142,350	56.8	52,610	21.0	54,420	21.7	1,340	0.5	250,720	100.0

[a] Includes passenger travel by school bus, taxi, and truck in both 1963 and 1972 and trips by motorcycle in 1972.

Source: SEWRPC.

Table 91

AVERAGE WEEKDAY INTERNAL TRANSIT TRIPS PER TRANSIT TRIPMAKING HOUSEHOLD IN THE URBANIZED AREAS OF THE REGION BY AUTOMOBILE AVAILABILITY: 1963 AND 1972

Automobiles Available	1963 Households Number	1963 Households Percent of Total	1963 Transit Trips Number	1963 Transit Trips Percent of Total	1963 Average Trips per Household	1972 Households Number	1972 Households Percent of Total	1972 Transit Trips Number	1972 Transit Trips Percent of Total	1972 Average Trips per Household	Percent Change Households	Percent Change Transit Trips
None	39,300	35.6	127,100	39.7	3.2	27,400	37.4	74,900	40.5	2.7	- 30.3	- 41.1
One	56,200	50.8	153,000	47.9	2.7	30,800	42.1	76,600	41.5	2.5	- 45.2	- 49.9
Two.	13,500	12.2	35,800	11.2	2.7	12,300	16.8	28,300	15.3	2.3	- 8.9	- 20.9
Three or More . . .	1,500	1.4	3,900	1.2	2.6	2,700	3.7	5,000	2.7	1.9	80.0	28.2
Total	110,500	100.0	319,800	100.0	2.9	73,200	100.0	184,800	100.0	2.5	- 33.8	- 42.2

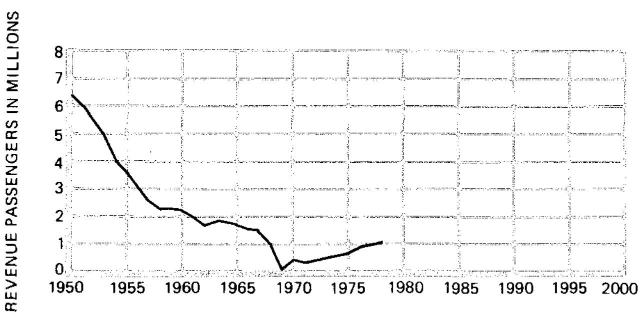
Source: SEWRPC.

the Region. In addition, while the out-of-pocket costs of transit service have remained about the same in the three urbanized areas of the Region since 1972, the operating costs of its principal alternative, the automobile, which include fuel, parking, insurance, and maintenance, have substantially increased. In the Kenosha urbanized area, as shown in Figure 16, transit ridership declined from 6.5 million in 1950 to 400,000 in 1972, or by more than 6 million revenue passenger trips. Transit ridership, however, recently has increased from 400,000 revenue passengers in 1972 to approximately 1,153,000 revenue passengers in 1978. In the Racine urbanized area, transit ridership declined from 9.9 million trips in 1950 to 0.5 million trips in 1972, or by more than 9 million revenue passenger trips. However, since 1972, as shown in Figure 17, transit usage has increased from 500,000 annual revenue passenger trips to almost 1,543,000 trips in 1978.

The Milwaukee urbanized area has experienced dramatic transit ridership changes since 1950, as shown in Figure 18. Transit ridership declined from more than 215 million revenue passengers in 1950 to about 90 million in 1963, or from about 242 to about 84 rides per capita. From 1963 to 1972, the trend of declining transit utilization continued, with transit ridership decreasing to only 52 million revenue passengers per year, or about

Figure 16

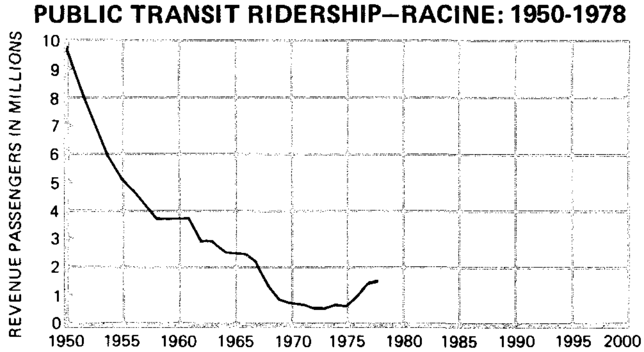
PUBLIC TRANSIT RIDERSHIP—KENOSHA: 1950-1978



Source: SEWRPC.

Figure 17

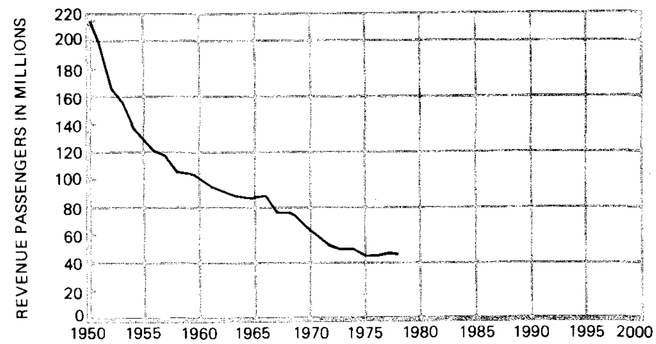
PUBLIC TRANSIT RIDERSHIP—RACINE: 1950-1978



Source: SEWRPC.

Figure 18

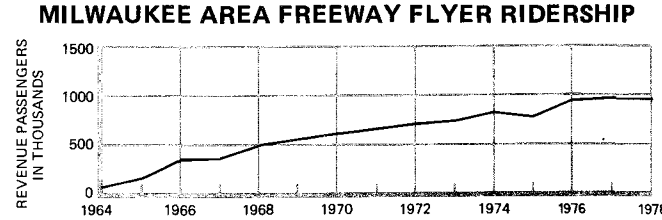
PUBLIC TRANSIT RIDERSHIP—MILWAUKEE: 1950-1978



Source: SEWRPC.

Figure 19

MILWAUKEE AREA FREEWAY FLYER RIDERSHIP



Source: SEWRPC.

50 rides per capita per year. Although ridership declined slightly since 1972 to 48.5 million trips in 1977, it appears that the historic trend of rapid decline has ended, and transit use in the Milwaukee area, in fact, has not only stabilized but has begun to increase. Total adjusted transit ridership in the Milwaukee urbanized area increased between 1977 and 1978 to approximately 52.6 million trips per year,[5] a slightly greater level of ridership than in 1972. Ridership on the nonstop, "Freeway Flyer" transit service to the downtown Milwaukee area, first introduced in 1964, has in particular steadily increased over the years to a level of more than 1 million revenue passenger trips in 1978 (see Figure 19).

[5]*The estimated Milwaukee urbanized area transit ridership is adjusted to account for a two-month transit strike which occurred at a time that ridership was reported as increasing by 7.2 percent over the previous year. Adjusted ridership figures are necessary to maintain comparability of historical ridership trends and are used for state and federal funding purposes.*

PURPOSE OF INTERNAL PERSON TRAVEL

Home-oriented travel in the Region accounted for the largest proportion of total internal person travel on an average weekday, as shown in Table 92. The importance of the home as a generator of person trips is evident by the fact that trips to home accounted for 41 percent of total trip destinations and 41 percent of total trip origins in the Region on an average weekday in both 1963 and 1972. As a consequence, trips having either an origin or destination at home constituted over 80 percent of total internal person travel within the Region in 1972. It is apparent that future travel facility and service requirements within the Region will be determined in large measure by the amount and location of future residential development.

Table 92

DISTRIBUTION OF AVERAGE WEEKDAY INTERNAL PERSON TRIPS IN THE REGION BY TRIP PURPOSE AT DESTINATION: 1963 AND 1972

Trip Purpose at Destination	Person Trips				Change: 1963-1972	
	1963		1972			
	Number	Percent of Total	Number	Percent of Total	Number	Percent
Home	1,458,900	40.5	1,836,200	40.8	377,300	25.9
Work	664,400	18.4	740,800	16.4	76,400	11.5
Personal Business	465,300	12.9	654,900	14.5	189,600	40.7
School	165,500	4.6	220,000	4.9	54,500	32.9
Social-Recreational	423,400	11.8	508,100	11.3	84,700	20.0
Shopping	425,500	11.8	544,900	12.1	119,400	28.1
Total	3,603,000	100.0	4,504,900	100.0	901,900	25.0

Source: SEWRPC.

Table 93

DISTRIBUTION OF AVERAGE WEEKDAY INTERNAL PERSON TRIPS IN THE REGION BY LAND USE AT DESTINATION: 1963 AND 1972

Land Use at Destination	Person Trips				Change: 1963-1972	
	1963		1972			
	Number	Percent of Total	Number	Percent of Total	Number	Percent
Residential	1,783,100	49.5	2,174,900	48.3	391,800	22.0
Commercial	934,500	25.9	1,281,400	28.4	346,900	37.1
Industrial	300,100	8.3	293,700	6.5	- 6,400	- 2.1
Governmental and Institutional	448,500	12.5	606,800	13.5	158,300	35.3
Transportation, Communication, and Utilities	61,900	1.7	59,000	1.3	- 2,900	- 4.7
Recreational and Others	74,900	2.1	89,100	2.0	14,200	19.0
Total	3,603,000	100.0	4,504,900	100.0	901,900	25.0

Source: SEWRPC.

Trips to work accounted for the next largest amount of trips—18 percent of the total in 1963 and 16 percent in 1972. Furthermore, trips to and from work accounted for 45 percent of peak-period travel in the Region in 1972. Of the remaining trip purpose categories, personal business trips accounted for 13 percent of the total in 1963 and 15 percent in 1972; shopping trips accounted for 12 percent in both 1963 and 1972; social-recreational trips accounted for 12 percent in 1963 and 11 percent in 1972; and trips to attend school accounted for 5 percent in both 1963 and 1972.

Substantial increases in tripmaking were found in all trip purpose categories between 1963 and 1972. The largest absolute increases were noted in trips to home (377,300, or 26 percent), in personal business trips (189,600, or 41 percent), and in shopping trips (119,400, or 28 percent). Furthermore, trips for social-recreational purposes increased by 84,700, or 20 percent; for work purposes by 76,400, or 12 percent; and to attend school by 54,500, or 33 percent.

LAND USES ATTRACTING INTERNAL PERSON TRIPS

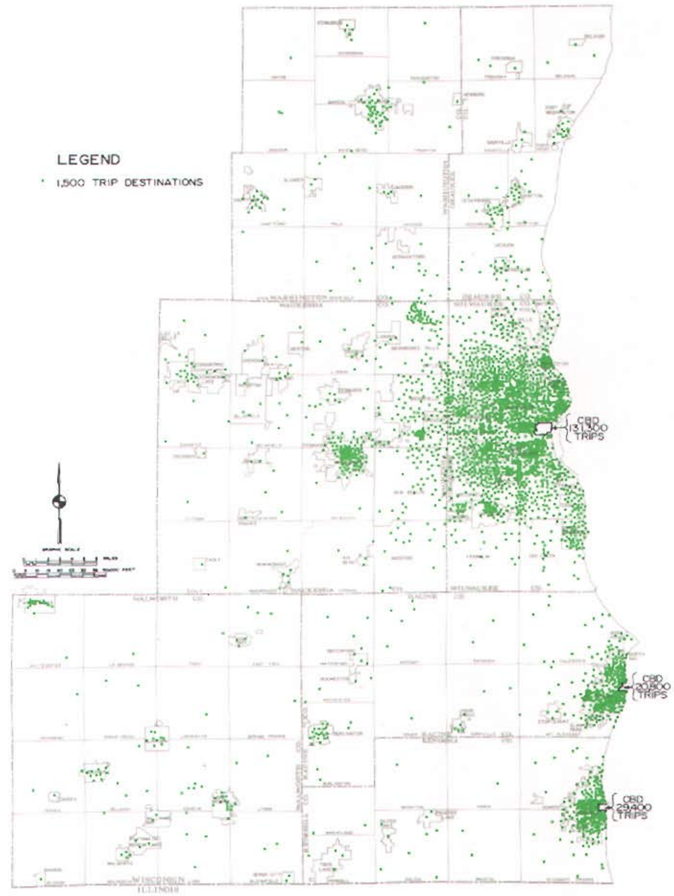
The impact of the home upon person travel on an average weekday is also shown by the finding that trips to residential land uses accounted for nearly half of total internal person trip destinations in 1963 and 1972, as shown in Table 93. The majority of these consisted of trips made by family members returning to their homes, but also included trips by visiting friends or relatives, or by salesmen or repairmen making business calls. Commercial land uses, including retail stores, professional offices, and service establishments, as well as hotels, motels, and places of amusement, attracted 26 percent of total person trips in 1963 and 28 percent in 1972. Governmental and institutional land uses, such as schools, post offices, hospitals, libraries, and other public buildings, attracted about 13 percent of the total in 1963 and about 14 percent in 1972.

Industrial land uses, comprising durable and nondurable manufacturing establishments as well as wholesale and storage areas, accounted for 8 percent of the total trip destinations in 1963 and 6 percent in 1972. Of other land uses, trips to recreational, agricultural, and open land and water areas together accounted for 2 percent of the total in both 1963 and 1972. Trips to transportation, communication, and utility land uses accounted for 2 percent in 1963 and over 1 percent in 1972.

Significant increases in tripmaking from 1963 to 1972 were found in trips to residential land uses (391,800 trips, or 22 percent), commercial land uses (346,900 trips, or 37 percent), and governmental and institutional land uses (158,300 trips, or 35 percent). A smaller increase was found in trips to recreational, agricultural, and open land and water-area land uses—14,200 trips, or 19 percent. Decreases in tripmaking from 1963 to 1972 were found in both industrial land uses and in transportation, communication, and utility land uses, reflecting the decrease in employment in each of these categories which occurred within the Region during the period. The former decreased by 6,400 trips, or 2 percent, while the latter decreased by 2,900 trips, or 5 percent.

Map 42

AVERAGE WEEKDAY INTERNAL PERSON TRIP DESTINATIONS IN THE REGION: 1972



The amount of travel attracted to a given subarea of the Region is determined by the amount, kinds, and intensity of land use development present in that area. In 1972 the highest concentrations of internal person trip destinations were found in the highly developed central business districts and major wholesale, industrial, and commercial areas of the larger cities in the Region. The overall pattern produced by plotting the location of internal person trip destinations closely resembles the existing urban development pattern.

Source: SEWRPC.

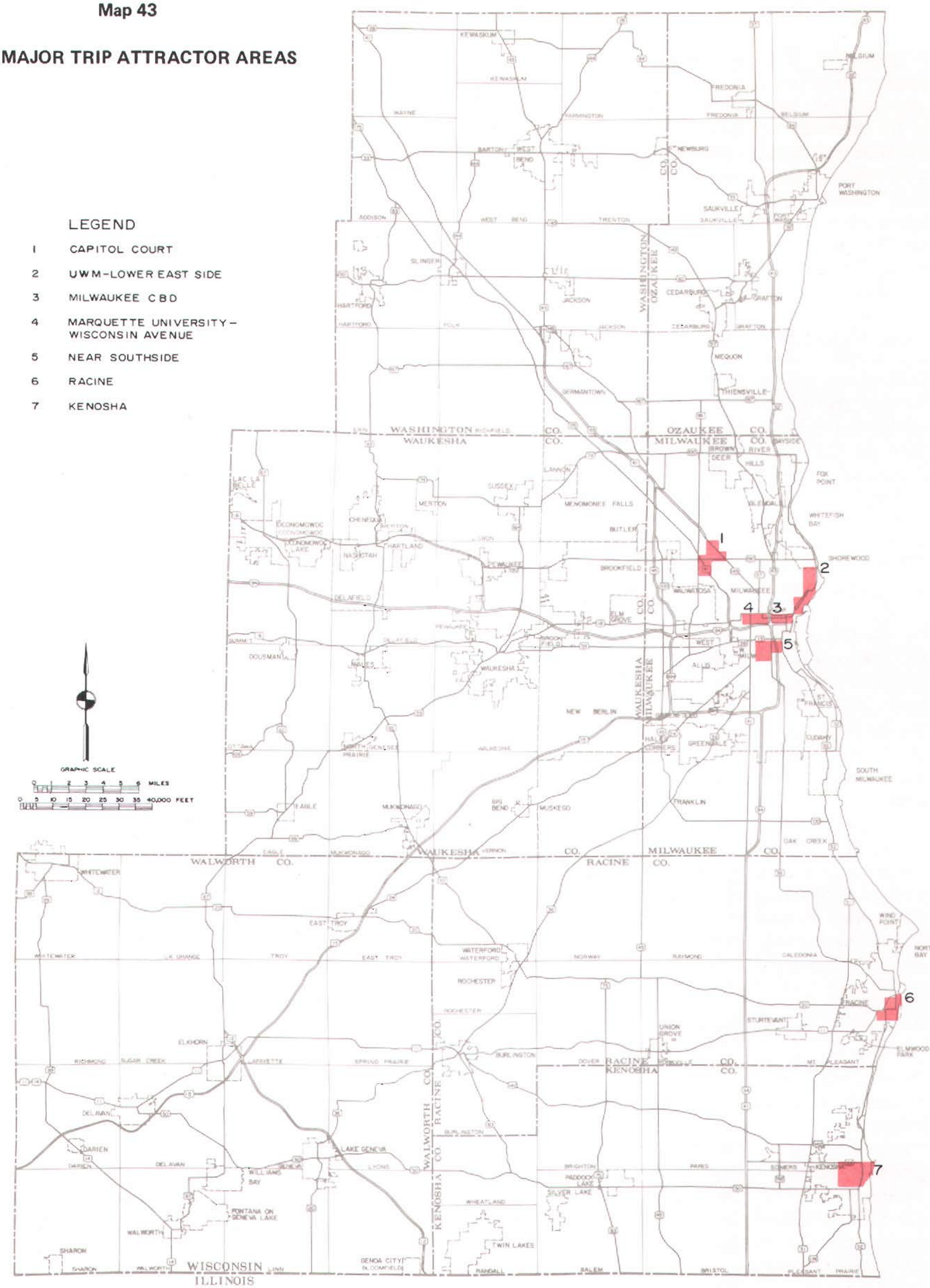
LOCATION OF TRAVEL

The amount of travel attracted to a given area is largely determined by the amount, type, and intensity of development in that area. Map 42 shows the spatial distribution of internal person trip destinations within the Region on an average weekday in 1972, when such destinations totaled 4.5 million. The highest concentrations of internal person trip destinations occur in the highly developed central business districts and major industrial and commercial areas of the larger cities in the Region. Significant concentrations of person trip destinations, however, are also found in many smaller communities.

As shown on Map 43 and in Table 94, the Milwaukee CBD attracted the singularly largest amount of person trips in the Region, with more than 250,000 internal person trips entering, leaving, and made within its boundaries on an average weekday in 1972. Thus, the Milwaukee CBD accounted for 5.6 percent of the total person trips made in the Region in 1972, and for 7.3 percent in 1963. The next largest average weekday trip attractor areas in the Milwaukee urbanized area are the University of Wisconsin-Milwaukee/Lower East Side area (123,000 trips), the Marquette University/Wisconsin Avenue area (107,000 trips), the Capitol

Map 43

1972 MAJOR TRIP ATTRACTOR AREAS



The amount of travel attracted to a given area is largely determined by the amount, type, and intensity of development in that area. The Milwaukee central business district accounted for the singularly largest concentration of person trip destinations in the Region in 1972, with more than 250,000 internal person trips entering, leaving, and occurring within its boundary on an average weekday. The next largest average weekday trip attractor areas in the Milwaukee urbanized area are the University of Wisconsin-Milwaukee/Lower East Side area, the Marquette University/Wisconsin Avenue area, the Capitol Court area, and the Near South Side area. The Kenosha and Racine central business districts were the next two largest trip attractor areas in the Region in 1972.

Source: SEWRPC.

Table 94

INTERNAL MILWAUKEE URBANIZED AREA PERSON TRIPS ENTERING, LEAVING, AND OCCURRING WITHIN THE FIVE LARGEST TRIP ATTRACTORS ON AN AVERAGE WEEKDAY BY MODE OF TRAVEL: 1972

Trip Attractor	Mode of Travel								Total Trips	Percent
	Auto Driver Trips	Percent	Auto Passenger Trips	Percent	Bus Passenger Trips	Percent	Other[a] Trips	Percent		
Milwaukee CBD										
Entering.	67,500	56.6	24,790	20.8	26,350	22.1	580	0.5	119,220	100.0
Leaving	68,030	56.9	25,350	21.2	25,410	21.3	670	0.6	119,460	100.0
Within.	6,820	56.6	2,470	20.5	2,660	22.1	90	0.8	12,040	100.0
Total	142,350	56.8	52,610	21.0	54,420	21.7	1,340	0.5	250,720	100.0
UWM-Lower East Side										
Entering.	33,300	63.1	13,330	25.2	5,770	10.9	400	0.8	52,800	100.0
Leaving	33,350	61.4	14,430	26.6	6,230	11.5	280	0.5	54,290	100.0
Within.	9,540	60.2	4,910	31.0	1,140	7.2	260	1.6	15,850	100.0
Total	76,190	62.0	32,670	26.5	13,140	10.7	940	0.8	122,940	100.0
Marquette University-Wisconsin Avenue										
Entering.	28,110	58.8	11,210	23.4	7,790	16.3	730	1.5	47,840	100.0
Leaving	28,100	59.4	11,010	23.3	7,470	15.8	740	1.5	47,320	100.0
Within.	7,530	65.6	2,680	23.3	1,060	9.2	220	1.9	11,490	100.0
Total	63,740	59.8	24,900	23.3	16,320	15.3	1,690	1.6	106,650	100.0
Capitol Court										
Entering.	29,510	62.9	14,610	31.1	2,340	5.0	450	1.0	46,910	100.0
Leaving	29,550	63.5	14,580	31.3	1,980	4.2	450	1.0	46,560	100.0
Within.	5,690	65.6	2,870	33.1	110	1.3	- -	- -	8,670	100.0
Total	64,750	63.4	32,060	31.4	4,430	4.3	900	0.9	102,140	100.0
Near South Side										
Entering.	26,280	63.7	9,670	23.5	4,650	11.3	620	1.5	41,220	100.0
Leaving	26,040	63.0	10,280	24.9	4,400	10.6	620	1.5	41,340	100.0
Within.	6,180	60.3	2,690	26.3	1,370	13.4	- -	- -	10,240	100.0
Total	58,500	63.0	22,640	24.4	10,420	11.2	1,240	1.4	92,800	100.0

[a] *Includes passenger travel by school bus, taxi, truck, motorcycle, and charter bus.*

Source: SEWRPC.

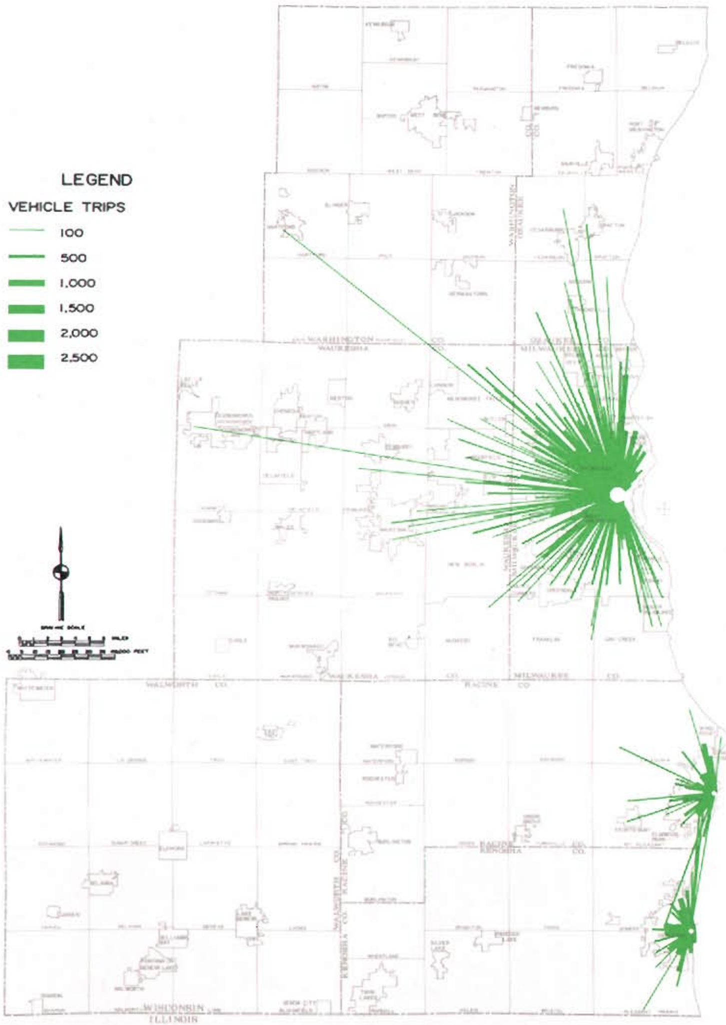
Court area (102,000 trips), and the Near South Side area (93,000 trips). Collectively, the five major trip attractor areas in the Milwaukee urbanized area account for 15 percent of the total 4.5 million internal person trips made on an average weekday within the Region. The Kenosha and Racine CBD's accounted for 129,000 and 96,000 trips, respectively, on an average weekday in the Region in 1972.

Table 94 illustrates the dependence on the automobile as the primary mode of travel to all of the major trip attractors in the Milwaukee area. The percentage of auto driver and auto passenger travel to these attractors ranged from a low of 78 percent of all trips to the Milwaukee CBD to 95 percent of all trips to the Capitol Court area. Thus, the greatest amount of transit travel is made to the Milwaukee CBD, with 22 percent of all trips entering, leaving, and made within the area made on public transit. On the other hand, only 4 percent of all trips to the Capitol Court area were made using transit.

Map 44 shows the "desire lines" connecting the points of origin to the points of destination of public transit trips to the Milwaukee CBD in 1972, and indicates that the origins of internal transit trips destined for the Milwaukee CBD are limited for the most part to the highly developed portions of the Milwaukee urbanized area. Map 45 shows the points of origin of internal vehicle trips destined for the Milwaukee CBD and indicates, also, that most such trips to the CBD originate within the developed portions of the Milwaukee urbanized area.

Map 44

AVERAGE WEEKDAY MASS TRANSIT TRIP ORIGINS WITH DESTINATIONS IN THE MILWAUKEE, RACINE, AND KENOSHA CENTRAL BUSINESS DISTRICTS: 1972

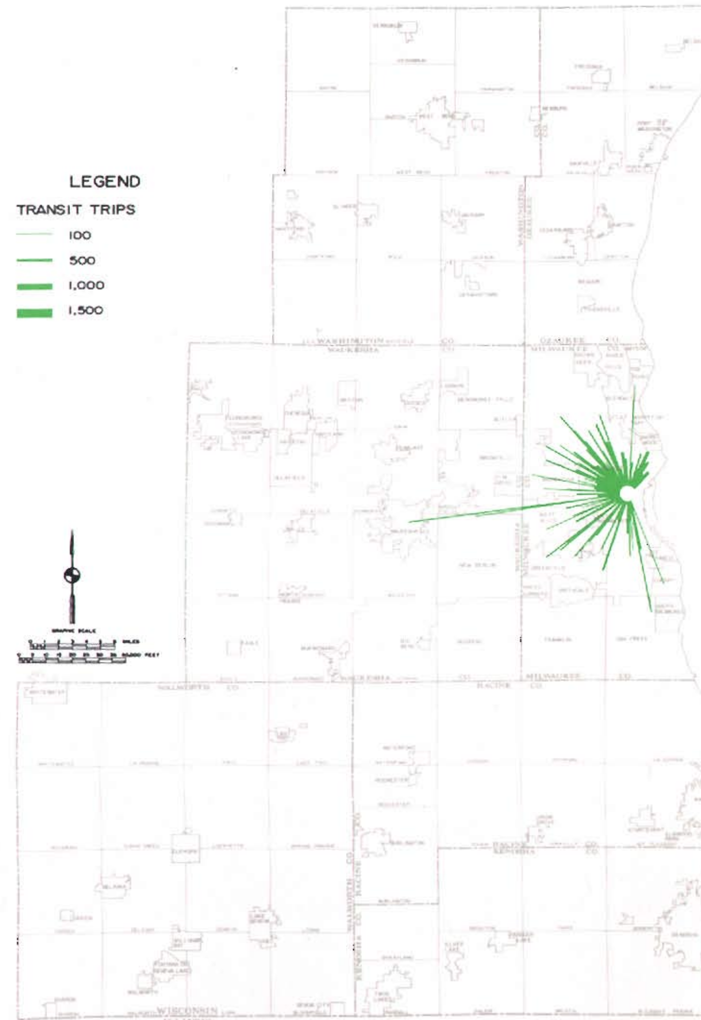


The above map shows the "desire lines" connecting the points of origin to the points of destination of public transit trips to the central business district of the City of Milwaukee in 1972, and indicates that the origins of internal transit trips destined for the Milwaukee central business district are limited for the most part to the highly developed portions of the Milwaukee urbanized area.

Source: SEWRPC.

Map 45

AVERAGE WEEKDAY VEHICLE TRIP ORIGINS WITH DESTINATIONS IN THE MILWAUKEE, RACINE, AND KENOSHA CENTRAL BUSINESS DISTRICTS: 1972



The above map shows the points of origin of internal vehicle trips destined for the central business district of Milwaukee, and indicates that most vehicle trips to the central business district originate within the developed portions of the Milwaukee urbanized area.

Source: SEWRPC.

HOURLY PATTERNS OF INTERNAL PERSON TRAVEL

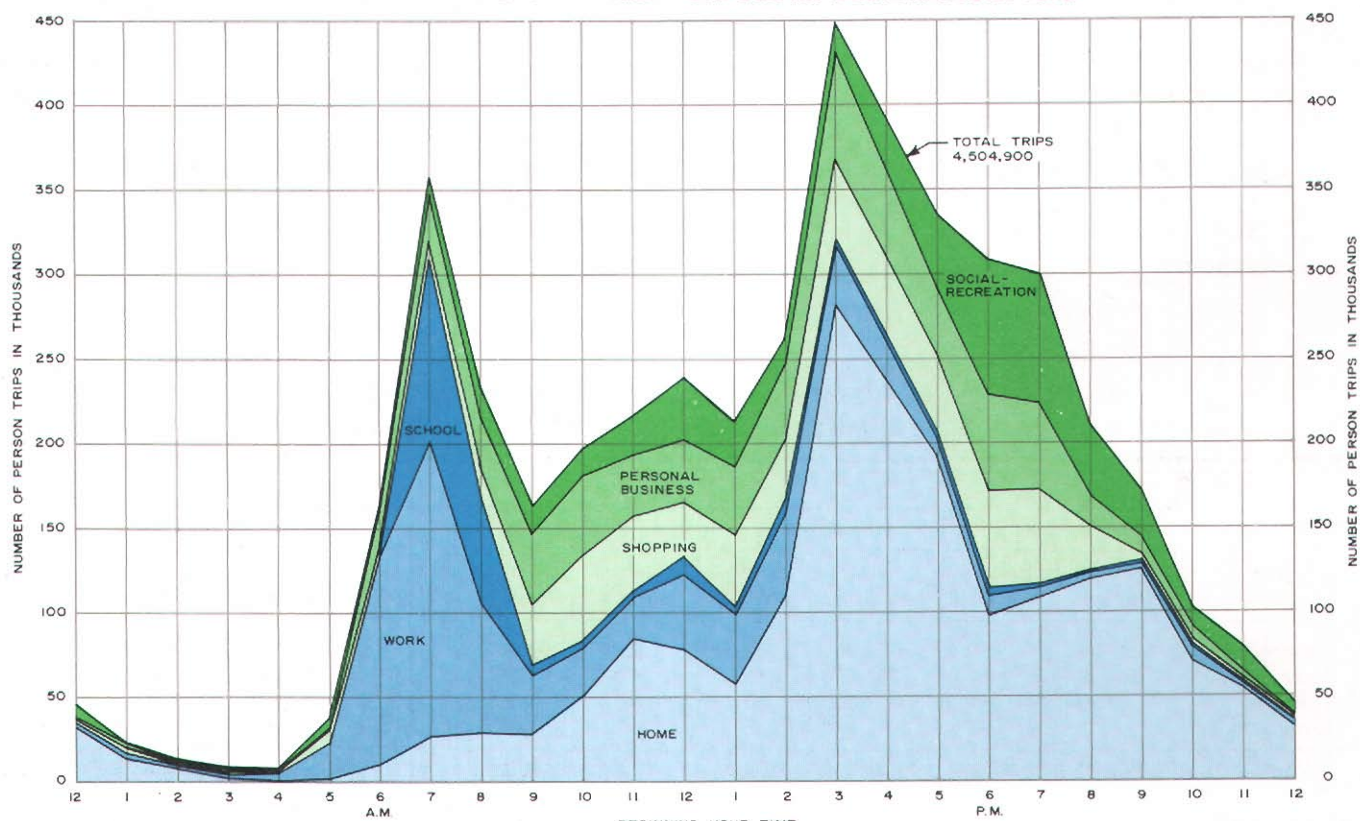
The hourly distribution patterns of internal person trips by trip purpose indicate that, although total person trip volumes increased substantially within the Region on an average weekday from 1963 to 1972, the regular ebb and flow of travel remained remarkably similar, both in the proportion of trips by trip purpose within the hourly distributions and in the proportion and times of peak periods. The single exception was a more pronounced decline in 1963 than in 1972 in tripmaking activity after 6 p.m.

The patterns formed by the hourly distribution of person trips by trip purpose at destination present a graphic representation of the volume of person travel within the Region on an average 1972 weekday (see Figure 20). The patterns show relative inactivity during the early morning hours followed by a sharp peak around 7 a.m. as trips to work and school begin. Trips for shopping, personal business, and social-recreational purposes begin during the later morning hours and continue fairly evenly until midafternoon. The afternoon peak period, beginning at 3 p.m., accounts for a larger number of trips and is more sustained than the morning peak period, and is characterized predominantly by trips to return home. Person trip activity declines sharply following the afternoon peak, but the decline tapers off in the early evening hours as trips for shopping and social-recreational purposes reach their maximum hourly volumes for the day.

The 1972 hourly distribution patterns of internal person trips by mode of travel are shown in Figure 21. The largest hourly volumes of auto driver, school bus, and public transit passenger trips in 1972 occur during the morning and afternoon peak periods, while the largest hourly volumes of auto, truck, and taxi passenger trips combined occur in the hour beginning at 7:00 p.m. During each hour of the day, auto driver trips outnumber trips by all other modes combined.

Figure 20

HOURLY VARIATION OF AVERAGE WEEKDAY INTERNAL PERSON TRIPS IN THE REGION BY TRIP PURPOSE AT DESTINATION: 1972



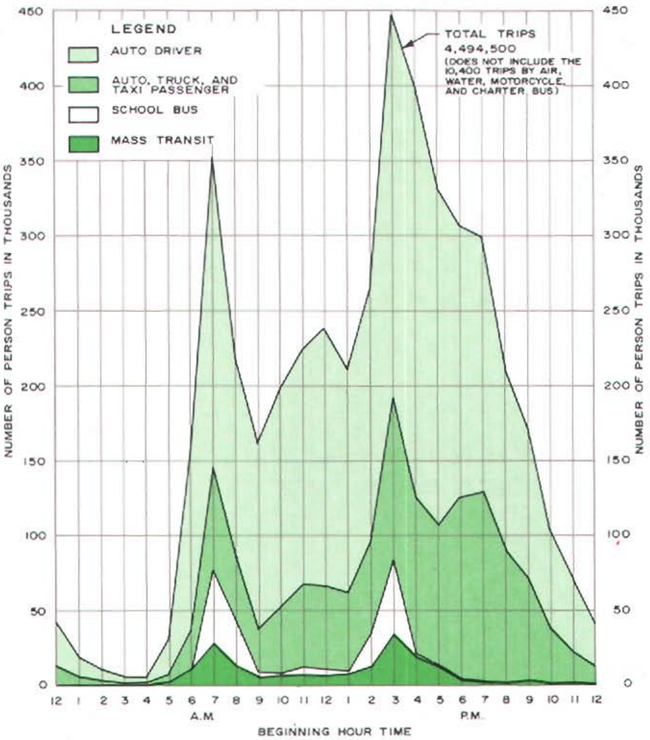
Source: SEWRPC.

INTERNAL VEHICLE TRAVEL

In addition to the approximately 704,600 automobiles and 21,000 motorcycles available to residents of the Region in 1972, there were about 77,250 trucks and 450 taxis licensed for use. These figures indicate that there were 177,300, or 34 percent, more automobiles in the Region in 1972 than in 1963, 18,750, or 32 percent, more trucks, and 50, or 10 percent, less taxis. It is estimated that 758,900 automobiles and 113,000 trucks were available to residents of the Region in 1978, increases of 9 percent and 42 percent, respectively, over 1972.

Figure 21

HOURLY VARIATION OF AVERAGE WEEKDAY INTERNAL PERSON TRIPS IN THE REGION BY MODE OF TRAVEL: 1972



Source: SEWRPC.

Approximately 803,300 autos, trucks, taxis, and motorcycles made a total of 3,290,300 vehicle trips within the Region on an average weekday in 1972, an increase of 823,900 vehicle trips, or 33 percent, between 1963 and 1972. This increase is substantially higher than the 25 percent increase in total internal person trips during the same period, and reflects the more rapid growth in automobile availability (34 percent) and truck availability (32 percent) than in the regional population, which increased only 9 percent.

Automobiles, which averaged 4.1 vehicle trips per day in both 1963 and 1972, accounted for 88 percent of total vehicle trips in both 1963 and 1972. Trucks, which averaged 5 trips per day in 1963 and 4.8 trips per day in 1972, accounted for 12 percent of total vehicle trips in 1963 and 11 percent in 1972. Taxis, which averaged 14 trips per day in 1963 and 31.8 trips per day in 1972, accounted for less than 0.5 percent of total trips in both 1963 and 1972. Motorcycles, which averaged 0.4 trip per day in 1972, accounted for 0.3 percent of total trips. The average number of vehicle trips per day for all vehicles was 4.2 in 1963 and 4.1 in 1972 (see Table 95).

Table 95

VEHICLE AVAILABILITY AND AVERAGE WEEKDAY INTERNAL VEHICLE TRIPS IN THE REGION BY TYPE: 1963 AND 1972

Type of Vehicle	1963					1972				
	Vehicles		Vehicle Trips		Average Number of Trips	Vehicles		Vehicle Trips		Average Number of Trips
	Number	Percent of Total	Number	Percent of Total		Number	Percent of Total	Number	Percent of Total	
Automobile . .	527,300	89.9	2,166,000	87.8	4.1	704,600	87.7	2,897,000	88.0	4.1
Truck.	58,500	10.0	293,400	11.9	5.0	77,250	9.6	371,000	11.3	4.8
Taxi.	500	0.1	7,000	0.3	14.0	450	0.1	14,300	0.4	31.8
Motorcycle. . .	- -	- -	- -	- -	- -	21,000	2.6	8,000	0.3	0.4
Total	586,300	100.0	2,466,400	100.0	4.2	803,300	100.0	3,290,300	100.0	4.1

Source: SEWRPC.

SUMMARY

Personal travel is an orderly, regular, and measurable occurrence, evidenced by recognizable travel patterns. Recognition of those patterns and travel aspects which demonstrate a high degree of repetitiveness is a prerequisite to an understanding of future personal travel behavior and, consequently, to sound transportation planning. The inventory of travel describes in detail each of the component parts of total travel. Each of these parts is essential to a complete understanding of total travel and each contributes to the overall travel habits and patterns in the Region, and to the conceptual processes involved in establishing generalized norms of travel behavior.

This chapter has presented in summary form the basic findings of the 1972 regional inventory of travel. To measure the changes occurring in travel habits and patterns within the Region, comparisons have been made between the findings of the 1963 and 1972 travel inventories. Wherever possible, the travel inventory data presented in this chapter have been updated to 1978. It should be noted that through the use of the Commission's mathematical travel simulation models, 1978, as well as any future year, travel habits and patterns can be estimated, given estimates of demographic, economic activity, and land use characteristics of the Region. Those travel habit and pattern characteristics discussed in the chapter which bear special significance to primary transit planning include the quantity, purpose, mode, and time of day in which travel occurs. A basic understanding of these characteristics of travel behavior is essential to the consideration of future alternative primary transit system plans in this study. By examining the existing and historical trends in the Region's and the Milwaukee area's travel habits and patterns, the extent and characteristics of trips which primary transit in the Milwaukee area could serve can be ascertained, as well as the degree of change which primary transit plans can be reasonably expected to bring about.

On an average weekday in 1972, nearly 4.5 million person trips and 3.4 million vehicle trips were made within southeastern Wisconsin by residents of the Region. These internal trips were principally made by automobiles. The number of person trips made on an average weekday increased between 1963 and 1972 from 2.2 to 2.5 trips per capita and from 7.3 to 7.9 trips per household. The amount of tripmaking by people in a household is strongly related to the number of automobiles available to the household, the income level of the household, and the number of people in the household. Auto driver trips alone accounted for 64 percent of total internal travel in 1972, while auto passenger trips accounted for an additional 27 percent of the total. Of the remaining modes, public transit trips accounted for 4 percent, school bus trips for 4 percent, and all other modes together (taxi and truck passengers and motorcycle drivers) for less than 0.5 percent in 1972. Transit usage was found to be highest in trips to the Milwaukee central business district (CBD) in 1972, where 22 percent of all trips entering, leaving, or made within the area were made on public transit. This compares with 36 percent in 1963.

While substantial increases in tripmaking were found in a comparison of the 1963 and 1972 travel inventories, overall declines in public transit travel in the Region continued. However, there are indications that this decline has stabilized or even reversed. In the Milwaukee urbanized area, transit ridership declined from 215 million revenue passengers in 1950 to about 90 million in 1963, or from about 242 to about 84 rides per capita. From 1963 to 1972, the trend of declining transit utilization continued, with transit ridership decreasing to only 52 million revenue passengers, or about 50 rides per capita, in 1972. Since then, only slight declines have been recorded, and in 1977, 48.5 million revenue passengers were served. Total transit ridership in the Milwaukee area increased between 1977 and 1978 to 52.6 million trips per year. It should be noted that 1978 ridership was adjusted to reflect a two-month transit strike. In the Racine and Kenosha urbanized areas, the pattern of sharp decline in transit ridership also appears to have been reversed.

Trips having either an origin or destination at home constituted over 80 percent of total internal travel in 1972, highlighting the interdependence of residential development and transportation facilities and services. The next most important trip purposes in 1972 were trips to work, which accounted for 16 percent of total internal travel. Other internal trips were made for personal business, shopping, and social-recreational purposes and to attend school. It is apparent that future travel facility and service requirements within the Region will be determined largely by the amount and location of future residential development. Also important are the principal areas to which trips are attracted for work, shopping, and other purposes. On an average weekday in 1972, the areas attracting the greatest amount of trips were the central business district and major industrial and commercial centers of the

Milwaukee area and, to a much lesser extent, the central business districts and industrial and commercial centers of other large cities of the Region.

Significant increases in tripmaking from 1963 to 1972 were found in trips to residential land uses (22 percent), commercial land uses (37 percent), and governmental and institutional land uses (35 percent). Decreases in tripmaking over the same period were found in trips to industrial land uses (2 percent), and to transportation, communication, and utility land uses (5 percent).

The hourly distribution patterns of internal travel indicate that the flow of travel remained very similar both in the proportion of trips by trip purpose and in the proportion and times of peak periods between 1963 and 1972. Of the peak-hour movements, trips to and from work accounted for 45 percent of the total in 1972.

Chapter VI

EXISTING AND PLANNED TRANSPORTATION FACILITIES AND SERVICES

INTRODUCTION

Transportation facilities and services are among the most critical elements that influence travel characteristics and shape the spatial distribution of rural and urban development within an area. The availability or lack of availability of a transportation facility or service will influence the path and mode as well as the frequency of personal travel. The accessibility of a site to population and employment concentrations and to community facilities and services, as determined by the transportation system, will influence the type and intensity of its development. Transportation facilities and services thus form the basic framework for both rural and urban development and, to a considerable degree, determine the efficiency of the other functional elements of such development.

Any transportation system planning effort must, therefore, include an examination of the supply as well as of the demand for transportation facilities and services. The examination of demand is achieved through travel inventories and travel simulation model studies, while examination of supply is achieved through an inventory of the location, capacity and use of the existing transportation system. Location, capacity, and utilization inventories are necessary to establish the characteristics of the existing transportation system so that its existing and future deficiencies can be determined and used to guide primary transit system plan preparation, testing, and evaluation. Accordingly, this chapter presents a description of the location, capacity, and usage of the existing arterial street and highway and transit systems of the Region. A discussion of the plan year 2000 arterial street and highway system and public transit system for the Region is also presented in this chapter, as this planned system provides the structure within which alternative primary transit plans are to be examined in the study. Transportation facilities and services for both highways and public transit are described herein, because a change in one component of the transportation system can result in the need to effect changes in the other components of the total system.

EXISTING SUPPLY OF STREETS AND HIGHWAYS

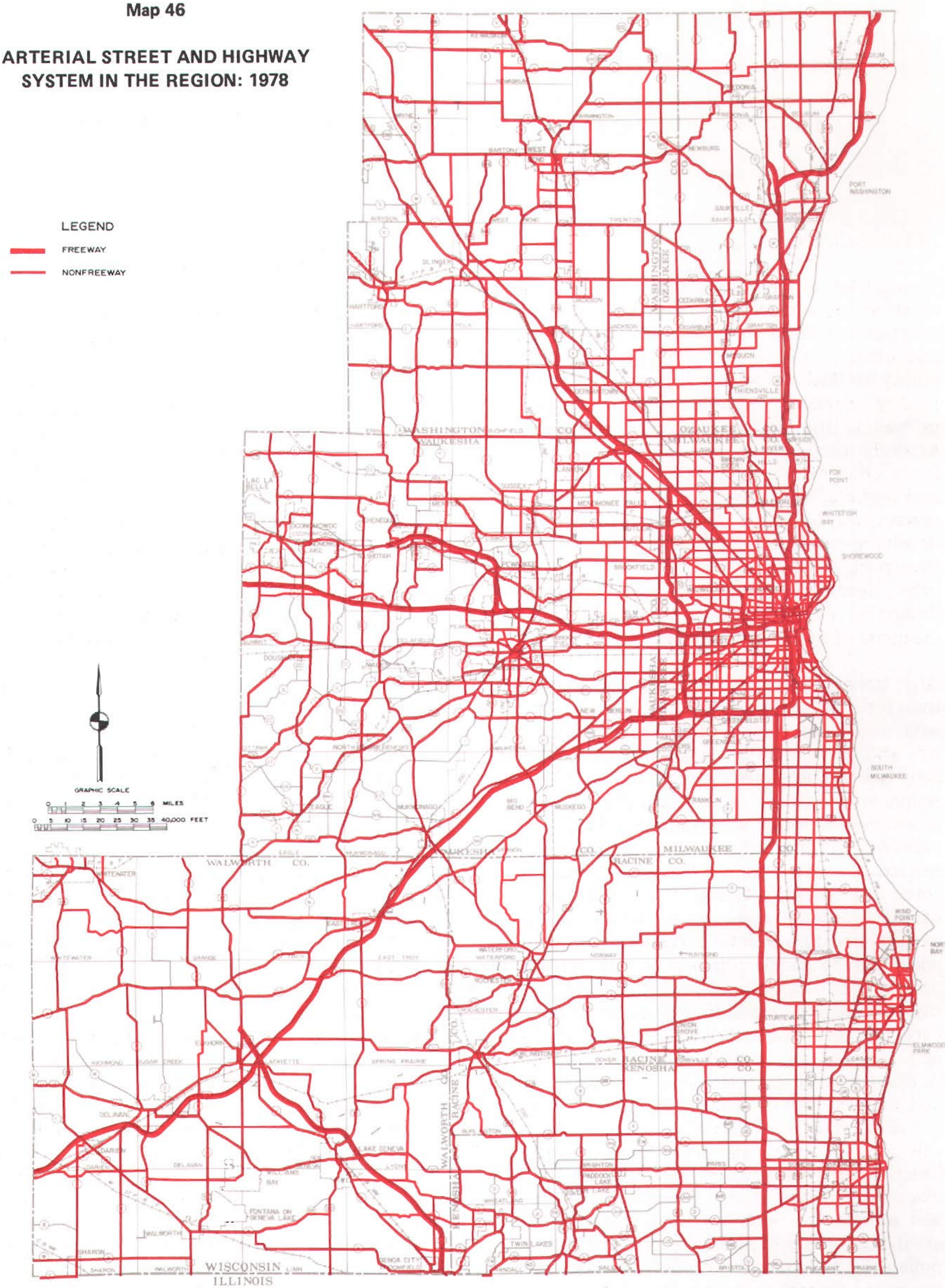
The total street and highway system of the Region in 1978 was composed of 10,440 miles, of which about 3,300 miles, or 31.6 percent, were classified by primary function as arterials, and 7,140 miles, or 68.4 percent, were classified as collector and land access streets (see Map 46 and Table 96)—a total increase of 1,492 miles, or 17 percent, over 1963. Arterial street mileage between 1963 and 1978 increased by approximately 3 percent, or 106 miles—a lesser rate of increase than in total street mileage over the same time period—principally as a result of freeway and expressway construction, which changed the function of numerous parallel and other surface facilities from an arterial to a collector or land access function. This was particularly true between 1963 and 1972, when total arterial street mileage actually decreased by about 2 percent, or 70 miles.

Arterials consist of those streets and highways of the Region which serve the movement of heavy volumes of through traffic between major subareas of the Region, between such subareas and points outside the Region, and through the Region. It is these arterials which the transportation system planning effort must address. Freeways, expressways, certain parkways, and standard arterial streets and highways are all types of facilities having design characteristics typical of arterial streets and highways. As shown in Table 96, freeways constituted over 7 percent of the approximately 3,300 miles of arterial street and highway system in the Region in 1978. From 1972 to 1978, the miles of freeways in the Region increased 47 percent—from 162 to 238 miles—with the completion of the North-South Freeway, the Rock Freeway, the East-West Freeway, and the Airport Spur Freeway, as well as of portions of USH 16, the West Bend Freeway, USH 41, and the Lake Freeway.

All other arterial streets within the Region increased by 202 miles from 1972 to 1978, so that in 1978 freeways constituted 7.2 percent of the total arterial system.

Map 46

ARTERIAL STREET AND HIGHWAY SYSTEM IN THE REGION: 1978



In 1978 there were a total of 10,440 miles of streets and highways of all kinds—arterial, collector, and land access—open to traffic within the Region, of which 3,290 miles, or about 32 percent, were functioning as arterial streets and highways. Although the responsibility for the financing, construction, operation, and maintenance of these arterial facilities rests with one federal agency, one state agency, seven county units of government, and 147 local units of government within the Region, these facilities must form a single integrated system able to safely and efficiently serve the existing and probable future travel demand within the Region without regard to county and municipal boundary lines.

Source: SEWRPC.

As indicated on Map 47 and in Table 97, the design, construction, operation, and maintenance of the existing arterial street and highway system is the responsibility of the state, county, and local levels of government. The three jurisdictional systems are, in turn, underlaid by a system of federal aid routes as indicated on Map 48 and in Table 98. These jurisdictional classifications and supporting federal aid route configurations have important implications for both highway and transit plan implementation.

Arterial Street Utilization

The utilization of the existing arterial street and highway system measured in terms of average weekday traffic volume for each system segment was last comprehensively determined in 1972 as part of the Commission's long-range land use-transportation plan reevaluation. In order to obtain complete data for the entire arterial network in 1972, the regular counting programs conducted by the Wisconsin Department of Transportation and by the City and County of Milwaukee were extensively supplemented by counts taken by other local municipalities, as well as by the Commission itself. As shown in Table 99, arterial streets and highways were the most heavily utilized in the urban areas of the Region in 1972. Milwaukee County alone accounted for 54 percent of the over 20.1 million vehicle miles of travel which occurred on the regional arterial street and highway system on an average weekday in 1972.

Table 96

DISTRIBUTION OF STREET AND HIGHWAY MILEAGE IN THE REGION BY TYPE OF FACILITY AND COUNTY: 1978

County	Mileage by Type of Facility					
	Arterial			Collector and Minor Streets	Total[a]	Arterial Miles as Percent of Total
	Freeways	Other	Total			
Kenosha	12.0	307.4	319.4	588.9	908.3	35.2
Milwaukee	69.2	684.8	754.0	2,048.8	2,802.8	26.9
Ozaukee	27.6	274.6	302.2	473.9	776.1	38.9
Racine	12.0	401.7	413.7	701.3	1,115.0	37.1
Walworth	50.3	368.4	418.7	960.1	1,378.8	30.4
Washington	8.6	399.7	408.3	816.3	1,224.6	33.3
Waukesha	58.0	619.6	677.6	1,552.4	2,230.0	30.4
Region	237.7	3,056.2	3,293.9	7,141.7	10,435.6	31.6
Percent of Total	7.2	92.8	100.0	68.4	100.0	- -

[a] *Total street and highway mileage does not include private streets and roads.*

Source: SEWRPC.

Table 97

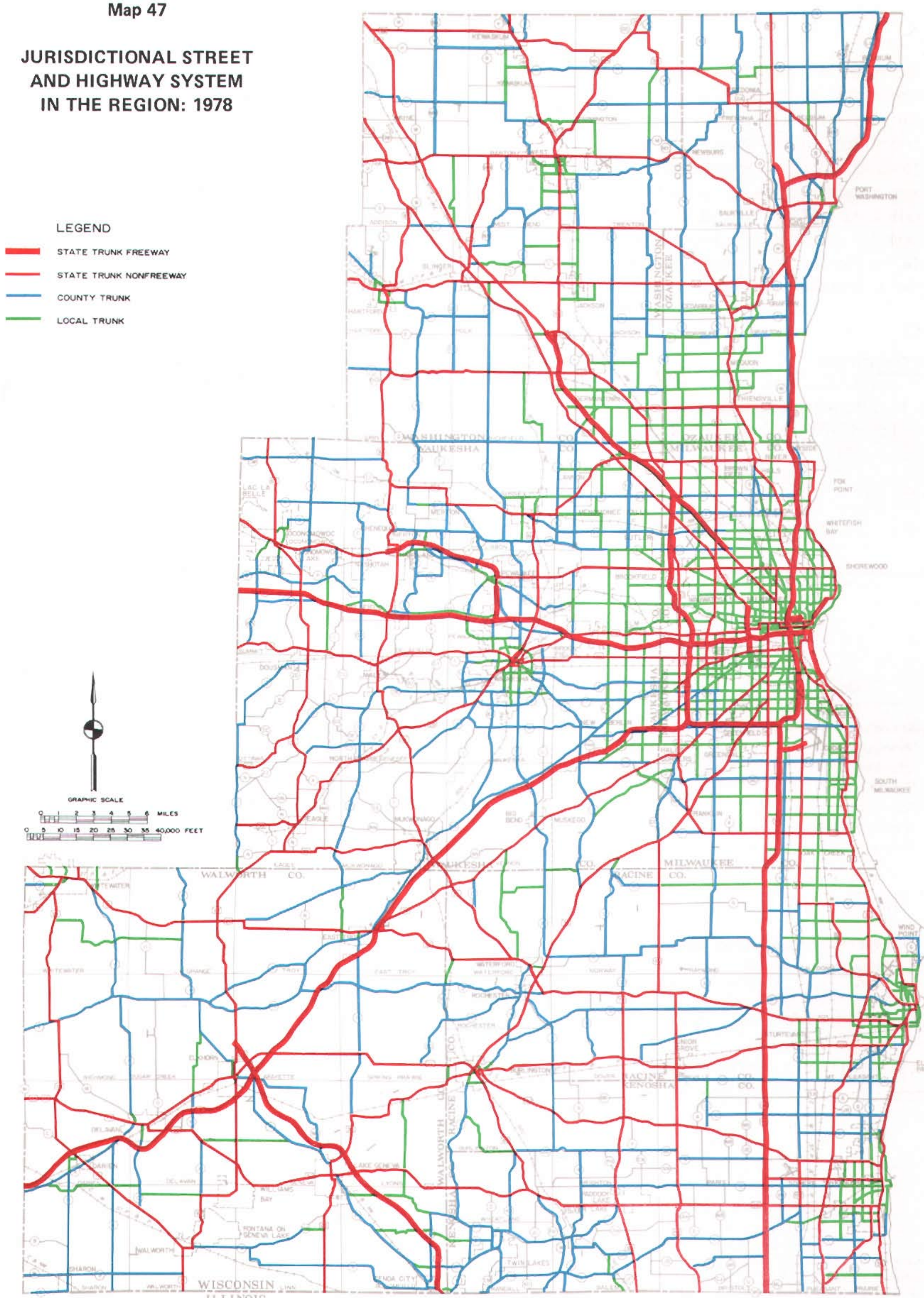
DISTRIBUTION OF STREET AND HIGHWAY MILEAGE IN THE REGION BY JURISDICTION AND COUNTY: 1978

County	Existing Arterials (miles)						County Trunk Highway	Existing Nonarterials (miles)		Total Miles
	State Trunk Highway		Connecting Streets	County Trunk Highway	Local Trunk Highway	Total		Local Trunk Highway	Total	
	Freeway	Nonfreeway								
Kenosha	12.0	99.9	12.0	156.6	38.9	319.4	110.6	478.3	588.9	908.3
Milwaukee	69.2	95.2	93.1	82.7	413.8	754.0	62.4	1,986.4	2,048.8	2,802.8
Ozaukee	27.6	62.7	9.1	126.7	76.1	302.2	12.9	461.0	473.9	776.1
Racine	12.0	125.5	19.7	143.6	112.9	413.7	20.7	680.6	701.3	1,115.0
Walworth	50.3	136.6	13.6	186.3	31.9	418.7	28.3	931.8	960.1	1,378.8
Washington	8.6	171.2	7.9	140.8	79.8	408.3	49.8	766.5	816.3	1,224.6
Waukesha	58.0	172.0	18.4	288.1	141.1	677.6	144.1	1,408.3	1,552.4	2,230.0
Region	237.7	863.1	173.8	1,124.8	894.5	3,293.9	428.8	6,712.9	7,141.7	10,435.6

Source: Wisconsin Department of Transportation and SEWRPC.

Map 47

JURISDICTIONAL STREET AND HIGHWAY SYSTEM IN THE REGION: 1978

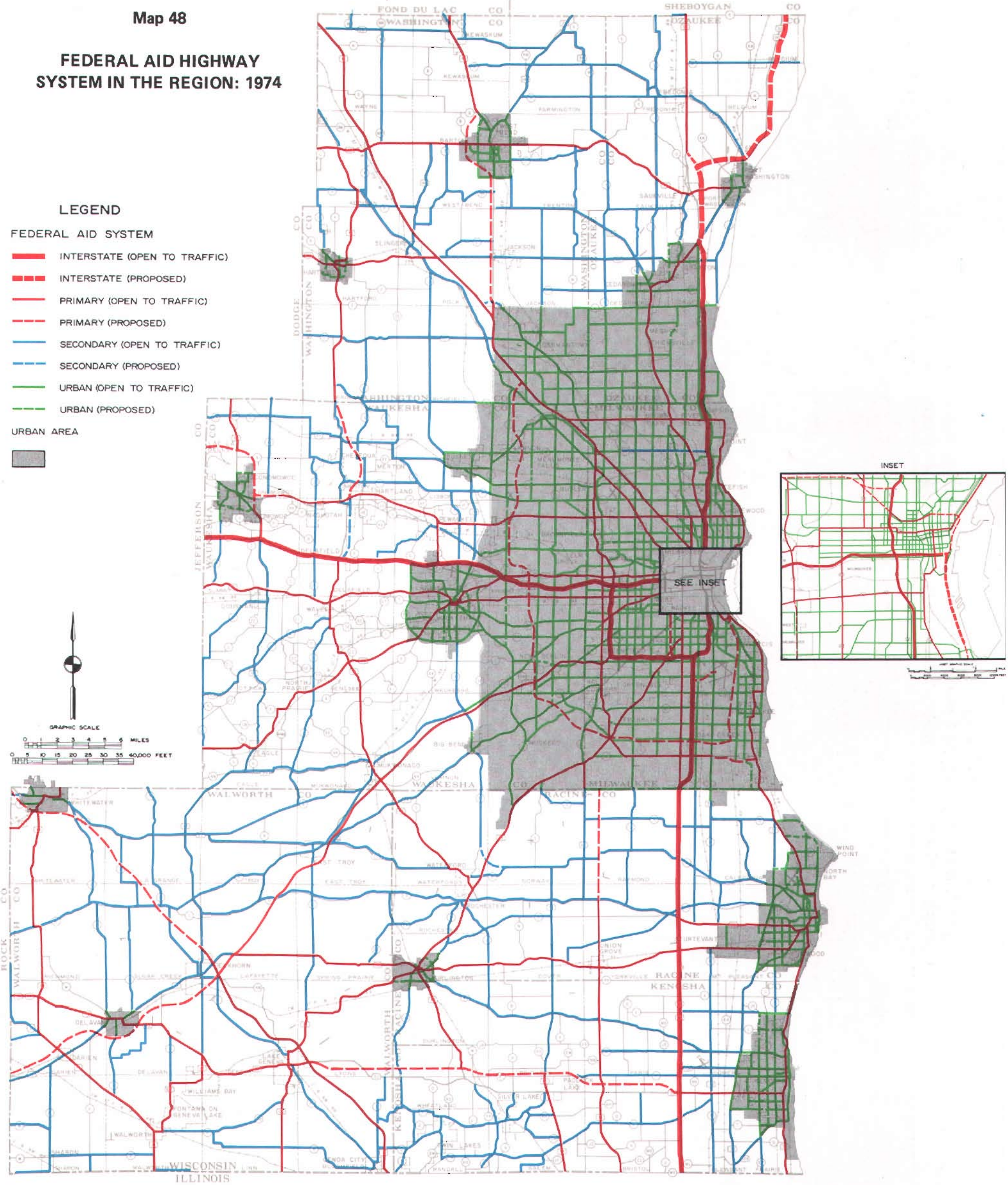


As shown on the above map, the design, construction, operation, and maintenance of the existing arterial street and highway system is the responsibility of three levels of government: state, county, and local. Because of the nature of local streets and highways and the piecemeal additions and deletions which have been made in the county trunk highway system over time, only the state trunk highway system constitutes a truly integrated arterial street and highway system within the Region.

Source: SEWRPC.

Map 48

FEDERAL AID HIGHWAY SYSTEM IN THE REGION: 1974



Streets and highways designated as part of the federal aid highway system are eligible for federal aid in partial support of their improvement. Federal participation in highway improvements should be focused on those facilities which constitute the arterial system, since these facilities serve not only intracommunity travel, but also intercommunity, intercounty, interregional, and interstate travel. Currently, misalignments of federal aid routes—that is, federal aid routes not located on existing or proposed arterial facilities—amount to 91 miles, or less than 3 percent of the federal aid system.

Source: SEWRPC.

Table 98

DISTRIBUTION OF STREET AND HIGHWAY MILEAGE IN THE REGION BY FEDERAL AID SYSTEM CLASSIFICATION, ARTERIAL STATUS, AND COUNTY: 1974

		Federal Aid														Nonfederal Aid (miles)				
		Interstate (miles)	Primary (miles)				Secondary (miles)				Urban (miles)									
Status	County	State Trunk Highway	State Trunk Highway	County Trunk Highway	Local Street	Total	State Trunk Highway	County Trunk Highway	Local Street	Total	State Trunk Highway	County Trunk Highway	Local Street	Total	Total	State Trunk Highway[a]	County Trunk Highway	Local Street	Total	Total Mileage[b]
On Existing Arterials	Kenosha	12.07	39.09	--	--	39.09	40.92	60.98	--	101.90	13.13	11.58	22.29	47.00	200.06	18.18	54.84	6.61	79.63	279.69
	Milwaukee	44.69	153.91	--	--	153.91	--	5.39	--	5.39	52.71	63.51	382.36	498.58	702.57	2.70	--	28.94	31.64	734.21
	Ozaukee	9.90	34.48	--	--	34.48	21.17	49.49	0.20	70.86	15.42	20.98	44.55	80.95	196.18	17.80	32.87	3.43	54.10	250.29
	Racine	12.02	92.40	--	--	92.40	39.52	99.33	--	138.85	12.38	12.87	50.13	75.38	318.65	--	23.30	7.47	30.77	349.42
	Walworth	--	155.77	--	--	155.77	28.53	153.48	10.06	192.07	3.10	0.50	2.52	6.12	353.96	4.60	13.72	35.91	54.23	408.19
	Washington	--	86.15	--	--	86.15	75.88	78.84	--	154.72	17.29	13.12	17.58	47.99	288.86	8.00	35.24	7.10	50.34	339.20
	Waukesha	24.66	141.14	--	--	141.14	47.61	107.21	6.84	161.66	29.76	105.15	101.82	236.73	564.19	4.70	55.54	24.07	84.31	648.50
	Total	103.34	702.94	--	--	702.94	253.63	554.72	17.10	825.45	143.79	227.71	621.25	992.75	2,624.48	55.98	215.51	113.53	385.02	3,009.50
On Existing Streets—Proposed Arterials	Kenosha	--	--	--	--	--	--	12.95	--	12.95	--	0.56	9.36	9.92	22.87	--	--	--	--	22.87
	Milwaukee	--	--	--	--	--	--	--	--	--	--	9.54	--	9.54	9.54	--	--	--	--	9.54
	Ozaukee	--	--	--	--	--	--	0.40	--	0.40	--	2.53	24.08	26.61	27.01	--	--	--	--	27.01
	Racine	--	--	--	--	--	--	--	--	--	--	--	10.78	10.78	10.78	--	--	--	--	10.78
	Walworth	--	--	--	--	--	--	--	--	--	--	--	1.35	1.35	1.35	--	--	--	--	1.35
	Washington	--	--	--	--	--	--	13.95	--	13.95	--	1.06	28.48	29.54	43.49	--	--	--	--	43.49
	Waukesha	--	--	--	--	--	--	10.10	--	10.10	--	--	19.93	19.93	30.03	--	--	--	--	30.03
	Total	--	--	--	--	--	--	37.40	--	37.40	--	13.69	93.98	107.67	145.07	--	--	--	--	145.07
On Existing Streets—Nonarterials (misalignments)	Kenosha	--	--	--	--	--	--	25.59	3.02	28.61	--	--	--	--	28.61	--	100.74	458.32	559.06	587.67
	Milwaukee	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.29	1,866.82	1,871.71	1,871.11
	Ozaukee	--	--	--	--	--	--	--	7.69	7.69	--	--	--	--	7.69	--	13.34	435.76	449.10	456.79
	Racine	--	--	--	--	--	--	7.82	--	7.82	--	--	--	--	7.82	--	9.80	710.90	720.70	728.52
	Walworth	--	--	--	--	--	--	25.10	3.42	28.52	--	--	--	--	28.52	--	14.28	890.18	904.46	932.98
	Washington	--	--	--	--	--	--	10.04	--	10.04	--	--	--	--	10.04	--	38.61	751.95	790.56	800.60
	Waukesha	--	--	--	--	--	--	6.60	1.68	8.28	--	--	--	--	8.28	--	165.91	1,254.98	1,420.89	1,429.17
	Total	--	--	--	--	--	--	75.15	15.81	90.96	--	--	--	--	90.96	--	346.97	6,368.91	6,715.88	6,806.84
Subtotal—Existing Facilities	Kenosha	12.07	39.09	--	--	39.09	40.92	99.52	3.02	143.46	13.13	12.14	31.65	56.92	251.54	18.18	155.58	464.93	638.69	890.23
	Milwaukee	44.69	153.91	--	--	153.91	--	5.39	--	5.39	52.71	73.05	382.36	508.12	712.11	2.70	4.29	1,895.76	1,902.75	2,614.86
	Ozaukee	9.90	34.48	--	--	34.48	21.17	49.89	7.89	78.95	15.42	23.51	68.63	107.56	230.89	17.80	46.21	439.19	503.20	734.09
	Racine	12.02	92.40	--	--	92.40	39.52	107.15	--	146.67	12.38	12.87	60.91	86.16	337.25	--	33.10	718.37	751.47	1,088.72
	Walworth	--	155.77	--	--	155.77	28.53	178.58	13.48	220.59	3.10	0.50	3.87	7.47	383.83	4.60	28.00	926.09	958.69	1,342.52
	Washington	--	86.15	--	--	86.15	75.88	102.83	--	178.71	17.29	14.18	46.06	77.53	342.39	8.00	73.85	759.05	840.90	1,183.29
	Waukesha	24.66	141.14	--	--	141.14	47.61	123.91	8.52	180.04	29.76	105.15	121.75	256.66	602.50	4.70	221.45	1,279.05	1,505.20	2,107.70
	Total	103.34	702.94	--	--	702.94	253.63	667.27	32.91	953.81	143.79	241.40	715.23	1,100.42	2,860.51	55.98	562.48	6,482.44	7,100.90	9,961.41
On Proposed Arterials	Kenosha	--	18.18	--	--	18.18	--	--	--	--	--	--	3.65	3.65	21.83	--	--	--	--	21.83
	Milwaukee	--	32.12	--	--	32.12	--	--	--	--	--	--	20.76	20.76	52.88	--	--	--	--	52.88
	Ozaukee	17.20	--	--	--	--	--	--	--	--	--	--	4.55	4.55	21.75	--	--	--	--	21.75
	Racine	--	6.89	--	--	6.89	--	2.27	--	2.27	--	--	9.85	9.85	19.01	--	--	--	--	19.01
	Walworth	--	31.78	--	--	31.78	--	--	0.53	0.53	--	--	0.76	0.76	33.07	--	--	--	--	33.07
	Washington	--	14.02	--	--	14.02	0.78	--	0.78	--	--	--	7.20	7.20	22.00	--	--	--	--	22.00
	Waukesha	--	37.88	--	--	37.88	3.89	--	--	3.89	--	--	14.02	14.02	55.79	--	--	--	--	55.79
	Total	17.20	140.87	--	--	140.87	4.67	2.27	0.53	7.47	--	--	60.79	60.79	226.33	--	--	--	--	226.33
Total	Kenosha	12.07	57.27	--	--	57.27	40.92	99.52	3.02	143.46	13.13	12.14	35.30	60.57	273.37	18.18	155.58	464.93	638.69	912.06
	Milwaukee	44.69	186.03	--	--	186.03	--	5.39	--	5.39	52.71	73.05	403.12	528.88	764.99	2.70	4.29	1,895.76	1,902.75	2,667.74
	Ozaukee	27.10	34.48	--	--	34.48	21.17	49.89	7.89	78.95	15.48	23.51	73.18	112.11	252.64	17.70	46.21	439.19	503.20	755.84
	Racine	12.02	99.29	--	--	99.29	39.52	109.42	--	148.94	12.38	12.87	70.76	96.01	356.26	--	33.10	718.37	751.47	1,107.73
	Walworth	--	187.55	--	--	187.55	28.53	178.58	14.01	221.12	3.10	0.50	4.63	8.23	416.90	4.60	28.00	926.09	958.69	1,375.59
	Washington	--	100.17	--	--	100.17	76.66	102.83	--	179.49	17.29	14.18	53.26	84.73	364.39	8.00	73.85	759.05	840.90	1,205.29
	Waukesha	24.66	179.02	--	--	179.02	51.50	123.91	8.52	183.93	29.76	105.15	135.77	270.68	658.29	4.70	221.45	1,279.05	1,505.20	2,163.49
	Total	120.54	843.81	--	--	843.81	258.30	669.54	33.44	961.28	143.79	241.40	776.02	1,161.21	3,086.84	55.88	562.48	6,482.44	7,100.90	10,187.74

[a] *Represents the traveled portion of a federal aid route in those cases where the officially designated federal aid route is on a new alignment.*

[b] *The total mileage of arterial streets and highways as classified by jurisdiction does not include ramp and frontage roads attendant to the freeway system which are the responsibility of the State of Wisconsin, but which are not considered within the mileage of the state trunk highway system and which are not included in federal aid mileage.*

Source: SEWRPC.

Freeways and expressways, while constituting less than 7 percent of the arterial street and highway mileage in the Region in 1972, carried approximately 31 percent of the total arterial travel. As measured by traffic counting programs conducted by the Wisconsin Department of Transportation and the City of Milwaukee, travel on freeways and expressways in Milwaukee County substantially increased between 1972 and 1978. Increases in standard arterial street and highway traffic volumes between 1972 and 1978 were also observed. Substantial increases in standard arterial volumes occurred in outlying portions of Milwaukee County, as shown on Maps 49 and 50, and in Table 100. This pattern of generally increasing arterial traffic volume would appear, however, to have changed since 1978. In comparing arterial street and highway traffic volumes in April 1978 with April 1979 volumes, it can be seen that both increases and decreases have occurred.

Relationship of System Utilization to Capacity

As part of the Commission's long-range land use-transportation plan reevaluation, each designated arterial street and highway segment within the Region in 1972 was defined in terms of its design capacity; that is, the maximum number of vehicles which could pass a given point on the facility within 24 hours under existing roadway and desirable operating conditions.[1] The 24-hour design capacity of each street and highway segment was established by first determining its peak-hour design capacity, or the maximum number of vehicles which could pass a given point on the facility within the peak hour, and then converting that value to a 24-hour design capacity. The peak-hour design capacity of freeways and expressways was defined as a function of the segment's pavement width, modified by factors representing the percentage of trucks in the total traffic flow, the directional imbalance in the traffic flow, and the location of the segment with respect to the intensity of urban development. The peak-hour design capacity of standard arterial streets and highways was defined as a function of the segment's intersection approach pavement width, the peak-hour factor, or duration of peak traffic flow within the peak hour, and the load factor, or proportion of traffic signal cycles during the peak which are considered to be fully utilized. This design capacity is further refined to reflect specific intersection conditions such as the location of the intersection with respect to the intensity of urban development, the directional imbalance in the traffic flow, the intersection approach gradient, the percentage of right- and left-turning vehicle movements, the percentage of trucks in the total traffic flow, the provision for parking along the street or highway, and the percentage of the traffic signal cycle which was allocated to the green phase.

Table 99

ARTERIAL VEHICLE MILES OF TRAVEL IN THE REGION ON AN AVERAGE WEEKDAY BY COUNTY: 1972

County	1972 Average Weekday Vehicle Miles of Travel (in thousands)		
	Freeway and Expressway	Other Arterials	Total
Kenosha	382	1,046	1,428
Milwaukee . . .	3,977	6,718	10,695
Ozaukee	223	627	850
Racine	415	1,398	1,813
Walworth. . . .	56	817	873
Washington . .	190	961	1,151
Waukesha . . .	970	2,344	3,314
Region	6,213	13,911	20,124

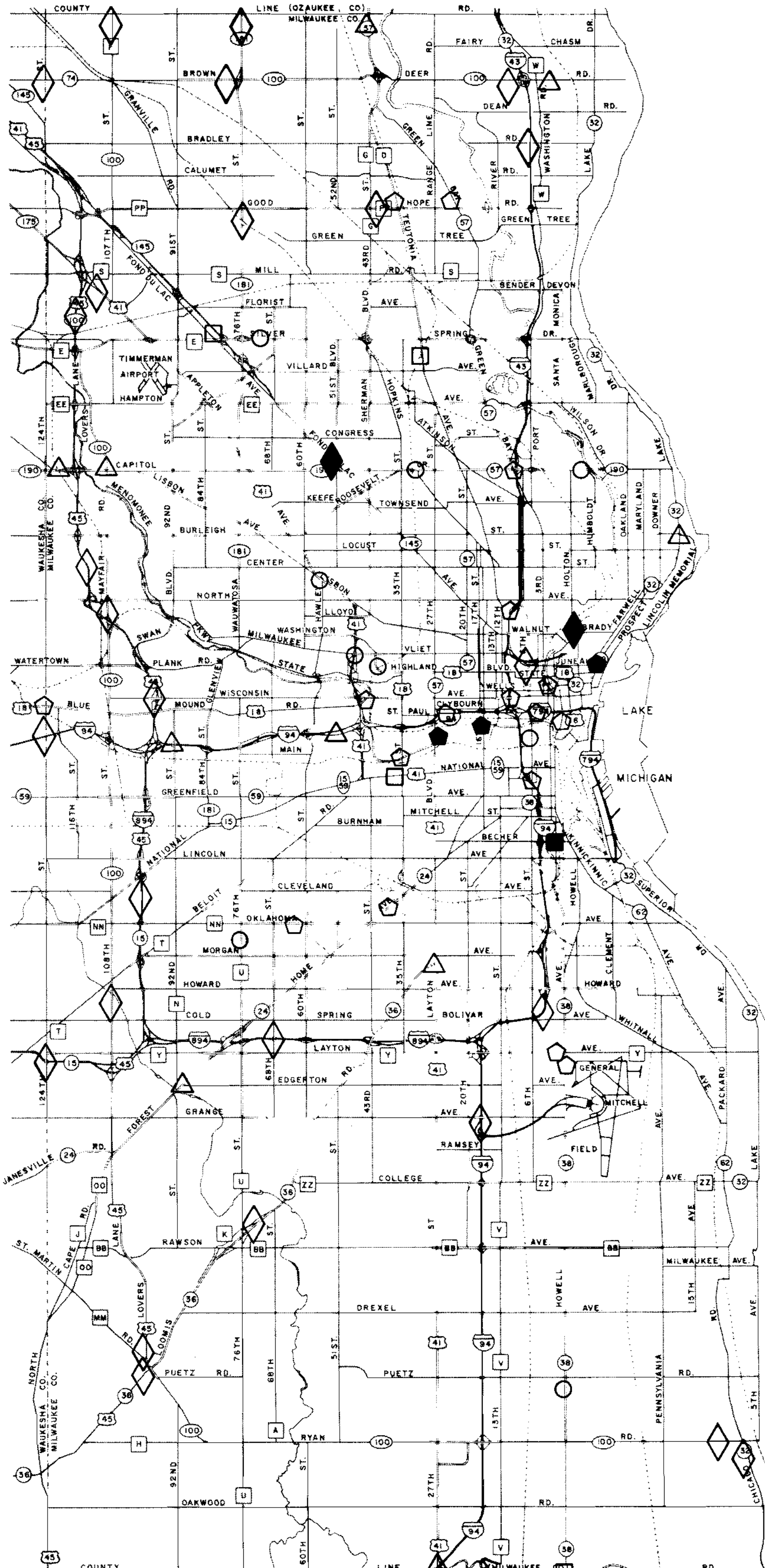
Source: SEWRPC.

[1] *The design capacity of arterial facilities differs from their maximum capacity—the maximum number of vehicles which could pass a given point on a facility within 24 hours under existing roadway and operating conditions—in that the design capacity requires desirable operating conditions to be maintained. Maintaining desirable operating conditions on an arterial facility requires that the traffic flow breakdown conditions characteristic of maximum capacity arterial facility operation do not occur, and that unstable flow conditions characteristic of near maximum capacity arterial facility operation do not occur. The unstable flow conditions of near maximum capacity arterial facility operation include restricted operating speeds, necessary speed changes, momentary traffic stoppages, and some backups behind turning vehicles causing delays for more than one traffic signal cycle. Under traffic breakdown conditions, stoppages are more frequent with substantially lower operating speeds, and substantial delays of more than one traffic signal cycle generally occur at controlled intersections.*

The design capacity of an arterial facility is a level of traffic volume set sufficiently below the maximum capacity of an arterial facility, approximately 70 percent of maximum capacity. An arterial facility operating at design capacity does, however, place some constraints on speed and lane-changing and result in some backups and delays behind turning vehicles at controlled intersections.

Map 49

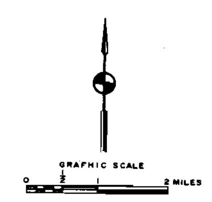
PERCENT CHANGE IN AVERAGE WEEKDAY TRAFFIC VOLUMES IN MILWAUKEE COUNTY: 1972-1978



LEGEND

PERCENT CHANGE IN AVERAGE WEEKDAY TRAFFIC VOLUMES: 1972–1978

- ■ LESS THAN 20.1
- ● –10.1 TO –20.0
- ▲ –6.1 TO –10.0
- ⬟ –2.1 TO – 6.0
- ◆ –0.1 TO – 2.0
- □ 0.0 TO 2.0
- ○ 2.1 TO 6.0
- △ 6.1 TO 10.0
- ⬠ 10.1 TO 20.1
- ◇ GREATER THAN 20.1

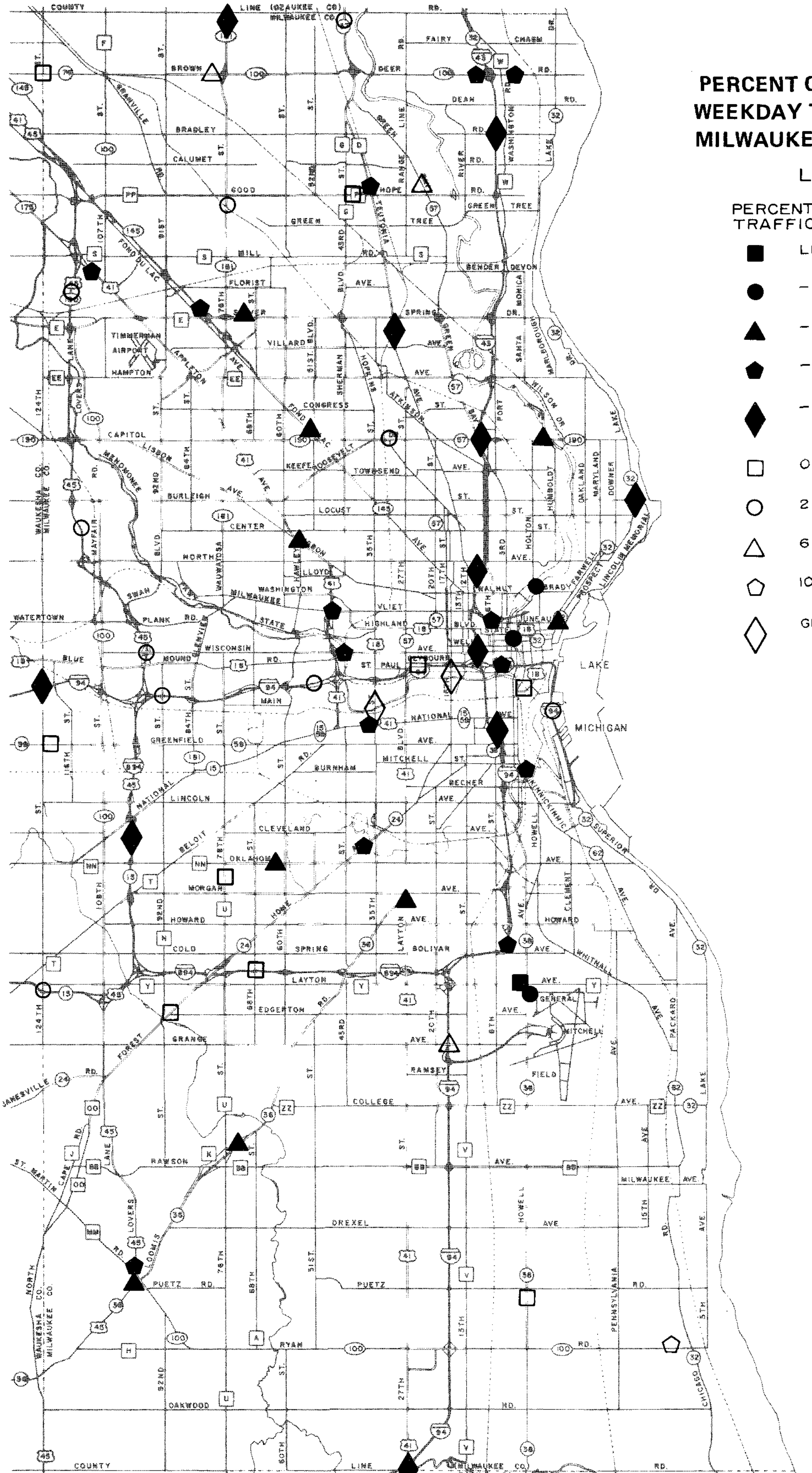


Freeways and expressways, while constituting less than 7 percent of the arterial street and highway mileage in 1972, carried approximately 31 percent of the total arterial travel. As measured by traffic counting programs conducted by the Wisconsin Department of Transportation and the City of Milwaukee, travel on freeways and expressways in Milwaukee County increased between 1972 and 1978. General increases in standard arterial street and highway traffic volumes between 1972 and 1978 were also observed. Substantial increases in standard arterial volumes occurred in outlying portions of Milwaukee County, as shown above.

Source: SEWRPC.

Map 50

PERCENT CHANGE IN AVERAGE WEEKDAY TRAFFIC VOLUMES IN MILWAUKEE COUNTY: 1978-1979



LEGEND

PERCENT CHANGE IN AVERAGE WEEKDAY TRAFFIC VOLUMES: 1978 – 1979

- ■ LESS THAN 20.1
- ● –10.1 TO –20.0
- ▲ –6.1 TO –10.0
- ⬟ –2.1 TO – 6.0
- ◆ –0.1 TO – 2.0
- □ 0.0 TO 2.0
- ○ 2.1 TO 6.0
- △ 6.1 TO 10.0
- ⬠ 10.1 TO 20.1
- ◇ GREATER THAN 20.1

As measured by traffic counting programs conducted by the Wisconsin Department of Transportation and the City of Milwaukee, minor decreases in traffic volumes have been observed on some freeway facilities, and on some arterial streets in central parts of Milwaukee County. A comparison of 1979 traffic count data with comparable data from 1978 indicates freeway traffic declines of about 2 percent along the North-South Freeway (IH 43 and IH 94) and of about 5 percent along the East-West Freeway (IH 794). Increases in freeway traffic volumes of about 2 percent were found along the East-West Freeway (IH 94) between N. 92nd Street and N. 26th Street, and of about 4 percent along the Zoo Freeway (USH 45). Just over one-half of 38 standard arterial street locations in Milwaukee County used in the comparison showed increases in traffic volumes. The decreases in freeway traffic volumes, while small, may mean a leveling of the trend of significant increases which began early in the 1970's.

Source: SEWRPC.

Table 100

CHANGES IN AVERAGE WEEKDAY TRAFFIC VOLUME IN MILWAUKEE COUNTY: 1972-1979

Location	Average Weekday Traffic Volume[a]			Percent Change	
	1972	1978	1979	1972-1978	1978-1979
IH 43 at W. Wells Street	96,320	111,220	111,890	15.5	0.6
IH 43 at W. Vine Street	101,830	113,520	111,640	11.5	- 1.7
IH 43 at W. Capitol Drive	74,140	87,960	86,920	18.6	- 1.2
IH 43 at W. Calumet Road	36,700	45,380	44,780	23.7	- 1.3
IH 94 at Waukesha County Line	56,820	74,780	74,600	31.6	- 0.2
IH 94 at N. 92nd Street	100,620	110,610	113,810	9.9	2.9
IH 94 at Cemetery Access Road	108,790	116,990	120,340	7.5	2.9
IH 94 at N. 26th Street	111,800	123,713	125,830	10.7	1.7
IH 94 at W. Scott Street	99,330	109,390	108,390	10.1	- 0.9
IH 94 at W. Waterford Avenue	67,610	85,130	82,990	25.9	- 2.5
IH 94 at W. Grange Avenue	61,110	79,190	87,040	29.6	9.9
IH 94 North of Racine County Line	28,970	38,010	35,780	31.2	- 5.9
IH 794 at N. 5th Street	62,220	72,980	69,470	17.3	- 4.8
IH 794 at Daniel Hoan Memorial Bridge	- -	16,170	16,670	- -	3.1
IH 894 at W. Cleveland Avenue	65,650	86,700	86,600	32.1	- 0.1
IH 894 at S. 68th Street	52,910	71,400	72,410	34.9	1.4
USH 41 at W. Vliet Street	50,780	52,750	50,360	3.9	- 4.5
USH 45 at W. Wisconsin Avenue	85,700	106,540	108,750	24.3	2.1
USH 45 at W. Center Street	75,900	92,670	97,240	22.1	4.9
USH 45 at W. Florist Avenue	41,420	53,680	56,020	29.6	4.4
USH 145 at N. 84th Street	16,180	16,450	15,820	1.7	- 3.8
STH 15 at S. 124th Street	10,160	19,870	20,620	95.6	3.8
Park Freeway at N. 8th Street	28,690	37,390	35,480	30.3	- 5.1
W. Appleton Avenue east of USH 45	7,190	10,950	10,450	52.3	- 4.6
W. Bluemound Road east of Waukesha County Line	21,360	23,960	- -	12.2	- -
W. Brown Deer Road west of Waukesha County Line	5,560	13,170	13,380	136.9	1.6
W. Brown Deer Road west of N. 76th Street	13,120	25,570	27,870	94.9	9.0
W. Brown Deer Road west of IH 43	15,680	19,930	19,410	27.1	- 2.6
W. Brown Deer Road east of N. Port Washington Road	8,120	8,910	8,530	9.7	- 4.3
W. Capitol Drive east of Waukesha County Line	40,730	43,710	- -	7.3	- -
W. Capitol Drive west of N. 31st Street	40,630	41,930	44,390	3.2	5.9
E. Capitol Drive west of N. Humboldt Boulevard	23,430	24,630	22,630	5.1	- 8.1
Cedarburg Road south of Ozaukee County Line	13,050	14,220	14,970	9.0	5.3
S. Chicago Avenue south of E. Ryan Road	8,160	10,520	- -	28.9	- -
W. Fond du Lac Avenue north of W. Capitol Drive	24,780	24,240	22,320	- 2.2	- 7.9
W. Forest Home Avenue east of S. 92nd Street	14,480	15,560	15,710	7.5	1.0
W. Forest Home Avenue west of S. 35th Street	16,150	19,000	18,420	17.6	- 3.1
W. Good Hope Road east of N. 43rd Street	12,030	22,880	23,100	90.2	1.0
W. Green Bay Road north of W. Good Hope Road	8,090	9,380	10,270	15.9	9.5
W. Greenfield Avenue east of Waukesha County Line	13,080	16,500	16,500	26.1	- -
W. Highland Boulevard west of N. 40th Street	9,810	10,100	- -	3.0	- -
N. Holton Street north of E. Brady Street	10,580	10,430	9,020	- 1.4	- 13.5
S. Howell Avenue north of Racine County Line	5,850	5,910	- -	1.0	- -
S. Howell Avenue south of E. Puetz Road	9,430	9,970	10,060	5.7	0.9
S. Howell Avenue south of E. Layton Avenue	22,350	26,320	23,160	17.8	- 12.0
W. Kilbourn Avenue east of N. Plankinton Avenue	11,800	13,020	11,060	10.3	- 15.1
S. Kinnickinnic Avenue south of E. Maple Avenue	16,280	12,090	13,360	- 25.7	10.5
N. Lake Drive north of E. Kenwood Boulevard	12,600	13,410	13,280	6.4	- 1.0
W. Layton Avenue west of S. Howell Avenue	27,700	32,180	18,100	16.2	- 43.8
W. Lisbon Avenue west of N. 56th Street	28,200	29,740	27,460	5.5	- 7.7
W. Loomis Road west of S. Lovers Lane Road	7,210	8,970	8,390	24.4	- 6.5
W. Loomis Road east of S. 76th Street	6,100	7,450	6,840	22.1	- 8.2
S. Lovers Lane Road north of W. Loomis Road	6,670	9,390	8,990	40.8	- 4.3
N. Mayfair Road south of W. North Avenue	18,940	34,450	N/A	81.9	- -
N. Mayfair Road north of W. Capitol Drive	12,020	13,080	N/A	8.8	- -
W. National Avenue west of S. 35th Street	16,130	16,280	15,580	0.9	- 4.3
W. Oklahoma Avenue west of S. 60th Street	16,400	19,280	18,100	17.6	- 6.1
N. Prospect Avenue north of E. Juneau Avenue	24,160	23,560	21,370	- 2.5	- 9.3
E. Ryan Road west of S. Chicago Avenue	3,430	7,120	8,150	107.6	14.5
W. Silver Spring Drive west of N. 68th Street	25,310	26,370	24,730	4.2	- 6.2
N. Teutonia Avenue south of W. Sheridan Avenue	15,210	15,480	15,600	1.8	0.8
N. Teutonia Avenue north of W. Good Hope Road	13,910	16,140	15,770	16.0	- 2.3
N. Water Street south of E. Erie Street	8,700	10,170	10,320	16.9	1.5
W. Wisconsin Avenue east of N. 45th Street	15,610	17,570	16,530	12.6	- 5.9
S. 6th Street north of W. Florida Street	12,000	12,280	- -	2.3	- -
N. 16th Street south of W. Clybourn Street	12,750	12,230	16,940	- 4.1	38.5
S. 27th Street south of W. Morgan Avenue	37,330	40,020	37,470	7.2	- 6.4
N. 27th Street south of W. St. Paul Avenue	20,420	19,650	- -	- 3.8	- -
S. 35th Street north of W. National Avenue	20,650	23,450	34,780	13.6	48.3
S. 76th Street south of W. Oklahoma Avenue	19,310	20,320	20,350	5.23	0.1
N. 76th Street south of W. Good Hope Road	20,540	35,520	36,450	72.9	2.6
N. 76th Street south of Ozaukee County Line	5,300	11,830	11,610	123.2	- 1.9
N. 107th Street south of Ozaukee County Line	2,200	4,910	- -	123.2	- -
S. 108th Street south of W. Howard Avenue	13,970	18,990	- -	35.9	- -
S. 108th Street south of W. Greenfield Avenue	25,690	33,420	- -	30.1	- -

[a] *The average weekday traffic volumes were established from traffic counts taken in the month of April.*

Source: Wisconsin Department of Transportation, City of Milwaukee, and SEWRPC.

The peak-hour design capacities were converted to 24-hour design capacities under the assumption that 10 percent of the daily travel on standard arterial streets and highways occurred within the peak hour, and that 8 percent of the daily travel on freeways and expressways occurred within the peak hour.

Comparisons of the average weekday traffic utilizing particular sections of the arterial system with the capacity of these sections, referred to as volume-to-design capacity (V/C) ratios, are a useful means of identifying and quantifying existing and probable near future conditions of traffic congestion. The volume-to-design capacity ratios in 1963, 1967, 1970, and 1972 for each segment of the arterial network are presented in Table 101. In order to facilitate their presentation, the V/C ratios have been grouped into three categories: under design capacity, V/C = 0.90 or less; at design capacity, V/C = 0.91 to 1.10; and over design capacity, V/C = 1.11 or more. The significance of these ranges of volume-to-design capacity ratios is that those facilities operating under design capacity provide fully adequate service, with stable flow and few restrictions on operating speed. Those facilities operating at design capacity provide adequate service with a stable flow, but have a higher volume, with additional restrictions on speed and lane-changing, some occurrences of restricted traffic flow, and some delays at controlled intersections behind turning vehicles. Those facilities operating over design capacity experience traffic congestion at times approaching unstable flow, with restricted speeds, monetary stoppages, necessary speed changes, delays at controlled intersections for more than one traffic signal cycle, and little freedom to manuever.

Most of the arterial system mileage within the Region operating at or over design capacity in 1972 was located in the intensely developed urbanized areas of the Region. About 87 percent of the arterial street and highway mileage within the Region which was operating at or over design capacity in 1972 was located within the Milwaukee, Racine, and Kenosha urbanized areas. Moreover, as shown in Table 100, over 16 percent of Milwaukee County's arterial mileage was operating at or over design capacity in 1972. On the other hand, in the three still primarily rural counties, Ozaukee, Walworth, and Washington, 6 percent or less of the arterial mileage was operating at or over design capacity in 1972. As shown in Table 101, between 1963 and 1972, the number of miles of arterial streets and highways operating over design capacity in the Region was reduced from about 192 to about 166, or by about 14 percent. The reduction in the number of miles of arterial facilities operating over design capacity was even more pronounced in Milwaukee County, where the number of miles of facilities operating at over design capacity was reduced by nearly one-half, from about 116 miles to about 61 miles. The number of miles of arterial facilities operating at design capacity in the Region, however, increased from about 140 in 1963 to about 152 in 1972, or by about 9 percent. In Milwaukee County, the number of miles of arterial facilities operating at design capacity decreased over this same period by nearly 16 percent, or from about 85 miles to about 72 miles. The net effect of these changes in arterial facility capacity and use was a reduction of about 14 miles, or 4 percent, in arterial facilities operating at or over design capacity in the Region, and a reduction of about 69 miles, or almost 35 percent, in Milwaukee County.

EXISTING SUPPLY AND USE OF PUBLIC TRANSIT

In addition to the street and highway system, a major element of the regional transportation system is public transportation. Some form of public transportation is essential to the provision of a balanced transportation system in any urbanized area, not only to meet the needs of that segment of the population unable to command direct use of personalized transportation, but also to provide an alternative, more efficient mode of travel for certain types of trips within and between urbanized areas. As shown in Figure 22, public transportation can be classified as fixed route or nonfixed route service, according to whether service is provided on regular schedules over prescribed routes or on a demand responsive basis. Public transportation can be further divided into common carrier and special carrier service, according to whether service is provided to the general public or limited to special subgroups of the general public. Thus, public transportation can be divided for analysis purposes into four basic types: fixed route common carrier, fixed route special carrier, nonfixed route common carrier, and nonfixed route special carrier service. All of these types of services but nonfixed route common carrier service were provided in 1979 in the Milwaukee urbanized area.

Fixed route common carrier service is by far the most heavily utilized form of public transportation service operating in southeastern Wisconsin in 1979. Fixed route common carrier public transpor-

Table 101

VOLUME-TO-CAPACITY RATIOS FOR THE ARTERIAL STREET AND HIGHWAY SYSTEM IN THE REGION BY COUNTY: 1963, 1967, 1970, AND 1972[a]

County	1963						
	V/C Range: 0.00-0.90		V/C Range: 0.91-1.10		V/C Range: Above 1.10		Total Mileage
	Mileage	Percent of Total	Mileage	Percent of Total	Mileage	Percent of Total	
Kenosha	260.8	92.6	7.2	2.6	13.5	4.8	281.5
Milwaukee	589.8	74.5	85.4	10.8	116.3	14.7	791.5
Ozaukee	250.3	94.5	6.3	2.4	8.3	3.1	264.9
Racine	327.7	93.3	10.0	2.8	13.6	3.9	351.3
Walworth.	390.5	97.7	3.9	1.0	5.3	1.3	399.7
Washington . . .	401.8	99.9	0.5	0.1	0.0	0.0	402.3
Waukesha	635.6	91.2	26.6	3.8	34.8	5.0	697.0
Region	2,856.5	89.6	139.9	4.4	191.8	6.0	3,188.2

County	1967						
	V/C Range: 0.00-0.90		V/C Range: 0.91-1.10		V/C Range: Above 1.10		Total Mileage
	Mileage	Percent of Total	Mileage	Percent of Total	Mileage	Percent of Total	
Kenosha	272.1	91.5	12.9	4.3	12.5	4.2	297.5
Milwaukee	706.3	83.1	68.1	8.0	75.4	8.9	849.8
Ozaukee	277.1	96.6	6.7	2.3	3.2	1.1	287.0
Racine	337.7	90.9	13.1	3.5	20.7	5.6	371.5
Walworth.	397.8	97.6	5.8	1.4	4.1	1.0	407.7
Washington . . .	409.1	99.6	1.5	0.4	0.0	0.0	410.6
Waukesha	641.6	90.6	38.1	5.4	28.6	4.0	708.3
Region	3,041.7	91.3	146.2	4.4	144.5	4.3	3,332.4

County	1970						
	V/C Range: 0.00-0.90		V/C Range: 0.91-1.10		V/C Range: Above 1.10		Total Mileage
	Mileage	Percent of Total	Mileage	Percent of Total	Mileage	Percent of Total	
Kenosha	264.2	91.1	9.3	3.2	16.5	5.7	290.0
Milwaukee	713.5	86.8	61.6	7.5	47.0	5.7	822.1
Ozaukee	232.0	93.6	13.1	5.3	2.7	1.1	247.8
Racine	303.4	87.1	19.0	5.5	25.9	7.4	348.3
Walworth.	390.5	96.9	6.8	1.7	5.5	1.4	402.8
Washington . . .	317.6	95.3	6.2	1.9	9.3	2.8	333.1
Waukesha	605.5	92.1	16.6	2.5	35.7	5.4	657.8
Region	2,826.7	91.1	132.6	4.3	142.6	4.6	3,101.9

County	1972						
	V/C Range: 0.00-0.90		V/C Range: 0.91-1.10		V/C Range: Above 1.10		Total Mileage
	Mileage	Percent of Total	Mileage	Percent of Total	Mileage	Percent of Total	
Kenosha	250.4	87.2	14.7	5.1	22.0	7.7	287.1
Milwaukee	662.9	83.3	71.8	9.0	61.0	7.7	795.7
Ozaukee	237.9	93.8	10.1	4.0	5.5	2.2	253.5
Racine	316.0	88.9	19.1	5.4	20.3	5.7	355.4
Walworth.	404.5	98.2	2.7	0.7	4.8	1.1	412.0
Washington . . .	326.0	94.6	9.7	2.8	9.1	2.6	344.8
Waukesha	603.5	90.0	23.8	3.6	42.9	6.4	670.2
Region	2,801.2	89.8	151.9	4.9	165.6	5.3	3,118.7

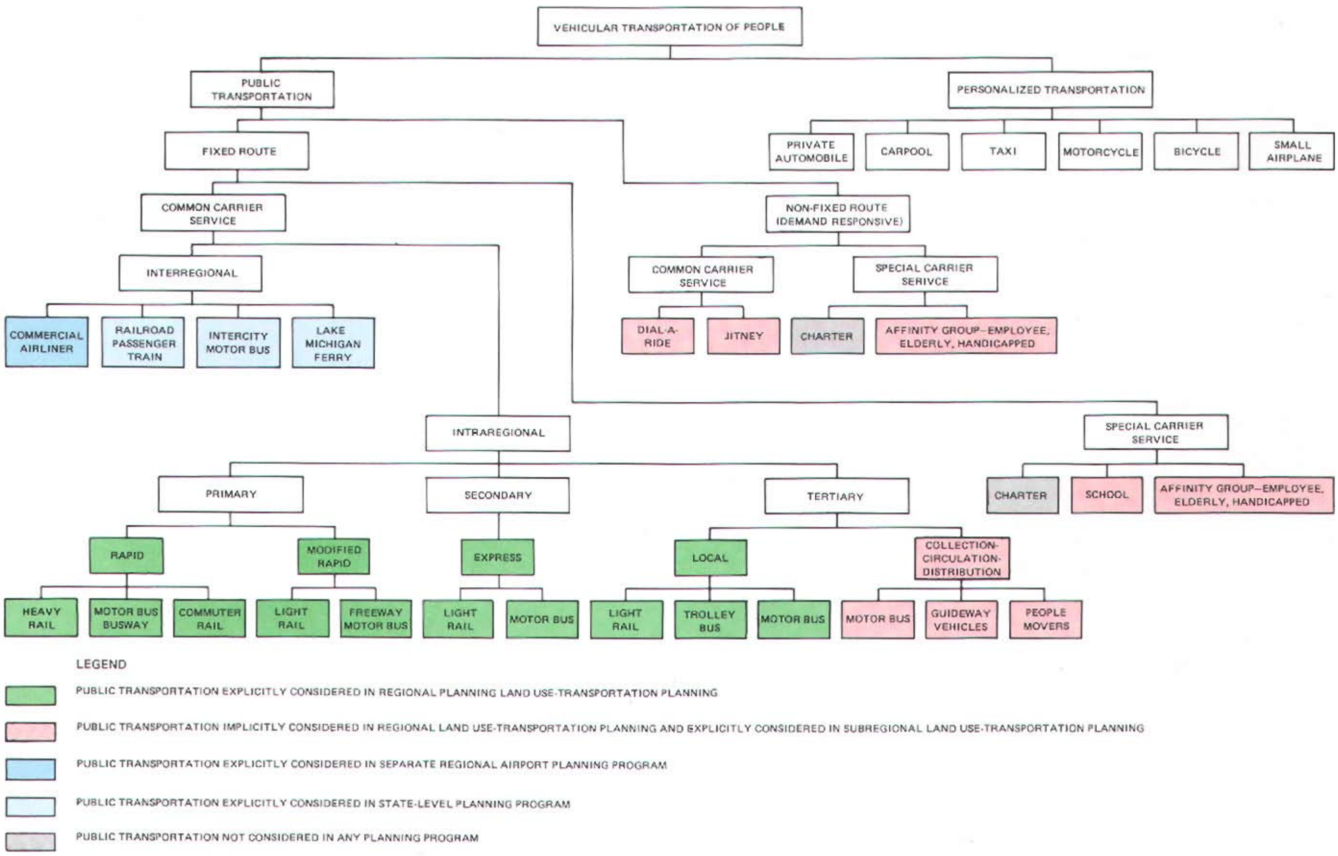
[a] *The significance of the volume-to-capacity ratio of the ranges used is:*

0.00 - 0.90 - Under design capacity, fully adequate and safest operational level.
0.91 - 1.10 - At design capacity but still adequate.
Over 1.10 - Over design capacity, congested at times.

Source: SEWRPC.

Figure 22

CLASSIFICATION OF PUBLIC TRANSPORTATION



Source: SEWRPC.

tation service may be divided into interregional service, which provides service across regional boundaries to meet external travel demand, and intraregional service, which provides service within the Region to meet internal travel demand. This inventory is concerned only with service intended to meet internal travel demand and only as that demand may be suited for primary transit service. Thus, interregional fixed route common carrier service will not be discussed except as its associated terminal facilities may constitute major trip generators for the intraregional primary transit system.

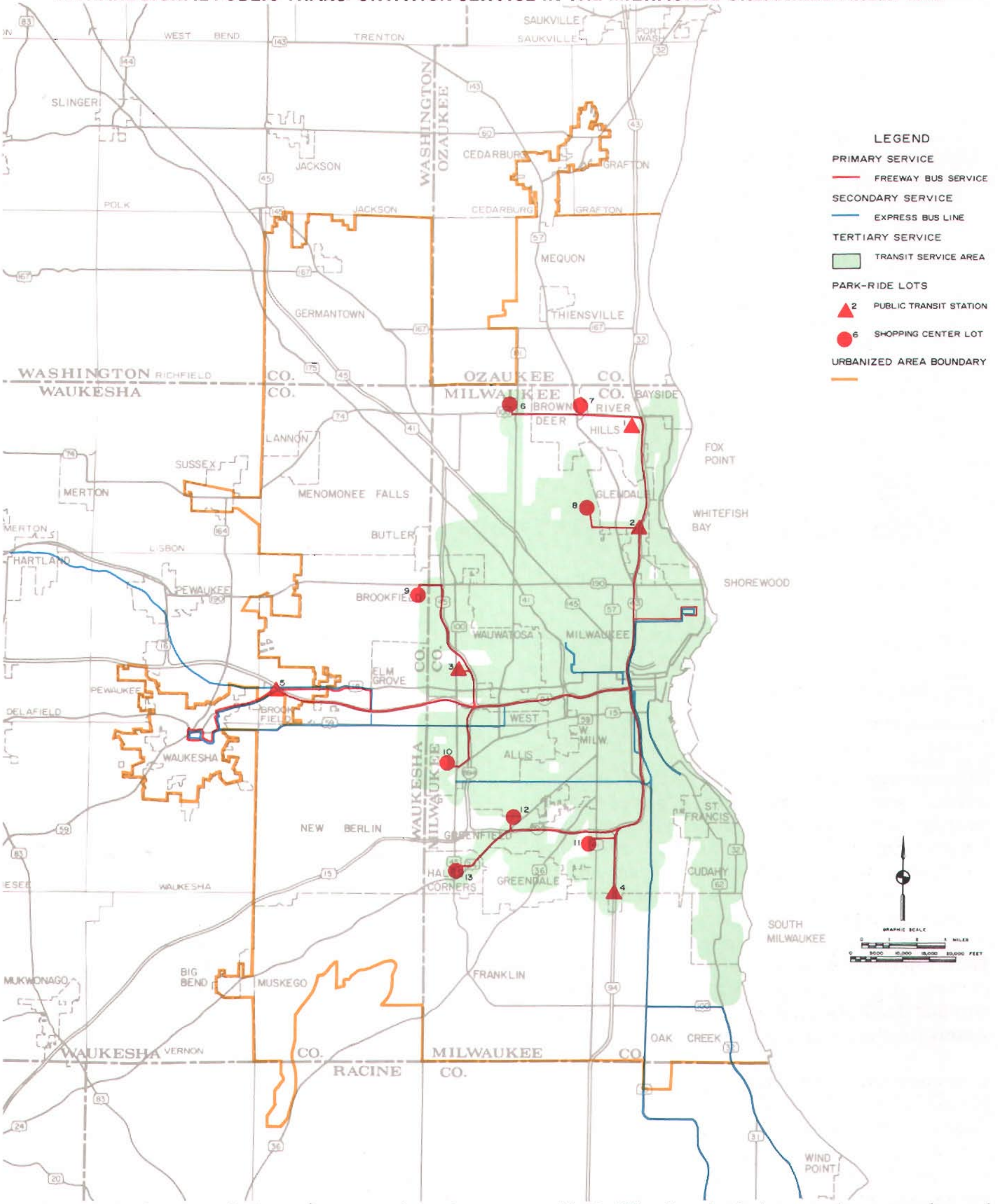
Milwaukee Urbanized Area

In the Milwaukee urbanized area, fixed route common carrier service, fixed route special carrier service, and nonfixed route special carrier service are currently provided. Fixed route common carrier service was operated at primary, secondary, and tertiary levels in 1979, as shown on Map 51. All tertiary level service and nearly all primary and secondary level service were limited to Milwaukee County.

Primary service, by definition, joins the major regional activity centers—commercial, industrial, institutional, and recreational—to each other and to the various residential communities constituting the Region. Characterized by relatively high operating speeds and relatively low accessibility, primary transit service can be provided in a rapid form through exclusive, fully grade-separated rights-of-way or in a modified rapid form through operation in mixed traffic on freeways, or on exclusive, but not fully grade-separated, rights-of-way. Existing primary transit service in the Milwaukee urbanized area consists of the modified rapid transit "Freeway Flyer" motor bus service provided by the Milwaukee County Transit System, the county-owned but privately managed major transit operator in the Milwaukee urbanized area, and the Waukesha-Milwaukee service provided by Wisconsin Coach Lines, Inc., a privately owned transit operator under contract to Waukesha County. Primary transit service by a travel mode other than the motor bus was last provided in 1972, when commuter rail service between the City of

Map 51

INTRAREGIONAL PUBLIC TRANSPORTATION SERVICE IN THE MILWAUKEE URBANIZED AREA: 1979



As shown on the above map, fixed-route common carrier service was operated in the Milwaukee urbanized area at primary, secondary, and tertiary levels by motor bus in 1979. All tertiary levels of service and nearly all primary and secondary levels of service were limited to Milwaukee County. The existing modified rapid primary transit service utilizing motor buses was initiated in 1964 as a single route providing six vehicle trips during peak travel periods between the Milwaukee central business district and one privately owned outlying shopping center parking lot. This service has been expanded to include 10 freeway bus routes providing 203 weekday vehicle trips, primarily as peak-travel-period service, to 13 outlying park-ride lots.

Source: SEWRPC.

Watertown and the Milwaukee central business district (CBD) was discontinued. The rail service provided two trips per weekday and served 60 passengers daily in 1972. The existing modified rapid transit Freeway Flyer service was initiated in 1964 as a single route providing six vehicle trips during peak travel periods between the Milwaukee central business district and one privately owned outlying shopping center parking lot. This service has been expanded to 10 freeway bus routes providing 203 weekday vehicle trips, primarily as peak-travel-period service, to 13 outlying park-ride lots, as shown in Table 102. Of the 13 park-ride lots, eight are located in privately owned shopping center parking lots. The other five are publicly owned and maintained transit stations specifically designed for change of mode operations. Total ridership on the Freeway Flyers, as shown in Figure 19 in Chapter V, has increased from about 81,000 annual revenue passengers in the first year of operation to about 969,600 annual revenue passengers in 1978. The current base Freeway Flyer fare on the Milwaukee County Transit System is 60 cents; the Wisconsin Coach Lines primary service bus fare is distance-related.

Existing secondary service in the Milwaukee urbanized area is composed of five express bus routes, three operated by the Milwaukee County Transit System and two operated by Wisconsin Coach Lines, Inc. The secondary level of intraregional common carrier fixed route service, by definition, consists of express service; that is, service provided over arterial streets with stops located only at intersecting transit routes and major traffic generators, generally no less than 1,200 feet apart. The secondary public transportation system may provide a "feeder" service to the primary system, and may offer better access to some subregional areas than does tertiary service. An average of 304 weekday vehicle trips are made on the existing five Milwaukee County Transit System express routes, and approximately 46 vehicle trips per weekday are made on the Wisconsin Coach Lines, Inc., two express routes. The Milwaukee County express bus fare has been 50 cents since May 15, 1976, and is equal to the regular fare; the Wisconsin Coach Lines express bus fare is distance-related. In 1972 secondary service consisted of five express bus routes operated by Wisconsin Coach Lines, Inc., and two lines operated by the Milwaukee and

Table 102

SELECTED CHARACTERISTICS OF PRIMARY TRANSIT PARK-RIDE LOTS IN THE MILWAUKEE URBANIZED AREA: 1979

Number on Map 51	Location	Civil Division	Number of Parking Spaces Available	Average Weekday Vehicle Trips[a] Inbound a.m.	Inbound p.m.	Outbound a.m.	Outbound p.m.
	Public Transit Stations						
1	North-South Freeway and W. Brown Deer Road	Village of River Hills	250	8	1	3	7
2	North-South Freeway and W. Silver Spring Drive	City of Glendale	190	9	6	4	9
3	Zoo Freeway and W. Watertown Plank Road	City of Wauwatosa	200	7	3	2	8
4	North-South Freeway and W. College Avenue	City of Milwaukee	300	6	2	4	5
5	East-West Freeway and Barker Road	Town of Brookfield	200	4	1	- -	4
	Shopping Center Lots						
6	N. 76th Street and W. Brown Deer Road	City of Milwaukee	100	6	1	2	5
7	N. Green Bay Road and W. Brown Deer Road	Village of Brown Deer	100	6	1	2	5
8	N. Teutonia Avenue and Florist Avenue	City of Milwaukee	100	9	5	4	9
9	N. 125th Street and W. Capitol Drive	City of Brookfield	140	7	2	3	8
10	S. 108th Street and W. Cleveland Avenue	City of West Allis	100	7	2	2	8
11	S. 27th Street and W. Layton Avenue	City of Greenfield	100	7	3	4	7
12	S. 76th Street and W. Cold Spring Road	City of Greenfield	200	9	3	4	11
13	S. 108th Street and W. Grange Avenue	Village of Hales Corners	100	6	1	3	7

[a] *Service offered primarily between the hours of 6:30-8:30 a.m. and 4:00-6:00 p.m.*

Source: SEWRPC.

Suburban Transport Corporation (now Milwaukee County Transit System),[2] one less route than is provided currently. Secondary intraregional public transit in 1963 was composed of 10 express bus routes to the Milwaukee CBD, eight operated by Greyhound Lines and Wisconsin Coach Lines, Inc., and two operated by the Milwaukee and Suburban Transport Corporation.

Existing tertiary transit service in the Milwaukee urbanized area is provided only in Milwaukee County, as shown on Map 51. The tertiary level of fixed route common carrier transit service, by definition, provides two basic functions: local service and collection-circulation-distribution service. Both are characterized by a high degree of accessibility and relatively low operating speeds. Local service is provided primarily over arterial and collector streets, with stops for passenger pickup and discharge located no more than 1,200 feet apart. Collection-circulation-distribution service is provided for the movement of passengers within major activity centers. Currently, 44 local service routes within Milwaukee County are operated by the Milwaukee County Transit System, with approximately 5,107 vehicle trips being made on those routes. This local service was used by an estimated 43,616,900 annual revenue passengers in 1978 (including secondary service and school trip passengers), or about 171,500 passengers per average weekday. Only one tertiary service route in Milwaukee County serves other than a local service function—the shuttle service in the Milwaukee CBD, which provides a collection-circulation-distribution function between 9:30 a.m. and 4:00 p.m. In 1978 the downtown shuttle provided 229 weekday vehicle trips and was utilized by approximately 2,900 revenue passengers per day, or 731,500 annually. Local tertiary service bus fare has been 50 cents since May 15, 1976.

Tertiary transit service in the Milwaukee area was composed of 40 local service routes in 1963 and 36 routes in 1972. Tertiary services were provided by the Milwaukee and Suburban Transport Corporation. Approximately 5,235 average weekday trips in 1963 and 5,215 such trips in 1972 were made utilizing tertiary transit service.

Special carrier fixed route service in the Milwaukee urbanized area is currently provided by the Milwaukee County Transit System to selected public and private grade, junior high, and high schools and to the University of Wisconsin-Milwaukee. The "UBUS" special carrier fixed route service provided to the University of Wisconsin-Milwaukee was begun in the fall of 1973 as a single charter route providing local transit service to the university. Currently, the Milwaukee County Transit System operates seven UBUS routes, five of which were incorporated into the transit system as regular routes in 1973.

Special carrier service on nonfixed routes is currently provided to the elderly and handicapped in the Milwaukee urbanized area by more than 35 private and public agencies. An estimated 800,000 trips by elderly and handicapped individuals were made in special carrier service vehicles in 1976, based on a special inventory of public, private, nonprofit public, and nonprofit private providers of elderly and handicapped transportation services conducted by the Regional Planning Commission.

PLANNED TRANSPORTATION FACILITIES AND SERVICES FOR SOUTHEASTERN WISCONSIN

Recommendations for arterial street and highway system development, public transit system development, and transportation system management in southeastern Wisconsin to the year 2000 are set forth in the regional transportation system plan for southeastern Wisconsin,[3] which was formally adopted by the Southeastern Wisconsin Regional Planning Commission on May 19, 1978. The study was conducted by the Regional Planning Commission with the involvement of concerned and affected elected and appointed public officials from all levels of government as well as representatives from private enterprise and the general public. The study provided a reevaluation of the findings of the original regional transportation system plan adopted by the Regional Planning

[2] *On July 1, 1975, Milwaukee County acquired the assets of the Milwaukee and Suburban Transport Corporation and began operation of the transit system. In Milwaukee County, the Milwaukee and Suburban Transport Corporation continued to experience ridership losses. Ridership in the Milwaukee area declined steadily from 285,200 average daily revenue passengers in 1963 to 175,000 average daily revenue passengers in 1972.*

[3] *See SEWRPC Planning Report No. 25, A Regional Land Use Plan and a Regional Transportation Plan for Southeastern Wisconsin: 2000.*

Commission in 1966. The recommended plan and the changes from the original plan which it proposed are intended to represent a consensus on desirable transportation system development and management measures in the Region to the year 2000.

Recommendations were made in the plan under four general categories: freeways, standard surface arterial streets and highways, public transit facilities and services, and transportation systems management. Regarding transportation systems management, the transportation plan recommends the expansion of the freeway traffic management system in the Milwaukee area; the expansion of curb parking restrictions on major surface arterials during peak-hour travel periods; the establishment of a continuing carpool promotional program; and the institution of a parking fee structure that would discourage long-term parking in, and encourage mass transit use to, the central business district of Milwaukee. These four recommendations were designed to accomplish several objectives, including ensuring that maximum use is made of existing transportation facilities before commitments are made to new capital investment; encouraging the use of high-occupancy vehicles such as buses, vans, and carpools; effecting motor fuel savings; and reducing vehicle miles of travel in congested areas of the Region. Another transportation systems management recommendation of the regional plan is that a series of special studies be undertaken to integrate the "stub ends" of currently uncompleted freeway segments, including the Park Freeway-East, the Lake Freeway-North and -South, and the Stadium Freeway-South, into the existing arterial street system.

The Commission's transportation systems management (TSM) plan, prepared and adopted in late 1977[4] and updated in 1978,[5] expands upon the recommendations of the long-range plan to maximize the efficiency of the existing transportation system in southeastern Wisconsin. This short-range plan proposes a coordinated areawide program of 24 actions to ensure full and efficient use of existing arterial street and highway facilities, to reduce vehicle use in congested areas, to improve transit service, and to increase internal transit management efficiency. Among the actions recommended in the plan are a study of work time rescheduling for the Milwaukee area, a study of arterial corridor transportation systems management alternatives, a study of taxi fares and regulations, a downtown parking rate structure study, and the continued implementation and improvement of transit service and carpool and vanpool promotion programs.

The transportation systems management recommendations of the long-range plan are a particularly important element of the TSM plan, because the freeway system element of the plan is divided into two "tiers," an upper tier and a lower tier. Although remaining on the long-range plan, freeway facilities on the upper tier are to have no further work undertaken toward construction for a period of at least a decade. During that decade, the aforementioned transportation systems management measures intended to reduce the anticipated peak-hour travel demand in Milwaukee County while obtaining the highest possible efficiency from existing transportation facilities and services are to be implemented. The two-tier plan envisions that if at some later time it is determined that these actions to modify travel demand and achieve maximum facility and service efficiency have been effective, then steps can be taken at that time to formally remove the upper-tier freeway proposals from the long-range plan. On the other hand, if the consensus at such future time is that travel demand modification and improved transportation efficiency efforts have not worked well, and that arterial street and transit improvements have not adequately provided the needed transportation service, work can again proceed toward the construction of the upper-tier freeways. In the meantime, the plan recommends that all rights-of-way currently cleared for the remaining freeway segments be held in a transportation land bank, with appropriate consideration given to the use of the land for park and open space purposes. The plan also recommends that any currently undeveloped lands needed to accommodate the construction of the freeways in the upper tier of the plan continue to be held in open use. It is recommended in the plan that the freeway facilities in the lower tier of the plan be constructed as soon as possible.

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[4] *See SEWRPC Community Assistance Planning Report No. 21, A Transportation Systems Management Plan for the Kenosha, Milwaukee, and Racine Urbanized Areas in Southeastern Wisconsin: 1978.*

[5] *See SEWRPC Community Assistance Planning Report No. 26, A Transportation Systems Management Plan for the Kenosha, Milwaukee, and Racine Urbanized Areas in Southeastern Wisconsin: 1979.*

The lower tier of the regional transportation system plan includes 60 miles of proposed freeways, and the upper tier, an additional 37 miles of proposed freeways. Thus, by the year 2000 a maximum total of 97 additional miles are proposed to be added to the current committed freeway system. (Seven miles of freeway are currently committed for construction.) The year 2000 regional freeway system would then approximate 336 miles.

Planned Arterial Streets and Highways

The total arterial street and highway system in the Region, including both surface arterials and upper- and lower-tier freeways, would increase in mileage by about 516 miles under the adopted plan by the year 2000—from 3,010 miles in 1972 to 3,526 miles in the year 2000 (see Map 52 and Table 103). The additional mileage proposed reflects, in part, the addition of existing nonarterial facilities to the arterial system and, in part, the construction of new surface arterial facilities, which would account for about 228 miles under the adopted plan.

Table 104 summarizes by county the improvements to the arterial street and highway system proposed in the adopted plan. The improvements are categorized as system preservation, system improvement, or system expansion. System preservation includes all arterial improvements required to maintain the adequacy of the existing system without significantly increasing the capacity of the system—for example, resurfacing or reconstruction projects for the same capacity and nonsignificant street widening projects. System improvement includes all projects which would significantly increase the capacity of the existing system through street widening or relocation. System expansion includes all projects which would significantly increase the capacity of the existing system through the construction of new facilities.

Under the adopted plan about 2,621 miles of the proposed 3,526-mile arterial system are in the system preservation category, representing about 75 percent of the total future arterial system. This includes 196 miles, or 6 percent of the total system, on which no work is required; 1,545 miles, or 44 percent of the total system, on which only resurfacing is required; and 880 miles, or 25 percent of the total system, on which reconstruction to the same capacity is required. About 721 miles, or about 20 percent of the future system, are in the system improvement category. About 677 of these miles, or about 19 percent of the total system, would be reconstructed for additional capacity. The remaining 44 miles, or about 1 percent of the total system, represent the construction of replacement facilities. The remaining 184 miles, or 5 percent of the total future system, are in the system expansion category, and represent the construction of new facilities.

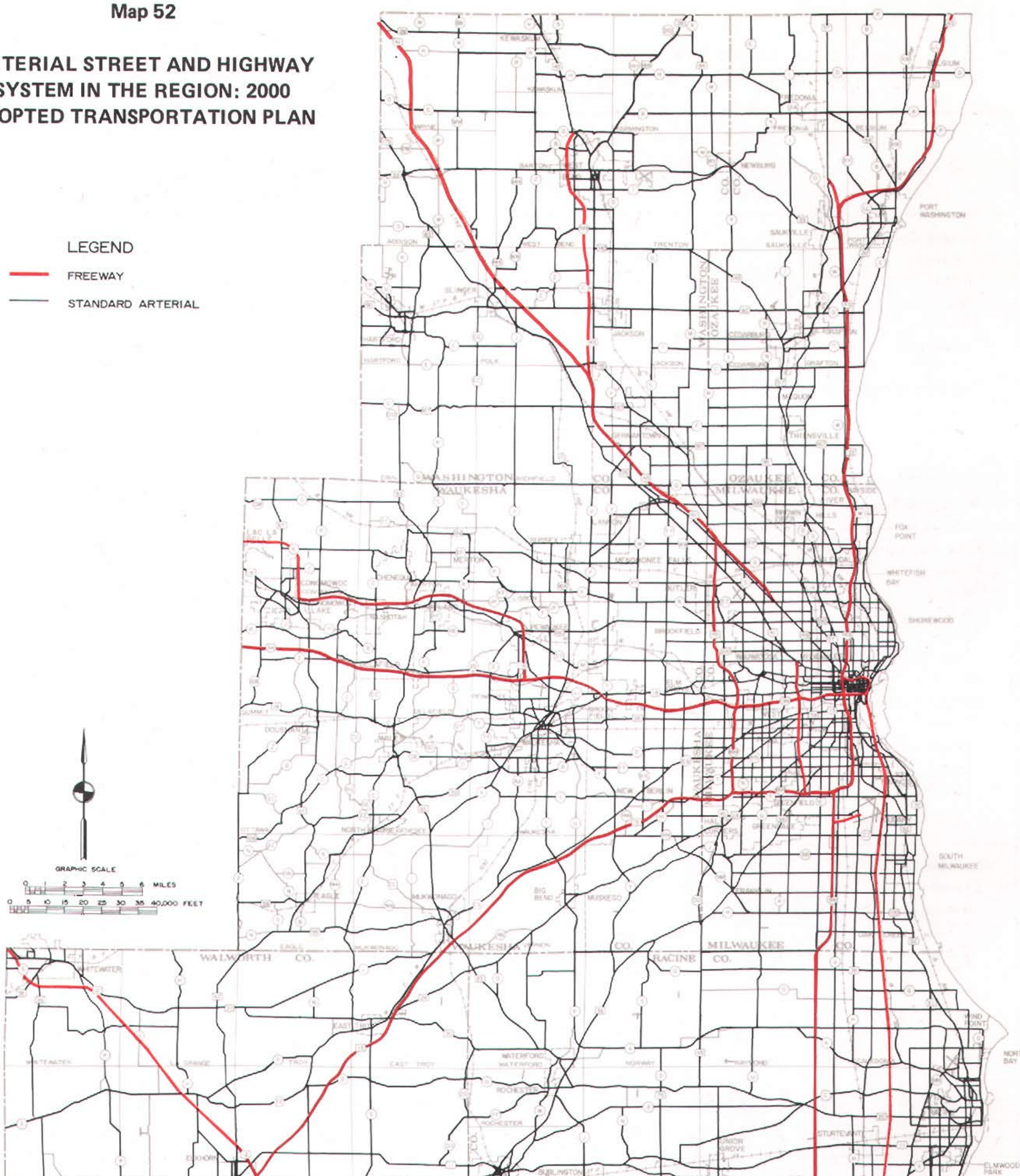
PLANNED PUBLIC TRANSIT
FACILITIES AND SERVICES

The adopted regional transportation plan includes transit system development proposals for the three urbanized areas of the Region—Kenosha, Milwaukee, and Racine—including for the Milwaukee urbanized area, three levels of transit service—primary, secondary, and tertiary.

Recommended public transit facilities for the Milwaukee area are identified in Table 105. The transit network proposed in the adopted plan is shown on Map 53. All primary service recommended is of the modified rapid transit type, consisting of the operation of motor buses in mixed traffic on traffic-managed freeways and over connecting surface arterials. The adopted plan recommends the development of no true rapid transit facilities, but rather the development of a freeway traffic management system in the Milwaukee urbanized area—a system designed to permit the provision of primary transit service over the freeway system. Under this recommendation, operation of the freeway system in the Milwaukee urbanized area would be carefully monitored, freeway ramps would be metered, and access to the freeway would be constrained to ensure high rates of traffic flow at reasonable speeds. Buses and other high-occupancy vehicles would be granted preferential access to the freeway system. However, the potential for providing modified rapid bus, or primary transit, service to a large sector of Milwaukee County was lost when the Park Freeway-West and the Stadium Freeway-North "gap closure" were eliminated from the new freeway system plan by the Regional Planning Commission. In addition, according to the new transportation system plan, portions of two freeway segments planned to carry modified rapid bus transit, the Stadium Freeway-South and the Lake Freeway, will not be constructed for at least 10 years, and then only after another evaluation of their need. Furthermore, the planned freeway traffic management system proposed to constrain automobile access to the freeway system while giving preferential access to buses is anticipated to be designed

Map 52

ARTERIAL STREET AND HIGHWAY SYSTEM IN THE REGION: 2000 ADOPTED TRANSPORTATION PLAN



Under the adopted transportation plan, arterial street and highway system mileage within the Region would total about 3,526 miles by the year 2000, an increase of about 516 miles, or about 17 percent, over 1972. Freeways would comprise 336 miles, or about 9 percent, of the total arterial system in the year 2000, an increase of 174 miles over 1972. Such freeways would, however, be expected to carry about 42 percent of the average daily traffic load. Of this increase, 97 miles represent seven planned new freeways. Of this total system about 2,650 miles, or about 75 percent, would fall into the system preservation category, including facilities for which no work, resurfacing, or reconstruction for same capacity is proposed; about 707 miles, or 20 percent, would fall into the system improvement category, for which reconstruction for additional capacity or new construction of replacement facilities is proposed; and about 176 miles, or 5 percent, would fall into the system expansion category, wherein the construction of new facilities is proposed.

Source: SEWRPC.

Table 103

ARTERIAL STREET AND HIGHWAY FACILITIES IN THE REGION BY ARTERIAL FACILITY TYPE BY COUNTY: 1972 AND 2000 ADOPTED TRANSPORTATION PLAN

Arterial Facility Type	Miles of Arterial Facilities: 1972	Planned Increment	2000
Kenosha County			
Freeway			
4-lane	--	--	--
6-lane	12.1	12.2	24.3
8-lane	--	--	--
Subtotal	12.1	12.2	24.3
Standard Arterial			
2-lane	243.6	- 2.9	240.7
4-lane	24.1	61.7	85.8
6-lane	--	8.8	8.8
Subtotal	267.7	67.6	335.3
County Total	279.8	79.8	359.6
Milwaukee County			
Freeway			
4-lane	12.7	- 1.9	10.8
6-lane	49.0	23.9	72.9
8-lane	2.1	--	2.1
Subtotal	63.8	22.0	85.8
Standard Arterial			
2-lane	339.5	- 131.6	207.9
4-lane	268.7	143.9	412.6
6-lane	62.2	6.6	68.8
Subtotal	670.4	18.9	689.3
County Total	734.2	40.9	775.1
Ozaukee County			
Freeway			
4-lane	10.8	14.8	25.6
6-lane	--	2.0	2.0
8-lane	--	--	--
Subtotal	10.8	16.8	27.6
Standard Arterial			
2-lane	233.0	19.9	252.9
4-lane	6.5	23.9	30.4
6-lane	--	--	--
Subtotal	239.5	43.8	283.3
County Total	250.3	60.6	310.9
Racine County			
Freeway			
4-lane	--	--	--
6-lane	12.0	12.1	24.1
8-lane	--	--	--
Subtotal	12.0	12.1	24.1
Standard Arterial			
2-lane	303.5	18.4	321.9
4-lane	28.0	56.5	84.5
6-lane	5.9	5.9	11.8
Subtotal	337.4	80.8	418.2
County Total	349.4	92.9	442.3

Arterial Facility Type	Miles of Arterial Facilities: 1972	Planned Increment	2000
Walworth County			
Freeway			
4-lane	19.1	48.1	67.2
6-lane	--	--	--
8-lane	--	--	--
Subtotal	19.1	48.1	67.2
Standard Arterial			
2-lane	379.4	10.7	390.1
4-lane	9.7	16.2	25.9
6-lane	--	--	--
Subtotal	389.1	26.9	416.0
County Total	408.2	75.0	483.2
Washington County			
Freeway			
4-lane	0.4	35.6	36.0
6-lane	6.4	--	6.4
8-lane	--	--	--
Subtotal	6.8	35.6	42.4
Standard Arterial			
2-lane	305.6	61.8	367.4
4-lane	26.8	1.0	27.8
6-lane	--	--	--
Subtotal	332.4	62.8	395.2
County Total	339.2	98.4	437.6
Waukesha County			
Freeway			
4-lane	29.1	19.4	48.5
6-lane	8.7	7.4	16.1
8-lane	--	--	--
Subtotal	37.8	26.8	64.6
Standard Arterial			
2-lane	565.5	- 55.9	509.6
4-lane	41.3	80.6	121.9
6-lane	3.9	17.4	21.3
Subtotal	610.7	42.1	652.8
County Total	648.5	68.9	717.4
Southeastern Wisconsin Region			
Freeway			
4-lane	72.1	116.0	188.1
6-lane	88.2	57.6	145.8
8-lane	2.1	--	2.1
Subtotal	162.4	173.6	336.0
Standard Arterial			
2-lane	2,370.1	- 79.6	2,290.5
4-lane	405.1	383.8	788.9
6-lane	72.0	38.7	110.7
Subtotal	2,847.2	342.9	3,190.1
Region Total	3,009.6	516.5	3,526.1

Source: SEWRPC.

Table 104

ARTERIAL STREET AND HIGHWAY SYSTEM PRESERVATION, IMPROVEMENT, AND EXPANSION BY ARTERIAL FACILITY TYPE BY COUNTY: 2000 ADOPTED TRANSPORTATION PLAN

Arterial Facility Type	System Preservation				System Improvement			System Expansion		Total (miles)
	No Work Required (miles)	Resurface (miles)	Reconstruct for Same Capacity (miles)	Percent of Total	Reconstruct for Additional Capacity (miles)	New Construction—Replacement Facility (miles)	Percent of Total	New Construction—New Facility	Percent of Total	
Kenosha County										
Freeway	- -	12.1	- -	49.8	- -	- -	- -	12.2	50.2	24.3
Standard Arterial . . .	0.9	128.2	114.2	72.6	70.0	9.7	23.8	12.3	3.7	335.3
Subtotal	0.9	140.3	114.2	71.0	70.0	9.7	22.2	24.5	6.8	359.6
Milwaukee County										
Freeway	9.8	53.0	- -	73.5	5.4	- -	6.3	17.6	20.6	85.4
Standard Arterial . . .	62.5	319.0	72.5	65.9	219.7	3.7	32.4	11.9	1.7	689.3
Subtotal	72.3	372.0	72.5	66.7	225.1	3.7	29.5	29.5	3.8	774.7
Ozaukee County										
Freeway	16.8	8.8	- -	92.8	2.0	- -	7.2	- -	- -	27.6
Standard Arterial . . .	4.0	145.3	89.8	84.4	38.6	2.0	14.3	3.6	1.3	283.3
Subtotal	20.8	154.1	89.8	85.1	40.6	2.0	13.7	3.6	1.2	310.9
Racine County										
Freeway	- -	12.0	- -	49.8	- -	- -	- -	12.1	50.2	24.1
Standard Arterial . . .	5.7	119.7	182.3	73.6	81.7	5.9	20.9	22.9	5.5	418.2
Subtotal	5.7	131.7	182.3	72.3	81.7	5.9	19.8	35.0	7.9	442.3
Walworth County										
Freeway	50.3	- -	- -	74.9	- -	- -	- -	16.9	25.1	67.2
Standard Arterial . . .	9.3	226.8	133.9	88.9	22.0	10.2	7.8	13.8	3.3	416.0
Subtotal	59.6	226.8	133.9	87.0	22.0	10.2	6.6	30.7	6.4	483.2
Washington County										
Freeway	2.2	6.4	- -	20.3	21.1	- -	49.8	12.7	29.9	42.4
Standard Arterial . . .	1.8	218.7	112.8	84.3	40.2	6.8	11.9	14.9	3.8	395.2
Subtotal	4.0	225.1	112.8	78.7	61.3	6.8	15.6	27.6	6.3	437.6
Waukesha County										
Freeway	14.1	35.6	- -	76.9	8.8	- -	13.6	6.1	9.5	64.6
Standard Arterial . . .	18.5	259.7	174.9	69.4	167.0	6.0	26.5	26.7	4.1	652.8
Subtotal	32.6	295.3	174.9	70.1	175.8	6.0	25.3	32.8	4.6	717.4
Southeastern Wisconsin Region										
Freeway	93.2	127.9	- -	65.8	37.3	- -	11.1	77.6	23.5	336.0
Standard Arterial . . .	102.7	1,417.4	880.4	75.3	639.2	44.3	21.4	106.1	3.3	3,190.1
Total	195.9	1,545.3	880.4	74.3	676.5	44.3	20.4	183.7	5.3	3,526.1

Source: SEWRPC.

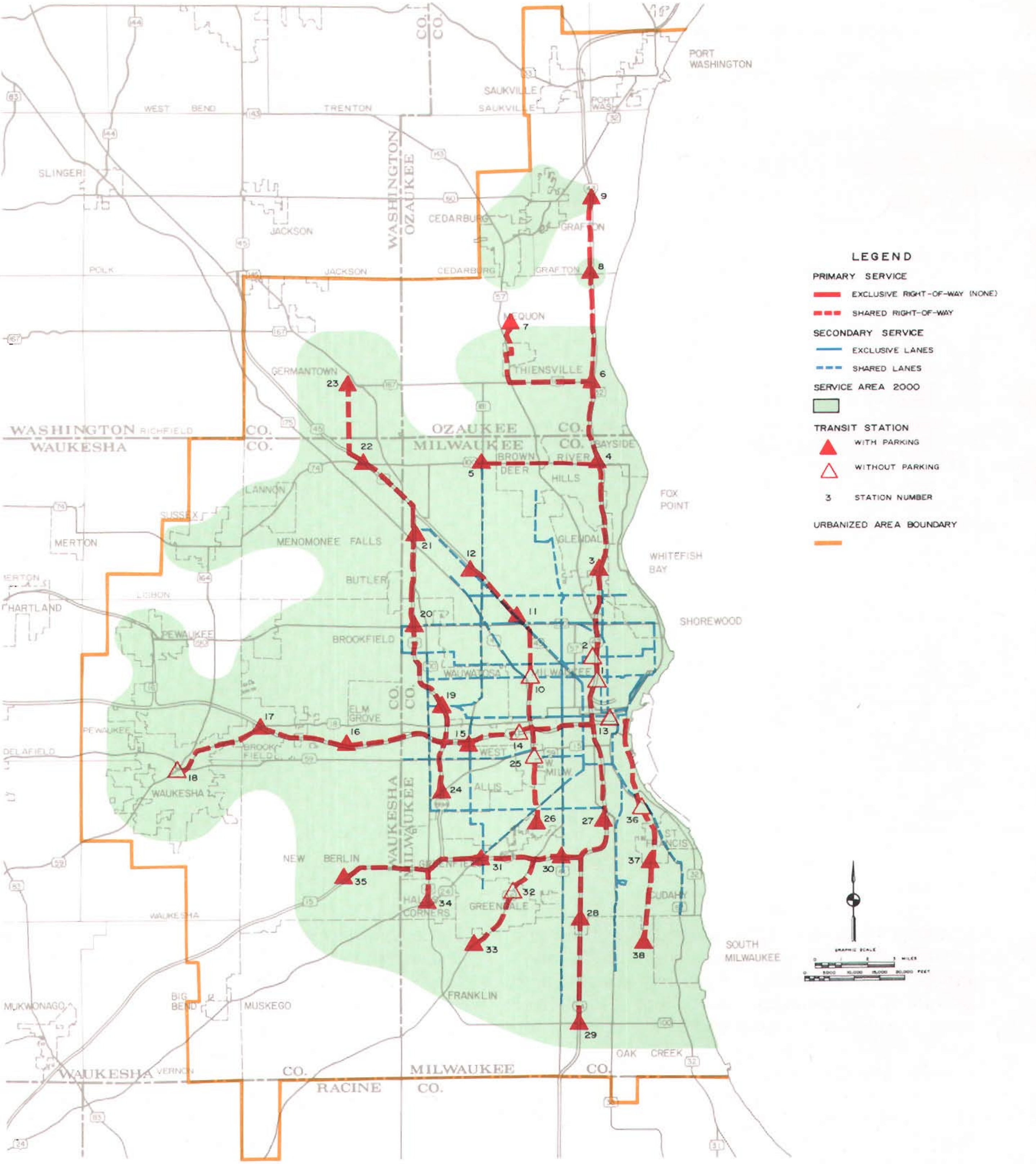
primarily to ensure high rates of traffic flow, and consequently will only allow buses on freeways which would otherwise be severely congested to operate at maximum speeds of 35 to 55 miles per hour. This would be substantially less than the top speeds possible on an exclusive transit guideway. Finally, whether a freeway traffic management system can be, or will be, implemented in the Milwaukee urbanized area is uncertain, and further study of its impacts and feasibility is required prior to its implementation.

Primary transit service would be provided over a total of 80 miles of freeway facility, with 27 miles of connecting surface arterials, under the adopted plan. A total of 38 public transit stations would be established along the primary transit system, six of which are already in existence (see Table 106). Under the plan secondary transit service, which consists of express bus routes on arterial streets with stops generally located at intersecting transit routes, is to be provided on 14 individual transit routes operating over 156 miles of surface arterials. Traffic lanes reserved for the operation of buses during specified hours of the day would be provided on eight individual transit routes utilizing over 10 miles of surface arterials.

Under the plan, extensive additions to local, or tertiary, transit service routes are to be provided. Tertiary public transit service consists of local

Map 53

TRANSIT SYSTEM IN THE MILWAUKEE URBANIZED AREA: 2000 ADOPTED TRANSPORTATION PLAN



Under the adopted transportation plan, transit service would be provided over 3,073 round-trip route miles of transit line in the Milwaukee urbanized area. Of this total, 1,052 route miles would provide primary service, 361 route miles secondary service, and 1,660 route miles tertiary service. The system would require the operation of about 1,027 buses during peak ridership periods. This would represent an increase of 2,012 round-trip route miles and 585 buses over 1972. The plan also recommends the provision of 38 public park-ride transportation stations, an increase of 34 stations over 1972.

Source: SEWRPC.

Table 105

PUBLIC TRANSIT FACILITIES IN THE MILWAUKEE URBANIZED AREA: 1972 AND 2000 ADOPTED TRANSPORTATION PLAN

Transit Facility Characteristic	Existing 1972	Planned Increment	Total 2000
Round-Trip Route Miles			
Primary	150	902	1,052
Secondary.	56	305	361
Tertiary	855	805	1,660
Total	1,061	2,012	3,073
Miles of Special Facilities			
Exclusive Rights-of-Way. . . .	- -	- -	- -
Exclusive Lanes on Streets . .	- -	9.5	9.5
Vehicle Requirements (number of buses)			
Peak Period	442	585	1,027
Midday Period	220	407	627

Source: SEWRPC.

transit service provided over arterial and collector streets with frequent stops for passenger boarding and alighting. The plan envisions the extension of local transit service to all of the Milwaukee urbanized area, including areas of urban development in southern Ozaukee and Washington Counties, eastern Waukesha County, and southern Milwaukee County not presently being served.

SUMMARY

The entire street and highway system of the Region in 1978 was composed of 10,440 miles, of which about 3,300 miles, or 31.6 percent, were classified by primary function as arterials, and 7,140 miles, or 68.4 percent, were classified as collector and land access streets, a total increase of 1,492 miles, or 17 percent, over 1963. Arterial street mileage between 1963 and 1978 increased by about 3 percent, or 106 miles. From 1972 to 1978 the miles of freeway in the Region increased by 47 percent—from 162 to 238 miles—with the completion of the North-South Freeway, the Rock Freeway, the East-West Freeway, and the Airport Spur Freeway, as well as of portions of USH 16, the West Bend Freeway, USH 41, and the Lake Freeway.

Freeways and expressways, while constituting less than 7 percent of the arterial street and highway mileage in the Region when last comprehensively determined in 1972, carried approximately 31 percent of the total arterial travel. As measured in continuing traffic counting programs conducted by the Wisconsin Department of Transportation and the City of Milwaukee, freeway utilization in Milwaukee increased, in some cases substantially, between 1972 and 1978. Substantial increases in standard arterial street and highway traffic volumes between 1972 and 1978 primarily occurred on facilities in the outlying areas of Milwaukee County. However, a comparison of the most recently obtainable 1979 traffic volume data with comparable data from 1978 indicates minor decreases in arterial street traffic volumes on some freeway facilities, and on arterial streets in central parts of Milwaukee County.

Most of the arterial system mileage within the Region operating at or over design capacity in 1972 was located in the intensely developed urbanized areas of the Region. Over 16 percent of Milwaukee County's arterial mileage was operating at or over design capacity in 1972.

Public transit service in the Milwaukee area is limited largely to Milwaukee County and currently consists of fixed route common carrier service, fixed route special carrier service, and nonfixed route special carrier service. Existing primary fixed route common carrier service consists of modified rapid transit "Freeway Flyer" motor bus service which is operated by the Milwaukee County Transit System, and the Waukesha-Milwaukee service provided by Wisconsin Coach Lines, Inc. Primary service is provided primarily during peak travel hours on 10 freeway bus routes from 13 outlying park-ride lots to the Milwaukee central business district. Total Freeway Flyer ridership has increased from about 81,000 annual revenue passengers in 1964 to nearly one million annual revenue passengers in 1978.

Secondary public transportation service in the Milwaukee area is currently composed of five express bus routes operating over arterial streets. An average of 350 weekday vehicle trips were made on these express bus routes in 1979. Tertiary transit service in Milwaukee County was composed of 44 service routes making approximately 5,107 weekday vehicle trips in 1978. Secondary and tertiary transit service in the Milwaukee area was used by an estimated 43,616,900 revenue passengers in 1978, or about 171,500 passengers per average weekday.

The adopted regional transportation system plan for the year 2000 is composed of four elements: freeways, standard arterial streets and highways,

Table 106

SELECTED CHARACTERISTICS OF PRIMARY TRANSIT STATIONS IN THE MILWAUKEE URBANIZED AREA: 2000 ADOPTED TRANSPORTATION PLAN

Transit Station Identification					Type of Service				Passenger Facilities		
Primary Service Corridor	Number	Name	Civil Division	Status	Primary	Secondary	Tertiary	Collection-Distribution	Shelter	Number of Parking Spaces	Buses per Peak Hour in Peak Direction
East Side	1	W. North Avenue	City of Milwaukee	Proposed	X	X	X		X	- -	24
	2	W. Locust Street	City of Milwaukee	Proposed	X	X	X		X	- -	14
	3	Northshore	City of Glendale	Existing	X	X	X	X	X	200	6
	4	W. Brown Deer Road	Village of River Hills	Existing	X		X	X	X	325	8
	5	Northridge	City of Milwaukee	Proposed	X	X	X		X	150	4
	6	STH 167—Mequon	City of Mequon	Proposed	X		X	X	X	300	6
	7	MATC—Mequon	City of Mequon	Existing	X		X		X	100	6
	8	CTH C—Grafton	Town of Grafton	Proposed	X				X	100	4
	9	CTH Q—Grafton	Town of Grafton	Proposed	X		X	X	X	325	4
Northwest	10	N. Sherman Boulevard	City of Milwaukee	Proposed	X	X	X		X	- -	9
	11	Capitol Court	City of Milwaukee	Proposed	X	X	X		X	200	9
	12	W. Silver Spring Drive	City of Milwaukee	Proposed	X	X	X		X	150	5
East-West	13	Downtown Milwaukee	City of Milwaukee	Proposed	X	X	X	X	X	- -	159
	14	VA Center	City of Milwaukee	Proposed	X				X	- -	7
	15	State Fair Park	City of Milwaukee	Proposed	X	X	X		X	300	14
	16	Brookfield Square	City of Brookfield	Proposed	X		X	X	X	100	5
	17	Goerkes Corners	Town of Brookfield	Existing	X		X	X	X	300	10
	18	Waukesha	City of Waukesha	Proposed	X		X	X	X	- -	10
Zoo Freeway-North	19	Watertown Plank Road	City of Wauwatosa	Existing	X	X	X	X	X	250	12
	20	W. Capitol Drive	City of Wauwatosa	Proposed	X	X	X	X	X	300	8
	21	W. Good Hope Road	City of Milwaukee	Proposed	X		X	X	X	300	3
	22	STH 74—Menomonee Falls	Village of Menomonee Falls	Proposed	X		X	X	X	300	4
	23	Mequon Road—Germantown	Town of Germantown	Proposed	X		X		X	150	2
Zoo Freeway-South	24	W. National Avenue	City of West Allis	Proposed	X	X	X	X	X	350	14
Stadium Freeway-South	25	W. National Avenue	Village of West Milwaukee	Proposed	X	X	X		X	- -	6
	26	W. Morgan Avenue	City of Milwaukee	Proposed	X		X	X	X	100	6
IH 94-South	27	W. Morgan Avenue	City of Milwaukee	Proposed	X	X	X	X	X	200	14
	28	W. College Avenue	City of Milwaukee	Existing	X		X	X	X	375	9
	29	W. Ryan Road	City of Oak Creek	Proposed	X		X		X	375	3
Airport Freeway	30	S. 27th Street	City of Milwaukee	Proposed	X	X	X	X	X	375	8
	31	S. 76th Street	City of Greenfield	Proposed	X	X	X	X	X	300	11
	32	W. Grange Avenue	Village of Greendale	Proposed	X		X		X	- -	3
	33	W. Rawson Avenue	City of Franklin	Proposed	X		X		X	200	3
	34	Hales Corners	Village of Hales Corners	Proposed	X		X	X	X	325	6
	35	Moorland Road—New Berlin	City of New Berlin	Proposed	X		X		X	100	2
Lake Freeway	36	E. Oklahoma Avenue	City of Milwaukee	Proposed	X	X	X		X	- -	17
	37	E. Layton Avenue	City of Cudahy	Proposed	X		X	X	X	200	8
	38	E. Rawson Avenue	City of Oak Creek	Proposed	X		X	X	X	425	9

Source: SEWRPC.

public transit facilities and services, and transportation systems management. The regional freeway system for the year 2000 includes the nearly 232 miles of freeways in the area open to traffic; 7 miles of freeways committed for construction; an additional 60 miles of proposed freeways in the lower tier of the plan; an additional 12 lane-miles of existing freeways recommended for significant improvement in the lower tier of the plan; and 37 miles of proposed freeways in the upper tier of the plan. The standard arterial street and highway system would increase from 2,850 miles in 1972 to about 3,190 miles in the year 2000. The additional mileage reflects the addition of existing nonarterial facilities to the arterial system. The construction of new and replacement arterial facilities would total only about 150 miles under the current plan. Under the adopted plan, about 2,261 miles of the total arterial street system, or about 74 percent, are designated for system preservation—arterial improvements required to maintain the adequacy of the existing system without significantly increasing the capacity of the system. This includes 196 miles on which no work would be required; 1,545 miles on which only resurfacing would be required; and 880 miles on which reconstruction to the same capacity would be required. About 720 miles, or 20 percent, are designated for system improvement—projects which would significantly increase the capacity of the existing system through street widening or relocation—including 676 miles that would be reconstructed for additional capacity and 44 miles that would involve new construction of a replacement facility. The remaining 184 miles, or 5 percent, are designated for system expansion, meaning the construction of new facilities would be required.

The adopted transportation system plan includes transit development proposals for the three urbanized areas in the Region—Milwaukee, Kenosha, and Racine. In the Milwaukee urbanized area, the plan envisions the provision of three levels of transit service: primary, secondary, and tertiary. Primary service in the plan would be of the modified rapid transit type, provided by the operation of motor buses in mixed traffic over 80 miles of freeways and over 27 miles of surface arterial streets on extensions of the freeway routes. It is envisioned that the vehicles used for the primary service would provide for the collection and distribution of passengers at the end of each route. The primary transit service would be supported by the implementation of a comprehensive freeway operational control system, as recommended.

The secondary level of transit service envisioned in the plan would provide express bus service over arterial streets, with stops generally located only at intersecting bus routes. Under the recommended plan, secondary service would be provided over 14 individual transit routes, with exclusive transit lanes—that is, traffic lanes where only buses would be allowed during specified hours of the day—on eight transit routes. The exclusive transit lanes would total nearly 10 miles. Shared secondary transit service would be provided over a total of about 146 miles of arterial facilities.

The tertiary level of public transit service envisioned in the plan would consist of local transit service provided primarily over arterial and collector streets, with frequent stops for passenger boarding and alighting. Under the plan, extensive additions to the tertiary transit service to all of the Milwaukee urbanized area, including the newer urban residential areas in southern Ozaukee and Washington Counties, eastern Waukesha County, and southern Milwaukee County, would be provided.

In addition to the arterial street and highway and transit facility and service recommendations described above, the adopted regional transportation system plan for 2000 includes four major transportation system management recommendations. These management recommendations consist of the expansion of a freeway traffic management system in the Milwaukee area; the expansion of curb parking restrictions on major surface arterials during peak-hour travel periods; the establishment of a continuing carpooling promotional program; and the institution of a parking fee structure to discourage long-term parking in the central business district of Milwaukee. The management recommendations are designed to accomplish several objectives, including ensuring that maximum use is made of existing transportation facilities before commitments are made to new capital investment; encouraging the use of high-occupancy vehicles such as buses, vans, and carpools; effecting motor fuel savings; and reducing vehicle miles of travel in congested areas.

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Chapter VII

POTENTIAL PRIMARY TRANSIT FIXED GUIDEWAY ALIGNMENTS ALONG EXISTING RIGHTS-OF-WAY

INTRODUCTION

The availability of potential exclusive fixed guideway alignments along freeway, existing or inactive railway, and electric power transmission rights-of-way is an important consideration in the Milwaukee area primary transit system alternatives analysis, since such availability may significantly affect the cost and practicality of alternative system configurations and of alternative modes.[1] This chapter presents the findings of an inventory of the extent, location, and physical characteristics of such potential fixed guideway alignments in the greater Milwaukee area, the inventory having been conducted under the alternatives analysis. The inventory findings are intended to be used in the design and evaluation of alternative primary transit system plans under the alternatives analysis.

Exclusive primary transit guideway alignments generally can be developed through an existing urban area at significantly lower cost, and with substantially less community and environmental disruption, on existing and abandoned trunkline railroad rights-of-way, abandoned electric interurban railway rights-of-way, freeway rights-of-way, and electric power transmission line rights-of-way than on completely new alignments located elsewhere. The intent of this chapter is to identify and examine the availability of those rights-of-way that are essentially clear of substantial urban development, and that possess horizontal and vertical alignments on which primary transit guideways may be readily developed, thus eliminating the need not only to disrupt existing land use development, but also to do major earthwork and install lengthy structures for the guideway.

As already noted, the assessment presented herein of the potential of each individual right-of-way to accommodate primary transit service was based primarily upon the adequacy of the right-of-way cross-section. This assessment should not be construed as a substitute for subsequent, more detailed engineering studies, but rather as a basis for dismissing from further consideration those rights-of-way found in this initial screening to be impractical as a location for primary transit facilities. The inventory was compiled from right-of-way information obtained from the electric power company, railroad companies, and public agencies responsible for freeway construction and maintenance, as well from field surveys conducted by the Commission. In the case of abandoned railway rights-of-way, the possible ease of new guideway construction on the existing grade demands that special consideration be given to any changes that have occurred in the right-of-way since the former railway was dismantled.

It should be stressed that the desirability of any particular transit alignment will be determined not only by the cost and disruption attendant to its development, but also, importantly, by the land uses and potential travel demand which the alignment might serve. An existing, readily available right-of-way that is not properly accessible to major potential transit trip generators will have little utility for primary transit development. Also, it should be recognized that some types of primary transit technology, if accorded adequate preferential treatment at street intersections, can provide an adequately high level of service even if not developed on a totally exclusive right-of-way, as these technologies can utilize surface arterial street boulevard medians or reserved lanes. Thus, the findings of the inventory of potentially available existing primary transit rights-of-way presented in this chapter must be regarded as only one consideration in the proper design and evaluation of alternative primary transit facility alignments and system configurations.

This chapter is divided into five principal sections: 1) abandoned electric railway rights-of-way, 2) electric power transmission line rights-of-way, 3) active and inactive freeway rights-of-way, 4) active and abandoned trunkline railway rights-of-way, and 5) potential commuter rail routes. The findings of the commuter rail route inventory are presented separately from the findings of the active and abandoned trunkline railway right-of-way inven-

[1] *See Milwaukee Area Primary Transit System Alternatives Analysis Prospectus, SEWRPC, 1978.*

tory because the commuter rail mode would utilize the existing rail facilities in the right-of-way as opposed to requiring the construction of a new guideway in the right-of-way. Therefore, the commuter rail mode would require the collection of detailed engineering and operating data about the trackage as well as about the right-of-way per se. Except for this inventory of potential commuter rail routes, the inventory of all existing rights-of-way in this chapter is intended to provide information pertinent to the possible development of new fixed guideway facilities on the rights-of-way for the light rail transit, heavy rail rapid transit, and exclusive busway modes.

The findings of the inventories of abandoned electric railway, active and abandoned trunkline railway, and electric power transmission line rights-of-way include data on the physical characteristics of the rights-of-way, i.e., the extent, width, vertical and horizontal alignment and clearances, and on the number and type of intersecting streets and other structures found within, under, or over the rights-of-way. The potential use of these rights-of-way for use by motor bus, light rail transit, and heavy rail rapid transit facilities is assessed in light of the data on the fixed guideway requirements of each type of facility presented in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology.

With respect to existing and cleared freeway rights-of-way, the inventory findings include information on current directional traffic volumes on the existing freeways,and on the recommended disposition under the adopted long-range transportation system plan of the cleared rights-of-way. The physical characteristics of the existing and cleared freeway rights-of-way are presented with emphasis on the right-of-way alignment and cross-section and the location of interchanges and structures over and under the right-of-way. The potential uses of the existing and cleared freeway rights-of-way, including the potential use of the existing freeway lanes, medians, and shoulders, are assessed through the identification of possible problems that may be encountered in the development of primary transit service within the freeway corridors.

The findings of the inventory of existing mainline railroad facilities include data on the physical and operating characteristics of the trackage as necessary to evaluate alternative commuter rail routes at a system planning level, and to estimate the extent and cost of track improvements necessary for initiating commuter rail service over each of the alternative routes considered. The physical characteristics of the railroad facilities inventoried include the existing horizontal and vertical track alignment and overall condition, as well as the existing right-of-way width and position of track within the right-of-way. Other physical characteristics inventoried include the number and type of grade crossings and the location and condition of any structures or facilities within the individual rights-of-way. The inventory of operational characteristics for potential commuter rail routes includes pertinent information on maximum speeds and speed restrictions, existing train movements, and the extent of traffic congestion, and an assessment of available excess facility capacity. The potential use of existing mainline railroad facilities for commuter rail operations is assessed through the identification of safety and efficiency problems that might be encountered in utilization of the facilities.

In order to use any given right-of-way for the development of primary transit facilities and services, certain minimum right-of-way widths and certain vertical clearances must be met. Table 107 sets forth the pertinent right-of-way width, vertical clearance, and horizontal and vertical alignment requirements. Absolute minimum and maximum requirements are given for each mode. These requirements represent extreme minimums and therefore, while providing sufficient space and adequate alignment for the guideway installation, may constrain other system design considerations such as vehicle selection, vehicle speed, and expansion or conversion potential. Desirable minimum and maximum requirements are also given for each mode. The guideway dimensions given are for level, tangent guideways and do not include provision for station or other support facilities. Moreover, these dimensions are not applicable on horizontal or vertical curves since additional clearances may be required on such curves. For such additional data, refer to SEWRPC Technical Report No. 24. Table 107 clearly does not apply to modes that utilize existing facilities for a guideway such as the commuter rail and motor bus on freeway modes, the latter operating either on existing lanes in mixed traffic or over reserved lanes, or to the motor buses on arterial street mode, again operating either on existing lanes in mixed traffic or over reserved lanes.

Table 107

RIGHT-OF-WAY WIDTH, VERTICAL CLEARANCE, AND HORIZONTAL AND VERTICAL ALIGNMENT REQUIREMENTS FOR PRIMARY TRANSIT SYSTEM FIXED GUIDEWAY DEVELOPMENT

Requirements	Light Rail Transit		Heavy Rail Rapid Transit		Exclusive Class A Busway		Exclusive Class B Busway	
	Absolute	Desirable	Absolute	Desirable	Absolute	Desirable	Absolute	Desirable
Minimum Guideway Right-of-Way Width[a]								
Surface								
Single Guideway	9'-10"	20'-0"	11'-6"	24'-0"	11'-0"	20'-0"	11'-0"	20'-0"
Dual Guideway	19'-8"	32'-0"	23'-6"	38'-0"	22'-0"	32'-0"	22'-0"	32'-0"
Aerial								
Single Guideway	15'-10"	19'-0"	17'-6"	20'-6"	15'-0"	24'-0"	15'-0"	24'-0"
Dual Guideway	21'-10"	30'-0"	25'-2"	31'-6"	26'-0"	36'-0"	26'-0"	36'-0"
Minimum Vertical Clearance[b]	13'-6"	17'-0"	13'-3"	17'-0"	12'-6"	14'-9"	12'-6"	14'-9"
Minimum Horizontal Curvature[c]	8°	8°	7°	7°	23°	7°30'	23°	7°30'
Maximum Gradient (percent)	8	4	4	3	8[d]	5	8	6
Grade-Separated Crossings	Optional		Essential		Essential		Optional	

NOTE: Commuter rail and motor bus operation on existing freeways, expressways, and arterial streets assumes the existence of adequate horizontal and vertical clearances.

[a] *These data apply only to level, tangent guideway segments. Segments which are curved either horizontally or vertically may require additional clearance. Such variations for cross-sectional requirements are set forth in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology.*

[b] *Measured from either top of rail or top of roadway surface.*

[c] *Applicable only for mainline application; does not apply to station and storage areas, junctions, intersections, or crossovers.*

Source: SEWRPC.

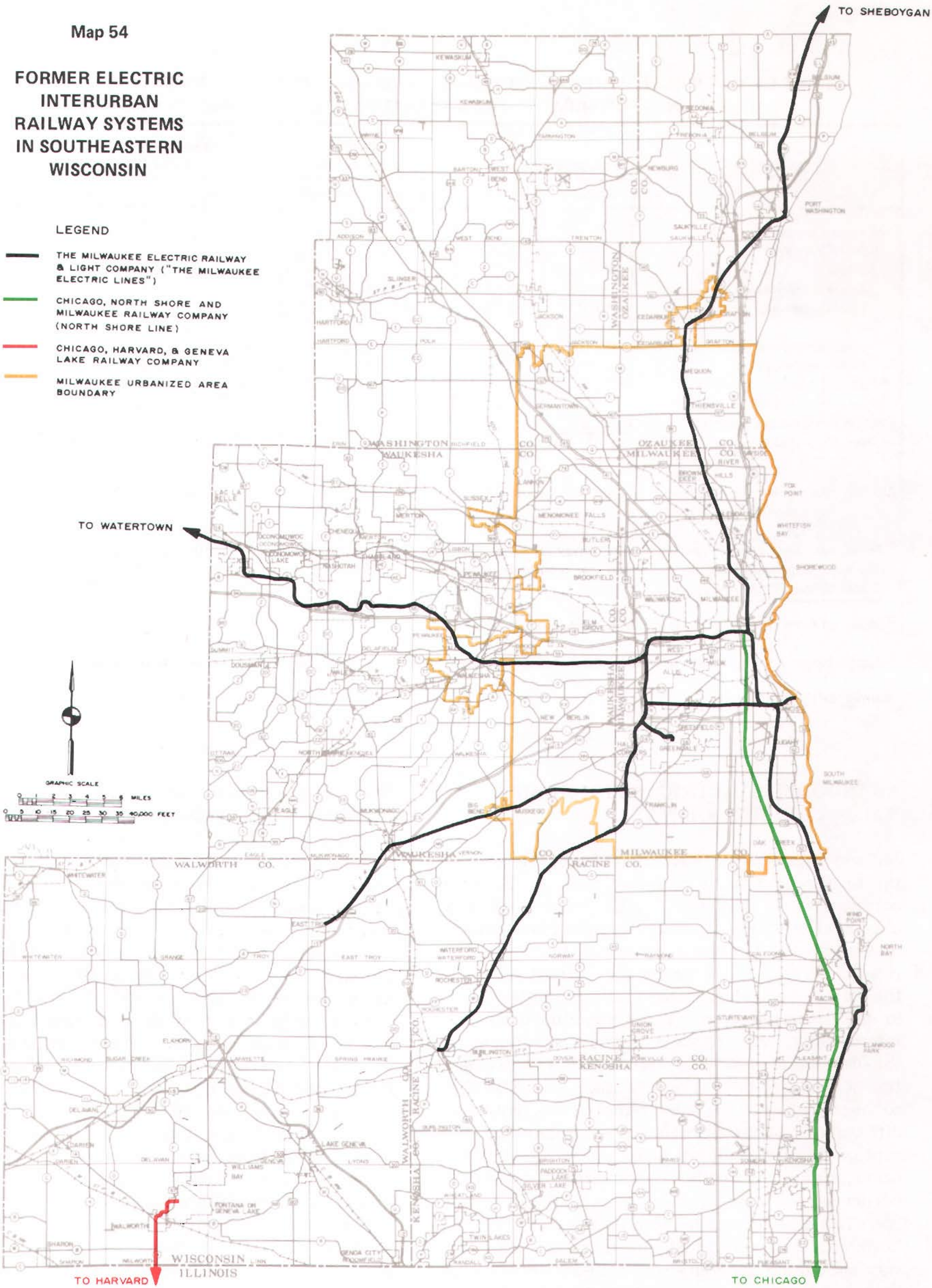
ABANDONED ELECTRIC INTERURBAN RAILWAY RIGHTS-OF-WAY

Railway rights-of-way have the potential to serve as the location for fixed guideway facilities. Because contemporary light rail transit technology and alignment characteristics have evolved from electric interurban and street railway system technology, it is especially useful to assess the current status of the former electric interurban railway rights-of-way in the Milwaukee area. These abandoned electric interurban railway rights-of-way are significant to the development of new fixed guideway primary transit facilities in that new facilities might be able to be constructed on these rights-of-way with less difficulty, cost, and urban and environmental disruption than if built on lands currently used for other purposes. In addition, the difficulty and cost of developing new primary transit system guideways could be further reduced by the facts that the horizontal and vertical alignment of the rights-of-way should be generally well suited to busway or light rail transit development, and horizontal and vertical clearances may have remained adequate.

Two electric interurban railway systems served the Milwaukee urbanized area from 1895 to 1963. The largest of these two systems was owned and operated by The Milwaukee Electric Railway & Light Company (the Milwaukee Electric Lines). This company and its predecessor and successor companies developed and operated an electric interurban railway system which included lines radiating from the Public Service Building at N. 3rd Street and W. Michigan Avenue in downtown Milwaukee north to Port Washington and Sheboygan, west to Oconomowoc and Watertown, south-west to East Troy and to Burlington, and south to Racine and Kenosha (see Map 54). High-speed electric trains were operated over these routes, providing relatively frequent service to much of southeastern Wisconsin. Suburban service of a greater frequency was provided as far as West Junction—located near S. 100th Street and W. Greenfield Avenue—and to Cudahy and South Milwaukee. A freight-only "belt line" was also constructed through southern Milwaukee County. During the late 1920's and early 1930's, an ambitious improvement program was pursued which involved

Map 54

FORMER ELECTRIC INTERURBAN RAILWAY SYSTEMS IN SOUTHEASTERN WISCONSIN



A network of electric interurban railway lines served the Milwaukee area from 1895 to 1963. The largest of the two systems which served the area was owned and operated by The Milwaukee Electric Railway & Light Company (the Milwaukee Electric Lines), with lines radiating from the Public Service Building at N. 3rd Street and W. Michigan Street in downtown Milwaukee north to Port Washington and Sheboygan, west to Oconomowoc and Watertown, southwest to East Troy and Burlington, and south to Racine and Kenosha. Beginning in 1939 segments were progressively abandoned, service on the last major segment between the Public Service Building and Waukesha/Hales Corners being discontinued in 1951. The rights-of-way once used by the electric interurban railway lines are largely intact today, owned by the Wisconsin Electric Power Company and used for electric power transmission line rights-of-way.

Source: SEWRPC.

the modernization of rolling stock and support facilities, rehabilitation of certain track segments, and construction of high-speed, fully grade-separated routes into the City of Milwaukee. This program earned the Milwaukee Electric Lines a reputation of having some of the most highly engineered railway lines in the electric interurban railway industry.

Portions of this system were later under the control of The Milwaukee Electric Railway & Transport Company, the Kenosha Motor Coach Lines, Inc., and The Milwaukee Rapid Transit & Speedrail Company (Speedrail). Beginning in 1939, certain segments of the extensive system were abandoned, service on the last major segment between the Public Service Building and Waukesha/ Hales Corners being discontinued in 1951. Small segments were initially retained for freight service, but have also all since been abandoned. Rights-of-way used for the system are, however, still largely intact today, being owned by the Wisconsin Electric Power Company and used for electric power transmission line rights-of-way.

For the purpose of the inventory and assessment, that portion of the Milwaukee Electric Lines system within the Milwaukee urbanized area was divided into six segments based primarily upon the original operating divisions. As shown on Map 54, these segments include: 1) the Milwaukee Northern Division between the Public Service Building and Grafton; 2) the Local Rapid Transit Line between the Public Service Building and West Junction; 3) the Watertown Division between West Junction and the City of Waukesha; 4) the Muskego Lakes Division between West Junction and Big Bend, including the Burlington line between St Martin's and the Durham Hill station; 5) the Lakeside Belt Line between the Lakeside Power Plant and Greenwood Junction; and 6) the Milwaukee-Racine-Kenosha Division between the Public Service Building and the Racine County line. Two considerations should be noted here. First, those portions of the above system that are located outside what is recognized today as the Milwaukee urbanized area are not included in the inventory and assessment since these lie outside the study area. Second, certain segments of the system utilized public streets as a right-of-way. All of these streets are still in existence as public motor vehicle thoroughfares and therefore were not included in the inventory of the individual rights-of-way.

The second electric interurban railway system serving the Milwaukee urbanized area was the Chicago, North Shore & Milwaukee Railway Company (North Shore Line). Within the seven-county Southeastern Wisconsin Region, this operation consisted of a single route from a station at N. 6th Street and W. Michigan Avenue in downtown Milwaukee to Chicago by way of the cities of Racine and Kenosha (see Map 54). Abandoned in 1963, the right-of-way of this railway line is largely but not entirely intact within the Milwaukee urbanized area, being owned largely by Milwaukee County. Those portions of the North Shore Line that are located outside the Milwaukee urbanized area and those which utilized the public streets as a right-of-way are not included in the inventory and assessment.

The City of Milwaukee was also served by an extensive electric street railway system operated primarily from 1890 to 1958 by The Milwaukee Electric Railway & Light Company (TMER&L), and later by the Milwaukee & Suburban Transit Corporation. The operation of street railway routes was largely over public street rights-of-way, although several segments did utilize private rights-of-way in what would approximate a light rail mode today. Such segments are also listed and discussed below.

The Milwaukee Electric Lines— Milwaukee Northern Division

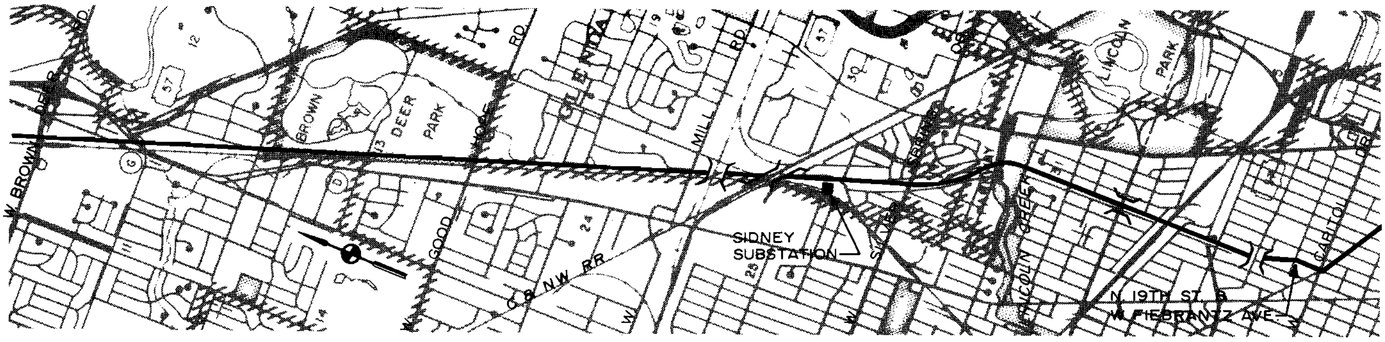
The Milwaukee Northern Division of the Milwaukee Electric Lines consisted of a 56.7-mile-long electric interurban railway route extending from the Public Service Building in downtown Milwaukee to the City of Sheboygan. The 17.5-mile segment pertinent to this right-of-way inventory and assessment includes that portion between N. 19th Street and W. Fiebrantz Avenue on the north side of the City of Milwaukee, to the northern limits of the Village of Grafton on the present northerly fringe of the Milwaukee urbanized area. South of W. Fiebrantz Avenue, the route used 4.5 miles of public streets as right-of-way to gain entrance into downtown Milwaukee. As shown on Map 55, the route segment under consideration passes through the communities of Glendale, Brown Deer, Mequon, Thiensville, Cedarburg, and Grafton.

The interurban railway line was double track from the Public Service Building to a point just north of W. Fiebrantz Avenue and between W. Silver Spring Drive and the Village of Brown Deer. The remainder of the route was single track with passing sidings. Between W. Fiebrantz Avenue and W. Silver Spring Drive, many of the crossings were grade-separated in a program designed to improve the line to what the Milwaukee Electric Lines

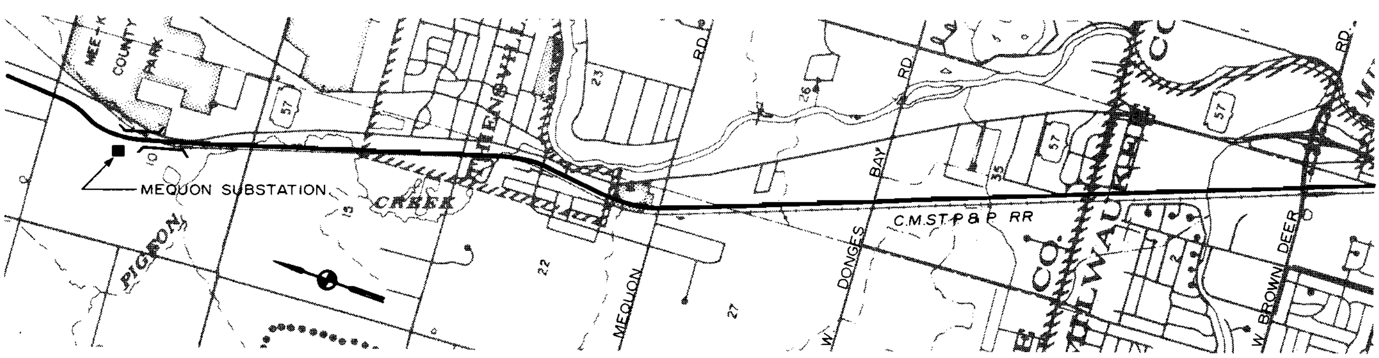
Map 55

DETAILED ALIGNMENT OF THE FORMER TMER&L COMPANY MILWAUKEE NORTHERN DIVISION RIGHT-OF-WAY WITHIN THE MILWAUKEE URBANIZED AREA

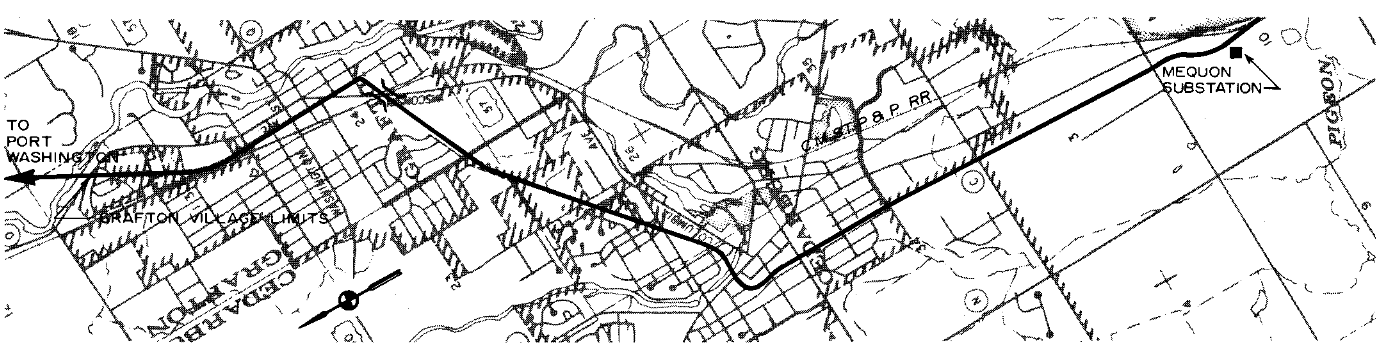
FIEBRANTZ AVE. – W. BROWN DEER RD.



W. BROWN DEER RD. — MEQUON SUBSTATION



MEQUON SUBSTATION — GRAFTON VILLAGE LIMITS



LEGEND

RIGHT-OF-WAY — FORMER OVERPASS — FORMER UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The portion of the former Milwaukee Northern Division right-of-way of the Milwaukee Electric Lines within the Milwaukee area consists of a 17.5-mile segment extending from N. 19th Street and W. Fiebrantz Avenue on the north side of the City of Milwaukee to the northern limits of the Village of Grafton. South of W. Fiebrantz Avenue, the route used 4.5 miles of public streets as right-of-way to gain entrance to downtown Milwaukee. Passing through the communities of Glendale, Brown Deer, Mequon, Thiensville, Cedarburg, and Grafton, the right-of-way crosses a total of 46 public streets and highways, railway main lines, and railway spur tracks. Although some relocation of wooden electric power line poles and steel latticed electric power transmission line towers might be necessary, the right-of-way has potential for the location of at-grade fixed guideway primary transit facilities.

Source: SEWRPC.

referred to as "Rapid Transit" status. North of W. Silver Spring Drive most of the remaining grade crossings were at-grade except for two crossings with the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road), located at the Mequon substation and in the Village of Grafton.

The right-of-way is generally 66 feet in width. The right-of-way is located along the east side of the Milwaukee Road main line from Milwaukee to Green Bay between the Sidney and Mequon electric power substations—a distance of about 9.7 miles. The Milwaukee Northern Division right-of-way segment under consideration utilized public street rights-of-way for approximately 0.6 mile within the Village of Grafton.

The right-of-way itself is largely intact for the entire length within the study area. All major and most minor bridges have been removed. The earthwork for grade separations, including embankments, fills, and cuts, as well as bridge abutments and piers, has been either removed or altered, or has deteriorated since the railway was dismantled to a point of questionable usefulness for the construction of any new primary transit facility. The right-of-way underpasses beneath the two Chicago & North Western Transportation Company (C&NW) alignments just south of W. Mill Road, however, have been preserved. In addition, three trunkline spur tracks have been constructed across the subject right-of-way subsequent to the dismantling of the Milwaukee Northern Division, one of which has since been removed.

The former track grade is now used primarily as an access road to electric power transmission poles and towers, and is owned by the Wisconsin Electric Power Company. Approximately seven miles of the grade between Mequon Road and STH 57 in the Village of Grafton is used as a public bicycle trail. Wooden power line poles are generally situated on either side of the former railway grade between W. Fiebrantz Avenue and the Village of Thiensville at about 100- to 150-foot intervals, with approximately 15 feet lateral clearance between the two rows of poles. A single line of wooden poles is in place between the Village of Thiensville and the City of Cedarburg, some being located directly on the former railway grade. Such wooden pole lines are not in place between the City of Cedarburg and the Village of Grafton.

From W. Fiebrantz Avenue to Lincoln Creek, one row of steel transmission line poles is centered on the right-of-way at about 550-foot intervals, but appears to present no vertical or horizontal clearance problems. From Lincoln Creek to the Sidney substation, steel lattice transmission towers are in place, the supports and footings of which straddle the former railway grade on the right-of-way. These towers were designed to, and for a time period did, accommodate installation of a double-track interurban railway guideway. Conventional steel lattice transmission towers are located on the right-of-way between the Sidney substation and the northern limits of the Village of Thiensville. Between the Sidney substation and W. Brown Deer Road, the row of towers is located directly on the eastern half of the former grade. Sufficient additional space does exist adjacent to the west side of the grade, however, to permit a dual fixed guideway to be constructed. For a distance of about 4,000 feet in the Village of Thiensville, the towers are centered on the former grade. Relocation of some power transmission towers and poles would be necessary to re-utilize the original railway alignment.

Three electric power transmission substation facilities have been constructed directly on the former grade. The first is the Sidney substation, located midway between W. Silver Spring Drive and W. Mill Road in the Village of Glendale. The other two are located directly south of W. Good Hope Road in the Village of Glendale and directly north of W. Donges Bay Road in the City of Mequon. No other structures have been constructed on the grade; however, approximately 0.1 mile of the right-of-way within the City of Cedarburg has been converted to a municipal parking lot.

In general, the Milwaukee Northern Division right-of-way of the former Milwaukee Electric Lines is largely intact, and it may be concluded that the right-of-way would be suitable for use by a primary transit guideway. The relocation of wooden power line poles along most of the right-of-way north of W. Brown Deer Road would be necessary for dual guideway installation, and the relocation of select steel latticed transmission towers in several areas as well as of the three substation facilities—now situated on the former grade—may be desirable in order to provide geometrics for a high-speed guideway alignment.

Crossings with public streets and other railway lines appear to constitute the most serious limitation and potentially largest capital cost consideration if at-grade crossings are to be minimized. At most locations where grade separations may be desirable, major earthwork, in addition to installation of a structure, would be necessary. At locations where the former interurban railway alignment was grade-separated, the remaining fills, cuts, and abutments have been removed or altered to the extent of being unusable. As of January 1980, this right-of-way crossed a total of 39 public streets and highways, five railway main lines, and two railway spur tracks.[2]

The Milwaukee Electric Lines—
Local Rapid Transit Line

The Local Rapid Transit Line of the Milwaukee Electric Lines consisted of a 7.4-mile-long electric interurban railway route from the Public Service Building at N. 3rd Street and W. Michigan Avenue in downtown Milwaukee to a point near the Zoo Freeway (IH 894) overpass over the Chicago & North Western's Belton Junction in western Milwaukee County, formerly known as West Junction. The 6.6-mile segment pertinent to this inventory and assessment includes that portion between N. 8th Street and W. Clybourn Street in downtown Milwaukee to the former West Junction station site in the City of West Allis. East of N. 8th Street, the route utilized 0.8 mile of public streets as right-of-way to gain entrance to the Public Service Building. As shown on Map 56, the route segment under consideration passes through the communities of Milwaukee, Wauwatosa, and West Allis, and is closely followed by the alignment of certain portions of the existing freeway system.

The Local Rapid Transit Line consisted of a double-track main line over its entire length, built to very high engineering standards in order to permit high-speed operation of interurban trains from Waukesha, Watertown, East Troy, and Burlington, as well as local trains from Hales Corners and West Junction, into downtown Milwaukee with no interference from other traffic. Between N. 8th Street and West Junction, all crossings of the facility with other streets and highways, and with trunkline railways, were fully grade-separated. East of N. 29th Street, a third track was in place for freight and switching movements, while between N. Mitchell Boulevard and N. 68th Street the right-of-way was shared with a double-track street railway line operating on an exclusive, fully grade-separated right-of-way. The alignment of the route skirted the northern edge of the Menomonee River Valley as far west as N. 42nd Street, passed the present site of the Milwaukee County Stadium and Veteran's Administration Center, turned south at N. 92nd Street, and passed near the present site of the Milwaukee County Zoo before paralleling S. 100th Street as well as the Zoo Freeway (IH 894) to West Junction.

Construction of the Milwaukee County Freeway System during the 1960's has resulted in the complete elimination of much of this right-of-way as a continuous and intact corridor of land. The existing East-West Freeway (IH 94) has been constructed directly over much of the former interurban railway grade between N. 8th Street and N. Mitchell Boulevard at the Veteran's Administration Center. Between N. Hawley Road and the former site of West Junction, significant segments of the former grade are occupied by the freeway interchanges, including the Zoo Interchange and interchanges with N. Hawley Road and W. Greenfield Avenue. It is estimated that 42 percent, or 2.8 miles, of the right-of-way between N. 8th Street and West Junction is currently used for freeway purposes. Another 3 percent of the right-of-way, or about 0.2 mile, is currently part of the Milwaukee County Stadium parking lot.

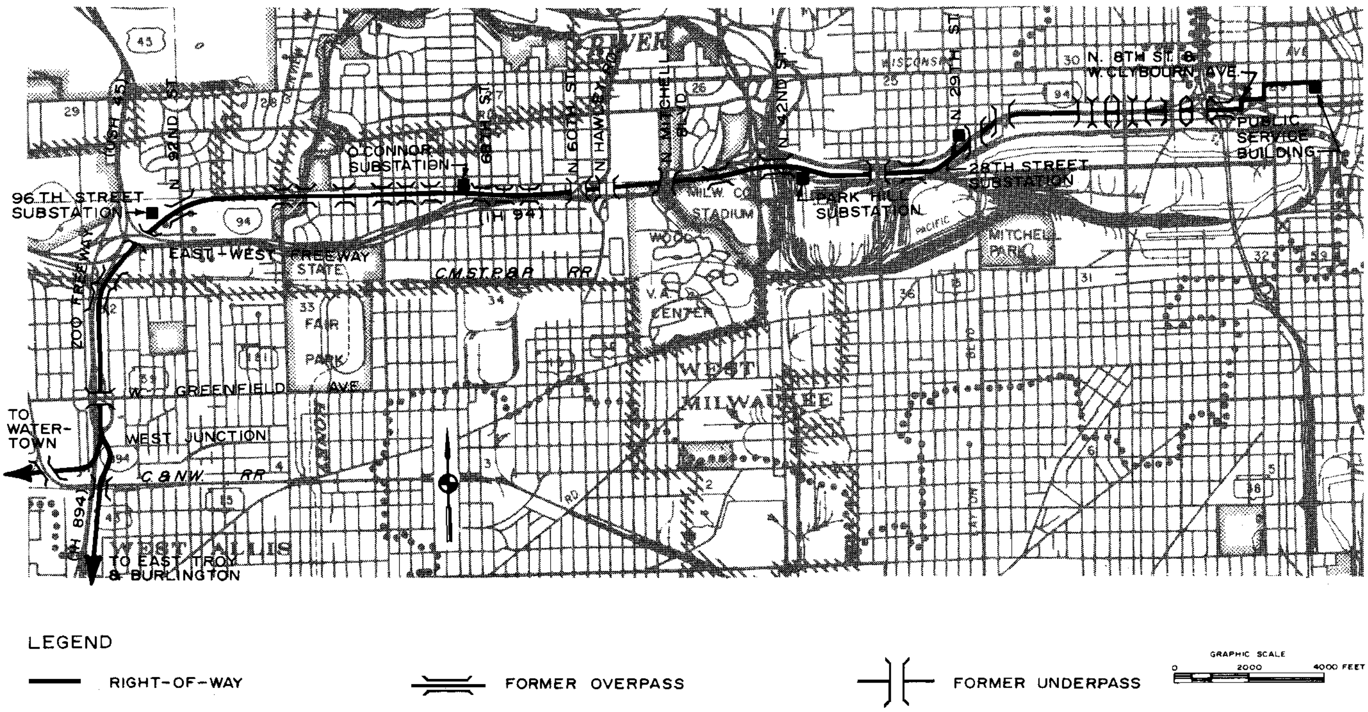
Because the Local Rapid Transit Line was fully grade-separated, its construction was marked by extensive earthwork and bridge structures. Since the line's dismantling, virtually all bridges, trestles, abutments, support piers, and retaining walls have been removed. In addition, most cuts have been filled in and most embankments have been leveled either to conform to the surrounding landforms or to prepare for other uses such as freeway alignments and parking areas. Therefore, although certain right-of-way segments remain, these segments are, for all practical purposes, currently at-grade.

The right-of-way segments that are still intact are owned by the Wisconsin Electric Power Company and are used as right-of-way for high-voltage power transmission lines. Between the 28th Street and Park Hill substations, and between N. Mitchell Boulevard and N. Hawley Road, steel lattice transmission towers are in place, the supports and footings of which straddle the former railway grade. These towers were designed to allow installation of a four-track interurban railway. The number of tracks actually located beneath the towers varied

[2] *Totals do not include that 0.6-mile portion of the right-of-way that utilized public streets within the Village of Grafton.*

Map 56

ALIGNMENT OF THE FORMER TMER&L COMPANY LOCAL RAPID TRANSIT LINE RIGHT-OF-WAY



The portion of the former Local Rapid Transit Line right-of-way of the Milwaukee Electric Lines within the Milwaukee area consists of a 6.6-mile segment extending from N. 8th Street and W. Clybourn Avenue in downtown Milwaukee to the former West Junction Station site in the City of West Allis. This route segment passes through the communities of Milwaukee, Wauwatosa, and West Allis, and is closely followed by the alignment of certain portions of the existing freeway system. The right-of-way crosses a total of 28 street, highway, and railway main lines. Because the continuity of the right-of-way has been destroyed by freeway development, there is only fair potential for the location of an at-grade fixed guideway primary transit facility along this right-of-way.

Source: SEWRPC.

from two to four, depending upon the location. From N. 60th Street to the 96th Street substation, two rows of steel transmission poles are located directly on the alignment of the former railway grade at about 600-foot intervals, but appear to present no undue vertical or horizontal clearance problems, the lateral clearance between the poles being approximately 30 feet.

Between the 96th Street substation and West Junction, two rows of conventional steel lattice transmission towers are generally located along both sides of the former grade, and some towers are situated directly on the grade. In addition, one row of wooden power line poles is generally situated along the west side of the former railway grade at about 100-foot intervals, with approximately 30-feet lateral clearance between the wooden poles and steel latticed towers. The right-of-way between N. 29th Street and the former site of West Junction is generally 100 feet wide.

Two electric power substations have been constructed directly on the former railway grade. The first is the Park Hill substation located between N. 40th and 41st Streets, and the second is the O'Connor substation located at N. 68th Street and W. Fairview Avenue.

It may be concluded that the Local Rapid Transit Line of the former Milwaukee Electric Lines has limited potential for use as a primary transit guideway. That segment between N. 8th Street and N. 29th Street is no longer intact, making such utilization impossible. The segment between N. 29th Street and N. 60th Street has poor potential because only short segments—separated by freeway facilities and an electric power substation—remain intact. The segment between N. 60th Street and West Junction has fair potential for use as a primary transit right-of-way, although this right-of-way is broken in three locations as a result of freeway construction and the installation of an electric power substation. In addition, the original earthwork has been largely removed.

Crossings with public streets, freeways, and other railway lines appear to constitute the most serious limitations and potentially largest capital cost consideration if at-grade crossings are to be minimized. At most locations where grade separations may be desirable—and particularly in the case of freeway interchanges and entrance ramps—major earthwork, in addition to the installation of a structure, would be necessary. As of January 1980, this right-of-way—west of N. 29th Street—crossed three freeway alignments, 23 public streets and highways, and two railway main lines.

The Milwaukee Electric Lines—Watertown Division

The Watertown Division of the Milwaukee Electric Lines consisted of a 50.1-mile-long electric interurban railway route from the Public Service Building in downtown Milwaukee to the City of Watertown. The 13.4-mile segment pertinent to this right-of-way inventory and assessment includes that portion between West Junction and the former location of the Silvernale station at the present western fringe of the Milwaukee urbanized area. East of West Junction, the route utilized the Local Rapid Transit Line to gain entrance into downtown Milwaukee. As shown on Map 57, the route segment under consideration passes through the communities of West Allis, New Berlin, and Waukesha.

The interurban railway line was double track over the entire 13.4-mile distance except for approximately 0.1 mile of single track in downtown Waukesha. The former interurban railway line was predominantly located at-grade, with former grade separations occurring only at the Chicago & North Western Belt Line, S. Lovers Lane Road (now S. 108th Street), S. 124th Street, and the former STH 30 overpass at the Silvernale station. Between the former stations at the Waukesha East Limits—located at the foot of Lincoln Avenue—and Waukesha West Limits—located at the intersection of Summit Avenue and W. Moreland Boulevard, a distance of 2.9 miles—the right-of-way segment under consideration utilized public streets. Except for that portion utilizing public street right-of-way, the entire 13.4-mile-long section is generally 66.0 feet wide.

Between the former site of the West Junction station and S. 108th Street, the right-of-way as well as the railway grade are no longer intact. The construction of the Zoo Freeway (IH 894) and two mainline railway tracks across the right-of-way since the dismantling of the interurban railway, as well as relatively recent commercial and industrial development in the area, have served to eliminate the former interurban alignment and grades. West of S. 108th Street, the remaining right-of-way is largely intact and is owned by the Wisconsin Electric Power Company. Between S. 108th Street and the former station at Waukesha East Limits, the right-of-way parallels and is adjacent to the right-of-way of the Chicago & North Western Transportation Company's branch line to Madison, Wisconsin.

The grade is located on an embankment between S. 108th Street and S. 124th Street. West of S. 124th Street, the right-of-way is located at-grade. Between the Waukesha West Limits and Silvernale stations, the remaining right-of-way is also largely intact and is owned by the Wisconsin Electric Power Company. The right-of-way segments which are intact are used as service roads for access to power transmission poles and towers along the right-of-way.

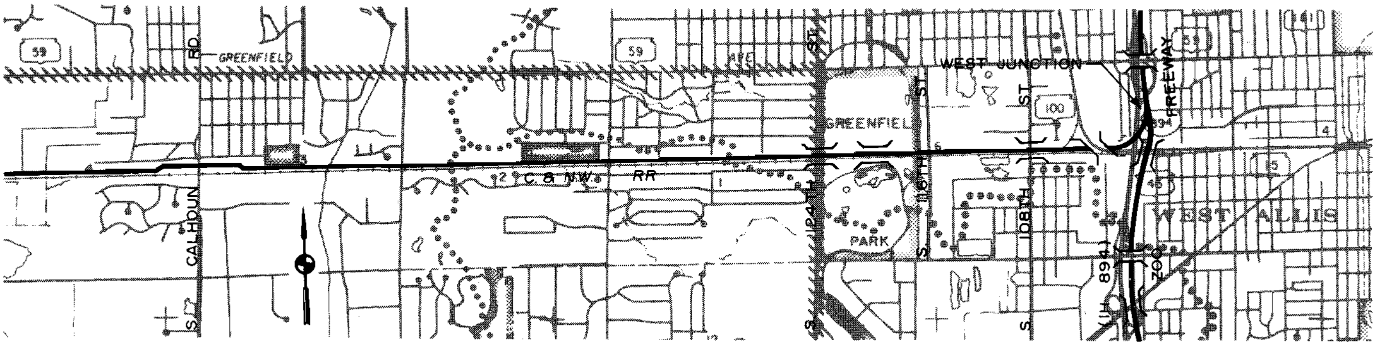
A single row of wooden power line poles is generally situated adjacent to the former railway grade along its entire length at 100- to 150-foot intervals, with approximately 30 feet of lateral clearance across the width of the grade. One row of steel power transmission poles is located on the right-of-way north of the grade between West Junction and S. 116th Street. Between S. 116th Street and Waukesha East Limits, a single row of steel lattice transmission towers is situated on the north side of the grade. West of the former Waukesha West Limits station, wooden "x-frame" power line poles are located directly on the grade. An electric power distribution facility is located directly on the former interurban railway grade west of S. Calhoun Road in the City of New Berlin.

In general, it may be concluded that the Watertown Division right-of-way of the former Milwaukee Electric Lines west of S. 108th Street has good potential for use as a primary transit guideway for light rail transit, heavy rail rapid transit, or exclusive busway. Between S. 108th Street and

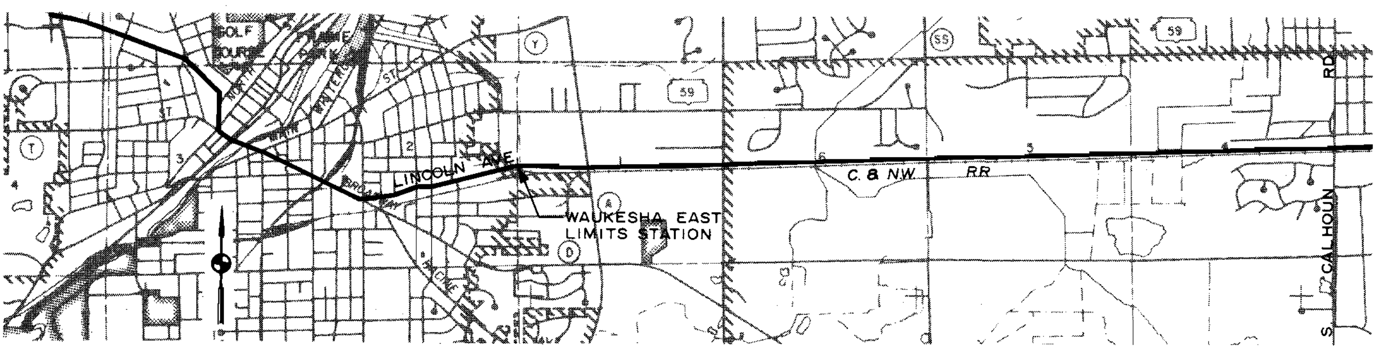
Map 57

ALIGNMENT OF THE FORMER TMER&L COMPANY WATERTOWN DIVISION RIGHT-OF-WAY WITHIN THE MILWAUKEE URBANIZED AREA

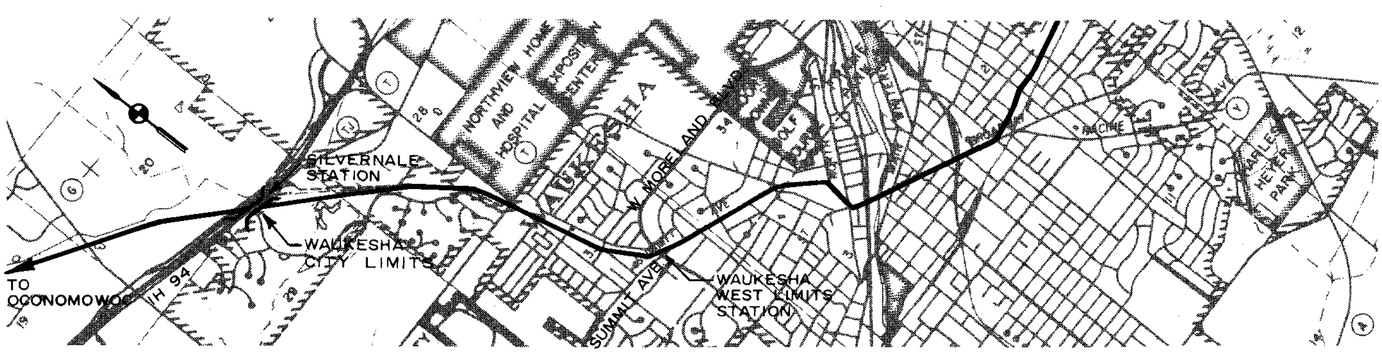
WEST JUNCTION – S. CALHOUN RD.



S. CALHOUN RD – WAUKESHA CBD



WAUKESHA CBD – WAUKESHA CITY LIMITS



LEGEND

RIGHT-OF-WAY

FORMER OVERPASS

FORMER UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The portion of the former Watertown Division right-of-way of the Milwaukee Electric Lines within the Milwaukee area consists of a 13.4-mile segment extending between West Junction and the former location of the Silvernale Road station at the western fringe of the Milwaukee urbanized area northwest of the City of Waukesha. East of West Junction, the route utilized the Local Rapid Transit Line to gain entrance into downtown Milwaukee. From S. 108th Street to the City of Waukesha eastern limits, the right-of-way is generally intact. Passing through the communities of West Allis, New Berlin, and Waukesha, the right-of-way crosses a total of one freeway, 11 public streets and highways, two railway main lines, and two railway spur tracks, not including a 2.9-mile portion of the right-of-way which utilized public streets within the City of Waukesha. This right-of-way has good potential for the location of an at-grade fixed guideway.

Source: SEWRPC.

West Junction, the potential for such use is poor because of freeway and railway facility construction across the right-of-way. Crossings with public streets and other railways as well as the relocation of the power distribution facility at S. Calhoun Road appear to constitute the principal constraints and largest capital cost considerations. As of January 1980, this right-of-way crossed one freeway, 11 public streets and highways, two railway main lines, and two railway spur tracks, not including that 2.9-mile portion of the right-of-way which utilized public streets within the City of Waukesha. Reconstruction of grade separations between West Junction and S. 124th Street may involve large amounts of earthwork in addition to substantial structures since all such improvements for the interurban railway have generally been removed or altered to the extent of being unusable.

The Milwaukee Electric Lines—Muskego Lakes Division

The Muskego Lakes Division of the Milwaukee Electric Line consisted of two electric interurban railway routes extending 15.0 miles from the Public Service Building in downtown Milwaukee to St. Martin's Junction, and from there 21.0 miles to the Village of East Troy and 21.0 miles to the City of Burlington. The segments pertinent to this right-of-way inventory and assessment include the 7.6-mile portion between the former West Junction station, located near the Zoo Freeway (IH 894) overpass of the Chicago & North Western's Belton Junction, and the former site of St. Martin's Junction; the 8.3-mile portion between St. Martin's Junction and the Village of Big Bend on the western fringe of the Milwaukee urbanized area; and the 3.0-mile portion between St. Martin's Junction and the southern fringe of the Milwaukee urbanized area approximately 1.0 mile west of the former Durham Hill station at North Cape Road. North of West Junction, trains to and from East Troy and Burlington utilized the Local Rapid Transit Line to gain access into downtown Milwaukee. As shown on Map 58, the route segments under consideration pass through the communities of West Allis, Milwaukee, Greenfield, Hales Corners, Franklin, Muskego, and Big Bend.

The Muskego Lakes Division was operated entirely as a single-track railway with passing sidings. The segment between West Junction and W. Oklahoma Avenue was completely grade-separated from all streets and trunkline railroads. South of W. Oklahoma Avenue, the alignment crossed most public roads at-grade. Between West Junction and W. Layton Avenue, the Zoo Freeway (IH 894) parallels the right-of-way, which varies from 100 to 120 feet in width. The right-of-way then swings to the west and parallels the east side of S. 108th Street and North Cape Road through the Village of Hales Corners. At St. Martin's Junction, the right-of-way to the Village of Big Bend is situated on a western alignment before paralleling STH 24 between the City of Muskego and the Village of Big Bend. The right-of-way to Burlington parallels S. 116th Street south of St. Martin's Junction and the existing alignment of STH 36. South of W. Layton Avenue, all right-of-way segments are generally 66 feet wide.

Although significant portions of these rights-of-way are still intact, some segments have been converted to other uses since the dismantling of the interurban railway. That portion between West Junction and W. Layton Avenue is generally intact south of W. Cleveland Avenue, although all bridge structures and attendant earthwork for embankments and approaches have been removed or have deteriorated. Portions of the right-of-way are now occupied by freeway entrance and exit ramps at W. Lincoln Avenue, W. National Avenue, and W. Beloit Road, and at the Hale Interchange.

Major portions of the right-of-way between W. Layton Avenue and St. Martin's Junction are no longer intact. Approximately 44 percent of its length is now used for commercial or residential development and streets and highways. South and west of St. Martin's Junction, the right-of-way is intact.

Those portions of the right-of-way that have remained intact are owned by the Wisconsin Electric Power Company and are used primarily as access roads to power transmission poles and towers located along the right-of-way. Wooden power line poles are situated along one or both sides of the former grade where it is still in existence. Two rows of conventional steel lattice transmission towers are in place on the right-of-way between West Junction and W. Howard Avenue. A single row of towers continues on the right-of-way between W. Howard Avenue and St. Martin's Junction. Between the intersections of North Cape Road and W. Forest Home Avenue with and Sunnybrook Road, the transmission towers follow an easement adjacent to and west of W. Forest Home Avenue instead of the original electric interurban railway alignment, which is now occupied by private residences. Between St. Martin's Junction and the Village of Big Bend, a single row of conventional steel lattice transmission towers follows the right-of-way, but is located on an easement to the north of the right-of-way.

Two electric power transmission substation facilities are located directly on the former railway grade. These are situated on the site of the former St. Martin's Junction and where the right-of-way crosses STH 24 east of the Village of Big Bend. In addition, a Wisconsin Electric Power Company equipment maintenance and material storage yard is located on the right-of-way at College Avenue.

In general, the Muskego Lakes Division right-of-way of the former Milwaukee Electric Lines is only partially intact. The section between the former location of West Junction and W. Layton Avenue has only fair potential for use in the development of fixed guideway facilities for primary transit since the alignment suffers from many breaks caused by freeway construction. The section between W. Layton Avenue and St. Martin's Junction has poor potential because much of the right-of-way has been converted to other uses. Finally, the two sections of right-of-way south and west of St. Martin's Junction possess good potential for use in the development of light rail transit, heavy rail rapid transit, or exclusive busway, since these segments are largely intact.

The relocation of wooden power line poles along most of the remaining rights-of-way may be necessary for dual guideway construction since the original electric interurban railway grade was designed for single-track operation. Crossings with public streets appear to constitute the most serious limitation and largest capital cost consideration if at-grade crossings are to be minimized. At most locations where grade separations may be desirable, substantial earthwork, in addition to the installation of the structure itself, would be necessary. At locations where the former interurban railway alignment was grade-separated, the remaining fills, cuts, and abutments have been removed or have deteriorated or been altered to the extent of being unusable. As of January 1980, this right-of-way crossed a total of one freeway, 36 public streets and highways, and one railway main line.[3]

To complete this discussion of the Muskego Lakes Division rights-of-way, a former branch line demands mention. During the mid-1930's, a single-track line was constructed from a junction at W. Layton Avenue—then known as Brookdale Station—to the Village of Greendale, a distance of approximately 2.2 miles. The line was constructed solely to transport building supplies and construction workers to the Village of Greendale, which was then under development by the Federal Resettlement Administration. After two years of operation, and upon the substantial completion of the Village of Greendale, the railway line was discontinued. The right-of-way and grade used by this line have since been completely removed, the land now being utilized for public parklands and for residential and commercial development.

[3] *Totals do not include that portion of the right-of-way which utilized public streets in the community of St. Martin's.*

The Milwaukee Electric Lines— Lakeside Belt Line

The Lakeside Belt Line of the Milwaukee Electric Lines consisted of an electric railway route extending from the Lakeside Power Plant in the City of St. Francis to a location known as Greenwood Junction in the City of Greenfield—at the Zoo Freeway (IH 894) and W. Howard Avenue—where the line connected with the Muskego Lakes Division trackage. The entire 9.5-mile-long route was considered in this right-of-way inventory and assessment. Unlike the other electric interurban railway routes considered, the Lakeside Belt Line was originally designed primarily for freight train movements and was never used for regularly scheduled passenger train movements. As shown on Map 59, the route under consideration passes through the communities of St. Francis, Milwaukee, and Greenfield.

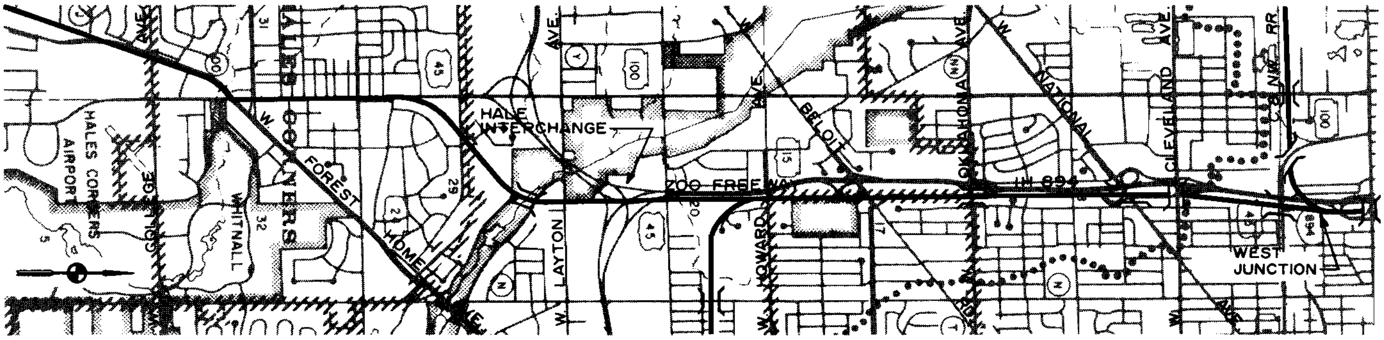
The Lakeside Belt Line was completely grade-separated from all public streets and trunkline railroads. The line was operated with single track and passing sidings except for a second track of the Milwaukee-Racine-Kenosha Division between Belt Line Crossing and S. Clement Avenue. Other trackage included short spur tracks to an interchange with the Chicago & North Western Railway at St. Francis Junction, and a connection with the Milwaukee Road at Powerton Junction. West of S. Pennsylvania Avenue, the right-of-way is located on an east-west alignment approximately midway between W. Howard Avenue and W. Cold Spring Road (Bolivar Avenue).

The right-of-way itself is largely intact. Currently owned by the Wisconsin Electric Power Company, it is generally 150 to 180 feet wide west of S. Kinnickinnic Avenue. East of this street, the right-of-way widens considerably to accommodate the former coal storage yard and other facilities that

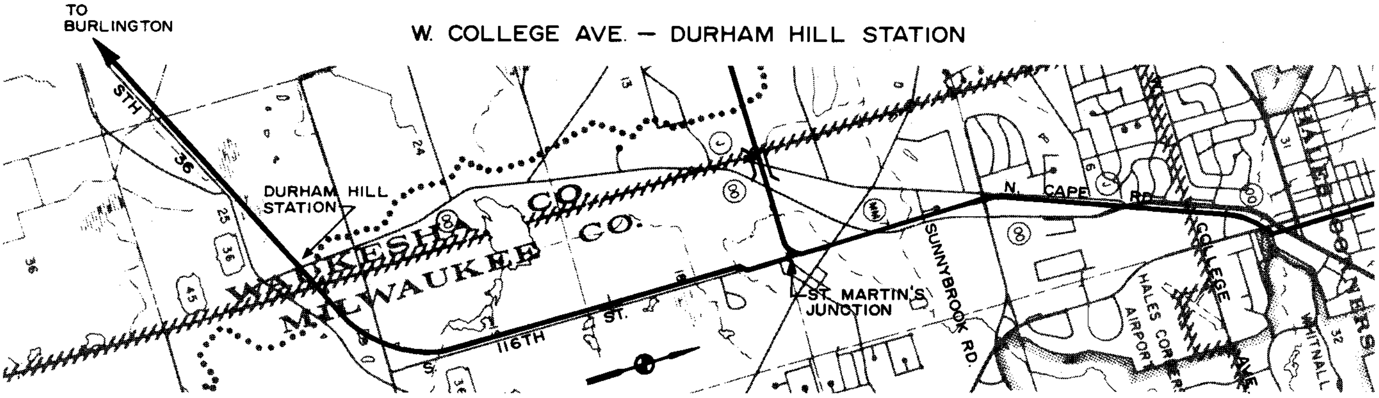
Map 58

ALIGNMENT OF THE FORMER TMER&L COMPANY MUSKEGO LAKES DIVISION RIGHT-OF-WAY WITHIN THE MILWAUKEE URBANIZED AREA

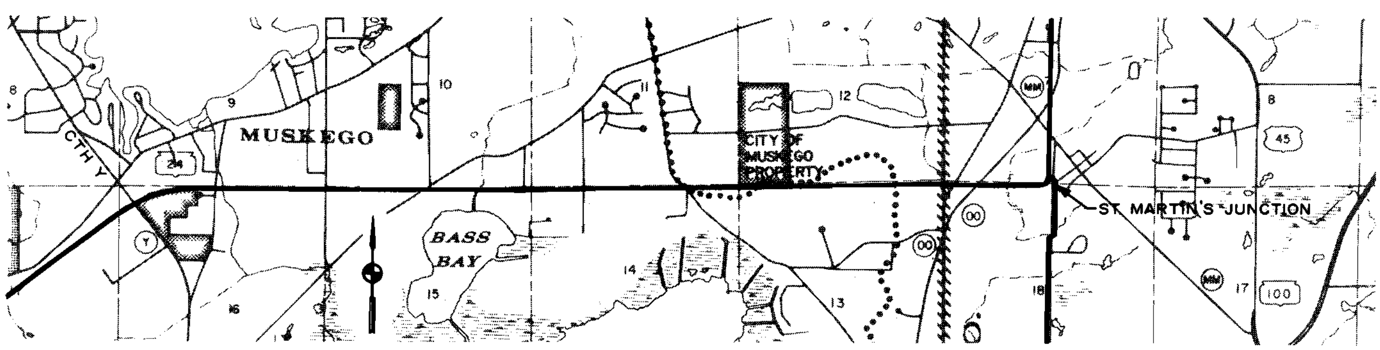
WEST JUNCTION — W. COLLEGE AVE.



W. COLLEGE AVE. — DURHAM HILL STATION

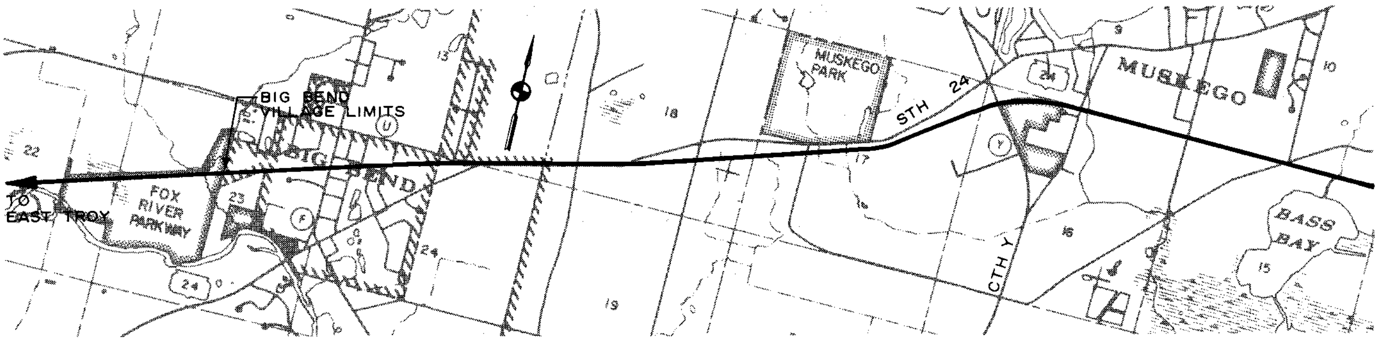


ST. MARTIN'S JUNCTION — CTH Y



Map 58 (continued)

CTH Y — BIG BEND VILLAGE LIMITS



LEGEND

RIGHT-OF-WAY

FORMER OVERPASS

FORMER UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The portion of the former Muskego Lakes Division right-of-way of the Milwaukee Electric Lines within the Milwaukee area consists of a 7.6-mile segment between the former West Junction station and the former site of St. Martin's Junction; an 8.3-mile branch segment between St. Martin's Junction and the Village of Big Bend; and a 3.0-mile branch segment between St. Martin's Junction and a point about 1.0 mile west of the former Durham Hill station at North Cape Road. North of West Junction, trains to and from East Troy and to and from Burlington utilized the Local Rapid Transit Line to gain access into downtown Milwaukee. Passing through the communities of West Allis, Milwaukee, Greenfield, Hales Corners, Franklin, Muskego, and Big Bend, the right-of-way, including both branches southwest of St. Martin's Junction, crosses one freeway, 36 public streets and highways, and one railway main line. Because of the location of freeway interchanges between West Junction and W. Layton Avenue, the potential for the location of at-grade fixed guideway primary transit facilities along this segment of right-of-way is only fair; the potential is good, however, south and west of St. Martin's Junction.

Source: SEWRPC.

are part of the Lakeside Power Plant complex. All bridges, except the overpass at the crossing with the Chicago & North Western's New Line Subdivision, have been removed. The grade east of S. Kansas Avenue is still intact, except at bridge locations. West of S. Kansas Avenue, the entire grade has been either filled in or leveled to match the surrounding topography. The alignment of the former grade, in some instances, is now used for access to power lines.

Two rows of wooden power line poles—spaced at about 100-foot intervals—are in place along both sides of the former electric railway track alignment between Lakeside Power Plant and Powerton Junction. The distance between these two rows of poles is approximately 15 feet except between Belt Line Crossing and S. Clement Avenue, a distance of 0.5 mile, where poles have been relocated—some of which are directly on the former railway grade. Between the former location of Greenwood Junction and S. 16th Street, a single row of conventional steel lattice transmission towers is centered on the right-of-way. Between S. 16th Street and S. Kansas Avenue, there are three rows of this type of transmission tower. East of the Chicago & North Western trackage near S. Kinnickinnic Avenue, four rows of transmission towers are in place as far east as the Lakeside Power Plant. No electric power substations or other structures are located directly on the former interurban railway grade.

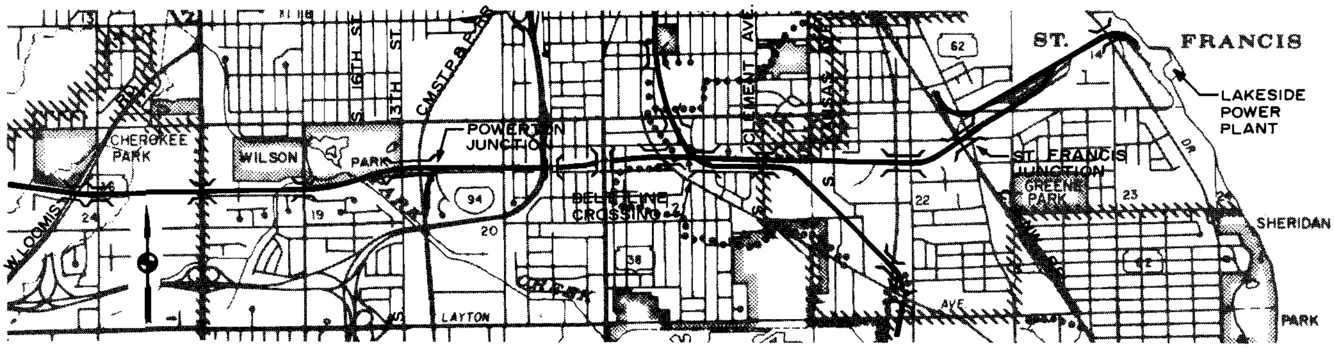
In general, it may be concluded that the Lakeside Belt Line right-of-way of the former Milwaukee Electric Lines is largely intact, and that there is good potential for its use in the development of a primary transit guideway for light rail transit, heavy rail rapid transit, or exclusive busway. The relocation of wooden power lines east of S. 13th Street may be necessary for the installation of a dual guideway.

Crossings with freeways, public streets, and trunkline railway lines appear to constitute the most serious limitation and largest capital cost consideration if at-grade crossings are to be minimized. At most locations where grade separations may be desirable, substantial earthwork, in addition to installation of the structure itself, would be necessary. At locations where the former interurban railway alignment was grade-separated, the remaining fills, cuts, and abutments have been removed or altered to the extent of being unusable. As of January 1980, this right-of-way crossed a total of one freeway, 28 public streets and highways, and three railway main lines.

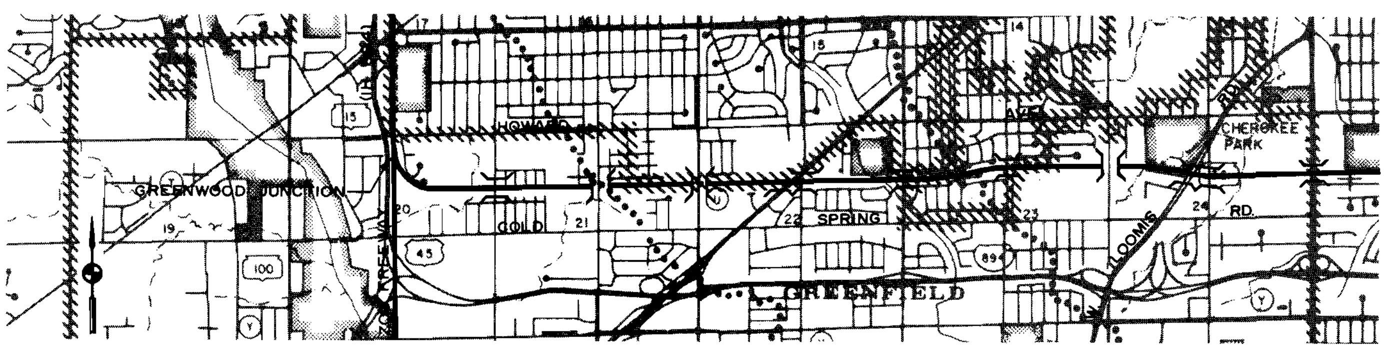
Map 59

ALIGNMENT OF THE FORMER TMER&L COMPANY LAKESIDE BELT LINE RIGHT-OF-WAY

LAKESIDE POWER PLANT — W. LOOMIS RD.



W. LOOMIS RD. — GREENWOOD JUNCTION



LEGEND

RIGHT-OF-WAY

FORMER OVERPASS

FORMER UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The former Lakeside Belt Line right-of-way of the Milwaukee Electric Lines within the Milwaukee area consists of a 9.5-mile segment extending from the Lakeside Power Plant in the City of St. Francis to a location known as Greenwood Junction in the City of Greenfield, where the line once connected with the Muskego Lakes Division trackage. Passing through the communities of St. Francis, Milwaukee, and Greenfield, the right-of-way crosses one freeway, 28 public streets and highways, and three railway main lines. At locations where the former electric interurban railway alignment was grade-separated, the remaining fills, cuts, and abutments have been removed or altered to the extent of being unusable. Although relocation of wooden electric power line poles may be necessary, the right-of-way is intact and has good potential for the location of at-grade fixed guideway primary transit facilities.

Source: SEWRPC.

The Milwaukee Electric Lines—Milwaukee-Racine-Kenosha Division

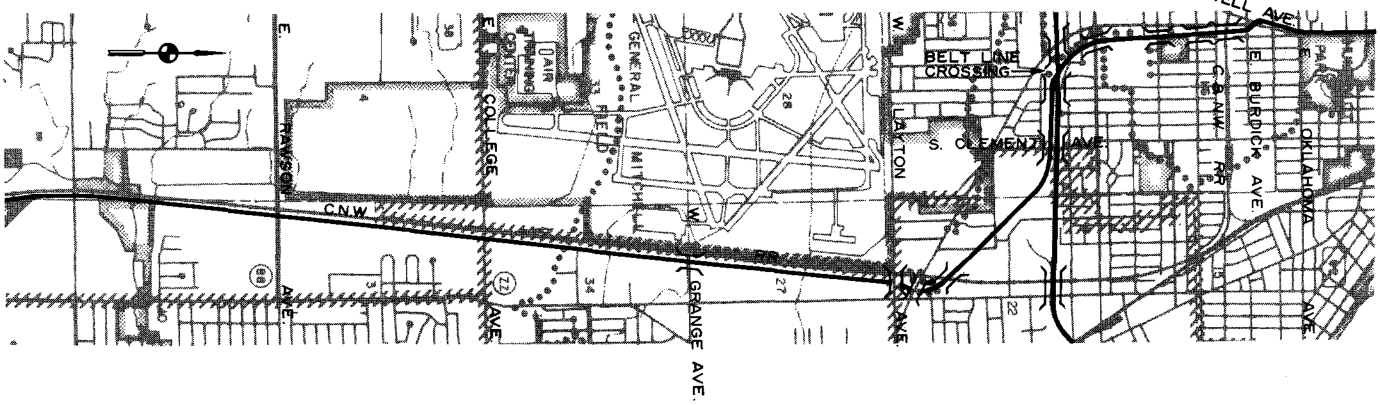
The Milwaukee-Racine-Kenosha Division (hereafter referred to as the M-R-K Division) of the Milwaukee Electric Lines consisted of a 34.3-mile-long electric interurban railway route from the Public Service Building in downtown Milwaukee to the City of Kenosha. The 13.6-mile segment pertinent to this right-of-way inventory and assessment includes that portion between the intersection of S. Howell and E. Burdick Avenues and the Racine County line at the southern fringe of the Milwaukee urbanized area. North of E. Burdick Avenue, the route utilized 3.4 miles of public streets as right-of-way to gain entrance into downtown Milwaukee. As shown on Map 60, the route segment under consideration passes through the communities of Milwaukee, St. Francis, Cudahy, and Oak Creek.

The interurban railway line was double track north of Belt Line Crossing. The remainder of the railway

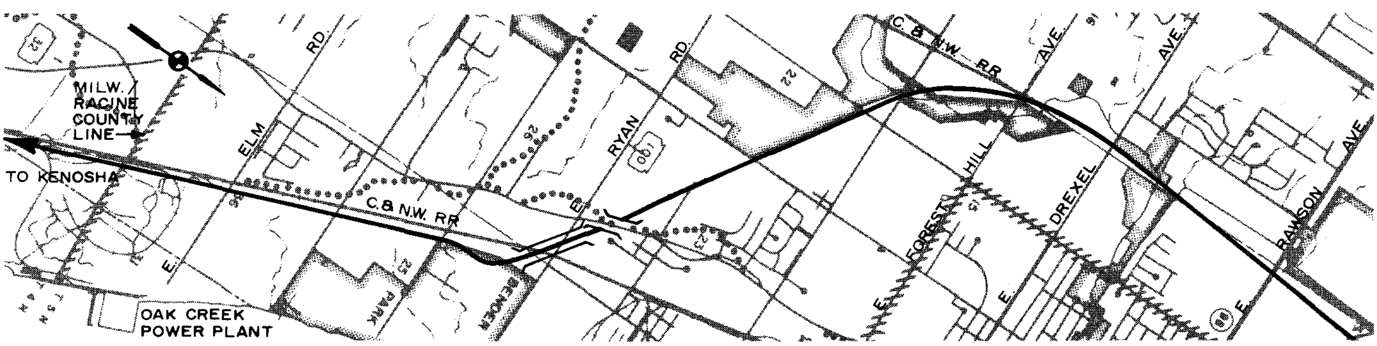
Map 60

ALIGNMENT OF THE FORMER TMER&L COMPANY MILWAUKEE-RACINE-KENOSHA DIVISION RIGHT-OF-WAY WITHIN THE MILWAUKEE URBANIZED AREA

E. BURDICK AVE. — E. RAWSON AVE.



E. RAWSON AVE. — MILWAUKEE/RACINE COUNTY LINE



LEGEND

RIGHT-OF-WAY — FORMER OVERPASS — FORMER UNDERPASS — GRAPHIC SCALE 0 2000 4000 FEET

The portion of the former Milwaukee-Racine-Kenosha Division right-of-way of The Milwaukee Electric Lines within the Milwaukee area consists of a 13.6-mile-segment extending from the intersection of S. Howell and E. Burdick Avenues to the Racine County line. North of E. Burdick Avenue, the route utilized 3.4 miles of public streets as right-of-way to gain entrance into downtown Milwaukee. Passing through the communities of Milwaukee, St. Francis, Cudahy, and Oak Creek, the right-of-way crosses 26 public streets and highways and three railway main lines. The potential for the location of at-grade primary transit facilities along this right-of-way is good between S. Clement Avenue and E. Elm Road in the City of Oak Creek. The remaining portions of the right-of-way have been largely converted to other uses.

Source: SEWRPC.

segment under consideration was single track with passing sidings. Between Belt Line Crossing and S. Clement Avenue, the M-R-K Division shared the right-of-way with the Lakeside Belt Line. Between E. Burdick and E. College Avenues, the route was fully grade-separated. South of E. College Avenue, only trunkline railway crossings were grade-separated, the highway crossings being at-grade.

Between S. Whitnall and E. Forest Hill Avenues—a distance of 4.7 miles—and south of E. Ryan Road—a distance of 1.9 miles—the right-of-way parallels the Chicago & North Western Railway's New Line and Kenosha Subdivisions of the Wisconsin Division, respectively.

The right-of-way is largely intact and is owned by the Wisconsin Electric Power Company. South of E. Layton Avenue, it is generally 100 feet in width. Between E. Burdick Avenue and the former site of Belt Line Crossing, single-family homes and public alleys are now located on the former right-of-way and grade. As noted in the previous section of this chapter, the segment of the M-R-K Division located between Belt Line Crossing and S. Clement Avenue adjacent to the Lakeside Belt Line is intact. South of S. Clement Avenue, the grade is still intact as far as E. Elm Road, located approximately 0.6 mile north of the Racine County line. At locations where the former interurban railway alignment was grade-separated, the remaining fills, cuts, and abutments have been leveled or altered or have deteriorated to the extent of being unusable. Lengthy stretches of the former grade are now used as access roads to the power lines located on the right-of-way. South of E. Elm Road, the right-of-way is now part of property occupied by the Wisconsin Electric Power Company's Oak Creek Power Plant.

A single row of wooden line poles—spaced at 100- to 150-foot intervals—is in place along the west side of the former track alignment between S. Clement Avenue and the Racine County line. Between S. Whitnall and E. College Avenues, four additional rows of wooden power line poles are located along the east side of the right-of-way. A single row of conventional steel lattice transmission towers is located on the right-of-way between E. College Avenue and the Racine County line. The row of towers is generally located to the east of the former railway grade generally as far south as E. Drexel Avenue. Between E. Drexel Avenue and the Racine County line, most of the towers have been constructed at least partially on the grade or former track alignment. No electric power substations are located directly on the former interurban railway grade. However, the Wisconsin Natural Gas Company has located three small natural gas metering stations on the former grade. These are located just north of W. Layton, W. Grange, and W. College Avenues.

In general, it may be concluded that the M-R-K Division right-of-way of the former Milwaukee Electric Lines is largely intact between S. Clement Avenue in the City of St. Francis and E. Elm Road in the City of Oak Creek. This segment has good potential for use in the development of a primary transit guideway. The sections of right-of-way within the Milwaukee urbanized area that are north of Belt Line Crossing and south of E. Elm Road have no potential for the location of light rail transit, heavy rail rapid transit, or exclusive busway facilities. Residential structures have been constructed on the former alignment north of Belt Line Crossing, and the alignment south of E. Elm Road is utilized for the Oak Creek Power Plant.

Crossings with public streets and trunkline railways appear to constitute the most serious limitation and largest capital cost consideration if at-grade crossings are to be minimized. At most locations where grade separations may be desirable, substantial earthwork, in addition to installation of the structure itself, would be necessary. As of January 1980, this right-of-way crossed a total of 26 public streets and highways and three railway main lines.

The North Shore Line

The North Shore Line consisted of a 127.2-mile-long electric interurban railway between the Cities of Milwaukee and Chicago, with two separate routes through Chicago's north shore suburbs as well as two branches in northern Illinois. The 11.1-mile segment pertinent to this right-of-way inventory and assessment includes that portion of the Milwaukee division between the intersection of S. 5th Street and W. Harrison Avenue on the south side of the City of Milwaukee and the Racine County line at the southern fringe of the Milwaukee urbanized area. North of W. Harrison Avenue, the route utilized 2.8 miles of public streets as right-of-way to gain entrance into downtown Milwaukee. As shown on Map 61, the route segment under consideration passes through the communities of Milwaukee and Oak Creek.

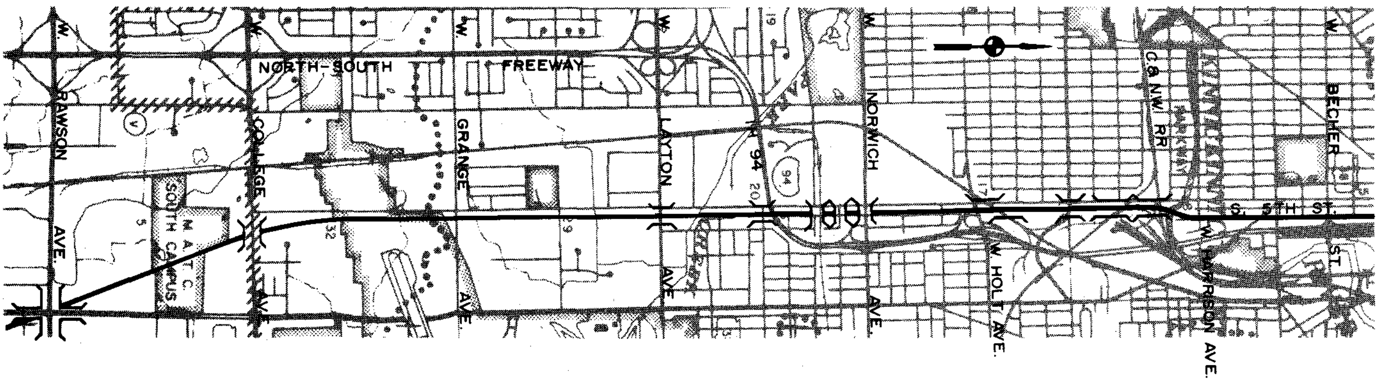
The pertinent segment of the North Shore Line consisted entirely of a double-track main line, except for approximately 0.5 mile of single track on the bridge over the Milwaukee Road main line to Chicago located at W. Holt Avenue. Except for one highway crossing at W. Grange Avenue, the alignment was grade-separated between W. Harrison Avenue and E. Puetz Road. South of E. Puetz Road, highway and railway crossings were at-grade. In general, the right-of-way is parallel to and located adjacent to the east side of S. 6th Street as far south as W. College Avenue.

Subsequent to the abandonment of the North Shore Line, Milwaukee County purchased the right-of-way between W. Harrison Avenue and the Racine County line for the purpose of preserving this segment as an intact corridor. The right-of-way width varies between 100 and 140 feet, being 120 feet wide over most of the segment. Most of the right-of-way between W. Harrison Avenue and the Racine County line is intact, although Milwaukee County has sold certain portions to other parties. The Wisconsin Department of Transportation purchased two small portions for con-

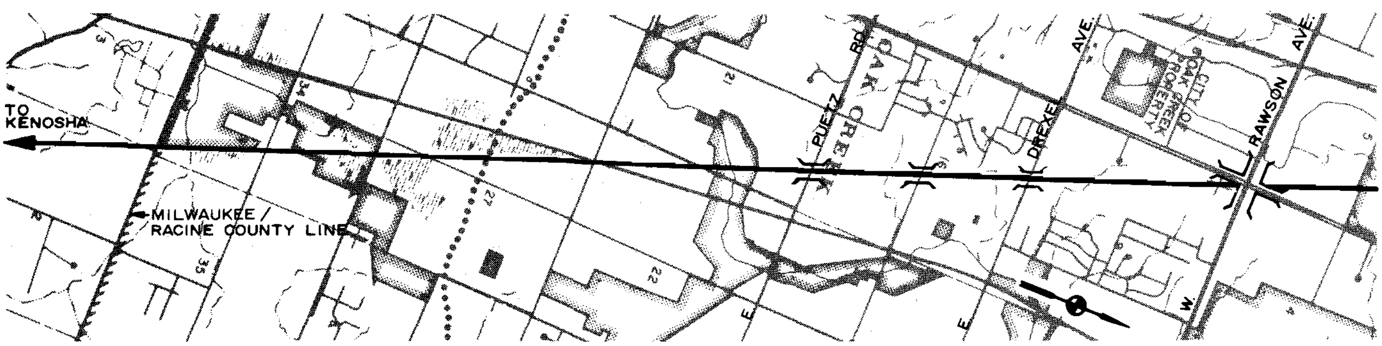
Map 61

ALIGNMENT OF THE FORMER NORTH SHORE LINE MILWAUKEE DIVISION RIGHT-OF-WAY WITHIN THE MILWAUKEE URBANIZED AREA

W. HARRISON AVE. — W. RAWSON AVE.



W. RAWSON AVE. — MILWAUKEE/RACINE COUNTY LINE



LEGEND

RIGHT-OF-WAY

FORMER OVERPASS

FORMER UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The portion of the former Chicago, North Shore & Milwaukee Electric Railway right-of-way within the Milwaukee area consists of an 11.1-mile segment extending from the intersection of S. 5th Street and W. Harrison Avenue on the south side of the City of Milwaukee to the Racine County line. North of W. Harrison Avenue, the route utilized 2.8 miles of public streets as right-of-way to gain entrance into downtown Milwaukee. South of E. College Avenue to the Racine County line the right-of-way is intact. Passing through the communities of Milwaukee and Oak Creek, the right-of-way crosses two freeways, 21 public street and highway crossings, three railway main lines, and one railway spur track. This right-of-way has good potential for the location of at-grade fixed guideway primary transit facilities south of E. College Avenue.

Source: SEWRPC.

struction of the North-South Freeway (IH 94) and the Airport Spur Freeway (STH 119). In addition, the Milwaukee Area Technical College purchased approximately 0.5 mile of the right-of-way directly south of W. College Avenue for construction of its South Campus. Milwaukee County has leased other portions to various other parties for parking lots, a truck terminal, and airport facilities. Also, several public streets have been constructed across the right-of-way since the interurban railway was dismantled.

The railway grade is only partially intact on the right-of-way. In particular, the high fill between W. Harrison and W. Holt Avenues is still in existence, but between W. Holt Avenue and the Milwaukee Area Technical College, most fills have been leveled or severely altered and most cuts have been filled in to correspond with the surrounding topography. South of the Milwaukee Area Technical College South Campus, the track grade is still in existence into Racine County. Except at the W. Norwich Avenue and E. Drexel Avenue crossings, all bridges at former grade separations with highways or other railways have been removed.

A row of wooden power line poles is located along both sides of the railway grade between W. Layton and College Avenues and south of the Milwaukee Area Technical College South Campus. The poles are spaced at about 100-foot intervals, with approximately 40 feet lateral clearance between the two rows. A single row of conventional steel lattice electric transmission towers is located on the right-of-way to the west of the grade between W. Rawson Avenue and E. Ryan Road. South of E. Ryan Road, the row of towers is located on an easement to the east of the right-of-way. No electric power substations are located directly on the former interurban railway grade.

In general, it may be concluded that the North Shore Line right-of-way within the Milwaukee urbanized area is largely intact between W. College Avenue and the Racine County line. North of W. College Avenue, however, the right-of-way's continuity is broken by the construction of several new streets and freeways across the former alignment. Because of this, plus the conversion of several portions of the right-of-way to other uses, such as parking lots and airport facilities, the portion north of W. College Avenue has poor potential for use in the development of primary transit fixed guideways. South of the Milwaukee Area Technical College South Campus, the right-of-way and grade are intact. This portion, therefore, has good potential for use as a fixed guideway right-of-way.

Crossings with public streets, freeways, and trunkline railways appear to constitute the most serious limitation and largest capital cost consideration if at-grade crossings are to be minimized. At most locations where grade separations may be desirable, substantial earthwork, in addition to installation of the structure itself, would be necessary. As of January 1980, this right-of-way crossed a total of two freeways, 21 public street and highway crossings, three railway main lines, and one railway spur track.

The Milwaukee Electric Lines— Street Railway System

At its maximum extent, the Milwaukee Electric Lines street railway system in and around the City of Milwaukee consisted of 15 to 20 lines, the specific number depending upon the classification of numerous branches from the main routes. These lines comprised a total of about 130 route miles of trackage. In addition, there was a "suburban" route between downtown Milwaukee and the City of South Milwaukee which was operated in much the same manner as were the typical street railway routes, although with different equipment including two-unit articulated trains.

Almost all trackage of the Milwaukee street railway system utilized public street rights-of-way. Certain segments of specific routes, however, were operated over private rights-of-way—that is, not shared with motor vehicle traffic. In order to complete this inventory of former exclusive rights-of-way that may be appropriate for primary transit guideways, segments of the street railway system known to have been located on private rights-of-way are described in Table 108, which also notes the disposition of each private right-of-way segment. Map 62 shows the general location of these segments within the Milwaukee urbanized area.

Most segments of former street railway routes which operated over private rights-of-way in and around the City of Milwaukee possess poor potential for use in the development of primary transit fixed guideways. Only one of the 10 segments indicated on Table 108, representing only 0.4 mile of right-of-way, has good potential for primary transit use since its alignment is still clear. Two segments, representing 2.5 miles and 1.0 mile of right-of-way, have only fair potential since only short discontinuous portions of these alignments are still clear. The remaining segments have all been converted to other uses and thus have poor potential.

ELECTRIC POWER TRANSMISSION LINE RIGHTS-OF-WAY

Electric power transmission line rights-of-way have been suggested as having potential for use in the development of primary transit fixed guideways. Consideration of such rights-of-way is based upon the premise that certain electric power transmission lines may have been constructed on continuous parcels of land which form intact corridors. Fixed guideway facilities may be able to be constructed in such corridors with less difficulty, cost, and urban and environmental disruption than on land which is currently used for other purposes.

This inventory and assessment applies only to electric power transmission "trunk" lines which transmit electric power at high voltages from

Table 108

FORMER CITY OF MILWAUKEE STREET RAILWAY ROUTE SEGMENTS LOCATED ON PRIVATE RIGHT-OF-WAY

Number on Map 62	Route	Location of Segment	Length (miles)	Number of Tracks	Present Use	Potential for Reuse
1	3—South Milwaukee Suburban . .	E. Waterford and S. Kinnickinnic Avenues to E. Plankinton and S. Kinnickinnic Avenues	0.8	2	Public street right-of-way	Poor
2	3—South Milwaukee Suburban . .	E. Grange and S. Packard Avenues to E. Dale and S. Packard Avenues	0.2	2	Public street	Poor
3	10—Wells-Downer.	N. 38th and W. Wells Streets to N. 44th and W. Wells Streets	0.4	2	Dismantled	Poor
4	10—Wells-Downer.	N. 52nd and W. Wells Streets to S. 70th Street and W. Greenfield Avenue	2.5	2	Public street, vacant, electric power transmission right-of-way, and residential development	Fair
5	10—Wells-Downer.	S. 87th and W. Lapham Streets to West Junction	1.0	2	Public street and vacant	Fair
6	10—Wells-Downer.	N. 69th Street and W. Motor Avenue to W. Harwood Avenue	0.5	2	Parking lot	Poor
7	13—Clybourn-Michigan.	N. 35th Street and W. St. Paul Avenue to connection with Local Rapid Transit Line at N. 41st Street	0.4	2	Vacant	Good
8	15—Oakwood-Delaware	E. Henry Clay Street and N. Marlborough Drive to E. Bradley Road	3.6	1	Municipal facilities, public street rights-of-way, and residential development	Poor
9	19—3rd-Burnham	S. 63rd and W. Burnham Streets to S. 67th Place and W. Becher Street	0.4	2	Public street	Poor
10	19—3rd-Burnham	McGeoch Avenue Spur	0.3	1	Commercial/industrial development	Poor

Source: SEWRPC.

generation plants to major substation and terminal facilities for conversion to lower voltages suitable for customer use. Such transmission lines generally require elaborate supporting structures, such as steel lattice towers or steel poles. The size of these structures, along with the necessary lateral clearance and an allowance for access by service vehicles, suggests that these lines have sufficient cross-sectional right-of-way area for development of primary transit fixed guideway facilities.

The Wisconsin Electric Power Company owns and operates all electric power transmission trunk lines within the Milwaukee urbanized area, a total of 1,987 miles in 1978 (see Map 63).[4] These 1,987 miles of line are located over 57 miles of right-of-way and approximately 174 miles of easements. Such transmission lines are physically situated either on continuous rights-of-way which are owned in fee simple by the power company or on easements obtained for power transmission purposes from other real property owners. The continuous rights-of-way owned in fee simple are specifically those that were formerly utilized for electric interurban railway alignments by The Milwaukee Electric Railway & Light Company (TMER&L). When the Public Utility Holding Company Act of 1935 forced the separation of the transit and electric utility portions of the company in 1938, the newly formed Wisconsin Electric Power Company[5] retained right of first refusal to the interurban railway rights-of-way, eventually regaining ownership to most segments following their abandonment. All of the rights-of-way formerly utilized by TMER&L Company that are currently utilized for electric power transmission are discussed under the previous section of this chapter entitled "Abandoned Electric Interurban Railway Rights-of-Way."

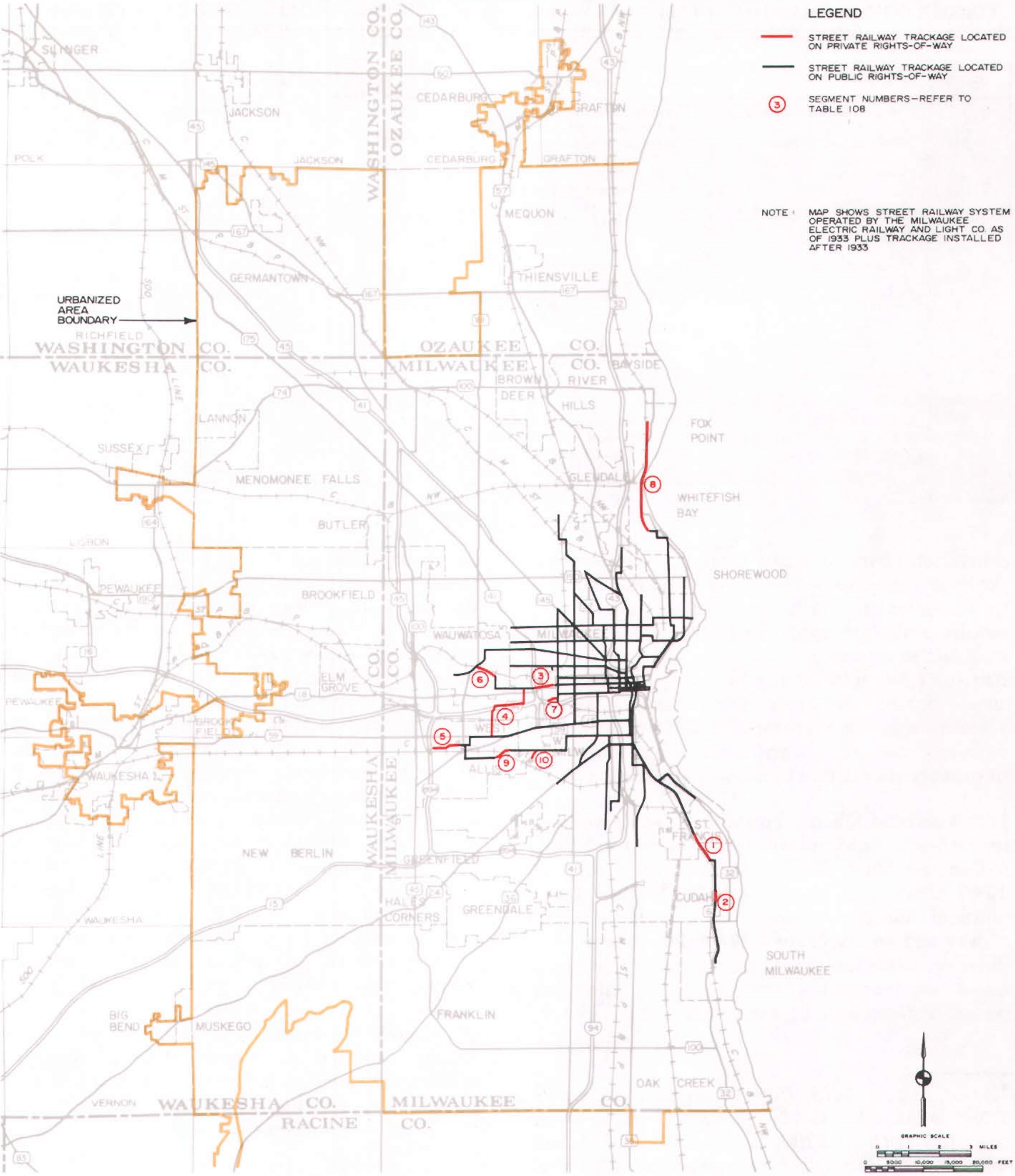
All electric power transmission trunk lines which are not located on former electric interurban railway rights-of-way are located on property easements held by the Wisconsin Electric Power Company. The easements, along with the aerial

[4] *As of August 1978, this system total represents 1,384 miles of 138-kilovolt (K.V.) transmission line, 103 miles of 230-K.V. transmission line, and 500 miles of 345-K.V. transmission line. This total mileage should not be construed as right-of-way or easement mileage since more than one transmission line may share the same tower or pole lines, and alignments.*

[5] *TMER&L Company transportation properties were turned over to the newly formed The Milwaukee Electric Railway & Transport Company.*

Map 62

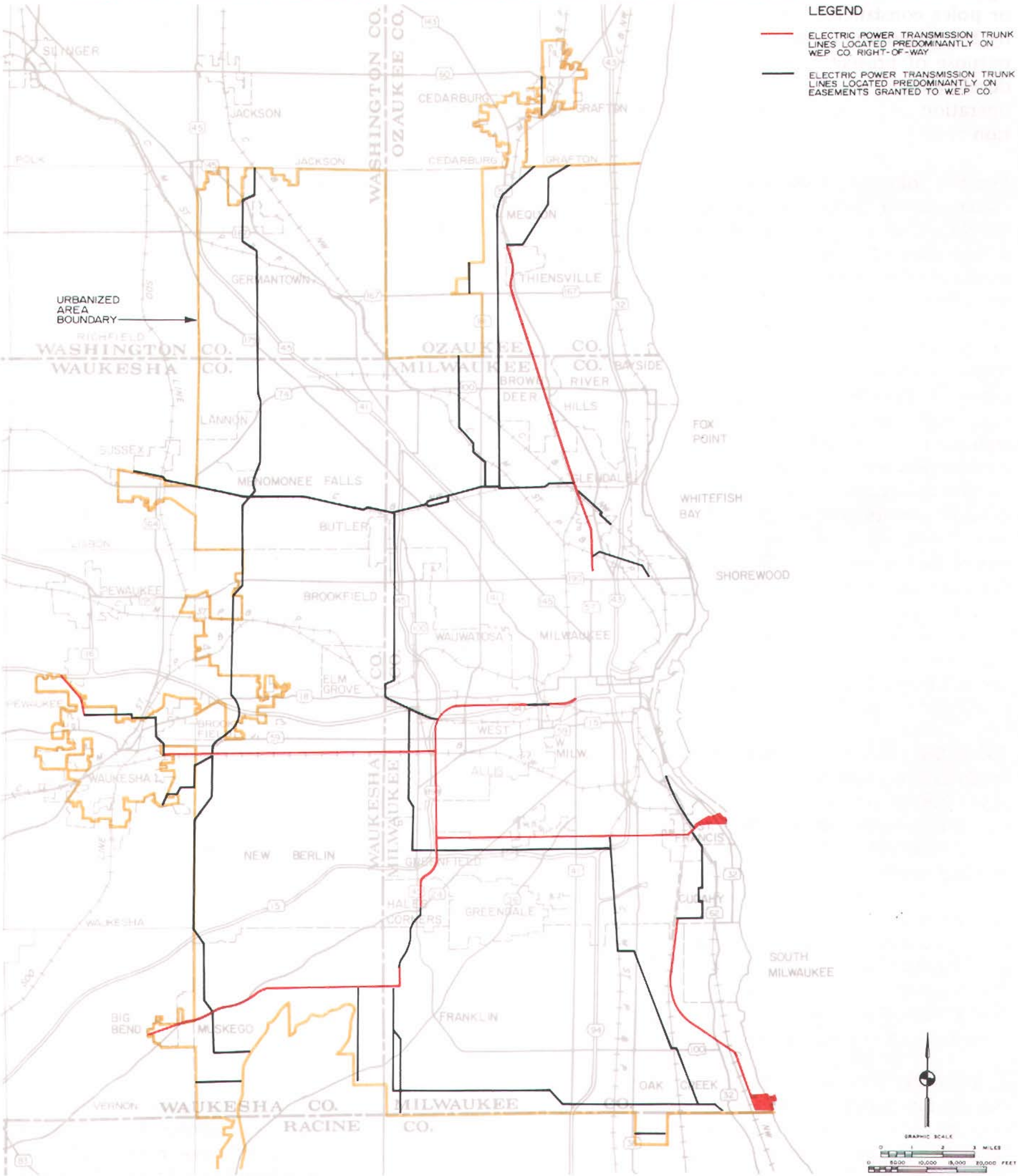
LOCATION IN THE MILWAUKEE URBANIZED AREA OF STREET RAILWAY ROUTE SEGMENTS WHICH UTILIZED PRIVATE RIGHT-OF-WAY



Certain segments of specific routes of the once extensive Milwaukee street railway system operated over private rights-of-way not shared with motor vehicle traffic. Within the Milwaukee area there were 10 segments of former street railway routes located on private rights-of-way, ranging in length from 0.2 mile to 3.6 miles, and totaling 10.1 miles in length. In general, most of these segments have poor potential for use in the development of fixed guideways for a primary transit system.

Source: SEWRPC.

ELECTRIC POWER TRANSMISSION TRUNK LINES WITHIN THE MILWAUKEE URBANIZED AREA



A total of 1,987 miles of electric power transmission trunk lines are owned and operated by the Wisconsin Electric Power Company within the Milwaukee area. These 1,987 miles of line are situated over 57 miles of continuous rights-of-way, which are owned in fee simple by the power company, and approximately 174 miles of easements obtained for power transmission purposes from other real property owners. The continuous rights-of-way owned in fee simple are specifically those that were formerly utilized for electric interurban railway alignments by The Milwaukee Electric Railway & Light Company.

Source: SEWRPC.

rights for the transmission lines between the towers or poles constructed on the easements, are leased by the Wisconsin Electric Power Company for the purpose of protecting the transmission lines from development which would interfere with the operation and maintenance of the power distribution system.

For the following reasons it does not appear that electric power transmission line easements could be developed as primary transit fixed guideways at a minimum of cost or disruption. First, the easements consist only of small areas of land connected by corridors over which only aerial rights are held by the power company. These areas of land are generally only slightly larger than the area required for the necessary transmission towers or poles or electric power substations. More often than not, the land between the towers used for transmissions of the electric lines is utilized in conjunction with the surrounding land use—such as agricultural, commercial, industrial, or residential uses, or streets and highways. Second, such property easements provide the Wisconsin Electric Power Company with only limited rights. Use of the easement for other than the transmission of electric power would be subject to approval of the individual landowners involved and could, therefore, be expected to present problems similar to those inherent in the acquisition of an entirely new right-of-way.

Third, the towers and other electrical transmission facilities constructed on the easements are generally situated on the existing topography. Unlike the transmission lines, which utilize the former interurban rights-of-way, there is no former or existing grade on or between the easements. Thus, there is no "head start" toward the preparation of the grade for development of a guideway as on some other readily available rights-of-way. Indeed, the construction of primary transit facilities over the easements could be even more costly than over new rights-of-way because of the possible need to reconstruct the power transmission lines.

It may be concluded from this inventory and assessment that the only electric power transmission trunkline rights-of-way having any potential for use in the development of primary transit fixed guideways are those formerly utilized for electric interurban railway alignments. All other electric power transmission trunk lines within the Milwaukee urbanized area are located on easements which could not easily accommodate primary transit facilities.

FREEWAY RIGHTS-OF-WAY

The Milwaukee area freeway system has significant potential for use in the provison of primary transit service. Without changes of any kind, it can be used to provide modified rapid transit service—the so-called Freeway Flyer service—since all state-of-the-art motor buses can be operated over the freeway system in mixed traffic. With certain modest changes, specifically the institution of an areawide operational control system and attendant ramp meters and preferential ramp access lanes for motor buses, a higher level of modified rapid transit service could be provided with conventional motor buses over the Milwaukee area freeways.

The Milwaukee area freeway system also might have potential for use in the provision of rapid transit service. Existing freeway lanes could be reserved for the exclusive use of motor buses, either in a normal flow direction or in a contraflow direction. Also, parts of the freeway right-of-way other than the traffic-carrying lanes may be usable as the right-of-way for busway, light rail transit, or heavy rail rapid transit fixed guideway facilities, particularly including the inside and outside shoulders of the freeway lanes.

The following sections of this chapter assess the feasibility of utilizing the freeway system to provide primary transit service in the Milwaukee area. An inventory of the physical characteristics and current use of the freeway system is provided. Also, pertinent data on right-of-way and shoulder width, and on critical vertical clearances, are provided for each segment of the freeway system, along with data on current directional traffic volumes during peak weekday travel hours. An assessment follows of the feasibility of the provision of rapid transit service by motor bus operating either over reserved freeway lanes or over a busway provided on the inside or outside shoulders of the lanes, by light rail transit operating on the inside or outside shoulders, and by heavy rail rapid transit operating on the inside or outside shoulders.

Freeway Inventory

There are a total of 102.9 miles of freeway on eight different routes serving the Milwaukee urbanized area. Three of those routes—IH 94 and its bypass around Milwaukee IH 894, USH 41, and USH 45—are major cross-country routes serving not only intraregional and interregional travel originating in or destined for the Milwaukee urbanized area, but travel through the area as well. IH 94, an east-west route, serves the northern tier of states from Michigan to Montana; USH 41, a north-south route, traverses the country from Florida to Michigan's Upper Peninsula; and USH 45, also a north-south route, traverses the country from Alabama to Michigan's Upper Peninsula. A spur of IH 94, IH 794, and two routes, the Park Freeway and STH 119 (the Airport Spur Freeway), serve specific destinations within the Milwaukee urbanized area. IH 794 and the Park Freeway provide freeway access to the Milwaukee central business district on the south side and north side of the district, respectively. STH 119 provides a direct freeway connection to General Mitchell Field, Milwaukee's commercial airport. The remaining three routes serve travel either originating in or destined for the Milwaukee urbanized area, or provides connection with a through route.

The freeway system in the Milwaukee urbanized area was divided for inventory purposes into 17 segments, as shown on Map 64. The termini of these segments are at the Milwaukee urbanized area limits, at freeway-to-freeway or freeway-to-surface arterial street interchanges, or at the terminus of the freeway itself. Data on the relationship of each segment to the total freeway system, its location within the urbanized area, its adjacent land use, and its current utilization are presented below, together with data on the physical characteristics of the freeway segment such as interchange and structure location and vertical and horizontal clearances.

A number of physical characteristics are common to most or all of the freeway segments, including 12-foot-wide traffic lanes and light poles located either two feet or five feet beyond the edge of the outside shoulder and between median barrier walls. Sign bridges on most freeway segments have an interior footing located between the median barrier walls and an exterior footing located sufficiently beyond the outside shoulder so as not to be a controlling factor for horizontal clearance. With respect to vertical clearances, sign bridges provide either 17 feet minimum clearance or a clearance of one foot more than that of an adjacent traffic-carrying structure.

To clarify the terms used in the inventory, a typical freeway cross-section, illustrating median width, shoulder width, and vertical and horizontal clearances, is presented in Figure 23. Figure 24 is provided to illustrate the descriptions of freeway interchange ramps and through traffic lanes given in the text.

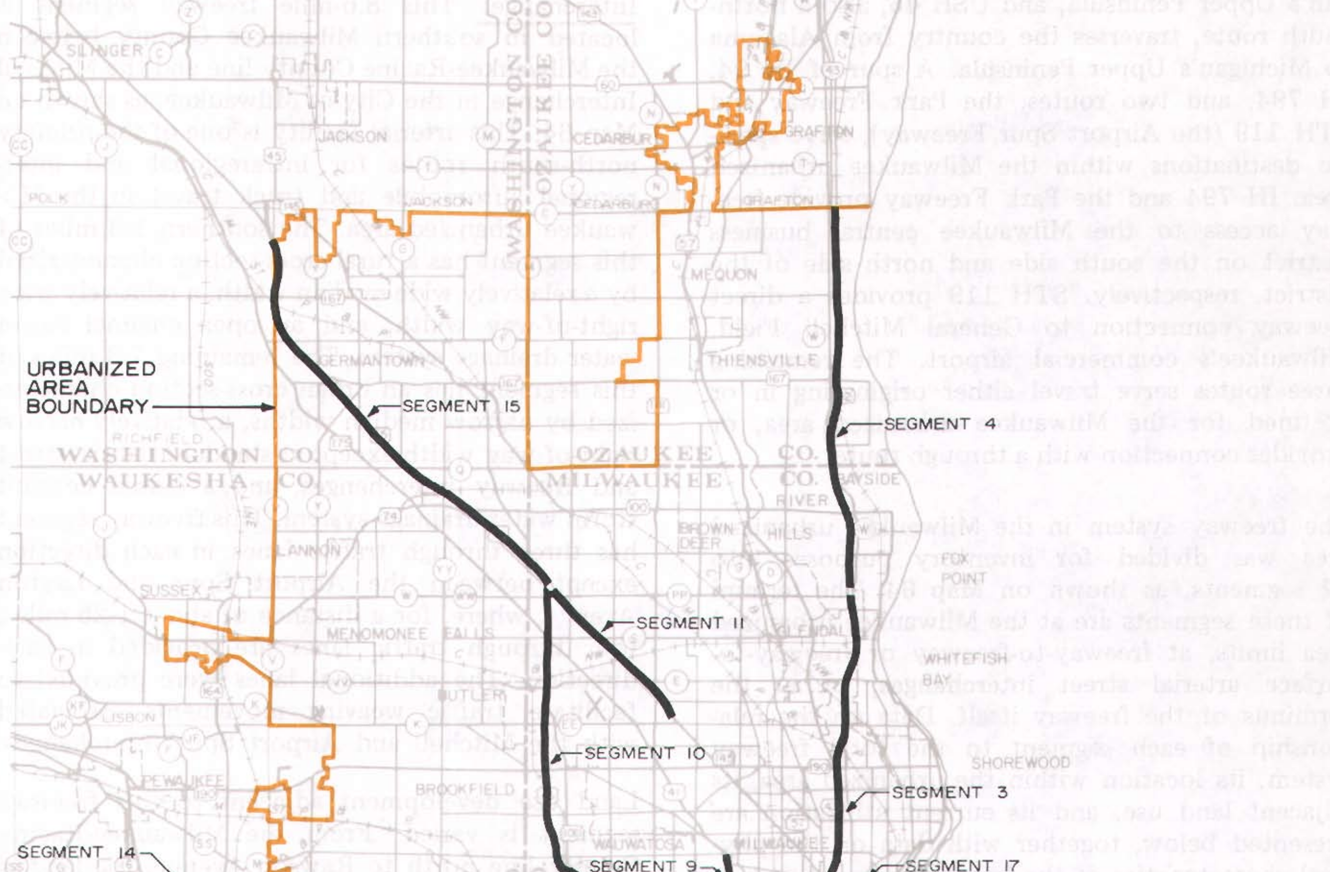
Segment No. 1—North-South Freeway (IH 94) From the Milwaukee-Racine County Line to the Mitchell Interchange: This 8.6-mile freeway segment is located in southern Milwaukee County between the Milwaukee-Racine County line and the Mitchell Interchange in the City of Milwaukee, as shown on Map 64. This arterial facility is one of the primary north-south routes for intraregional and interregional automobile and truck travel in the Milwaukee urbanized area. The southern 1.3 miles of this segment has a rural cross-section characterized by a relatively wide median width, a relatively wide right-of-way width, and an open channel storm water drainage system. The remaining 7.3 miles of this segment has an urban cross-section characterized by narrow median widths, a relatively narrow right-of-way width except at standard arterial street and freeway interchanges, and a closed conduit storm water drainage system. This freeway segment has three through traffic lanes in each direction except between the Airport Spur and Layton Avenue, where, for a distance of about 1.25 miles, four through traffic lanes are provided in each direction. The additional lanes were provided to facilitate traffic weaving movements associated with the Mitchell and Airport Spur Interchanges.

Land use development adjacent to this freeway segment is varied. From the Milwaukee-Racine County line north to Rawson Avenue, the land is primarily undeveloped, but contains some scattered residential development. Between Rawson Avenue and College Avenue, east of the freeway, there is commercial and industrial development, and west of the freeway there is residential development. From College Avenue north to the Mitchell Interchange, adjacent development is primarily residential.

Average weekday traffic volumes in 1979 ranged from 32,900 vehicles per average weekday just north of the Milwaukee-Racine County line to 83,400 vehicles per average weekday just south of W. Layton Avenue. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 2,480 vehicles northbound and 960 vehicles southbound were carried at the county line; and 3,290 vehicles northbound and 3,110 vehicles southbound were carried at W. Layton Avenue. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 1,210 vehicles northbound and 1,350 vehicles southbound were carried at the county line; and 3,270 vehicles northbound and 3,400 vehicles southbound were carried at the Mitchell Interchange. This freeway segment operates somewhat under design capacity during the peak hours in both directions.

Map 64

IDENTIFICATION OF FREEWAY RIGHTS-OF-WAY BY SEGMENT IN THE MILWAUKEE URBANIZED AREA

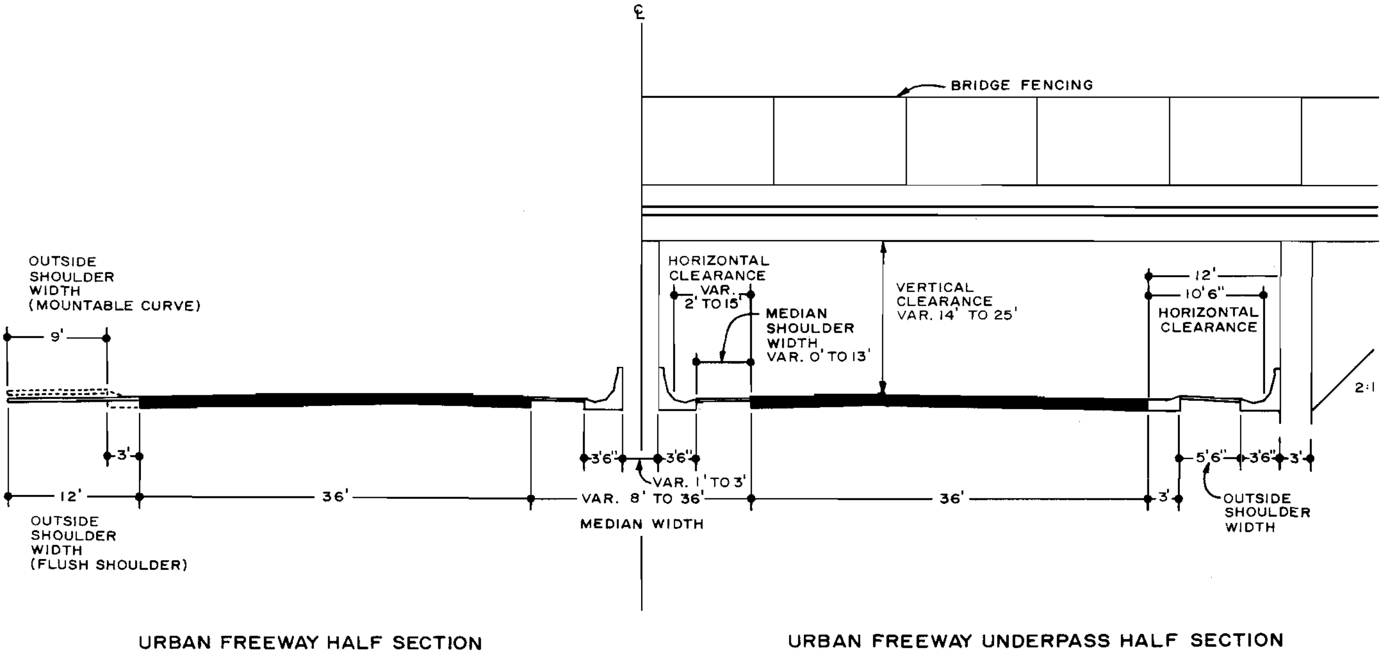


There are a total of 102.9 miles of freeway on eight different routes serving the Milwaukee area. For inventory purposes, the freeway system in the Milwaukee urbanized area was divided into 17 segments. These segments terminate at the Milwaukee urbanized area limits, at freeway-to-freeway or freeway-to-surface arterial street interchanges, or at the terminus of the freeway itself. The potential of each of these segments to serve as a location for various kinds of primary transit facilities was then analyzed.

Source: SEWRPC.

Figure 23

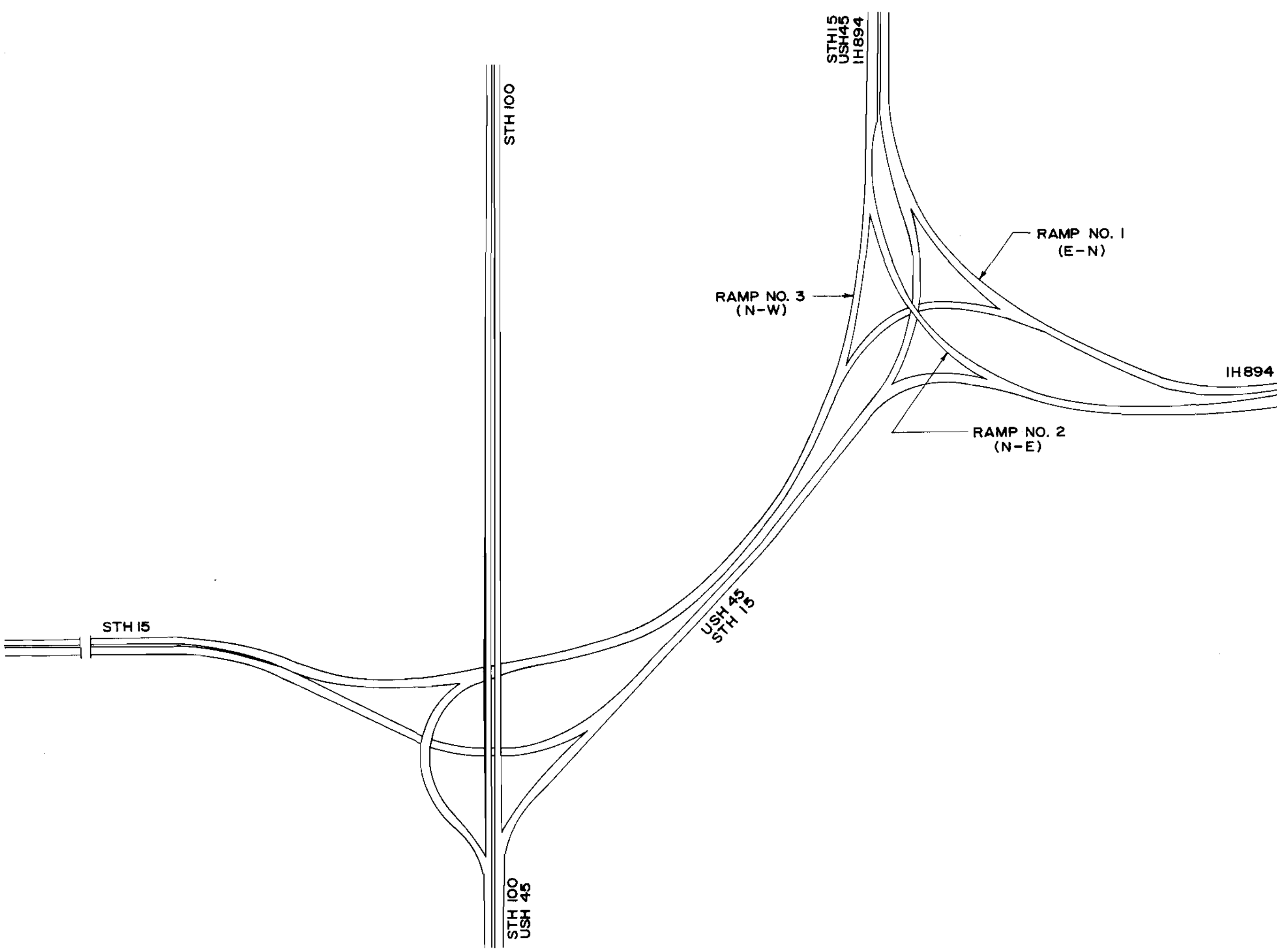
TYPICAL URBAN FREEWAY CROSS-SECTION



Source: SEWRPC.

Figure 24

TYPICAL FREEWAY INTERCHANGE RAMP DESIGNATIONS AS DEPICTED IN THE HALE INTERCHANGE



Source: SEWRPC.

Physical Characteristics: The right-of-way of this portion of the North-South freeway (IH 94) ranges in width from about 320 feet to 575 feet over its 1.3-mile-long segment of rural cross-section, and between about 270 feet and 320 feet over the remaining 7.3 miles of urban cross-section. At arterial street and freeway-to-freeway interchanges, the right-of-way width increases to accommodate the freeway entrance and exit ramps, requiring, for example, up to 1,000 feet from the freeway centerline at some arterial street crossings.

There are 27 structures at 16 locations on this freeway segment, as shown in Table 109. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Three of the structures are in the Mitchell Interchange, four of the structures cross watercourses, and the 20 remaining structures are arterial street overpasses or underpasses. The minimum vertical clearance at each underpass is presented in Table 109. The least clearance in the northbound direction is 16 feet 5 inches at the W. Layton Avenue structure, and the least clearance in the southbound direction is 15 feet 3 inches at the west-to-south ramp structure as it crosses the southbound lanes in the Mitchell Interchange. The Drexel Avenue structure provides the greatest clearance in the northbound direction, 17 feet 6 inches; and the Ryan Road and College Avenue structures provide the greatest clearance in the southbound direction on this segment, 17 feet 8 inches.

The median width of the rural cross-section portion of this segment ranges from about 36 feet to about 250 feet. From the county line north to Oakwood Road, 10-foot-wide flush median shoulders have been provided. The first seven feet of the shoulders adjacent to the roadway are of bituminous concrete, while the remaining three feet are of gravel. Between Oakwood Road and the Airport Spur Interchange the median is 36 feet wide. Through the Airport Spur Interchange, the median narrows from 36 feet to 10 feet and remains 10 feet wide to the Layton Avenue underpass. A barrier wall has been constructed in the center of the freeway median. Flush shoulders are provided between Oakwood Road and the Mitchell Interchange. The width of the inside shoulders is 15 feet where the median is 36 feet in width. No inside shoulders are provided where the median narrows to 10 feet.

Table 109

DETAILED STRUCTURE INFORMATION FOR SEGMENT 1—NORTH-SOUTH FREEWAY (IH 94): MILWAUKEE-RACINE LINE TO MITCHELL INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]		
						Northbound		Southbound				Northbound		Southbound
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside
Root River	2		X	Unlimited	Unlimited	--	--	--	--	No	No			
W. Oakwood Road	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No			
Oak Creek[c]	2		X	Unlimited	Unlimited	--	--	--	--	No	No			
W. Ryan Road	2	X		16'-6"	17'-8"	10'-6"	15'-0"	10'-6"	15'-0"	--	--	X	X	X
W. Puetz Road	1	X		16'-8"	17'-1"	11'-0"	15'-0"	11'-0"	15'-0"	--	--	X	X	X
W. Drexel Avenue	1	X		17'-6"	16'-9"	10'-10"	15'-0"	10'-10"	15'-0"	--	--	X	X	X
W. Rawson Avenue	2	X		16'-9"	16'-3"	13'-6"	15'-0"	13'-6"	15'-0"	--	--	X	X	X
W. College Avenue	2	X		16'-6"	17'-8"	10'-6"	15'-0"	10'-6"	15'-0"	--	--	X	X	X
W. Ramsey Avenue	2		X	Unlimited	Unlimited	--	--	--	--	Yes	Yes			
STH 119, Airport Spur Interchange	2	X		16'-10"	16'-4"	--[d]	11'-10"	--[d]	15'-0"	Yes	Yes		X	
W. Grange Avenue	2	X		16'-11"	16'-5"	10'-6"	2'-0"	10'-6"	2'-0"	--	--	X	X	X
W. Edgerton Avenue	2		X	Unlimited	Unlimited	--	--	--	--	Yes	Yes			
W. Layton Avenue	2	X		16'-5"	16'-5"	12'-9"	5'-1"	5'-0"	6'-7"	--	--	X	X	X
West-to-South Ramp, Mitchell Interchange	1	X		--	15'-3"	--	--	10'-6"	3'-0"	--	--		X	X
West-to-North Ramp, Mitchell Interchange	1	X		--	15'-10"	--	--	10'-6"	3'-0"	--	--		X	X
South-to-West Ramp, Mitchell Interchange	1	X	X	Unlimited	Unlimited	--	--	--	--	No	No			

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *Ramps cross structures northbound and southbound.*

[d] *This structure has no columns adjacent to the outside shoulders and no true horizontal clearance. However, there is a slope from the edge of the shoulder or from a ditch adjacent to the shoulder up to the abutment which limits the clearance available beyond the shoulder's edge.*

Source: SEWRPC.

Outside shoulders between the county line and Oakwood Road are 10 feet wide in each direction, with the first seven feet of the shoulder adjacent to the roadway constructed of bituminous concrete and the remaining three feet of gravel. North of Oakwood Road to the Mitchell Interchange, nine-foot-wide bituminous shoulders separated from the roadway by a three-foot-wide mountable curb are provided. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulder does not cross the Root River, Oak Creek, or the south-to-west ramp in the Mitchell Interchange structures. Finally, at all the freeway underpasses, a barrier wall has been provided to prevent vehicles which leave the mainline pavement from striking the structure columns adjacent to the outside shoulder, reducing that shoulder width to six inches at a minimum and three and one-half feet at a maximum.

There are five sign bridges on this segment of freeway, four with one footing between the median barrier walls and the other footing beyond the outside shoulder. The fifth sign bridge is located in the Mitchell Interchange, and its footings are protected by either a barrier wall, guardrail, or impact attenuators. Lighting on this segment of the North-South Freeway begins one-quarter mile south of Rawson Avenue and continues to Layton Avenue, with the poles placed in the median. From Layton Avenue through the Mitchell Interchange light poles are located two to five feet beyond the outside shoulders. With respect to vertical configuration, this freeway segment is at or very nearly at the same grade as adjacent lands.

Segment No. 2—North-South Freeway (IH 94) From the Mitchell Interchange to the Marquette Interchange: This freeway segment is about 5.8 miles long and is located entirely in the City of Milwaukee between the Mitchell Interchange and a point just south of the Marquette Interchange, as shown on Map 64. The North-South Freeway (IH 94) is one of the primary north-south routes for intraregional and interregional automobile and truck travel in the Milwaukee urbanized area. This freeway segment has an urban cross-section characterized by relatively narrow median widths, relatively narrow right-of-way widths except at standard arterial street and freeway-to-freeway interchanges, and a closed conduit storm water runoff drainage system. This freeway segment has three through traffic lanes in each direction except between W. Greenfield Avenue and W. Washington Street and between National Avenue and the Marquette Interchange, where four lanes are provided in each direction.

Land adjacent to this freeway segment is predominantly in residential use, except for the industrial development on the south side of the freeway between S. 6th Street and S. 13th Street near the Mitchell Interchange; the industrial and commercial development on both sides of the freeway between Holt Avenue and the Kinnickinnic River; the industrial and commercial development on the east side of the freeway at Becher Street; and the industrial development on both sides of the freeway between National Avenue and the Marquette Interchange.

Average weekday traffic volumes in 1979 ranged from 83,700 vehicles per average weekday just north of the Mitchell Interchange to 107,800 vehicles per average weekday south of the Marquette Interchange. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 5,160 vehicles northbound and 2,100 vehicles southbound were carried at the Mitchell Interchange, and 5,960 vehicles northbound and 2,050 vehicles southbound were carried at the Marquette Interchange. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 2,500 vehicles northbound and 4,740 vehicles southbound were carried at the Mitchell Interchange, and 3,760 vehicles northbound and 5,280 vehicles southbound were carried at the Marquette Interchange. The high peak-hour volumes indicate that this segment operates over design capacity in the peak direction during the peak hours at its southern end, and that it operates at design capacity in the peak direction during the peak hours at its northern end.

Physical Characteristics: This segment of the North-South Freeway has a right-of-way that ranges in width from about 220 feet to 275 feet except at arterial street and freeway-to-freeway interchanges, where the right-of-way width increases to accommodate freeway entrance and exit ramps. Right-of-way widths of up to about 550 feet from the freeway centerline are required at some arterial street crossings. In addition, between S. 13th Street and S. 6th Street near the Mitchell Interchange, the freeway has been constructed on a fill section, and from a point about one-quarter mile south of W. Howard Avenue to a point about 600 feet north of W. Howard Avenue, the freeway is in a cut section where up to about 430 feet of right-of-way has been provided. In general, this freeway segment is in a cut section when an arterial street crosses above it, and on a fill section when the arterial street passes underneath the freeway. With crossings spaced at a half-mile or less, only a small portion of this segment is built at the same grade as adjacent lands. From W. Mineral Street north, this segment is elevated or on a structure.

There are 30 structures at 19 locations on this segment, as shown in Table 110. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Three of the structures are in the Mitchell Interchange, one is a pedestrian structure, seven of the structures cross over a combination of rail facilities and arterial streets or watercourses, and the remaining 19 structures are arterial street overpasses or underpasses. The minimum vertical clearances for each freeway underpass are noted in Table 110. The least clearance in the northbound direction is 14 feet 9 inches at the W. Chase Avenue structure; the least clearance in the southbound direction is 14 feet 8 inches at the W. Mitchell Street structure. The W. Warnimont Avenue structure provides the greatest clearance in the northbound direction, 18 feet 5 inches; and the W. Greenfield Avenue structure provides the greatest clearance in the southbound direction on this segment, 17 feet 5 inches.

The median separating the opposing traffic movements is 28 feet wide from the Mitchell Interchange to a point about 500 feet north of W. Greenfield Avenue. The median begins to taper at this point to 11 feet in width over a distance of about 500 feet, and remains 11 feet wide to the Marquette Interchange. Barrier walls are provided in the center of the median between the east side of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Milwaukee Road) structure and the Marquette Interchange. Flush inside shoulders are provided from the east side of the S. 13th Street and Milwaukee Road structure to a point about 500 feet north of W. Greenfield Avenue. The width of the inside shoulders is nine feet where the median is 28 feet in width; no inside shoulders are provided where the median narrows to 11 feet in width. Median shoulders are not provided in the right-of-way of the six freeway overpass structure locations where there are no barrier walls provided in the center of the medians. In the approach to each of these structures, the barrier wall diverges from the center of the median to the wingwalls of the structure abutments at a 50:1 taper. Approximately 20 feet beyond each of the structures, barrier walls are again provided in the center of the median. In addition, flush distress areas are provided adjacent to the median barrier wall except at the S. 6th Street and the Menomonee Valley overpasses, where raised distress areas of about 4 feet 6 inches in width are provided. Outside shoulders, separated from the roadway by a three-foot mountable curb, are nine feet in width in each direction on this freeway segment. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulder only crosses the S. 6th Street and the W. Holt and W. Morgan Avenue structures; a narrower shoulder is provided along the southbound portion of the Oklahoma Avenue overpass and the Chicago & North Western Transportation Company railroad structure. The outside shoulder width is reduced by 3 feet 6 inches by a barrier wall at all freeway underpasses except those at S. Chase Avenue and at the northbound portion of W. Lincoln Avenue, where a guardrail is provided. Finally, on the east side of the freeway just south of W. Mineral Street, there is a retaining wall adjacent to the shoulder, reducing its width to 8 feet 6 inches.

Collector roads are also provided along certain portions of this freeway segment. A 15-foot-wide collector road is provided along the east side of the freeway laterally positioned about 34 feet from the outside edge of the pavement between the northbound exit ramp of the W. Howard Avenue interchange and the northbound entrance ramp at W. Holt and W. Morgan Avenues, a distance of about 0.9 mile. As noted in Table 110, four structures cross over this collector road: the structures at W. Howard Avenue and W. Warnimont Avenue, as part of the mainline facilities, are extended across the collector road, and two other structures, separate from the mainline structures, are provided at W. Holt Avenue and W. Morgan Avenue. A 17-foot collector road is provided along each side of the freeway about 34 feet from each edge of the pavement between W. Lincoln Avenue and W. Greenfield Avenue, a distance of about 0.9 mile. As indicated in Table 110, several structures cross over this collector road: the structures at W. Maple Street, W. Mitchell Street, W. Lapham Street, and W. Greenfield Avenue, as part of the mainline freeway structures, are extended across the collector road; the structures at W. Becher Street are not part of the mainline facility.

There are 18 sign bridges on this segment of freeway, two of which are in the Mitchell Interchange with their footings protected by either guardrail or impact attenuators. One footing of the six sign bridges that span the mainline pavement is located between the median barrier walls and the other is beyond the outside shoulder, protected by either

Table 110

DETAILED STRUCTURE INFORMATION FOR SEGMENT 2—NORTH-SOUTH FREEWAY (IH 94): MITCHELL INTERCHANGE TO MARQUETTE INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Northbound		Southbound				Northbound		Southbound	
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
West-to-South Ramp, Mitchell Interchange	1	X		--	15'-3"	--	--	10'-6"	3'-0"	--	--		X	X	--
West-to-North Ramp, Mitchell Interchange	1	X		--	15-10"	--	--	10'-6"	3'-0"	--	--		X	X	--
South-to-North Ramp, Mitchell Interchange	1	X	X	Unlimited	Unlimited	--	--	--	--	--	--				--
S. 13th Street and Chicago, Milwaukee, St. Paul & Pacific Railroad	2		X	Unlimited	Unlimited	--	--	--	--	No	No				--
S. 6th Street	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Howard Avenue	1	X		15'-2"	14'-11"	17'-10"	11-0"	3'-7"	11'-0"	--	--	X	X	X	14'-10" minimum vertical clearance over collector road; southbound off-ramp continues under structure
W. Warnimont Avenue	1	X		18'-5"	17'-1"	17'-6"	11'-0"	7'2"	6'-6"	--	--	X	X	X	Pedestrian structure: 14'-7" minimum clearance over collector road; northbound off-ramp and southbound on-ramp continue under structure
W. Holt Avenue and W. Morgan Avenue	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				Mainline structures
	2		X	Unlimited	Unlimited	--	--	--	--	No	No				Ramp structures
W. Oklahoma Avenue and Chicago & North Western Transportation Company	2		X	Unlimited	Unlimited	--	--	--	--	No	No				Northbound on-ramp crosses structure
Chicago & North Western Transportation Company and Kinnickinnic River	2		X	Unlimited	Unlimited	--	--	--	--	No	No				
W. Chase Avenue	1	X		14'-9"	15'-5"	--	11'-0"	--	11'-0"	--	--		X		
W. Lincoln Avenue	1	X		14'-10"	15'-2"	10'-8"	11'-0"	3'-7"	11'-0"	--	--	X	X	X	Northbound off- and on-ramps continue under structure
W. Becher Street	2		X	Unlimited	Unlimited	--	--	--	--	No	No				Mainline structures
	1		X	Unlimited	Unlimited	--	--	--	--	No[c]	No				Southbound ramp structure
	2		X	Unlimited	Unlimited	--	--	--	--	No[c]	No				Northbound ramp structures
W. Maple Street	1	X		15'2"	15'-0"	24'-9"	11'-0"	24'-9"	11'0"	--	--	X	X	X	Minimum vertical clearance over collector roads: 14'-9" northbound; 16'-2" southbound
W. Mitchell Street	1	X		15'-1"	14'-8"	17'-7"	10'-10"	17'-7"	11'-0"	--	--	X	X	X	Minimum vertical clearance over collector roads: 14'-8" northbound; 15'-3" southbound
W. Lapham Avenue	1	X		15'-6"	17'-0"	10'-10"	10'-10"	5'-6"	11'-0"	--	--	X	X	X	Minimum vertical clearance over collector roads: 14'-5" northbound; southbound off-ramp continues under structure
N. Greenfield Avenue	1	X		15'-11"	17'-5"	6'-8"	10'-8"	13'-6"	11'-0"	--	--	X	X	X	Northbound on ramp continues under structure; minimum vertical clearance over collector road, 15'-2" southbound
S. 6th Street	1		X	Unlimited	Unlimited	--	--	--	--	No	No				Northbound off- and southbound on-ramps continue onto structure
Menomonee Valley	1		X	Unlimited	Unlimited	--	--	--	--	No	No				Southbound on- and southbound off-ramps on south end of structure

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *These structures have sufficient width that a seven-foot-wide shoulder could be provided.*

Source: SEWRPC.

barrier wall or guardrail. Nine of the sign bridges span either collector roads or ramps, and their footings are protected by barrier wall, guardrail, or impact attenuators. The two remaining sign bridges span the entire width of the Menomonee Valley structure, and their footings are a part of the structure's parapet walls. Lighting on this segment of the freeway is provided by luminares mounted on poles located beyond the outside shoulder in each direction.

Segment No. 3—North-South Freeway (IH 43) From the Marquette Interchange to W. Good Hope Road: This 8.1-mile freeway segment is located in eastern Milwaukee County beginning at a point just north of the Marquette Interchange in the City of Milwaukee and proceeding north through the City of Glendale to W. Good Hope Road in the Village of River Hills, as shown on Map 64. This arterial facility not only serves as a link between the "North Shore" suburbs and the Milwaukee central business district, but is also one of the north-south routes for intraregional and interregional automobile and truck travel in the Milwaukee urbanized area. This urban freeway segment is characterized by narrow median widths, a relatively narrow right-of-way width except at standard arterial street and freeway interchanges, and a closed conduit storm water drainage system. Between the Marquette and Hillside Interchanges, four through lanes are provided in each direction. Only two through lanes in each direction are provided within the Hillside Interchange. From the north side of the Hillside Interchange to W. Silver Spring Drive there are three through lanes in each direction. It should be noted that from Henry Clay Street to W. Silver Spring Drive, the lanes are only 11 feet wide, rather than the standard 12-foot width. From W. Silver Spring Drive to W. Good Hope Road, two standard 12-foot-wide through lanes are provided in each direction.

Land use development adjacent to this freeway segment is varied. Along the southern portion of this freeway segment, for a distance of 0.3 mile from the Marquette Interchange, the land is primarily devoted to institutional use. Between this point and the Hillside Interchange, east of the freeway, there is some industrial development; to the west of the freeway, land use is mixed residential and commercial. From the Hillside Interchange north to W. Capitol Drive, the adjacent development is residential. North of W. Capitol Drive to W. Hampton Avenue, there is a mix of commercial, industrial, residential, and transportation development. Between W. Hampton Avenue and W. Bender Road, east of the freeway, there is commercial development; to the west of the freeway land use is devoted to park lands as well as commercial and residential development. Finally, between W. Bender Road and W. Good Hope Road there is institutional and residential development.

Average weekday traffic volumes in 1979 ranged from 110,300 vehicles per average weekday at W. Walnut Street to 53,500 vehicles per average weekday just south of W. Good Hope Road. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 3,424 vehicles northbound and 5,208 vehicles southbound were carried at W. Walnut Street, and 1,010 vehicles northbound and 2,460 vehicles southbound were carried at W. Good Hope Road. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 5,380 vehicles northbound and 3,525 vehicles southbound were carried at W. Walnut Street and 3,300 vehicles northbound and 1,600 vehicles southbound were carried at W. Good Hope Road. This segment of freeway operates over design capacity in the peak direction during the peak hours at its southern end. At its northern end it operates at design capacity in the peak direction during the morning peak hour, and over design capacity in the peak direction during the evening peak hour.

Physical Characteristics: The right-of-way of this segment of the North-South Freeway (IH 43) ranges in width from about 120 feet to 270 feet, except at the arterial street and freeway-to-freeway interchanges where the width increases to accommodate the freeway entrance and exit ramps. From W. Wisconsin Avenue north to W. Capitol Drive, the entrance and exit ramps at arterial street interchanges have been constructed within that basic corridor without requiring additional right-of-way. North of W. Capitol Drive to W. Good Hope Road, however, the geometry of the entrance and exit ramps at arterial street interchanges requires additional right-of-way of up to about 550 feet from the freeway centerline.

There are a total of 44 structures at 43 locations along this freeway segment, as noted in Table 111. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Eight of the structures are located in freeway-to-freeway interchanges, two are pedestrian structures, three are railroad structures, one is a combination arterial street and watercourse crossing, one spans a watercourse, and the remaining 29 structures are either arterial street overpasses or underpasses. The minimum vertical clearance for

Table 111

DETAILED STRUCTURE INFORMATION FOR SEGMENT 3—NORTH-SOUTH FREEWAY (IH 43): MARQUETTE INTERCHANGE TO W. GOOD HOPE ROAD

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
				Northbound	Southbound	Northbound		Southbound		Outside	Median	Northbound	Median	Southbound	
						Outside	Median	Outside	Median			Outside		Outside	
W. Wisconsin Avenue	1	X		14'-11"	15'-3"	10'-6"	4'-6"	11'-6"	4'-6"	--	--	X	X	X	--
W. Wells Street	1	X		19'-5"	19'-4"	11'-6"	4'-6"	10'-6"	4'-6"	--	--	X	X	X	--
North-to-East Off-Ramp at W. Wells Street	1	X		15'-5"	14'-11"	11'-6"	4'-6"	10'-6"	4'-6"	--	--	X	X	X	--
East-to-South On-Ramp at W. State Street	1	X		15'-10"	16'-0"	22'-6"	4'-9"	20' +	4'-11"	--	--	X	X	X	Ramps continue under structure; minimum vertical clearance northbound 17'-11"; southbound 16'-0"
W. State Street	1	X		21'-2"	24'-1"	10'-6"	5'-8"	10'-6"	5'-8"	--	--	X	X	X	Ramps continue under structure; minimum vertical clearance northbound 21'-2"; southbound 17'-8"
W. Highland Avenue	1	X		20'-7"	20'-1"	6'-6"	7'-6"	7'-6"	7'-7"	--	--	X	X	X	Ramp continues under structure; minimum vertical clearance southbound 21'-8"
W. Juneau Avenue	1	X		15'-2"	15'5"	10'6"	6'-0"	10'-6"	7'-7"	--	--	X	X	X	Ramp continues under structure; minimum vertical clearance southbound 15'-5"
W. Winnebago Street	1	X		15'-10"	14'-11"	11'-6"	--[c]	10'-6"	8'-5"	--	--	X	X	X	Ramp continues under structure; minimum vertical clearance northbound 15'-10"; southbound 14'-11"
Relocated W. Winnebago Street	1	X		14'-0"	--	8'-6"	2'-0"	--	--	--	--	X	X		--
South-to-North and South-to-Northwest, Hillside Interchange	1	X	X	--	14'-11"	--	--	8'-6"	4'-6"	Yes	No		X	X	--
North-to-East and West-to-East, Hillside Interchange[d] . .	1	X		--	18'-5"	--	--	8'-6"	2'-0"	--	--		X	X	Over east-to-south ramp
West-to-East, Hillside Interchange[d]		X		14'-6"	--	10'-6"	3'-1"	--	--	--	--	X	X	X	Over south-to-north and south-to-northwest ramp. Minimum vertical clearance over south-to-northwest ramp 18'-2"; horizontal clearance at south-to-northwest ramp 4'-9" median and 8'-9" outside
West-to-East, Hillside Interchange[d]		X		--	15'-9"	--	--	12'-0"	4'-6"	--	--		X	X	Over north-to-south ramp
North-to-East, Hillside Interchange[d]		X		15'-2"	--	10'-6"	3'-1"	--	--	--	--	X	X		Over south-to-north ramp
South-to-North, Hillside Interchange	1		X	Unlimited	Unlimited					Yes	No				--
North-to-South, Hillside Interchange	1		X	Unlimited	Unlimited					Yes	No				--
W. Walnut Street	2	X		15'-0"	14'-11"	10'-6"	4'-6"	10'-6"	4'-6"	--	--	X	X	X	--
W. Brown Street.	1	X		19'-4"	20'-4"	10'-6"	11'-6"	4'-8"	11'-5"	--	--	X	X	X	Ramps continue under structure; minimum vertical clearance northbound 18'3"; southbound 20'-8"

Table 111 (continued)

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Northbound		Southbound				Northbound		Southbound	
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
Park Freeway Connection . . .	2	X		15'-4"	15'-4"	12'-0"	11'-0"	9'-0"	10'-9"	- -	- -	X	X	X	Ramp continues under structures; minimum vertical clearance southbound 14'-9"
Relocated N. 8th Street	1	X		15'-8"	18'-7"	5'-10"	11'-0"	11'-6"	11'-7"	- -	- -	X	X	X	Ramp continues under structure; minimum vertical clearance northbound 15'-8"
W. North Avenue	1	X		15'-4"	18'-3"	10'-6"	10'-2"	11'-6"	11'-0"	- -	- -	X	X	X	Ramp continues under structure; minimum vertical clearance northbound 15'-4"
W. Wright Avenue.	1	X		14'-11"	15'-3"	5'-5"	11'-2"	5'-4"	10'-7"	- -	- -	X	X	X	Ramps continue under structure northbound and southbound
W. Center Street.	1	X		14'-10"	14'-9"	4'-1"	11'-0"	10'-6"	11'-0"	- -	- -	X	X	X	Ramp continues under structure northbound
W. Locust Street	1	X		15'-0"	15'-0"	10'-6"	10'-4"	10'-6"	10'-10"	- -	- -	X	X	X	- -
W. Burleigh Street.	1	X		15'-0"	15'-0"	10'-6"	11'-0"	3'-6"	11'-0"	- -	- -	X	X	X	Ramp continues under structure southbound
W. Ring Street.	1	X		15'-0"	15'-6"	6'-6"	11'-0"	10'-6"	11'-0"	- -	- -	X	X	X	Pedestrian structure: ramp continues under structure southbound
W. Keefe Avenue	1	X		15'-1"	16'-6"	10'-9"	11'-0"	10'-6"	11'-0"	- -	- -	X	X	X	- -
W. Atkinson Avenue	1	X		14'-7"	14'-11"	10'-6"	11'-0"	10'-6"	11'-0"	- -	- -	X	X	X	- -
W. Vienna Avenue	1	X		15'-2"	19'-0"	- -[e]	4'-9"	12'-9"	4'-9"	- -	- -		X	X	Pedestrian structure: ramps continue under structure southbound off 14'-9"; southbound on 15'-5"
W. Green Bay Avenue	1	X		14'-8"	14'-6"	11'-1"	4'-7"	12'-0"	3'-2"	- -	- -	X	X	X	Ramp continues under structure northbound
W. Capitol Drive.	1	X		14'-7"	14'-11"	11'-8"	4'-8"	10'-7"	4'-7"	- -	- -	X	X	X	- -
Southbound off to W. Green Bay Avenue.	1		X	Unlimited	Unlimited	- -	- -	- -	- -	No[f]	No				- -
Northbound off to W. Green Bay Avenue.	1		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				Ramps continue onto structure
Chicago, Milwaukee, St. Paul & Pacific Railroad . .	1		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
W. Glendale Avenue	1		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
W. Hampton Avenue and Milwaukee River.	1		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
	1		X	Unlimited	Unlimited	- -	- -	- -	- -	No[f]	No				Southbound on ramp from Hampton Avenue
Chicago & North Western Transportation Company. . .	1	X		14'-6"	14'-7"	10'-6"	3'-0"	10'-6"	3'-0"			X	X	X	- -
W. Lexington Boulevard	2		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
W. Silver Spring Drive	1		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
W. Bender Road.	1		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
Chicago & North Western Transportation Company. . .	1	X		14'-7"	14'-7"	5'-9"	3'-8"	7'-0"	6'-11"	- -	- -	X	X	X	Minimum vertical clearance over frontage roads: northbound 14'-6"; southbound 14'6"
W. Green Bay Road.	1	X		15'-2"	15'-0"	14'-7"	10'-6"	14'-3"	10'-6"	- -	- -	X	X	X	- -
W. Good Hope Road	1	X		15'-3"	14'-11"	14'-3"	10'-6"	14'-3"	10'-6"	- -	- -	X	X	X	- -

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure, overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *The south-to-northwest ramp of the Hillside Interchange is adjacent to the northbound through lanes, so that in effect there is nearly unlimited horizontal clearance at this point.*

[d] *Actual construction is a single structure of several units.*

[e] *There is no column in this direction adjacent to the outside shoulder and no true horizontal clearance. However, there is a slope from the edge of the shoulder or from a ditch adjacent to the shoulder up to the abutment which will limit the clearance available beyond the shoulder's edge.*

[f] *Deck of structure is 23 feet wide; it may be possible to provide the shoulder with appropriate pavement markings.*

Source: SEWRPC.

each freeway underpass is noted in Table 111. The least vertical clearance in the northbound direction is 14 feet 6 inches, and occurs at the Hillside Interchange where the west-to-east ramp crosses the south-to-northwest ramp and at the Chicago & North Western Transportation Company underpass north of W. Bender Road. The least clearance in the southbound direction is also 14 feet 6 inches and occurs at W. Green Bay Avenue. The W. State Street structure provides the greatest clearance, both in the northbound and southbound directions—21 feet 2 inches and 24 feet 1 inch, respectively.

The median width for this freeway segment varies. From a point approximately 160 feet south of the W. Wisconsin Avenue structure to a point about 330 feet south of the W. State Street southbound entrance ramp structure, 12-foot medians are provided. From this point, through the Hillside Interchange, and to a point approximately 50 feet north of the W. Brown Street structure, the median width varies continually. However, from this point to a point about 50 feet north of the W. Atkinson Avenue structure a 28-foot width is provided. From here, the median width begins to taper from 78 feet to 16 feet and remains 16 feet wide to a point 130 feet north of W. Capitol Drive. The median then tapers from 16 feet to eight feet in width in a distance of 520 feet and remains eight feet wide to a point about 100 feet north of the W. Hampton Avenue and Milwaukee River structure. From here, the median widens from eight feet to 16 feet 3 inches in a distance of about 580 feet and remains 16 feet 3 inches wide for about 0.25 mile. The median widens to 26 feet 6 inches about 750 feet south of the W. Silver Spring Drive structure, where it begins to taper to 8 feet 6 inches about 160 feet south of the W. Silver Spring structure. Approximately 0.4 mile north of the W. Silver Spring structure, the median widens from 8 feet 6 inches to 26 feet 6 inches in a distance of 600 feet. The median begins to taper again to 8 feet 6 inches as it approaches the W. Bender Road structure and then widens to 26 feet 6 inches at a point approximately 130 feet south of the Chicago & North Western Transportation Company structure. The median remains 26 feet 6 inches wide to W. Good Hope Road.

A barrier wall is provided in the median between W. Wisconsin Avenue and W. Juneau Avenue. From W. Juneau Avenue north through the Hillside Interchange to a point about 150 feet south of the W. Brown Street structure, barriers are provided only at the structures. Between W. Wisconsin Avenue and W. Brown Street, median shoulders are not provided. South of W. Brown Street to W. Lexington Boulevard a barrier wall is provided, together with flush shoulders where there is sufficient median width. The width of the inside shoulders is nine feet where the median is 28 feet wide. Where the median is 16 feet wide, three-foot flush shoulders are provided in each direction. No inside shoulders are provided where the median is 10 feet or less in width. Beam guards are provided in the median between W. Lexington Boulevard and W. Silver Spring Road, and between W. Bender Road and W. Good Hope Road. Between W. Silver Spring Road and W. Bender Road, a barrier wall is provided in the median. No median shoulders are provided along the entire portion of this freeway segment between W. Lexington Boulevard and W. Good Hope Road. It should be noted that the barrier wall continuity is interrupted at the Chicago, Milwaukee, St. Paul & Pacific Railroad, W. Glendale Avenue, and W. Hampton Avenue and Milwaukee River structures.

Between W. Wisconsin Avenue and the Chicago & North Western Transportation Company structure just north of W. Hampton Avenue, nine-foot-wide bituminous outside shoulders separated from the roadway by a three-foot-wide mountable curb are provided. North of W. Hampton Avenue to W. Silver Spring Drive, no outside shoulders are provided. Between W. Silver Spring Drive and W. Good Hope Road flush outside shoulders 9 feet 6 inches in width are provided. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exist ramps diverge from the mainline pavement. In addition, the outside shoulders do not cross the following structures: the Chicago, Milwaukee, St. Paul & Pacific Railroad, W. Hampton Avenue and Milwaukee River, W. Lexington Boulevard, and W. Silver Spring Drive structures. A barrier wall has been constructed at all freeway underpasses, except at those structures supported by retaining walls, to prevent vehicles that leave the mainline pavement from striking the columns adjacent to the shoulder, reducing that shoulder width by 3 feet 6 inches.

Retaining walls, constructed as a part of the structure's abutment, support the west side of the W. Wisconsin Avenue structure, and the structures at the east side of W. Wells Street, the southbound exit ramp to W. Wells Street, the southbound entrance ramp from W. State Street, and W. Highland Avenue, as well as the relocated structures at the west side of the N. 8th Street and W. North

Avenue and the structure at W. Green Tree Road. The outside shoulder width is reduced by six inches at these locations to 8 feet 6 inches except at the W. Highland Avenue structure, where the outside shoulder is 4 feet 6 inches wide. This freeway segment has frontage roads adjacent to the mainline pavement between W. Silver Spring Drive and W. Daphne Road on the east side of the freeway and between W. Silver Spring Drive and W. Green Tree Road on the west side of the freeway. The northbound roadway is separated from the frontage road by a barrier wall between W. Silver Spring Drive and W. Bender Road and by a beam guard north of W. Bender Road. The southbound roadway is separated from the frontage road by a barrier wall from W. Silver Spring Drive to W. Montclaire Avenue and by a beam guard north of W. Montclaire Avenue.

There are 19 sign bridges on this freeway segment, 17 which span the mainline pavement and 2 which span ramps. One footing of 12 of the sign bridges spanning the mainline is located in the median behind a barrier wall, and the other footing is beyond the outside shoulder. One of these sign bridges spans the entire width of the Chicago, Milwaukee, St. Paul & Pacific Railroad and its footings are contiguous with the structure's parapet walls. At those locations where no barrier wall is provided, the footings are located about 25 feet from the edge of the mainline pavement. Lighting on this segment of the North-South Freeway is provided only between the Marquette Interchange and W. Bender Road, with the poles placed in the median between the barrier walls. Between the Marquette Interchange and W. Capitol Drive, and between W. Green Tree Road and W. Good Hope Road, this freeway segment is in a cut section. Retaining walls are used extensively on this section to minimize right-of-way requirements. Between W. Capitol Drive and W. Silver Spring Drive, the freeway is in a fill section. From W. Silver Spring Drive to W. Green Tree Road, the freeway is at the same grade as the adjacent lands. It should be noted that the Milwaukee County Courthouse Annex has been constructed in part over the northbound main line between W. Wells Street and W. State Street. Finally, the northbound exit ramp to Kilbourn Avenue and the northbound entrance ramp from Kilbourn Avenue are through tunnels with 15 foot 1 inch minimum vertical clearance, 22 feet of pavement width, and 28 feet 6 inches overall width.

<u>Segment No. 4—North-South Freeway (IH 43) From W. Good Hope Road to W. Pioneer Road:</u> This 9.4-mile freeway segment is located on the eastern side of northern Milwaukee and southern Ozaukee Counties between W. Good Hope Road in the Village of River Hills in Milwaukee County and W. Pioneer Road in the City of Mequon in Ozaukee County, as shown on Map 64. This route is a high-speed link between the Milwaukee central business district and the "North Shore" suburbs of Milwaukee County and the communities in southern Ozaukee County, as well as an interregional facility for travel to and from points north of the Milwaukee urbanized area. This segment may be characterized as having a rural cross-section, with relatively wide median widths and a storm water runoff drainage system that consists of open channels. In addition, two traffic lanes are provided in each direction.

In Milwaukee County, the primary land use adjacent to this freeway segment is residential, except east of the freeway at W. Brown Deer Road where there is commercial development, and north of W. Donges Bay Road where the land, primarily undeveloped, is used for agriculture or is in other rural open uses. The southwest quadrant at STH 167 (Mequon Road) has commercial development, and north of STH 167 and east of the freeway the land is devoted to transportation.

Average weekday traffic volumes in 1979 ranged from 44,900 vehicles per average weekday just north of W. Good Hope Road to 27,400 vehicles per average weekday just south of W. Pioneer Road. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 1,040 vehicles northbound and 2,930 vehicles southbound were carried at W. Good Hope Road, and 660 vehicles northbound and 1,870 vehicles southbound were carried at W. Pioneer Road. During the even peak hour, 4:30 p.m. to 5:30 p.m., 2,720 vehicles northbound and 1,360 vehicles southbound were carried at W. Good Hope Road and 1,650 vehicles northbound and 530 vehicles southbound were carried at W. Pioneer Road. This segment of freeway operates over design capacity in the peak direction during the peak hours at its southern end, operates at design capacity in the peak direction during the morning peak hour, and operates under design capacity during the afternoon peak hour at its northern end.

Physical Characteristics: The right-of-way of this portion of the North-South Freeway (IH 43) ranges in width from about 180 feet to 270 feet except at arterial street and freeway-to-freeway interchanges, where the right-of-way width increases to accommodate the freeway entrance and exit ramps. The geometric configurations of the entrance and exit ramps require up to 550 feet from the freeway centerline at some arterial street crossings.

There are a total of nine structures at eight locations on this freeway segment, as shown in Table 112. (Maps detailing each freeway segment and identifying its structures are available in Commission files.) All nine of the structures are arterial street overpasses or underpasses. The minimum vertical clearance at each underpass is presented in Table 112. The least clearance in the northbound direction is 14 feet 7 inches at the W. Brown Deer Road structure and the least clearance in the southbound direction is 14 feet 8 inches at the W. Good Hope Road structure. The greatest northbound and southbound vertical clearances both occur at W. Highland Road—20 feet 9 inches and 17 feet 6 inches, respectively.

The median width for this freeway segment ranges from about 14 feet to about 70 feet. The median is 26 feet 6 inches wide at W. Good Hope Road, and in a distance of about 650 feet increases to 50 feet in width. The median remains 50 feet wide to a point about 0.5 mile south of W. Brown Deer Road where, in a distance of 0.2 mile, it tapers to 14 feet and remains 14 feet wide to a point about 0.3 mile north of W. Brown Deer Road. From that point, it widens to 50 feet in a distance of about 900 feet, and remains 50 feet wide for about 0.2 mile. The median then widens to 60 feet at a point about 80 feet south of W. County Line Road. At a point about 650 feet north of W. Donges Bay Road, the median begins to widen again, reaching 70 feet in width in a distance of about 0.2 mile and remaining 70 feet wide over the remainder of the segment. Median shoulders are not provided at the W. Good Hope Road structure or in the area of the 14-foot-wide median at W. Brown Deer Road, nor do they cross the structures at STH 167 (Mequon Road). The other portions of this freeway segment have six-foot-wide flush median shoulders.

The outside shoulders on this freeway segment are 10 feet wide and flush with the adjacent pavement. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement.

This freeway segment does not have any sign bridges nor any lighting. With respect to vertical configuration, this freeway segment is primarily at the same grade as the adjacent land.

Segment No. 5—Airport Freeway (IH 894) From the Mitchell Interchange to the Hale Interchange: This 5.5-mile freeway segment is located in south-

Table 112

DETAILED STRUCTURE INFORMATION FOR SEGMENT 4—NORTH-SOUTH FREEWAY (IH 43): W. GOOD HOPE ROAD TO W. PIONEER ROAD

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]		
						Northbound		Southbound				Northbound		Southbound
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside
W. Good Hope Road . . .	1	X		15'-3"	14'-8"	14'3"	10'-6"	14'-3"	10'-6"	- -	- -	X	X	X
W. Brown Deer Road[c] . .	1	X		14'-7"	15'-1"	5'6"	4'-3"	5'-6"	4'-3"	- -	- -	X	X	X
W. County Line Road . .	1	X		15'-0"	15'-0"	- -[d]	28'-6"	- -[d]	28'-6"	- -	- -		X	
W. Old Port Washington Road	1	X		17'-3"	14'-11"	10'-0"	28'-6"	10'-0"	28'-6"	- -	- -	X	X	X
W. Donges Bay Road . . .	1	X		16'-4"	15'-1"	- -[d]	28'6"	- -[d]	28'-6"	- -	- -		X	
STH 167 (W. Mequon Road)	2		X	Unlimited	Unlimited					Yes	No			
W. Highland Road.	1	X		20'-9"	17'-6"	10'-0"	33'-6"	10'-0"	33'-6"	- -	- -	X	X	X
W. Pioneer Road	1	X		15'-4"	15'-7"	- -[d]	33'-6"	- -[d]	33'-6"	- -	- -	X	X	X

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure, overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *Ramps continue under this structure.*

[d] *This structure has no columns adjacent to the outside shoulders and no true horizontal clearance. However, there is a slope from the edge of the shoulder or from a ditch adjacent to the shoulder up to the abutment which will limit the clearance available beyond the shoulder's edge.*

Source: SEWRPC.

ern Milwaukee County between the Mitchell Interchange in the City of Milwaukee and the Hale Interchange in the City of Greenfield, as shown on Map 64. It is the east-west leg of the IH 94 bypass route around the City of Milwaukee, with the Mitchell Interchange providing the connection to IH 94 at the eastern end of the bypass route. This freeway segment has an urban cross-section characterized by relatively narrow median widths, a relatively narrow right-of-way width except at arterial street and freeway-to-freeway interchanges, and a closed conduit storm water drainage system. Three through lanes are provided in each direction.

The predominant land use adjacent to this freeway segment is residential. However, commercial development occurs at S. 27th Street both north and south of the freeway, and at S. 76th Street on the south side of the freeway. West of S. 92nd Street to the Hale Interchange, undeveloped, open land flanks both sides of the freeway.

Average weekday traffic volumes in 1979 ranged from 68,800 vehicles per average weekday at S. 20th Street to 67,700 vehicles per average weekday just east of the Hale Interchange. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 4,270 vehicles eastbound and 1,970 vehicles westbound were carried at S. 20th Street, and 3,160 vehicles eastbound and 2,040 vehicles westbound were carried at the Hale Interchange. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 2,420 vehicles eastbound and 3,850 vehicles westbound were carried at S. 20th Street, and 2,340 vehicles eastbound and 2,970 vehicles westbound were carried at the Hale Interchange. Thus, the eastern end of this freeway segment operates at design capacity during the peak hours, while the western end of the segment operates under design capacity.

Physical Characteristics: This segment of the Airport Freeway has a right-of-way that ranges in width from about 200 feet to about 280 feet except at arterial street and freeway-to-freeway interchanges, where the width increases to about 550 feet to accommodate the geometry of the freeway entrance and exit ramps.

This freeway segment has a total of 25 structures at 21 locations, as shown in Table 113. (Maps detailing each freeway segment and identifying its structures are available in Commission files.) Ten of the structures are in the freeway-to-freeway interchanges, and the remaining 15 structures are arterial street overpasses or underpasses. The minimum vertical clearances for each freeway underpass are presented in Table 113. The least vertical clearance in the eastbound direction is 15 feet 2 inches at the south-to-west ramp structure as it crosses the west-to-north ramp in the Mitchell Interchange, and the least vertical clearance in the westbound direction is 16 feet 2 inches at W. Loomis Road. The greatest clearance available in both the eastbound and westbound directions is 17 feet 11 inches at the S. 60th Street structure and at the east-to-south ramp structure as it crosses W. Forest Home Avenue.

The median for this freeway segment is 28 feet wide between interchanges. Barrier walls are provided in the center of the median along with nine-foot-wide flush shoulders beginning at a point about 720 feet west of the S. 20th Street structure, and continuing to a point about 660 feet west of S. 36th Street. The barrier wall and flush shoulder construction is interrupted through the Greendale Interchange, but begins again at a point about 300 feet east of W. Loomis Road and continues to a point about 570 feet west of S. 92nd Street. Median shoulders and barrier walls are not provided at the structures at S. 51st Street and S. 84th Street. In the approach to these structures, the barrier wall diverges from the center of the median to the wingwalls of each structure's abutments at a 50:1 taper, and begins again in the center of the median approximately 20 feet beyond the structures.

Outside shoulders between the Mitchell Interchange and S. 76th Street are 10 feet wide in each direction. The shoulders increase to 12 feet in width from S. 76th Street to the Hale Interchange. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulders cross only the west-to-south ramp and the west-to-north ramp structures in the Mitchell Interchange, the S. 51st Street structure, the S. 84th Street structure, and the west-to-north ramp structure in the Hale Interchange. A barrier is provided to prevent vehicles leaving the mainline pavement from striking the columns adjacent to the shoulder at the S. 27th Street, S. 35th Street, W. Loomis Road, S. 68th Street at W. Forest Home Avenue, and S. 92nd Street structures. The shoulder width is reduced 3 feet 6 inches at these locations.

There are 13 sign bridges on this freeway segment. One is located in the Mitchell Interchange, 2 are in the Greendale Interchange, 1 is in the Hale Interchange, and the remaining 9 are located at various points along the segment. The nine sign bridges

Table 113

DETAILED STRUCTURE INFORMATION FOR SEGMENT 5—AIRPORT FREEWAY (IH 894): MITCHELL INTERCHANGE TO HALE INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Eastbound		Westbound				Eastbound		Westbound	
				Eastbound	Westbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
West-to-South Ramp, Mitchell Interchange	1		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
West-to-North Ramp,, Mitchell Interchange	1	X	X	15'-2"	--	41'-0"	22'-0"	--	--	Yes	No	X	X		--
South-to-West Ramp, Mitchell Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
S. 20th Street	2	X		16'-4"	16'-10"	10'-6"	4'-8"	10'-6"	4'-8"	--	--		X	X	--
S. 27th Street	2	X		17'-6"	16'-6"	10'-6"	11'-0"	3'-6"	11'-0"	--	--	X	X	X	Ramp continues under structure westbound
S. 35th Street	1	X		16'-5"	16'-6"	10'-7"	11'-0"	10'-7"	11'-0"	--	--	X	X	X	--
East-to-West Main Line, Greenfield Interchange . . .	1	X	X	--	--	--	--	--	--	No	No				North-to-east ramp under this structure is not in use at this time
West-to-North Ramp, Greenfield Interchange . . .	1	X		--	16'-3"	--	--	3'-6"	2'-6"	--	--		X	X	--
W. Loomis Road	1	X		16'-2"	16'-2"	10'-8"	11'-0"	10'-8"	11'-0"	--	--	X	X	X	Ramp continues under structure westbound
S. 51st Street	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
S. 60th Street	1	X		17'-11"	16'-4"	10'-7"	10'-10"	10'-7"	10'-10"	--	--	X	X	X	--
S. 68th Street	1	X		16'-9"	16'-3"	10'-6"	10'-11"	10'-6"	10'-11"	--	--	X	X	X	--
S. 76th Street	1	X		16'-4"	16'-6"	10'-6"	11'-0"	10'-6"	11'-0"	--	--	X	X	X	--
W. Forest Home Avenue;. . .	2	X		16'-5"	17'-3"	10'-7"	11'-0"	10'-6"	11'-0"	--	--	X	X	X	--
East-to-South Ramp at W. Forest Home Avenue . .	1	X		16'-7"	17'-11"	10'-7"	11'-0"	10'-7"	11'-0"	--	--	X	X	X	--
S. 84th Street	1		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
S. 92nd Street.	1	X		17'-3"	17'-8"	10'-8"	11'-0"	10'-8"	11'-0"			X	X	X	--
East-to-North Main Line, Hale Interchange.	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
East-to-West Ramp, Hale Interchange.	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
West-to-East Ramp, Hale Interchange.	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
West-to-North Ramp, Hale Interchange.	1	X	X	15'-7"	--	3'-0"	3'-0"	--	--	Yes	No	X	X		--
North-to-East Main Line, Hale Interchange.	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure, overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

Source: SEWRPC.

that are not in the interchanges have two footings, one of which is located between the barrier walls in the median, and the other of which is located beyond the outside shoulder. The footings not protected by median barriers are protected by either a guardrail or impact attenuators. Lighting on this segment is provided by luminaires mounted on poles placed beyond the outside shoulder. With respect to vertical configuration, this freeway segment is in a cut section from the Mitchell Interchange to W. Loomis Road except the portion between S. 27th Street and S. 35th Street, which is at the same grade as the adjacent land. The portion of this freeway segment between W. Loomis Road and S. 68th Street also is at the same grade as the adjacent land. From S. 68th Street to S. 84th Street, the freeway is in a cut section. Between S. 84th Street and the Hale Interchange, the freeway is essentially at the same grade as the adjacent land. It should be noted that the Greendale Interchange is the southern terminus of the proposed Stadium Freeway-South.

Segment No. 6—Zoo Freeway (IH 894) From the Hale Interchange to the Zoo Interchange: This 4.4-mile freeway system segment is located in western Milwaukee County between the Hale Interchange in the City of Greenfield and the Zoo Interchange in the City of West Allis, as shown on Map 64. It is the north-south leg of the IH 94 freeway bypass route around the City of Milwaukee, with the Zoo Interchange providing the connection to IH 94 as it proceeds west out of Milwaukee County. Characterized by relatively narrow median widths, relatively narrow rights-of-way except at arterial street and freeway-to-freeway interchanges, and a closed conduit storm water drainage system, this segment has an urban cross-section. Three through traffic lanes are provided in each direction.

The predominant land use adjacent to this freeway segment is residential except to the north of Lincoln Avenue, where there is industrial development to the west of the freeway right-of-way, and at Greenfield Avenue, where there is commercial development. In addition, there is a Wisconsin Electric Power Company power transmission right-of-way located on the eastern side of the freeway right-of-way between Oklahoma Avenue and the Zoo Interchange.

Average weekday traffic volumes in 1979 ranged from 76,700 vehicles per average weekday just north of the Hale Interchange to 107,000 vehicles per average weekday south of the Zoo Interchange. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 3,520 vehicles northbound and 2,890 vehicles southbound were carried at the Hale Interchange, and 4,810 vehicles northbound and 3,580 vehicles southbound were carried at the Zoo Interchange. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 3,100 vehicles northbound and 4,110 vehicles southbound were carried at the Hale Interchange, and 3,650 vehicles northbound and 5,070 vehicles southbound were carried at the Zoo Interchange. Because of the relatively high peak-hour volumes, this segment of freeway operates at design capacity in the peak direction during the afternoon peak hour at its southern end, and over design capacity in the peak direction during the peak hours at its northern end.

Physical Characteristics: The right-of-way of this segment of the Zoo Freeway ranges in width from about 200 feet to 270 feet except at arterial street and freeway-to-freeway interchanges, where the width increases to accommodate the freeway entrance and exit ramps, which require, for example, up to 500 feet of right-of-way from the freeway centerline at some arterial street crossings.

There are a total of 27 structures at 18 locations on this freeway segment, as indicated in Table 114. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Six of the structures are in the freeway-to-freeway interchanges, one is a pedestrian structure, six are railroad structures, and the remaining 14 structures are arterial street overpasses or underpasses. The minimum vertical clearance at each freeway underpass is presented in Table 114. The least clearance in the northbound direction is 16 feet 3 inches at the W. Howard Avenue structure, and the least clearance in the southbound direction is 14 feet 6 inches at the south-to-west ramp structure as it crosses the north-to-south ramp structure in the Zoo Interchange. The W. Beloit Road structure provides the greatest vertical clearance in the northbound direction, 17 feet 2 inches; and the W. Dakota Street structure provides the greatest vertical clearance in the southbound direction, 17 feet 10 inches.

The median for this segment is 28 feet wide between interchanges. Barrier walls are provided in the center of the median. Flush shoulders nine feet in width are provided from approximately 240 feet north of Cold Spring Road to Schlinger Avenue. Median shoulders and barrier walls are not provided in the right-of-way of four freeway overpass structures. In the approach to each of these

Table 114

DETAILED STRUCTURE INFORMATION FOR SEGMENT 6–ZOO FREEWAY (IH 894): HALE INTERCHANGE TO ZOO INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Northbound		Southbound				Northbound		Southbound	
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
West-to-North Ramp, Hale Interchange	1	X	X	--	15'-7"	--	--	3'-0"	3'0"	Yes	No		X	X	--
North-to-East Ramp, Hale Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
East-to-North Ramp, Hale Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
W. Cold Spring Road	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Howard Avenue	1	X		16'-3"	16'-5"	10'-6"	11'-0"	10'-6"	11'-0"	--	--	X	X	X	--
W. Beloit Road	1	X		18'-0"	16'-4"	10'-6"	11'-0"	10'-6"	11'-0"	--	--	X	X	X	Ramp continues under structure
W. Oklahoma Avenue	2		X	Unlimited	Unlimited	--	--	--	--	No	No				--
W. Dakota Street	1	X		17'-2"	17'-10"	10'-6"	11'-0"	10'-6"	11'-0"	--	--	X	X	X	Pedestrian overpass
W. Cleveland Avenue	1	X		16'-9"	16'-3"	10'-6"	11'-0"	10'-6"	11'-0"	--	--	X	X	X	--
W. National Avenue	2		X	Unlimited	Unlimited	--	--	--	--	No	No				Ramp crosses both structures
W. Lincoln Avenue	1	X		16'-7"	16'-5"	10'-0"	11'-0"	10'-6"	11'-0"	--	--	X	X	X	--
Chicago & North Western Transportation Company	2		X	Unlimited	Unlimited	--	--	--	--	No	No				--
W. Greenfield Avenue	2	X		16'-10"	16'-5"	10'-6"	11'-0"	10'-6"	11'-0"	--	--	X	X	X	Shoulder crosses southbound structure only
W. Schlinger Avenue	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
West-to-South, North-to-South, and South-to-North Ramps Over Chicago, Milwaukee, St. Paul & Pacific Railroad; Zoo Interchange	4		X	Unlimited	Unlimited	--	--	--	--	No	No				--
North-to-South Ramp, Zoo Interchange	1	X	X	--	14'-6"	--	--	10'-6"	2'-9"	Yes	No		X	X	--
South-to-West Ramp, Zoo Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No		X	X	--
South-to-North Ramp, Zoo Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No		X	X	--

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

Source: SEWRPC.

structures, the barrier wall diverges from the center of the median to the wingwalls of the structure abutments at a 50:1 taper. Approximately 20 feet beyond each of the structures, barrier walls are again provided in the center of the median.

Outside shoulders, nine feet in width and separated from the roadway by a three-foot mountable curb, are provided in each direction on this freeway segment. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulder crosses only the southbound structure at Schlinger Avenue, as noted in Table 114. Finally, at all freeway underpasses a barrier has been constructed to prevent vehicles from leaving the traveled way and striking the columns adjacent to the shoulder, reducing the shoulder width by 3 feet 6 inches.

There are five sign bridges on this freeway segment, each having one footing located between the barrier walls in the median and one footing placed beyond the outside shoulder, protected by either a barrier wall or guardrail. Lighting on this segment is provided by luminaires mounted on poles, located about two to five feet from the outside shoulders on both sides of the freeway. With respect to vertical configuration, this freeway segment is in a cut section at those locations where an arterial street crosses over it, and in a fill section at those locations where the freeway crosses over an arterial street. Because arterial overpasses and underpasses are spaced at increments of 0.5 mile or less, only a small portion of this freeway segment is built at the same grade as adjacent lands.

Segment No. 7—Lake and East-West Freeways (IH 794) From S. Carferry Drive to the Marquette Interchange: This 3.3-mile elevated freeway segment is located in eastern Milwaukee County between S. Carferry Drive and the Marquette Interchange in the City of Milwaukee, as shown on Map 64. The east-west leg of this freeway segment provides access to the Milwaukee central business district. The north-south leg of this freeway segment provides access to the Port of Milwaukee. Characterized by relatively narrow median widths, relatively narrow right-of-way widths except at the arterial street and freeway-to-freeway interchanges, and a closed conduit storm water drainage system, this freeway segment has an urban cross-section. Three through lanes are provided in each direction from S. Carferry Drive to N. 2nd Street, and four lanes are provided in each direction between N. 2nd Street and the Marquette Interchange.

Land use adjacent to this freeway segment is varied. North of the inner harbor entrance to the Port of Milwaukee, the land use is primarily industrial east of the Lake Freeway and south of the East-West Freeway. On the west side of the Lake Freeway there is recreational development, and on the north side of the East-West Freeway there is commercial and office space development. The land under the East-West portion of this freeway segment is used for parking.

Average weekday traffic volumes in 1977 ranged from 16,900 vehicles per average weekday just north of S. Carferry Drive to 69,000 vehicles per average weekday just east of the Marquette Interchange. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 1,420 vehicles northbound and 500 vehicles southbound were carried at S. Carferry Drive, and 4,230 vehicles eastbound and 2,230 vehicles westbound were carried at the Marquette Interchange. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 490 vehicles northbound and 1,250 vehicles southbound were carried at S. Carferry Drive, and 2,440 vehicles eastbound and 4,270 vehicles westbound were carried at the Marquette Interchange. As a result of the relatively high peak-hour volumes, the East-West Freeway portion of this segment operates at design capacity in the peak direction during the peak hours, but because of the lower peak-hour volumes on the Lake Freeway portion of the segment this portion operates under design capacity during the peak hours.

Physical Characteristics: The right-of-way of this segment of the freeway system ranges in width from about 150 feet to 280 feet, except at arterial street and freeway-to-freeway interchanges where the width increases to accommodate the freeway entrance and exit ramps. The geometric configuration of the ramps on this segment requires up to 350 feet of right-of-way from the freeway centerline.

As shown in Table 115, this freeway segment is completely elevated on two structures, each of which is comprised of several units. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) The Lake Freeway, or Lake Interchange, is composed of street overpasses, railroad overpasses, and water-

Table 115

DETAILED STRUCTURE INFORMATION FOR SEGMENT 7—LAKE AND EAST-WEST FREEWAY (IH 794): S. CARFERRY DRIVE TO MARQUETTE INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]		
						Northbound		Southbound				Northbound		Southbound
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside
Lake Freeway	1		X	Unlimited	Unlimited	--	--	--	--	Yes	No	--	--	--
South-to-West Ramp, Lake Interchange . .		X	X	--	16'-3"	--	--	--	--	--	--	--	--	--
East-West Freeway . .	1		X	Unlimited	Unlimited	--	--	--	--	No	No	--	--	--

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure, overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

Source: SEWRPC.

Table 116

MAINLINE STRUCTURE CLEARANCES OVER MEDIAN RAMPS

Location	Minimum Vertical Clearance
Eastbound Exit Ramp to N. Van Buren Street.	22'-2"
Eastbound Exit Ramp to N. Jackson Street	17'-5"
Westbound Exit Ramp to N. Milwaukee Street.	16'-9"
Westbound Entrance Ramp from N. Jackson Street	17'-3"
Southbound Entrance Ramp from N. Broadway	14'-9"
Westbound Entrance Ramp from N. Second Street.	14'-9"

Source: SEWRPC.

course overpasses. The East-West Freeway is composed of arterial street overpasses and watercourse overpasses. The south-to-west ramp of the Lake Interchange is the only location on this segment where a structure crosses the freeway, providing 16 feet 3 inches of clearance in the southbound direction of the Lake Freeway main line. An overhead obstruction also is provided at the point where the Lake Freeway passes through the arches supporting the freeway over the entrance to the inner harbor. There is 32 feet 4 inches of clearance available at that point. In addition, there are six freeway ramps on this freeway segment which pass under and terminate in the median of the mainline facility. The minimum vertical clearance between the ramps and mainline structure is shown in Table 116.

A 15-foot median with six-foot flush shoulders and a barrier wall are provided in each direction between S. Carferry Drive and the Lake Interchange. From the Lake Interchange to the Marquette Interchange, the median width is variable but inside shoulders are not provided. In addition, freeway entrance ramps merging with the westbound main line and freeway exit ramps diverging from the main line in both directions are provided on that portion of the freeway between the Lake and Marquette Interchanges. Ten-foot-wide flush outside shoulders are provided between S. Carferry Drive and the Lake Interchange. Between the Lake Interchange and the Marquette Interchange, no outside shoulders are provided. In addition, on Lake Interchange to Marquette Interchange the portion of this segment, a southbound freeway entrance ramp merges with the main line from the outside on the south side of the freeway.

There are 17 sign bridges on this freeway segment. The footings for these sign bridges are an integral part of the freeway structure parapet walls. Lighting is provided by luminaires mounted on poles, of which the footings are also an integral part of the retaining wall.

Segment No. 8—East-West Freeway (IH 94) From the Marquette Interchange to the Zoo Interchange: This 5.8-mile freeway segment is located in central Milwaukee County between the Marquette Interchange and the Zoo Interchange in the City of Milwaukee, as noted on Map 64. This east-west leg of IH 94 is one of the primary routes serving intraregional and interregional automobile and truck travel in the Milwaukee urbanized area and the Region. With relatively narrow median widths, relatively narrow right-of-way widths except at arterial street and freeway-to-freeway interchanges, and a closed conduit storm water drainage system, this segment may be characterized as having an urban cross-section. Three through lanes are provided in each direction except between N. 35th Street and the Stadium Freeway, where four traffic lanes are provided in each direction.

Land use adjacent to this freeway segment is varied. From the Marquette Interchange to N. 27th Street, there is institutional and commercial development north of the freeway and industrial and commercial development to the south of the freeway. A Wisconsin Electric Power Company substation is located north of the freeway just west of N. 27th Street. Continuing west to the Menomonee River, the land use is predominantly residential north of the freeway. South of the freeway, the land use is devoted to transportation and provides the right-of-way for electric power transmission lines owned by the Wisconsin Electric Power Company. From the Menomonee River to N. Mitchell Boulevard, the adjacent land serves as a parking area for Milwaukee County Stadium. Between N. Mitchell Boulevard and N. Hawley Road, cemeteries are located on both sides of the freeway. Land use is predominantly residential on both sides of the freeway from N. Hawley Road to N. 76th Street and remains primarily residential on the north side of the freeway to N. 84th Street. In addition, transmission line rights-of-way and a substation of the Wisconsin Electric Power Company are located directly adjacent to the westbound roadway between N. Hawley Road and N. 68th Street. South of the freeway, between N. 76th Street and N. 84th Street, the land is used for parking for the Wisconsin State Fair Park. North of the freeway just west of N. 84th Street, there is some institutional development. Both sides of the remainder of the segment are flanked by residential development. Finally, a Wisconsin Electric Power Company substation is located in the northeast quadrant of the Zoo Interchange.

Average weekday traffic volumes in 1979 ranged from 113,800 vehicles per average weekday at N. 13th Street to 114,400 vehicles per average weekday just east of the Zoo Interchange. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 5,060 vehicles eastbound and 4,020 vehicles westbound were carried at the Zoo Interchange. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 3,930 vehicles eastbound and 4,860 vehicles westbound were carried at N. 13th Street and 3,850 vehicles eastbound and 5,200 vehicles westbound were carried at the Zoo Interchange. Because of the relatively high peak-hour volumes, this segment of freeway operates over design capacity in the peak direction during the peak hours and at design capacity in the nonpeak direction during the peak hours except at the western end of the segment during the morning peak hour, where it operates under design capacity.

Physical Characteristics: The right-of-way of this segment of the East-West Freeway ranges in width from about 130 feet to about 260 feet except at arterial street and freeway-to-freeway interchanges, where the right-of-way width increases to about 450 feet from the freeway centerline to accommodate freeway entrance and exit ramps. In addition, because the freeway was constructed on a considerable cross slope between N. 16th Street and N. 27th Street, the right-of-way ranges up to about 430 feet wide in that area.

There are 37 structures at 34 locations on this freeway segment, as shown in Table 117. (Maps detailing each freeway segment and identifying its structures are available in Commission files.) Ten of the structures are in freeway-to-freeway interchanges, one is a pedestrian structure, two are railroad and watercourse overpasses, and the remaining 24 structures are arterial street overpasses or underpasses. The minimum vertical clearances at each freeway underpass are noted in Table 117. The least vertical clearance in the eastbound direction is 14 feet at the north-to-east ramp structure as it crosses the east-to-south ramp structure in the Stadium Interchange. The least vertical clearance in the westbound direction is 14 feet 3 inches and is located where the north-to-east ramp crosses IH 94 in the Stadium Interchange. The structure carrying southbound USH 41 over eastbound IH 94 provides the greatest vertical clearance in the eastbound direction, approximately 25 feet; and the cemetery access road structure provides the greatest vertical clearance in the westbound direction, 18 feet 7 inches.

The median width for this freeway segment ranges from about eight feet to 28 feet. The median is 16 feet wide from N. 13th Street to a point about 120 feet east of N. 27th Street, where it tapers to 10 feet in a distance of about 420 feet and remains 10 feet wide for about 710 feet. The median then widens to 12 feet at a point about 360 feet east of the N. 32nd Street overpasses and remains 12 feet wide to a point about 910 feet west of the N. 35th Street structure. From N. 35th Street to a point

Table 117

DETAILED STRUCTURE INFORMATION FOR SEGMENT 8—EAST-WEST FREEWAY (IH 94): MARQUETTE INTERCHANGE TO ZOO INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Eastbound		Westbound				Eastbound		Westbound	
				Eastbound	Westbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
N. 13th Street	2		X	Unlimited	Unlimited	--	--	--	--	No	No				--
N. 16th Street	1	X		14'-10"	15'-3"	13'-6"[d]	4'-6"	10'-6"	4'-6"	--	--	--[d]	X	X	--
N. 25th Street	1	X		16'-2"	18'-3"	6'-6"	5'-3"	8'-0"	5'-3"	--	--	X	X	X	--
N. 26th Street/ W. St. Paul Avenue	1[c]	X		15'-1"	17'-0"	12'-0"	5'-0"	8'-0"	5'-0"	--	---				--
		X		15'-1"	16'-3"	12'-0"	5'-0"	8'-0"	5'-0"	--	--				--
S. 27th Street	1	X		16'-2"	18'-3"	8'-0"	4'-6"	8'-0"	3'-1"	--	--	X	X	X	Ramp continues under structures eastbound
S. 32nd Street	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
S. 35th Street	1	X		15'-6"	15'-7"	9'-6"	3'-0"	9'-6"	3'-0"	--	--	X	X	X	--
Chicago, Milwaukee, St. Paul & Pacific Railroad/ Menomonee River	2		X	Unlimited	Unlimited	--	--	--	--	No	No				Ramps continue across structures
East-to-South Ramp Over West-to-East Main Line; Stadium Interchange	1	X		14'-8"	--	10'-6"	1'-6"	--	--	--	--	X	X		--
West-to-East Main Line Over South-to-North Main Line; Stadium Interchange	1	X	X	14'-8"	--	11'-0"	3'-0"	--	--	Yes	No				--
North-to-East Ramp Over East-to-South Ramp; Stadium Interchange	1	X		14'-0"	--	2'-0"	2'-0"	--	--	--	--	X	X		--
North-to-East Ramp Over East-to-West Main Line; Stadium Interchange		X		--	14'-3"	--	--	7'-2"	6'-4"	--	--		X	X	--
East-to-West Main Line Over South-to-North Main Line; Stadium Interchange	1	X	X	--	14'-7"	--	--	11'-0"	3'-0"	No	No		X	X	--
East-to-West Main Line Over West-to-North Ramp; Stadium Interchange			X	Unlimited	Unlimited	--	--	--	--	No	No				--
North-to-South Main Line Over South-to-West Ramp; Stadium Interchange	1	X		--	15'-7"	10'-0"	4'-0"	--	--	--	--		X	X	--
North-to-South Main Line Over West-to-East Main Line; Stadium Interchange		X		25' +	--	10'-6"	5'-10"	--	--	--	--	X	X		--
South-to-West Ramp Over West-to-East Main Line; Stadium Interchange	1	X		14'-9"	--	11'-0"	9'-6"	--	--	--	--	X	X		--
North-to-South Main Line Over East-to-West Main Line; Stadium Interchange		X		--	14'-9"	10'-1"	34'-4"	--	--	--	--		X	X	--

Table 117 (continued)

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Eastbound		Westbound				Eastbound		Westbound	
				Eastbound	Westbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
West Stadium Access Road	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
N. Mitchell Boulevard	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
Cemetery Access Road	1	X		17'-8"	18'-7"	10'-6"	2'-0"	6'-6"	2'-0"	- -	- -	X		X	Ramps continue under structure eastbound and westbound
N. Hawley Road.	1		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				Ramp continues across structure westbound; shoulder crosses eastbound structure only
N. 64th Street	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes				- -
N. 68th Street	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes				- -
N. 70th Street	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes				- -
N. 73rd Street	1	X		15'-4"	15'-4"	4'-6"	11'-0"	- -	4'-6"	- -	- -	X	X	X	Pedestrian structure; ramps continued under structure eastbound and westbound
N. 84th Street	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes				- -
N. 92nd Street.	1	X		14'-8"	15'-4"	10'-6"	11'-0"	10'-6"	11'-0"	- -	- -	X	X	X	- -
South-to-North Main Line Over West-to-East Main Line; Zoo Interchange	1	X		14'-4"	- -	10'-6"	7'-4"	- -	- -	- -	- -	X	X	X	- -
South-to-North Main Line Over East-to-West Main Line; Zoo Interchange	1	X	X	- -	14'-6"	- -	- -	10'-6"	4'-3"	- -	- -		X	X	- -
South-to-North Main Line Over East-to-South Ramp; Zoo Interchange		X		- -	14'-5"	- -	- -	9'-2"	2'-0"	- -	- -		X	X	- -
North-to-South Main Line Over West-to-East Main Line; Zoo Interchange	1	X	X	14'-6"	- -	10'-6"	4'-9"	- -	- -	- -	- -	X	X		- -
North-to-South Main Line Over East-to-West Main Line; Zoo Interchange	1	X		- -	14'-6"	- -	- -	12'-0"	4'-7"	- -	- -		X	X	- -

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *This structure has two legs: one carries traffic east and west on W. St. Paul Avenue and the other carries traffic north and south on N. 26th Street.*

[d] *Retaining wall adjacent to outside shoulder determines horizontal clearance.*

Source: SEWRPC.

about 280 feet west of the Chicago, Milwaukee, St. Paul & Pacific Railroad (the Milwaukee Road) and Menomonee River structures, the median widens to 26 feet and then varies through the Stadium Interchange to a point about 430 feet west of the cemetery access road structure, where it narrows to eight feet in width. The median remains eight feet wide to a point about 200 feet west of the N. Hawley Road structure, and then widens to 28 feet in a distance of about 950 feet and remains 28 feet wide to the Zoo Interchange.

Barrier walls and flush inside shoulders are provided in the median from N. 13th Street to the Milwaukee Road and Menomonee River structure and from the west stadium access road to a point about 380 feet west of N. 92nd Street. Where the median is 16 feet wide, the width of the inside shoulder is three feet. No inside shoulders are provided where the median has narrowed to 10 feet or less. Specifically, inside shoulders are not provided from N. 27th Street to a point about 200 feet west of N. Hawley Road, nor are median shoulders provided across the N. 13th Street structures. The remainder of this freeway segment is characterized by a 28-foot median and nine-foot inside shoulders to a point about 400 feet west of N. 92nd Street.

Outside flush shoulders, 10 feet wide and separated from the roadway by a one-foot mountable curb, are provided on this freeway segment, except when the freeway is in a super-elevated section. At these locations, the shoulder on the elevated side of the pavement is 11 feet wide and does not have a mountable curb. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulder does not cross the structures located at N. 13th Street, N. 32nd Street, the Milwaukee Road and Menomonee River, and the westbound roadway over northbound USH 41 in the Stadium Interchange. A barrier wall is provided at all freeway underpasses to prevent vehicles which leave the traveled way from striking the columns or retaining walls adjacent to the shoulder, resulting in the reduction of shoulder width. On the north side of the N. 16th Street, N. 26th Street and St. Paul Avenue, and N. 27th Street structures and on both the north and south sides of the N. 35th Street structure, the outside shoulder width is reduced by two feet. At the cemetery access road structure, N. 73rd Street structure, N. 76th Street structure, and N. 92nd Street structure, the outside shoulder width is reduced by 3 feet 6 inches. Retaining walls, constructed as a part of each structure's abutment, support the north side of the N. 25th Street structure, the N. 26th Street and W. St. Paul Avenue structure, and the N. 27th Street structure, and reduces the outside shoulder width to eight feet.

One footing of each of the 16 sign bridges on this freeway segment is located between the median barrier walls and the other footing is beyond the outside shoulder. Two of the sign bridges span structures, and their footings are integral parts of the structures' parapet walls. The footings of the remaining sign bridges are protected by either a guardrail or impact attenuators. Lighting on this freeway segment is provided by luminaires mounted on poles placed between the median barrier walls. With respect to vertical configuration, this freeway segment was constructed on a cross-slope between N. 13th Street and the Stadium Interchange. In addition, extensive use of retaining walls has minimized right-of-way requirements between N. 13th Street and N. 32nd Street. At the cemetery access structure, this freeway segment is at or very nearly at the same grade as adjacent lands and remains so to about N. 64th Street. West of N. 64th Street to about N. 73rd Street, the freeway is in a fill section. Between N. 73rd Street and N. 78th Street, the freeway is in a cut section. From N. 78th Street to N. 88th Street, the freeway segment is at the same grade as adjacent lands. From N. 88th Street to the Zoo Interchange, the freeway is in a cut section. The eastbound freeway entrance and exit ramps and the westbound freeway entrance ramp at N. Mitchell Boulevard are located in the median of this freeway segment.

<u>Segment No. 9—Stadium Freeway (USH 41) From W. National Avenue To W. Garfield Avenue:</u> This 2.7-mile freeway segment is located in central Milwaukee County in the City of Milwaukee, as shown on Map 64. Characterized by relatively narrow median widths, relatively narrow right-of-way widths except at arterial street and freeway-to-freeway interchanges, and a closed conduit storm water runoff drainage system, this segment has an urban cross-section. This freeway segment has three through traffic lanes in each direction except between W. National Avenue and a point about 550 feet north of the south stadium access road and through the Stadium Interchange, where two through traffic lanes are provided in each direction.

The land use adjacent to this freeway segment is varied. East of the freeway just north of W. National Avenue there is industrial development, and west of the freeway there is institutional development. At Milwaukee County Stadium, parking facilities are provided on both sides of the freeway to the Clarendon Place structure. Between the Clarendon Place structure and the Chicago, Milwaukee, St. Paul, and Pacific Railroad (the Milwaukee Road) and W. State Street structure, the land use east of the freeway is predominantly commercial and industrial, whereas west of the freeway the land use is predominantly residential. There is, however, some industrial development just south of W. State Street. North of W. State Street to W. Vliet Street, there is residential development east of the freeway, and governmental, park, and residential development west of the freeway. North of W. Vliet Street to W. Lloyd Street there is parkland development east of the freeway. Between W. Lloyd Street and W. Garfield Avenue, residential development flanks both sides of the freeway.

Average weekday traffic volumes in 1979 ranged from 27,500 vehicles per average weekday just north of W. National Avenue to 48,600 vehicles per average weekday just south of W. Washington Boulevard. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 1,260 vehicles northbound and 1,240 vehicles southbound were carried at W. National Avenue, and 1,400 vehicles northbound and 2,700 vehicles southbound were carried at W. Washington Boulevard. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 1,120 vehicles northbound and 1,170 vehicles southbound were carried at W. National Avenue, and 2,670 vehicles northbound and 1,455 vehicles southbound were carried at W. Washington Boulevard. Because of the relatively low peak-hour volumes, this segment of freeway operates design under capacity during the peak hours in both directions.

Physical Characteristics: The right-of-way of this freeway segment ranges in width from about 140 feet to about 250 feet. At arterial street and freeway-to-freeway interchanges, the right-of-way width increases to accommodate the freeway entrance and exit ramps, requiring up to about 500 feet of right-of-way from the freeway centerline at some arterial street crossings.

There are a total of 19 structures at 17 locations on this freeway segment, as shown in Table 118. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Four of the structures are in freeway-to-freeway interchanges, one is a railroad structure, two structures are combined arterial street and railroad structures, and the remaining 12 structures are arterial street overpasses or underpasses. The minimum vertical clearance at each freeway underpass is presented in Table 118. The least vertical clearance in the northbound direction is 14 feet 5 inches where northbound USH 41 passes under eastbound IH 94, and the least vertical clearance in the southbound direction is 14 feet 8 inches at W. Bluemound Road. The Milwaukee Road structure provides the greatest clearance in both the northbound and southbound directions—19 feet 4 inches and 19 feet 6 inches, respectively.

The median width for this freeway segment is 14 feet 9 inches between W. National Avenue and a point about 300 feet south of the east stadium access road, where it begins to taper. The median width varies through the Stadium Interchange to a point about 240 feet north of W. Vliet Street. A minimum width of about 12 feet is provided at W. Bluemound Road through this portion of this freeway segment. The median is 28 feet wide north of W. Vliet Street to W. Lloyd Street, the northern terminus of the freeway segment. Median barriers and inside shoulders are not provided between W. National Avenue and the Stadium Interchange. Between the Stadium Interchange and the northern terminus of the Stadium Freeway, barrier walls are provided. Flush inside shoulders are also provided where there is sufficient median width to accommodate them. The minimum shoulder width is about one foot and increases to about nine feet just south of the Milwaukee Road and W. State Street structures, and remains about nine feet wide to a point about 200 feet south of W. Lloyd Street. Inside shoulders are not provided at the Milwaukee Road and W. State Street overpass. In the approach to this structure, the barrier wall diverges from the center of the median to the wingwalls of the structure's abutments at a 50:1 taper. Approximately 20 feet beyond the structure, barrier walls are again provided in the center of the median.

Outside shoulders between W. National Avenue and the Stadium Interchange are 8 feet 7 inches in width. Between the Stadium Interchange and W. Lloyd Street, nine-foot outside shoulders, separated from the roadway by a three-foot mountable curb, are provided. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulder does not cross the south-

Table 118

DETAILED STRUCTURE INFORMATION FOR SEGMENT 9—STADIUM FREEWAY (USH 41): W. NATIONAL AVENUE TO W. GARFIELD AVENUE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Northbound		Southbound				Northbound		Southbound	
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
Chicago, Milwaukee, St. Paul & Pacific Railroad . . .	1	X		19'-4"	19'-6"	11'-4"	5'-3"	11'-4"	5'-3"	- -	- -	X	X	X	- -
South Stadium Access Road. . .	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				Ramps continue across structures
East Stadium Access Road. . . .	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
South-to-North Main Line Under West-to-East Main Line; Stadium Interchange . . .	1	X		14'-5"	- -	10'-6"	2'-0"	- -	- -	- -	- -	X	X		- -
South-to-North Main Line Under East-to-West Main Line; Stadium Interchange . . .	1	X		14'-7"	- -	10'-6"	2'-0"	- -	- -	- -	- -	X	X		- -
North-to-South Main Line Over South-to-West Ramp; Stadium Interchange	1	X	X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
North-to-South Main Line Over West-to-East Main Line[c]; Stadium Interchange			X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
North-to-South Main Line Over East-to-West Main Line[c]; Stadium Interchange . .			X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
South-to-North Ramp Over West-to-East Main Line; Stadium Interchange	1		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
Clarendon Place	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				Ramps continue across structures
W. Bluemound Road	1	X		14'-8"	14'-8"	4'-6"	3'-4"	4'-6"	3'-4"	- -	- -	X	X	X	Ramps continue under structures
W. Wisconsin Avenue	1	X		15'-6"	17'-0"	12'-0"	7'-6"	10'-6"	8'-6"	- -	- -				- -
W. Wells Street	1	X		18'-2"	15'-2"	10'-6"	10'-5"	10'-6"	10'-6"	- -	- -	X	X	X	- -
Chicago, Milwaukee, St. Paul & Pacific Railroad/ W. State Street.	2		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
W. Vliet Street.	1	X		15'-1"	16'-8"	10'-6"	10'-0"	10'-6"	10'-0"	- -	- -	X	X	X	- -
W. Washington Boulevard	1	X		15'-4"	14'-10"	10'-6"	10'-3"	10'-6"	10'-3"	- -	- -	X	X	X	Ramp continues under structure southbound
N. Lloyd Street	1	X		14'-7"	14'-9"	10'-6"	10'-4"	10'-6"	10'-4"	- -	- -	X	X	X	- -

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *Actual construction is a single structure with several units.*

Source: SEWRPC.

bound USH 41 structure in the Stadium Interchange, nor the Milwaukee Road and W. State Street structures. At all the freeway underpasses, a barrier wall has been provided to prevent vehicles that leave the mainline pavement from striking the structure columns or retaining walls adjacent to the outside shoulder, thereby reducing the shoulder width by 3 feet 6 inches where columns are provided and by two feet where retaining walls are provided. Retaining walls, constructed as a part a structure's abutment, support the west sides of the Milwaukee Road structure, both sides of the W. Bluemound Road structure, the east side of the W. Wisconsin Avenue and the W. Wells Street structures, and the west side of the W. Vliet Street structures.

There are nine sign bridges, four of which are south of the Stadium Interchange with footings placed behind beam guards. A fifth sign bridge, located just north of the Stadium Interchange, is cantilevered over the roadway from a single footing beyond the outside shoulder. One footing of the other four sign bridges is located between the median barrier walls and the other is beyond the outside shoulder. Lighting is provided by luminaires mounted on poles placed beyond the outside shoulder. With respect to vertical configuration, this freeway segment is at the same grade as the adjacent lands at W. National Avenue, but has been constructed in a fill section as it approaches the Stadium Interchange. Just south of W. Bluemound Road, the freeway is in a cut section and remains in a cut section to its northern terminus except between W. Wells Street and W. Martin Drive, where it is grade-separated.

Segment No. 10—Zoo Freeway (USH 45) From the Zoo Interchange to the North Interchange: This 9.2-mile freeway segment is located in western Milwaukee County between the Zoo Interchange in the City of West Allis and the North Interchange in the City of Milwaukee, as shown on Map 64. This route provides access to the Milwaukee central business district from the northwest suburbs of the City of Milwaukee, as well as serving intraregional and interregional automobile and truck travel in the Milwaukee urbanized area. Characterized by relatively narrow median widths, relatively narrow rights-of-way except at arterial street and freeway-to-freeway interchanges, and a closed conduit storm water drainage system, this freeway has an urban cross-section. Three through traffic lanes are provided in each direction except through the freeway-to-freeway interchanges, where two lanes are provided in each direction, and between W. Wisconsin Avenue and W. Watertown Plank Road, where four lanes are provided in each direction.

Land use adjacent to this freeway segment is varied. A Wisconsin Electric Power Company substation is located at the Zoo Interchange, and the transmission lines cross the freeway from the northwest quadrant. East of the freeway, between the Zoo Interchange and W. Wisconsin Avenue, there is residential development. The Milwaukee County Zoological Gardens are located west of the freeway between the Wisconsin Electric Power Company right-of-way and W. Bluemound Road. Between W. Wisconsin Avenue and N. Mayfair Road, the land use is institutionalized on both sides of the freeway. There is some commercial development at N. Mayfair Road. Development is primarily residential from N. Mayfair Road to W. Center Street on both sides of the freeway. North of W. Center Street, institutional development flanks both sides of the freeway, and south of W. Burleigh Street there is industrial development on both sides of the freeway. There is commercial and industrial development between W. Burleigh Street and the Chicago & North Western Transportation Company (C&NW) right-of-way on the east side of the freeway, and west of the freeway this type of development continues to just south of W. Hampton Avenue. North of the C&NW right-of-way to a point 0.5 mile south of W. Silver Spring Drive east of the freeway, there is park development. The land use is residential from a point 0.5 mile south of W. Silver Spring Drive. Just south of W. Hampton Avenue there is park and residential development on the west side of the freeway. West of the freeway between W. Hampton Avenue and W. Silver Spring Drive, there is industrial development and park development. North of W. Silver Spring Drive, there is some commercial and industrial development on both sides of the freeway, and beyond the C&NW right-of-way the land use is predominantly residential to the North Interchange on both sides of the freeway.

Average weekday traffic volumes in 1979 ranged from 110,700 vehicles per average weekday just north of the Zoo Interchange to 54,400 vehicles per average weekday south of W. Good Hope Road. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 4,510 vehicles northbound and 4,370 vehicles southbound were carried at the Zoo Interchange, and 1,840 vehicles northbound and 2,900 vehicles southbound were carried at

W. Good Hope Road. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 4,410 vehicles northbound and 4,790 vehicles southbound were carried at the Zoo Interchange, and 3,060 vehicles northbound and 2,070 vehicles southbound were carried at W. Good Hope Road. Because of the relatively high peak-hour volumes, this freeway segment operates at design capacity in both directions during the peak hours at its southern end, while the northern end of the segment operates under design capacity during the peak periods in both directions.

Physical Characteristics: The right-of-way of this freeway segment ranges in width from about 220 feet to about 300 feet. At the arterial street and freeway-to-freeway interchanges the right-of-way width increases to accommodate the freeway entrance and exit ramps, requiring up to about 650 feet from the freeway centerline at some arterial crossings. In addition, at the cut section between N. Mayfair Road and W. North Avenue, the right-of-way width increases to about 400 feet.

There are 45 structures at 30 locations on this freeway segment, as shown in Table 119. (Maps detailing each freeway segment and identifying its structures available in the Commission files.) Seven of the structures are in the freeway-to-freeway interchanges, one is a pedestrian structure, five are railroad structures, two are watercourse crossings, two are combined arterial street and railroad structures, and the remaining 28 are arterial street overpasses or underpasses. The minimum vertical clearance at each freeway underpass is noted in Table 119. The least clearance in the northbound direction is 14 feet 4 inches where the northbound lanes of USH 45 cross over the westbound lanes of IH 94. The least clearance in the southbound direction is 14 feet 2 inches at W. Bluemound Road. The greatest vertical clearance is provided at the Chicago & North Western Transportation Company structure in both the northbound and southbound direction—16 feet 7 inches and 15 feet 5 inches, respectively. It should be noted that at two-structure sites, the unreported structure may provide greater vertical clearance than the reported structure, but the clearance provided by the reported structure will still control.

The median width for this freeway segment is 28 feet from the Zoo Interchange to a point about 0.3 mile north of W. Burleigh Street, where it begins to taper; in a distance of about 425 feet it tapers to 20 feet in width. The median remains 20 feet wide to a point about 0.3 mile north of W. Capitol Drive. North of W. Capitol Drive the median widens to 36 feet in a distance of about 540 feet. At a point 0.4 mile north of W. Mill Road, the median tapers from 36 feet wide to 24 feet wide in a distance of about 700 feet, and remains 24 feet wide to the North Interchange. Barrier walls placed in the center of the median and flush inside shoulders are provided from a point about 950 feet south of W. Bluemound Road to a point about 850 feet north of W. Good Hope Road. The width of the inside shoulders is nine feet where the median is 28 feet wide, five feet where the median is 20 feet wide, 13 feet where the median is 36 feet wide, and seven feet where the median is 24 feet wide. Inside shoulders are not provided at each freeway overpass structure. In the approach to each of these structures, the barrier wall diverges from the center of the median to the wingwalls of the structure's abutments at a 50:1 taper. Approximately 20 feet beyond each of the structures, the barrier walls are again provided in the center of the median.

Outside shoulders between the Zoo Interchange and W. Meinecke Avenue are nine feet in width and separated from the roadway by a three-foot mountable curb. Between W. Meinecke Avenue and the North Interchange, 10-foot-wide flush outside shoulders are provided in each direction. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulder does not cross five of the six structures in the Zoo Interchange, the W. Watertown Plank Road structure, the Chicago, Milwaukee, St. Paul, and Pacific Railroad (Milwaukee Road) and N. Mayfair Road structures, the W. North Avenue structures, the W. Capitol Drive structures, and the structure that carries the northbound lanes of USH 45 over the STH 145 main line. Finally, at all freeway underpasses a barrier wall is provided to prevent vehicles that leave the traveled way from striking either the columns or the retaining wall abutment adjacent to the shoulder, reducing the shoulder width by 3 feet 6 inches where columns are provided and by 2 feet where retaining walls are provided. In addition, the parapet walls of the W. Capitol Drive structures restrict the outside shoulder width to 6 feet in each direction.

There are 10 sign bridges on this segment, one of which is in the Zoo Interchange. The footings of this bridge are located behind the beam guard. The remaining nine sign bridges are at different points

Table 119

DETAILED STRUCTURE INFORMATION FOR SEGMENT 10—ZOO FREEWAY USH 45: ZOO INTERCHANGE TO NORTH INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Northbound		Southbound				Northbound		Southbound	
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
East-to-North Main Line Over West-to-East Main Line; Zoo Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
North-to-South Main Line Over West-to-East Main Line; Zoo Interchange	1	X		--	14'-6"	--	--	11'-8"	4'-9"	Yes	No		X	X	--
South-to-West Ramp Over North-South Main Line; Zoo Interchange	1	X	X	Unlimited	Unlimited	--	--	--	--	No	No				--
South-to-North Main Line Over East-to-West Main Line; Zoo Interchange	1	X		14'-4"	--	13'-10"	5'-10"	--	--	No	No	X	X		--
North-to-East Ramp Over South-to-West Main Line; Zoo Interchange	1	X	X	Unlimited	Unlimited	--	--	--	--	No	No				--
North-to-South Main Line Over East-to-West Main Line; Zoo Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
W. Bluemound Road	2	X		16'-6"	14'-2"	10'-9"	9'-0"	10'-7"	9'-0"	--	--	X	X	X	--
W. Wisconsin Avenue	1	X		15'-2"	14'-6"	10'-6"	9'-0"	10'-6"	9'-0"	--	--	X	X	X	Ramps continue under structure northbound and southbound
W. Watertown Plank Road	2		X	Unlimited	Unlimited	--	--	--	--	No	No				--
W. Swan Boulevard	1	X		14'-11"	14'-11"	10'-6"	8'-9"	10'-6"	8'-9"	--	--	X	X	X	--
Chicago, Milwaukee, St. Paul & Pacific Railroad/ Mayfair Road	2		X	Unlimited	Unlimited	--	--	--	--	No	No				--
Chicago & North Western Transportation Company	1	X		16'-7"	15'-5"	10'-6"	7'-9"	8'-6"	7'-9"	--	--	X	X	X	--
W. North Avenue	2		X	Unlimited	Unlimited	--	--	--	--	No	No				--
W. Meinecke Avenue	1	X		14'-11"	15'-0"	5'-2"	9'-0"	5'-4"	9'-0"	--	--	X	X	X	Ramps continue under structure northbound and southbound
W. Center Street	1	X		14'-8"	15'-0"	10'-6"	9'-0"	10'-6"	9'-0"	--	--	X	X	X	--
W. Hadley Street	1	X		15'-6"	17'-9"	--[c]	12'-8"	--[c]	12'-8"	--	--				Pedestrian structure
W. Burleigh Road	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
Chicago & North Western Transportation Company	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Capitol Drive	2		X	Unlimited	Unlimited	--	--	--	--	No	No				--
W. Hampton Avenue	1	X		14'-11"	15'-4"	--[c]	13'-0"	13'-0"	--[c]	--	--		X		--
Menomonee River	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Silver Spring Drive	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
Chicago & North Western Transportation Company	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Carmen Avenue	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Florist Avenue	1	X		14'-9"	15'-0"	--[c]	15'-0"	--[c]	15'-0"				X		--
Southbound STH 175 to USH 41	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Mill Road	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
Northbound USH 41 to STH 175	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Good Hope Road	2	X		15'-1"	14'-8"	10'-9"	8'-6"	12'-3"	8'-6"			X	X	X	--
Northbound USH 41/45 Over STH 145; North Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *This structure has no columns adjacent to the outside shoulders and no true horizontal clearance. However, there is a slope from the edge of the shoulder or from a ditch adjacent to the shoulder up to the abutment which will limit the clearance available beyond the shoulder's edge.*

Source: SEWRPC.

along the segment and have one footing located between the median barrier walls and one footing beyond the outside shoulder behind the beam guard. Lighting on this segment from the Zoo Interchange to the South Interchange is provided by luminaires mounted on poles placed between the median barrier walls. North of the South Interchange, the poles are located beyond the outside shoulder. With respect to vertical configuration, this freeway segment is in a cut section from the Zoo Interchange to W. Watertown Plank Road. At W. Watertown Plank Road to W. Swan Boulevard, the freeway is essentially at the same grade as the adjacent land. Between W. Swan Boulevard and W. Center Street the freeway is in a cut section. North of W. Center Street, the freeway is in a fill section to a point about midway between W. Capitol Drive and W. Hampton Avenue. The freeway is essentially at the same grade as the adjacent lands over the remainder of this freeway segment, except between W. Silver Spring Drive and the South Interchange.

Segment No. 11—Fond du Lac Freeway (STH 145) From N. 68th Street to the North Interchange: This 4.4-mile freeway segment is located in northwestern Milwaukee County between N. 68th Street and the North Interchange in the City of Milwaukee, as shown on Map 64. This segment primarily serves intraregional automobile and truck travel, and may be characterized as having an urban cross-section because of a relatively narrow median width and relatively narrow right-of-way width except at the arterial street and freeway-to-freeway interchanges. Although the storm water drainage system for the northern two-thirds of the segment consists of open channels, the storm water drainage system of the southern third of the segment consists of a closed conduit storm water drainage system. Three through traffic lanes are provided in each direction on this segment.

The land use adjacent to this freeway segment is predominantly residential. There are areas of commercial development west of the freeway at N. 68th Street and at W. Silver Spring Drive. There is some industrial development on both sides of the freeway at W. Florist Avenue. Finally, there is park development on both sides of the freeway at the Little Menomonee River.

Average weekday traffic volumes in 1979 ranged from 14,600 vehicles per average weekday at N. 68th Street to 13,600 vehicles per average weekday at W. Good Hope Road. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 600 vehicles northbound and 1,130 vehicles southbound were carried at N. 68th Street, and 400 vehicles northbound and 1,030 vehicles southbound were carried at W. Good Hope Road. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 1,290 vehicles northbound and 480 vehicles southbound were carried at N. 68th Street, and 880 vehicles northbound and 480 vehicles southbound were carried at W. Good Hope Road. As a result of the relatively low peak-hour volumes on this freeway segment, it operates under design capacity during the peak hours in both directions.

Physical Characteristics: The right-of-way of this portion of the Fond du Lac Freeway ranges in width from about 150 feet to 280 feet. At arterial street and freeway-to-freeway interchanges the width increases to accommodate the freeway entrance and exit ramps, requiring up to 500 feet of right-of-way from the freeway centerline at some arterial street crossings.

There are 20 structures at 12 locations on this freeway segment, as shown in Table 120. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) One of the structures is in a freeway-to-freeway interchange, one is a pedestrian structure, two cross a watercourse, two form a combined arterial street and railroad crossing, and the remaining 14 structures cross arterial streets. The minimum vertical clearance at each freeway underpass is presented in Table 120. The least clearance in the northbound direction is 14 feet 6 inches as northbound USH 41/45 crosses over northbound STH 145, and the least clearance in the southbound direction is 14 feet 1 inch at the same location. The N. 84th Street structure provides the greatest vertical clearance in the northbound direction, 16 feet 1 inch; and the W. Silver Spring Drive structure provides the greatest vertical clearance in the southbound direction, 16 feet 9 inches.

The median width for this freeway segment ranges from about 14 feet to about 36 feet. Between N. 68th Street to a point about 100 feet south of the W. Sheridan Avenue structure, the median is 16 feet wide. South of the W. Sheridan Avenue structure, the median widens to 36 feet in a distance of about 620 feet and remains 36 feet to a point about 600 feet north of W. Good Hope Road, where it then tapers to 14 feet at the northbound USH 41/45 structure. A barrier wall is provided in the center of the median from a point

Table 120

DETAILED STRUCTURE INFORMATION FOR SEGMENT 11—FOND DU LAC FREEWAY (USH 45): N. 68TH STREET TO NORTH INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Northbound		Southbound				Northbound		Southbound	
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
W. Grantosa Drive.	2	X		14'-11'	15'-9"	7'-4"	6'-6"	6'-0"	6'-6"	- -	- -	X	X	X	Ramps continue under structure northbound and southbound
N. 76th Street	2	X		15'-8"	15'-6"	11'-0"	6'-9"	11'-0"	6'-9"	- -	- -	X	X	X	Ramps continue under structure northbound and southbound; minimum clearance at northbound ramp, 15'-7"
W. Sheridan Avenue	1	X		15'-6"	15'-1"	11'-0"	6'-6"	11'-0"	6'-6"	- -	- -	X	X	X	Pedestrian structure
W. Silver Spring Drive	2	X		15'-6"	16'-9"	11'-0"	6'-6"	7'-0"	6'-6"	- -	- -	X	X	X	Ramps continue under structure northbound and southbound
N. 84th Street	1	X		16'-1"	15'-6"	11'-2"	6'-6"	11'-2"	6'-6"	- -	- -	X	X	X	- -
W. Florist Avenue/ Chicago & North Western Transportation Company	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
N. 91st Street	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes[c]	No				Ramp continues across southbound structure
W. Mill Road.	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
Little Menomonee River	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
N. 107th Street	1	X		14'-8"	14'-10"	12'-1"	16'-9"	12'-1"	16'-9"	- -	- -	X	X	X	- -
W. Good Hope Road	2	X		14'-10"	14'-10"	3'-7"	16'-9"	10'-9"	16'-9"	- -	- -	X	X	X	Ramp continues under structure northbound
STH 145 under Northbound USH 41/45; North Interchange.	1	X		14'-6"	14'-1"	9'-0"	7'0"	9'-0"	7'-0"	- -	- -	X	X	X	- -

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *Shoulder crosses northbound structure only.*

Source: SEWRPC.

about 150 feet south of W. Good Hope Road to a point about 150 feet north of the USH 41/45 structure. Flush inside shoulders, six feet in width, are provided where the median is 36 feet wide. No inside shoulders are provided where the median is 16 feet wide. The median shoulders do not cross any of the freeway overpasses.

Outside shoulders between N. 68th Street and a point about 970 feet north of the W. Sheridan Avenue structure are nine feet wide and are separated from the roadway in each direction by three-foot mountable curbs. North of the W. Sheridan Avenue structure to the North Interchange, 10-foot-wide flush shoulders are provided. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulder does not cross the structure at N. 91st Street in the southbound direction. At the W. Good Hope Road structure and at the northbound USH 41/45 structure, a barrier wall is provided to prevent vehicles that leave the traveled way from striking the columns adjacent to the shoulder, reducing the shoulder width by 3 feet 6 inches.

There are seven sign bridges on this freeway segment, six with their footings protected by a beam guard. The seventh sign bridge is located between W. Good Hope Road and the North Interchange; one footing of this bridge is protected by a median barrier and the other footing is protected by a beam guard. Lighting on this segment of the Fond du Lac Freeway is provided by luminaires mounted on poles placed beyond the outside shoulders. With respect to vertical configuration, this freeway segment is at the same grade as the adjacent land near N. 68th Street, but is in a cut section as it passes under the W. Grantosa Drive structure and remains in cut section to W. Sheridan Avenue. North of W. Sheridan Avenue to the Little Menomonee River structure, the freeway is in a fill section. Between the Little Menomonee River structure and the North Interchange, the freeway is at the same grade as the adjacent land.

Segment No. 12—Rock Freeway (STH 15) From the Hale Interchange to Crowbar Road: This 8.3-mile freeway segment is located in both western Milwaukee County and eastern Waukesha County between the Hale Interchange in the City of Greenfield and Crowbar Drive in the City of New Berlin, as shown on Map 64. This route is one of the primary facilities linking the Milwaukee central business district and the communities in the southwest portion of the Milwaukee urbanized area. The portion of this freeway segment between the Hale Interchange and S. 124th Street has an urban cross-section characterized by relatively narrow median widths, a relatively narrow right-of-way width (except at standard arterial street and freeway-to-freeway interchanges), and a storm water drainage system that is a combination of closed conduit in the median and open channel outside the mainline roadway. The remaining portion of this freeway segment has a rural cross-section characterized by relatively wide median widths, a relatively wide right-of-way width, and an open channel storm water drainage system. This freeway segment has two through traffic lanes in each direction except between the Hale Interchange and S. 108th Street, where three through traffic lanes are provided in each direction. The additional lanes are provided to facilitate traffic weaving movements associated with the Hale Interchange.

Land use adjacent to this freeway segment is varied. North of the freeway between the Hale Interchange and S. 108th Street, there is commercial development. From S. 108th Street to S. 124th Street, there is residential development. South of the freeway between S. 108th Street and S. 116th Street, there is institutional development. Between S. 124th Street and Crowbar Drive, the land adjacent to the freeway on both sides is primarily undeveloped except in the vicinity of the arterial street crossings, where residential development has occurred, and just west of Racine Avenue, where there are quarrying operations on both sides of the freeway.

Average weekday traffic volumes on this segment in 1979 ranged from 52,600 vehicles per average weekday just west of the Hale Interchange to 15,700 vehicles per average weekday just east of Crowbar Drive. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 2,620 vehicles eastbound and 1,020 vehicles westbound were carried at the Hale Interchange, and 630 vehicles eastbound and 380 vehicles westbound were carried at Crowbar Drive. During the evening peak hour, 4:00 p.m. to 5:00 p.m., 1,170 vehicles eastbound and 2,920 vehicles westbound were carried at the Hale Interchange, and 410 vehicles eastbound and 830 vehicles westbound were carried at Crowbar Drive. Both the urban and the rural portions of this freeway segment are operating under design capacity during the peak hours in both directions.

Physical Characteristics: The right-of-way of this freeway segment ranges in width from about 220 feet to about 450 feet. At arterial street and freeway-to-freeway interchanges, the right-of-way width increases to accommodate the freeway entrance and exit ramps, requiring up to 650 feet from the freeway centerline at some arterial street crossings.

There are 25 structures at 18 locations on this freeway segment, as shown in Table 121. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Three of the structures are in the Hale Interchange, and the remaining 22 structures are arterial street overpasses or underpasses. The minimum vertical clearance at each freeway underpass is noted in Table 121. The least clearance in the eastbound direction is 14 feet 8 inches at the S. 116th Street structure, and the least clearance in the westbound direction is 14 feet 10 inches at the west-to-north ramp structure as it crosses the east-to-west mainline structure in the Hale Interchange. The Sunny Slope Road structure provides the greatest clearance in the eastbound direction, 17 feet 1 inch, and the Racine Avenue structure provides the greatest vertical clearance in the westbound direction, 18 feet 10 inches. It should be noted that at those locations characterized by more than one structure, the unreported structures may provide greater vertical clearance than the reported structure, but the clearances of the reported structure will control at these locations.

The median width for this freeway segment varies between the Hale Interchange and S. 108th Street. Between S. 108th Street and S. 124th Street the median is 30 feet in width. West of S. 124th Street, the median width varies but is not less than 60 feet. A barrier wall is provided in the median between S. 108th Street and S. 124th Street. Six-foot-wide flush inside shoulders are provided along the entire freeway segment except between S. 108th Street and S. 124th Street, where the width of the inside shoulders is 10 feet 3 inches. The median shoulders do not cross the west-to-east ramp structure in the Hale Interchange, the W. Layton Avenue and Root River structures, the S. 108th Street westbound structure, and the W. Beloit Road (1) structures. Finally, there are two freeway exit ramps that cross the median—the westbound exit ramp to S. 108th Street and the eastbound exit ramp to W. Layton Avenue. Outside shoulders, 10 feet in width, are provided along the entire freeway segment in both directions. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulders do not cross the west-to-east structure or the W. Layton Avenue and Root River structures.

There are five sign bridges on this freeway segment; their footings are protected by beam guards. Lighting on this freeway segment from the Hale Interchange to the W. Beloit Road (1) structures is provided by luminaires mounted on poles placed adjacent to the outside shoulder except where there is a median barrier, where the poles are mounted on the barrier wall. With respect to vertical configuration, from the Hale Interchange to S. 108th Street the eastbound roadway is at the same grade as the adjacent lands and the westbound roadway is in a fill section. Between S. 108th Street and the W. Beloit Road (1) structures, the freeway is at the same grade as the adjacent land and is in a cut section as it passes under Sunny Slope Road. Midway between Sunny Slope Road and the W. Beloit Road (2) structures, the freeway is in a fill section, and remains in a fill section to a point just west of Moorland Road. From that point on, the freeway is at the same grade as the adjacent land.

Segment No. 13—East-West Freeway (IH 94) From the Zoo Interchange to E. Moreland Boulevard: This 7.2-mile freeway segment is located in Milwaukee County and eastern Waukesha County between the Zoo Interchange in the City of West Allis and E. Moreland Boulevard in the Town of Brookfield, as shown on Map 64. This segment is one of the primary east-west routes serving intraregional and interregional automobile and truck travel in the Milwaukee urbanized area and the Region. The portion of the segment between the Zoo Interchange and Moorland Road has an urban cross-section characterized by relatively narrow median widths, a relatively narrow right-of-way width except at arterial street and freeway-to-freeway interchanges, and a closed conduit storm water drainage system. The portion of this freeway segment west of Moorland Road to E. Moreland Boulevard may be characterized as having a rural cross-section with relatively wide median widths, a relatively wide right-of-way width, and an open channel storm water drainage system. This freeway segment has three through traffic lanes in each direction except between Barker Road and E. Moreland Boulevard, where two through traffic lanes are provided in each direction.

Table 121

DETAILED STRUCTURE INFORMATION FOR SEGMENT 12—ROCK FREEWAY (STH 15): HALE INTERCHANGE TO CROWBAR ROAD

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Eastbound		Westbound				Eastbound		Westbound	
				Eastbound	Westbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
West-to-North Ramp Over East-to-West Main Line; Hale Interchange.	1	X	X	- -	14'-10"	- -	- -	6'-6"	10'-6"	- -	- -		X	X	- -
North-to-East Ramp Over West-to-North Ramp; Hale Interchange.	1	X	X	15'-7"	- -	3'-0"	3'-0"	- -	- -	- -	- -	X	X		- -
West-to-East Main Line; Hale Interchange.	1		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
W. Layton Avenue/ Root River	2		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
S. 108th Street— Westbound	1		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				Ramp crosses structure westbound
S. 108th Street— Eastbound	2	X		15'-0"	- -	12'-3"	8'-1"	- -	- -	- -	- -	X	X		- -
East-to-South Ramp Over West-to-East Main Line at S. 108th Street	1	X		15'-4"	- -	12'-0"	8'-0"	- -	- -	- -	- -	X	X		- -
S. 116th Street	1	X		14'-8"	14'-11"	- -[c]	12'-3"	- -[c]	12'-3"	- -	- -		X		- -
S. 124th Street	1	X		15'-6"	15'-0"	- -[c]	12'-3"	- -[c]	12'-3"	- -	- -		X		- -
Eastbound Off-Ramp to W. Layton Avenue.	1	X		- -	16'-5"	- -	- -	12'-0"	20'-0"	- -	- -	X	X		- -
W. Beloit Road (1)	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
N, Sunny Slope Road.	1	X		17'-1"	16'-8"	- -[c]	28'-6"	- -[c]	28'-6"	- -	- -		X		- -
W. Beloit Road (2)	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes				- -
N. Moorland Road	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes				- -
N. Calhoun Road	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes				- -
N. Martin Road	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes				- -
N. Racine Avenue.	1	X		16'-8"	18'-10"	- -[c]	26'-0"	- -[c]	33'-0"	- -	- -		X		- -
N. Crowbar Drive	1	X		16'-4"	16'-4"	- -[c]	42'-0"	- -[c]	42'-0"	- -	- -		X		There is a 110-foot open span between median columns

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *This structure has no columns adjacent to the outside shoulders and no true horizontal clearance. However, there is a slope from the edge of the shoulder or from a ditch adjacent to the shoulder up to the abutment which will limit the clearance available beyond the shoulder's edge.*

Source: SEWRPC.

The land use adjacent to this freeway segment is varied. The Milwaukee County Zoological Gardens are located on the north side of the freeway between the Zoo Interchange and S. 108th Street and land owned and operated by the Milwaukee County Zoo, and electric transmission lines owned by the Wisconsin Electric Power Company are located on the south side of the freeway. Between S. 108th Street and S. 124th Street, the land use on both sides of the freeway is predominantly commercial and industrial, but parkland, Wisconsin Electric Power Company transmission lines, and a major substation are located to the north of the freeway. From S. 124th Street to Moorland Road, the land use is predominantly residential on both sides of the freeway; however, some scattered office building and park development is located north of the freeway. The portion of the freeway segment between Moorland Road and Calhoun Road is bounded primarily by commercial and office building development to the north and residential development just east of Calhoun Road. Just west of Moorland Road south of the freeway there is parkland and residential development. The land use adjacent to the freeway right-of-way between Calhoun Road and E. Moreland Boulevard is predominantly undeveloped except north of the freeway at Brookfield Road, where there is some residential development, and just west of Barker Road, where there is industrial development.

Average weekday traffic volumes in 1979 ranged from 84,200 vehicles per average weekday just west of the Zoo Interchange to 64,200 vehicles per average weekday at Barker Road. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 4,220 vehicles eastbound and 3,080 vehicles westbound were carried at the Zoo Interchange, and 3,680 vehicles eastbound and 2,250 vehicles westbound were carried at Barker Road. During the evening peak hour, 4:00 p.m. to 5:00 p.m., 3,620 vehicles eastbound and 3,870 vehicles westbound were carried at the Zoo Interchange, and 2,310 vehicles eastbound and 2,930 vehicles westbound were carried at Barker Road. As a result of these peak-hour volumes, this freeway segment operates at design capacity in the peak direction during the peak hours at its eastern end. The western end of this segment operates over design capacity in the peak direction during the morning peak hour and at design capacity in the peak direction during the evening peak hour.

Physical Characteristics: The right-of-way of this portion of the East-West Freeway ranges in width from about 150 feet to about 35 feet. At arterial street and freeway-to-freeway interchanges, the right-of-way width increases to accommodate the freeway entrance and exit ramps, requiring up to about 700 feet of right-of-way from the freeway centerline at some arterial street crossings.

This freeway segment has a total of 25 structures at 17 sites, as shown in Table 122. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Four of the structures are in the Zoo Interchange, three are railroad structures, two are combined arterial street and watercourse crossings, and the remaining 16 are arterial street overpasses or underpasses. The minimum total vertical clearance at each freeway underpass is noted in Table 122. The least clearance in the eastbound direction is 14 feet 6 inches at both the northbound and southbound USH 45 structures in the Zoo Interchange as they cross the eastbound lanes of IH 94. The least clearance in the westbound direction is 14 feet 4 inches at the northbound USH 45 structure as it crosses over the westbound lanes of IH 94. The Barker Road structure provides the greatest clearance in the eastbound direction, 17 feet 3 inches; and the E. Moreland Boulevard structure provides the greatest clearance in the westbound direction, 18 feet 5 inches. It should be noted that at those locations where there is more than one structure, the unreported structure may provide greater clearance than the reported structure, but the clearance of the reported structure will control.

The median width for this freeway segment ranges from about 28 feet to about 60 feet. Between the Zoo Interchange and a point about 500 feet west of the Underwood Creek Parkway, the median is 28 feet wide. Between Underwood Creek Parkway and a point about 980 feet west of Sunny Slope Road, the median widens to 36 feet and remains 36 feet wide to a point about 180 feet west of S. Moorland Road. At Moorland Road, the median begins to widen again and is 46 feet wide in a distance of about 0.4 mile. At a point 500 feet east of Brookfield Road, the median narrows from its 46-foot width to 40 feet at a point about 0.2 mile west of Brookfield Road, and remains 40 feet wide to a point about 230 feet east of E. Moreland Boulevard. The median then widens to 60 feet west of E. Moreland Boulevard.

A barrier wall and flush inside shoulders are provided in the median from the Zoo Interchange to Moorland Road. The width of the inside shoulders is nine feet where the median is 28 feet wide and 13 feet where the median is 36 feet wide. West of

Table 122

DETAILED STRUCTURE INFORMATION FOR SEGMENT 13—EAST-WEST FREEWAY (IH 94): ZOO INTERCHANGE TO E. MORELAND BOULEVARD

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Eastbound		Westbound				Eastbound		Westbound	
				Eastbound	Westbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
East-to-West Main Line Under South-to-North Main Line; Zoo Interchange	1	X		--	14'-4"	--	--	10'-6"	7'-4"	--	--		X	X	--
East-to-South Ramp Under South-to-North Main Line; Zoo Interchange		X		--	14'-5"	--	--	9'-2"	2'-0"	--	--		X	X	--
East-to-West Main Line Under North-to-South Main Line; Zoo Interchange	1	X		--	14'-6"	--	--	12'-0"	4'-7"	--	--		X	X	--
West-to-East Main Line Under South-to-North Main Line; Zoo Interchange	1	X		14'-6"	--	10'-6"	4'-3"	--	--	--	--	X	X		--
West-to-East Main Line Under North-to-South Main Line; Zoo Interchange	1	X		14'-6"	--	10'-6"	4'-9"	--	--	--	--	X	X		--
Chicago & North Western Transportation Company	1	X		16'-4"	16'-7"	10'-6"	9'-0"	5'-7"	9'-0"	--	--				Ramp continues under structure westbound
S. 108th Street	2	X		16'-10"	16'-2"	--	10'-6"	10'-7"	10'-6"	--	--	X	X	X	Ramp continues under structure eastbound
Chicago, Milwaukee, St. Paul & Pacific Railroad	2		X	Unlimited	Unlimited	--	--	--	--	Yes	Yes				--
S. 116th Street	2		X	Unlimited	Unlimited	--	--	--	--	Yes	Yes				--
Underwood Creek Parkway/ Underwood Creek	2		X	Unlimited	Unlimited	--	--	--	--	Yes	Yes				--
N. Elm Grove Road	1	X		16'-7"	16'-10"	10'-6"	12'-5"	10'-6"	12'-5"	--	--				--
N. Sunny Slope Road	1	X		16'-7"	16'-3"	10'-6"	14'-3"	10'-6"	14'-3"	--	--				--
N. Moorland Road	2		X	Unlimited	Unlimited	--	--	--	--	Yes	Yes				--
	1		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
N. Calhoun Road	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
N. Brookfield Road	2		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
N. Barker Road	1	X		17'-3"	16'-6"	12'-0"	24'-6"	15'-0"	12'-6"	--	--	X	X	X	Collector roads continue under this structure eastbound and westbound
E. Moreland Boulevard	2	X		17'-1"	18'-5"	12'-0"	26'-7"	20'-7"	16'-8"	--	--	X	X	X	Collector road continues under this structure westbound

[a] *At sites with no structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

Source: SEWRPC.

Moorland Road to E. Moreland Boulevard, inside shoulders six feet in width are provided. Shoulders do not cross the Calhoun Road structures or the Brookfield Road structures.

Ten-foot-wide outside shoulders separated from the roadway by a one-foot mountable curb are provided in both directions on this freeway segment. Between the Zoo Interchange and S. 124th Street, where the freeway is in a super-elevated section, the shoulder is 11 feet wide and the super-elevated portion of the pavement is not provided with a mountable curb. Ten-foot shoulders are provided over the remainder of this freeway segment west of S. 124th Street. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, a barrier wall is provided at all freeway underpasses, except at Barker Road and E. Moreland Boulevard, to prevent vehicles which leave the traveled way from striking the columns or retaining walls adjacent to the shoulder, reducing the width of the shoulders by 3 feet 6 inches.

There are seven sign bridges on this portion of the East-West Freeway, four with one footing located between the median barrier walls and the other footing located beyond the outside shoulder. The footing beyond the shoulder is protected by either a beam guard or impact attenuators. The footings of the remaining three sign bridges are protected by either beam guards or impact attenuators. Lighting on this segment of the East-West Freeway is provided by luminaires mounted on poles generally located between the median barriers. At a point about midway between Sunny Slope Road and Moorland Road, the poles are located beyond the outside shoulder. There is no lighting beyond Moorland Road. With respect to vertical configuration, the freeway is built in a fill section from the Zoo Interchange to S. 124th Street and then is in a cut section; the freeway remains in a cut section to a point about midway between Sunny Slope Road and Moorland Road. From Moorland Road to Barker Road, the freeway is essentially at the same grade as the adjacent land. Between Barker Road and E. Moreland Boulevard, the freeway is in a cut section. With respect to vertical alignment, this segment is characterized by the steepest gradient, about 3.7 percent, and remains 3.7 percent from S. 124th Street to a point about midway between Sunny Slope Road and Moorland Road.

Segment No. 14—East-West Freeway (IH 94) From E. Moreland Boulevard to Meadowbrook Road: This 6.2-mile segment is located in central Waukesha County between E. Moreland Boulevard in the Town of Brookfield and Meadowbrook Road in the Town of Pewaukee, as shown on Map 64. This segment is one of the primary east-west routes serving intraregional and interregional automobile and truck travel in the Milwaukee urbanized area and the Region. Characterized by relatively wide medians, a relatively wide right-of-way, and an open channel storm water drainage system, this segment may be characterized as having a rural cross-section. Two through traffic lanes are provided in each direction on this freeway segment.

The land use adjacent to this freeway segment is varied. Between E. Moreland Boulevard and N. Springdale Road, there is commercial development on both sides of the freeway. From N. Springdale Road to STH 164, the land is predominantly undeveloped, with a quarrying operation located south of the freeway just west of Springdale Road. West of STH 164, the land remains predominantly undeveloped to Grandview Boulevard. There is commercial and industrial development at Grandview Boulevard. Commercial and industrial development flanks both sides of the freeway at Bluemound Road, and there is some commercial development at Grandview Boulevard. Between Grandview Boulevard and Meadowbrook Road, there is undeveloped land, parkland, and commercial land north of the freeway and undeveloped land and residential land south of the freeway.

In 1979, average weekday traffic volumes on this segment ranged from 44,400 vehicles per average weekday just west of E. Moreland Boulevard to 31,300 vehicles per average weekday at Meadowbrook Road. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 2,400 vehicles eastbound and 1,430 vehicles westbound were carried at E. Moreland Boulevard, and 1,500 vehicles eastbound and 710 vehicles westbound were carried at Meadowbrook Road. During the evening peak hour, 4:00 p.m. to 5:00 p.m., 1,600 vehicles eastbound and 2,020 vehicles westbound were carried at E. Moreland Boulevard, and 1,030 vehicles eastbound and 1,360 vehicles westbound were carried at Meadowbrook Road. This freeway segment operates over design capacity in the peak direction during the morning peak hour and at design capacity in the peak direction during the evening peak hour at E. Moreland Boulevard. This freeway segment operates under design capacity at Meadowbrook Road.

Physical Characteristics: The right-of-way of this freeway segment ranges in width from about 240 feet to about 280 feet. At arterial street and freeway-to-freeway interchanges, the right-of-way width increases to accommodate the freeway entrance and exit ramps, requiring up to about 950 feet of right-of-way from the freeway centerline at some arterial crossings.

There are a total of 18 structures at 12 sites on this freeway segment, as shown in Table 123. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) One of the structures is in a freeway-to-freeway interchange, two structures cross a watercourse, two structures are railroad crossings, and the remaining 13 structures are arterial street overpasses or underpasses. As shown in Table 123, the minimum vertical clearance in the eastbound direction is 14 feet 5 inches at Grandview Boulevard, and the least clearance in the westbound direction is 14 feet 7 inches at the USH 16 south-to-east ramp structure as it crosses the westbound lanes of the East-West Freeway. The Bluemound Road structure provides the greatest clearance in the eastbound direction, 18 feet 2 inches, and the E. Moreland Boulevard structure provides the greatest clearance in the westbound direction, 18 feet 5 inches. It should be noted that at those locations where there is more than one structure, the unreported structure may provide greater clearance than the reported structure, but the clearances of the reported structure will control.

The median width for this freeway segment ranges from about 40 feet to about 50 feet. From E. Moreland Boulevard to a point about 0.2 mile east of Springdale Road, the median is 40 feet wide. East of Springdale Road the median begins to widen to 50 feet and reaches 50 feet about 600 feet east of Springdale Road. The median remains 50 feet wide for the remainder of the segment, except the portion through the USH 16 interchange. There are six-foot flush median shoulders between E. Moreland Boulevard and Springdale Road and five-foot flush median shoulders west of Springdale Road. At Bluemound Road, for a distance of about 0.3 mile, a median barrier and flush inside shoulders 12 feet in width are provided in the eastbound direction. The median shoulder does not cross any of the overpass structures on this segment.

Ten-foot-wide outside shoulders are provided in each direction on this freeway segment. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. The outside shoulders cross only the N. Springdale Road structures.

There are two sign bridges on this portion of the East-West Freeway; their footings are protected by beam guards. With respect to vertical configuration, this freeway segment is in a cut section at E. Moreland Boulevard, but is then the same grade as the adjacent land to a point west of STH 164. From here, the freeway is in a cut section west to Bluemound Road. At Bluemound Road the land adjacent to the freeway right-of-way is at the same grade as adjacent lands and remains so for the remainder of the segment. In addition, frontage roads are located on both sides of the freeway between Grandview Boulevard and Meadowbrook Road.

Segment No. 15—Fond du Lac Freeway (USH 41/45) From the North Interchange to Holy Hill Road: This 10.9-mile segment is located in northwest Milwaukee County, passes through northeastern Waukesha County, and proceeds into southeastern Washington County between the North Interchange in the City of Milwaukee and Holy Hill Road in the Village of Germantown, as shown on Map 64. This segment is one of the primary routes serving intraregional and interregional automobile and truck travel between the Milwaukee urbanized area and communities north of the Milwaukee urbanized area. Characterized by relatively narrow median widths, relatively narrow rights-of-way except at arterial street and freeway-to-freeway interchanges, and a storm water drainage system that is more developed than that of rural segments, the portion of this segment from the North Interchange to a point about 760 feet north of County Line Road has an urban cross-section. The remainder of this freeway segment is characterized by relatively wide median widths, a relatively wide right-of-way width, and an open channel storm water drainage system, and has a rural cross-section. This freeway segment has three through traffic lanes in each direction except between Pilgrim Road and Water Street, where four traffic lanes are provided.

Land use development directly adjacent to this freeway segment is varied. The land use adjacent to the eastern end of this segment is primarily

Table 123

DETAILED STRUCTURE INFORMATION FOR SEGMENT 14—EAST-WEST FREEWAY (IH 94): E. MORELAND BOULEVARD TO MEADOWBROOK ROAD

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Eastbound		Westbound				Eastbound		Westbound	
				Eastbound	Westbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
E. Moreland Boulevard	2	X		17'-1"	18'-5"	12'-0"	26'-7"	20'-7"	16'-8"	- -	- -	X	X	X	Collector road continues under this structure westbound
W. Bluemound Road	2	X		18'-2"	16'-2"	12'-0"	28'-6"	12'-0"	28'-6"	- -	- -	X	X	X	Collector roads continue under this structure eastbound and westbound
N. Springdale Road	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No				- -
Fox River	2		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
Chicago, Milwaukee, St. Paul & Pacific/ Soo Line Railroads	2		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -
STH 164	1	X		15'-1"	15'-7"	11'-0"	23'-6"	11'-0"	23'-6"	- -	- -	X	X	X	- -
N. Busse Road.	1	X		14'-7"	16'-4"	10'-0"	23'-6"	10'-0"	23'-6"	- -	- -	X	X	X	- -
N. Pewaukee Road	1	X		15'-2"	14'-9"	22'-0"	23'-9"	22'-0"	23'-9"	- -	- -	X	X	X	- -
W. Bluemound Road	1	X		15'-0"	15'-0"	10'-0"	23'-9"	10'-0"	23'-9"	- -	- -	X	X	X	- -
South-to-East Ramp Over East-to-West Main Line; USH 16 Interchange.	1	X		- -	14'-7"	- -	- -	10'-0"	10'-0"	- -	- -		X	X	- -
N. Grandview Boulevard	1	X		14'-5"	15'-1"	10'-4"	23'-9"	10'-4"	23'-9"	- -	- -	X	X	X	- -
N. Meadowbrook Road.	2		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				- -

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

Source: SEWRPC.

undeveloped except between N. 124th Street and W. Brown Deer Road, where there is commercial development north of the freeway and residential development south of the freeway. West of Pilgrim Road to W. County Line Road there is commercial and industrial development north of the freeway and a combination of commercial, industrial, and residential development south of the freeway. The land adjacent to the remainder of this freeway segment is predominantly undeveloped except in the vicinity of arterial street crossings, where there is some residential development.

Average weekday traffic volumes in 1979 ranged from 38,100 vehicles per average weekday at N. 124th Street to 34,100 vehicles per average weekday at Holy Hill Road. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 1,250 vehicles northbound and 2,130 vehicles southbound were carried at N. 124th Street, and 894 vehicles northbound and 1,400 vehicles southbound were carried at Holy Hill Road. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 2,090 vehicles northbound and 1,360 vehicles southbound were carried at N. 124th Street, and 1,525 vehicles northbound and 1,150 vehicles southbound were carried at Holy Hill Road. As a result of the relatively low peak-hour volumes, this segment operates under design capacity during the peak hours in both directions.

Physical Characteristics: The right-of-way of this segment of the Fond du Lac Freeway ranges in width from about 180 feet to about 310 feet. At arterial street and freeway-to-freeway interchanges the width increases to accommodate the freeway entrance and exit ramps, requiring up to 600 feet of right-of-way from the freeway centerline at some arterial street crossings.

There are a total of 18 structures at 15 locations on this freeway segment, as shown in Table 124. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Three of the structures are in the North Interchange, one is a pedestrian structure, two are railroad structures, and the remaining 12 structures are arterial street overpasses and underpasses. The minimum vertical clearance for each freeway underpass is noted in Table 124. The least clearance in the northbound direction is 14 feet 10 inches at W. Brown Deer Road, and the least clearance in the southbound direction is 15 feet at W. County Line Road. The N. Water Street structure provides the greatest clearance in the northbound direction, 17 feet 3 inches, and the Friestadt Road structure provides the greatest clearance in the southbound direction, 18 feet 4 inches. It should be noted that at those locations where there are two or more structures, the unreported structure may provide greater vertical clearance than the reported structure, but the clearances of the reported structure will control.

The median width for this freeway segment ranges from about 24 feet to about 36 feet. Between the North Interchange and a point 0.2 mile west of N. 124th Street, a 24-foot median is provided; the median remains 24 feet wide to a point about 760 feet north of W. County Line Road. North of W. County Line Road, the median widens to 36 feet in a distance of about 560 feet and remains 36 feet wide along the rest of the segment. A median barrier and seven-foot flush inside shoulders are provided from a point about 0.2 mile east of N. 124th Street to northbound USH 41/45 and to the USH 41/45 southbound exit ramp to STH 145. West of N. 124th Street to a point 760 feet north of W. County Line Road, a box beam barrier and 11-foot-wide flush shoulders are provided. At the W. Brown Deer Road, Pilgrim Road, and W. County Line Road structures, as well as at the sign bridge locations, concrete median barriers are provided, reducing the width of the median shoulders to 9 feet 6 inches. The remainder of this freeway segment has 10-foot-wide flush shoulders. The median shoulders cross only the Chicago, Milwaukee, St. Paul & Pacific Railroad (Milwaukee Road) structure. In addition, the southbound USH 41/45 exit ramp to STH 145 is located in the median.

Ten-foot-wide outside shoulders are provided in both directions on this freeway segment. These shoulders are interrupted where the freeway entrance ramps merge with the mainline pavement and the freeway exit ramps diverge from the mainline pavement. In addition, the outside shoulders do not cross the south-to-north mainline USH 41/45 structure as it crosses the north-to-south mainline STH 145 structure, or the north-to-south mainline USH 41/45 to STH 145 structure as it crosses the south-to-north STH 145 structure.

There are five sign bridges on this freeway segment. Two of the bridges are in the North Interchange, and their footings are protected by beam guards. One footing of the remaining three sign bridges, located along the remainder of the segment, is located in the median, and one footing is

Table 124

DETAILED STRUCTURE INFORMATION FOR SEGMENT 15—FOND DU LAC FREEWAY (USH 41/45): NORTH INTERCHANGE TO GERMANTOWN/RICHFIELD TOWN LINE (HOLY HILL ROAD)

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Northbound		Southbound				Northbound		Southbound	
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
South-to-North USH 41/45 Over North-to-South STH 145; North Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
North-to-South USH 41/45 to North-to-South STH 145 Over South-to-North STH 145; North Interchange	1		X	Unlimited	Unlimited	--	--	--	--	No	No				--
North-to-South USH 41/45 Over STH 145; North Interchange	1		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
N. 124th Street	2		X	Unlimited	Unlimited	--	--	--	--	--	--				--
N. 124th Street	1		X	Unlimited	Unlimited	--	--	--	--	Yes	No				--
W. Brown Deer Road	1	X		14'-10"	15'-5"	5'-4"	9'-9"	5'-4"	9'-9"	--	--				Ramps continue under structure northbound and southbound
N. Pilgrim Road	1	X		15'-0"	15'-5"	2'-9"	9'-9"	2'-9"	9'-9"	--	--				Ramps continue under structure northbound and southbound
N. Water Street	1	X		17'-3"	16'-1"	29'-4"	11'-6"	29'-2"	11'-6"	--	--	X		X	Pedestrian structure
W. County Line Road	1	X		15'-6"	15'-0"	--[c]	9'-6"	--[c]	9'-6"	--	--		X		--
N. Maple Road	1	X		16'-9"	15'-7"	--[c]	22'-3"	--[c]	22'-3"	--	--		X		--
W. Lannon Road	2	X		15'-0"	15'-1"	--[c]	22'-3"	--[c]	22'-3"	--	--		X		--
W. Mequon Road	1	X		16'-4"	16'-0"	30'-0"	22'-3"	30'-0"	22'-3"	--	--	X	X	X	--
W. Friestadt Road	1	X		16'-9"	18'-4"	--[c]	22'-3"	--[c]	22'-3"	--	--		X		--
Chicago, Milwaukee, St. Paul & Pacific Railroad	2		X	Unlimited	Unlimited	--	--	--	--	Yes	Yes				--
W. Holy Hill Road	1	X		16'-9"	17'-4"	--[c]	22'-3"	--[c]	22'-3"	--	--		X		--

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

[c] *This structure has no columns adjacent to the outside shoulders and no true horizontal clearance. However, there is a slope from the edge of the shoulder or from a ditch adjacent to the shoulder up to the abutment which will limit the clearance available beyond the shoulder's edge.*

Source: SEWRPC.

located beyond the outside shoulder and protected by a beam guard. Lighting at the eastern end of this freeway segment is provided by luminaires mounted on poles placed beyond the outside shoulder. With respect to vertical configuration, this freeway segment is at the same grade as the adjacent land. In addition, frontage roads are provided on both sides of the North Interchange. North of the freeway a frontage road is provided to W. Brown Deer Road. West of Pilgrim Road on the north side of the freeway a frontage road is provided to N. Water Street, and south of the freeway a frontage road is provided between N. Water Street and W. County Line Road. There are also frontage roads on both sides of the freeway over portions of the segment between Mequon Road and Friestadt Road. Finally, just west of Pilgrim Road, there is an at-grade railroad crossing of the Milwaukee Road.

Segment No. 16—Airport Spur (STH 119) From S. Howell Avenue to the Airport Spur Interchange: This 1.8-mile freeway segment is located in eastern Milwaukee County between S. Howell Avenue and the Airport Spur Interchange in the City of Milwaukee, as shown on Map 64. This freeway segment facilitates travel to Milwaukee County's General Mitchell Field. Characterized by relatively narrow median widths, a relatively narrow right-of-way width except at arterial street and freeway-to-freeway interchanges, and a closed conduit storm water drainage system, this segment has an urban cross-section. Two through traffic lanes are provided in each direction on this freeway segment.

The land use adjacent to this freeway segment is predominantly residential and commercial. There is institutional development south of the freeway between the North-South Freeway (IH 94) and S. 13th Street. General Mitchell Field is located at the eastern end of the segment.

The average weekday traffic volume in 1979 on this segment was 14,350 vehicles per average weekday. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 790 vehicles eastbound and 300 vehicles westbound were carried along this segment. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 490 vehicles eastbound and 650 vehicles westbound were carried along this freeway segment. Because of the relatively low peak-hour volumes, this segment operates under design capacity in both directions.

Physical Characteristics: The right-of-way of this freeway segment ranges in width from about 310 feet to about 430 feet. At arterial street and freeway-to-freeway interchanges, the right-of-way width increases to accommodate the freeway entrance and exit ramps, requiring up to 400 feet of right-of-way from the freeway centerline at S. Howell Avenue.

There are a total of 12 structures at six locations on this freeway segment, as shown in Table 125. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Two of the structures are in the Airport Spur Interchange, two structures are railroad crossings, and the eight remaining structures are arterial street crossings. All of the structures on this freeway segment are overpasses.

Between S. Howell Avenue and a point about 240 feet east of S. 6th Street, the median width is varied. East of S. 6th Street the median is 26 feet wide. Where the median is 26 feet wide, barrier walls are provided in the center of the median along with eight-foot-wide flush shoulders. Barrier walls and flush inside shoulders are also provided on the west side of the eastbound structure at S. Howell Avenue and on the east side of the westbound structure.

Ten-foot-wide flush outside shoulders are provided in each direction on this freeway segment. These shoulders are interrupted where freeway entrance ramps merge with the mainline pavement and where freeway exit ramps diverge from the mainline pavement. In addition, in the approach to each of the structures a barrier wall is provided adjacent to the outside shoulder, reducing the width to 8 feet at those locations.

There are four sign bridges on this freeway segment. One footing of three of the bridges is in the median placed between the barrier walls, and the other footing is placed beyond the outside shoulder. The fourth sign bridge spans the entire freeway. Lighting on this segment is provided by luminaires mounted on poles placed between the median barrier walls. With respect to vertical configuration, the entire segment is built on a fill section. Finally, a frontage road is provided between S. Howell Avenue and S. 6th Street on the north side of the freeway.

Table 125

DETAILED STRUCTURE INFORMATION FOR SEGMENT 16—AIRPORT SPUR (STH 119): GENERAL MITCHELL FIELD TO AIRPORT SPUR INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]		
						Northbound		Southbound				Northbound		Southbound
				Northbound	Southbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside
S. Howell Avenue	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	No	- -	- -	- -
S. 6th Street	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes	- -	- -	- -
Chicago, Milwaukee, St. Paul & Pacific Railroad . .	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes	- -	- -	- -
S. 13th Street	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes	- -	- -	- -
S. 14th Street	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes	- -	- -	- -
IH 94; Airport Spur Interchange	2		X	Unlimited	Unlimited	- -	- -	- -	- -	Yes	Yes	- -	- -	- -

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

Source: SEWRPC.

Table 126

DETAILED STRUCTURE INFORMATION FOR SEGMENT 17—PARK FREEWAY: N. MILWAUKEE STREET TO HILLSIDE INTERCHANGE

Location of Structure	Number of Structures at This Location	Underpass	Overpass	Minimum Vertical Clearance[a]		Horizontal Clearance[a]				Shoulder Crosses		Column Location[b]			Remarks
						Eastbound		Westbound				Eastbound		Westbound	
				Eastbound	Westbound	Outside	Median	Outside	Median	Outside	Median	Outside	Median	Outside	
Park Freeway	2		X	Unlimited	Unlimited	- -	- -	- -	- -	No	No				Structures begin at N. Milwaukee Street and continue to a point west of N. 6th Street
N. 10th Street	1	X		14'-11"	22'-7"	6'-0"	3'-6"	8'-6"	9'-6"	- -	- -		X	X	Pedestrian structure; continues eastbound under structure—minimum vertical clearance 15'-7"
North-to-East Ramp Over East-to-South Ramp; Hillside Interchange	1	X		- -	22'-1"	- -	- -	8'-6"	4'-6"	- -	- -		X	X	- -
Relocated W. Winnebago Street; Hillside Interchange. . . .	1	X		14'-0"	- -	8'-6"	12'-0"	- -	- -	- -	- -	X	X		- -
Relocated W. Winnebago Street; Hillside Interchange. . . .	1	X		- -	- -	- -	- -	8'-6"	2'-0"	- -	- -		X	X	Minimum vertical clearance at this location is under south-to-north mainline structure
South-to-North Main Line Over East-to-South Ramp; Hillside Interchange	1	X		- -	14'-11"	- -	- -	8'-6"	2'-0"	- -	- -		X	X	- -

[a] *At sites with two structures, the minimum clearances presented here are the minimum available at the site. Data were obtained from the Wisconsin Department of Transportation plans; actual construction may result in minor deviations from the plan values.*

[b] *An "X" indicates the presence of columns supporting a structure overpassing the freeway; "outside" refers to a column adjacent to the edge of the shoulder.*

Source: SEWRPC.

Segment No. 17—Park Freeway From N. Milwaukee Street to the Hillside Interchange: This 1.1-mile freeway segment is located in eastern Milwaukee County between N. Milwaukee Street and the Hillside Interchange in the City of Milwaukee, as shown on Map 64. This segment facilitates access into and out of the northern side of the Milwaukee central business district. Characterized by relatively narrow median widths, a relatively narrow right-of-way width except at arterial street and freeway-to-freeway interchanges, and a closed conduit storm water drainage system, this segment has an urban cross-section. Three through traffic lanes are provided in each direction on this freeway segment.

The land use adjacent to this freeway segment is primarily commercial and industrial. At the eastern end of this freeway segment, there is some residential development, and there is institutional development on the south side of the freeway between N. 6th Street and N. 7th Street.

Average weekday traffic volumes in 1979 ranged from 18,500 vehicles per average weekday just east of the Milwaukee River to 35,700 vehicles per average weekday just east of the Hillside Interchange. During the morning peak hour, 7:00 a.m. to 8:00 a.m., 1,280 vehicles eastbound and 550 vehicles westbound were carried at the Milwaukee River, and 2,440 vehicles eastbound and 780 vehicles westbound were carried at the Hillside Interchange. During the evening peak hour, 4:30 p.m. to 5:30 p.m., 810 vehicles eastbound and 1,150 vehicles westbound were carried at the Milwaukee River, and 1,040 vehicles eastbound and 2,200 vehicles westbound were carried at the Hillside Interchange. Because of the relatively low peak-hour volumes, this freeway segment operates under design capacity during the peak hours in both directions.

Physical Characteristics: The right-of-way of this freeway segment ranges in width from about 180 feet to about 200 feet. At arterial street and freeway-to-freeway interchanges, the right-of-way width increases to accommodate the freeway entrance and exit ramps, requiring, for example, up to 400 feet from the freeway centerline at some arterial street crossings.

There are a total of seven structures at five locations on this freeway segment, as indicated in Table 126. (Maps detailing each freeway segment and identifying its structures are available in the Commission files.) Four of the structures are in the freeway-to-freeway interchange, one is a pedestrian structure, and the remaining two structures are combined arterial street, railroad, and watercourse structures. The two combined crossing structures extend between N. Milwaukee Street and a point about midway between N. 6th Street and N. 7th Street. The minimum vertical clearance at each freeway underpass is indicated in Table 126. The least clearance in the eastbound direction is 14 feet at the relocated Winnebago Street structure as it crosses the south-to-east ramp structure in the Hillside Interchange, and the least clearance in the westbound direction is 14 feet 11 inches at the south-to-north mainline IH 43 structure as it crosses the east-to-south ramp structure in the Hillside Interchange. The pedestrian structure at N. 10th Street provides the greatest vertical clearance in both the eastbound and westbound directions, with clearances of 14 feet 11 inches and 22 feet 7 inches, respectively.

The median width for this freeway segment varies along its entire length. A barrier wall is provided in the median from a point 150 feet east of the N. 10th Street structure through the Hillside Interchange; a flush median shoulder is also provided that varies in width up to 7 feet 6 inches. This shoulder is located adjacent to the east-to-south ramp structure only, and constitutes the only median shoulder on this segment. There are three ramps located in the median, each ramp terminating at N. 6th Street. Two of these ramps are exit ramps—one in each direction—that diverge from the mainline pavement, and the other is an eastbound entrance ramp that merges with the mainline pavement.

There are no outside shoulders provided on the elevated portion of the segment between N. Milwaukee Street and a point midway between N. 6th and N. 7th Streets. Seven-foot-wide outside shoulders are provided between the elevated portion of the freeway segment and the N. 10th Street pedestrian structure, which are separated from the roadway by a three-foot-wide mountable curb. The shoulder on the north side of the freeway is interrupted by a freeway entrance ramp that merges with the mainline pavement. In addition, the outside shoulder crosses neither of the structures at the eastern end of the segment. A barrier wall has been constructed at all the freeway underpasses adjacent to the outside shoulder to prevent vehicles that leave the traveled way from striking the columns, reducing the shoulder width by 3 feet 6 inches.

There are six sign bridges located on this segment. The footings of two of the bridges are an integral part of the parapet walls of the eastbound Park Freeway structure. One footing of the remaining four sign bridges is located in the median, and one footing is located beyond the outside shoulder; these footings are protected by beam guards. Lighting on this segment is provided by luminaires mounted on poles placed beyond the outside shoulder. With respect to vertical configuration, this freeway segment is elevated between N. Milwaukee Street and a point about midway between N. 6th and N. 7th Streets. From there it is in a cut section.

Marquette Interchange: The Marquette Interchange, located at the southwest corner of the Milwaukee central business district, marks the confluence of IH 43, IH 94, and IH 794. Because of its location, primary transit use of the freeway system will need to utilize this interchange, which makes the vertical clearances in the interchange of critical importance. The minimum vertical clearance at each underpass in the Marquette Interchange is presented in Table 127.

There are nine sign bridges in the interchange. Lighting is provided by luminaires mounted on poles located on parapet walls. Land use adjacent to the freeway within the interchange is primarily devoted to parking and industrial development.

Table 127

MARQUETTE INTERCHANGE MINIMUM VERTICAL CLEARANCES

Location	Minimum Vertical Clearance
East-to-South Ramp Over West-to-East Main Line	15'-0"
South-to-North Main Line Over North-to-East Ramp	15'-0"
South-to-North Main Line Over East-to-North Ramp	14'-10"
East-to-West Main Line Over South-to-North Main Line	15'-7"
East-to-West Main Line Over North-to-South Main Line	14'-11"
North-to-South Main Line Over West-to-North Ramp	15'-0"
North-to-East Ramp Over East-to-South Ramp	14'-10"

Source: SEWRPC.

Summary

The availability of potential exclusive fixed guideway alignments along freeway rights-of-way is an important consideration in the Milwaukee area primary transit system alternatives analysis, since such availability may significantly affect the cost and practicability of alternative system configuration and of alternative modes. This section has presented the findings of an inventory of the extent, location, and physical characteristics of freeway facilities in the Milwaukee urbanized area that are important to the assessment of alternative light rail transit, heavy rail rapid transit, and exclusive busway alignments. The inventory findings include pertinent data on the right-of-way and shoulder width of each segment of the freeway system, and on critical vertical clearances, along with data on current directional traffic volumes during peak weekday travel hours.

The Milwaukee urbanized area has about 103 miles of freeway on eight different routes, the majority of which may be characterized as having urban cross-sections. There are, however, sections of freeway rights-of-way in the Milwaukee urbanized area that are characterized as having rural cross-sections. Land use development adjacent to the freeway rights-of-way is varied, typically including residential, commercial, industrial, and institutional development. The average weekday traffic volumes in 1979 ranged from 13,600 vehicles per average weekday to 113,800 vehicles per average weekday. The lowest average weekday volumes generally occur at the fringes of the Milwaukee urbanized area, where the land is principally in agricultural and other rural open uses; and the highest average weekday traffic volumes generally occur at the Milwaukee central business district, where the intensity of urban development is the highest.

Freeway right-of-way widths are dependent upon the freeway type. Freeway segments having a rural cross-section are characterized by a right-of-way width ranging from about 320 feet to about 330 feet. For freeway segments characterized as having an urban cross-section, the right-of-way width is much narrower, characterized by a maximum width of about 230 feet. In addition, the right-of-way width for both types of freeway increase at arterial and street and freeway-to-freeway interchanges to accommodate the freeway entrance and exit ramps. Additional right-of-way width is required where topographic features along the freeway rights-of-way required a freeway segment to be constructed in cut sections to provide a smooth roadway profile, and to provide for side slopes at moderate grades to minimize erosion.

The freeway system in the Milwaukee urbanized area has a total of 358 structures that separate the freeway from arterial streets, freeways, railroads, and watercourses. These structures impose a restriction on the physical size of vehicles that can operate on the freeway system. Generally, structures in the freeway-to-freeway interchanges provide the most stringent restrictions with respect to both vertical and horizontal clearances.

The median of the rural cross-section portions of each freeway segment is generally characterized by widths greater than 40 feet, and, in general, medians less than 30 feet wide characterize urban cross-sections. Median widths between 30 feet and 40 feet could represent either freeway type, depending upon other construction details. In the Milwaukee urbanized area, freeway segments with an urban cross-section have been constructed with a physical barrier separating the opposing traffic movements, except the Fond du Lac Freeway (STH 145) and portions of the Park Freeway. Flush median shoulders are generally provided along those portions of freeway rights-of-way where median barriers are provided, except at the northern end of the North-South Freeway (IH 43) and at certain overpass and underpass structures. The East-West Freeway (IH 94), between the Marquette Interchange and the Zoo Interchange, the East-West Freeway (IH 794) between the Lake Interchange and the Marquette Interchange, and the Park Freeway are characterized by entrance and exit ramps that merge into and diverge from the mainline pavements in the median, interrupting the continuity of inside shoulder construction.

Outside shoulders are provided on virtually the entire freeway system, but vary in width. The outside shoulders are not continuous across every structure, particularly where freeway and entrance and exit ramps merge into and diverge from the mainline pavements, interrupting the outside shoulder construction. At the majority of freeway overpasses on segments having urban cross-sections, a barrier is provided adjacent to the outside shoulder columns, reducing the width of the shoulder—except at the Fond du Lac Freeway (STH 145) and at the northern end of the North-South Freeway (IH 43).

Other physical characteristics of the freeway system have been presented, including sign bridge and freeway lighting locations. In addition, the vertical configuration of each freeway segment has been described. In general, freeway segments having a rural cross-section are predominantly at the same grade as adjacent lands, while freeways characterized by an urban cross-section are primarily located in cut sections when passing under freeway crossings and in fill sections when passing over a freeway crossing.

Finally, a number of physical characteristics are common to most or all of the freeway segments, including 12-foot-wide traffic lanes and light poles located either two feet or five feet beyond the edge of the outside shoulder and between median barrier walls. Sign bridges on most freeway segments have an interior footing located between the median barrier walls and an exterior footing located sufficiently beyond the outside shoulder so as not to be a controlling factor for horizontal clearance. With respect to vertical clearances, sign bridges provide either 17 feet minimum clearance, or a clearance of one foot more than that of an adjacent traffic-carrying structure.

Feasibility of Using Freeways for Rapid Primary Transit

The feasibility of utilizing existing freeway corridors for the provision of rapid primary transit service over fixed guideways located in the freeway median, on the outside shoulders, or on nonroadway portions of the right-of-way, or for the provision of bus service operating over reserved lanes of the freeway, was determined by an evaluation of the inventory data for each freeway segment against the physical and operating requirements of the various primary transit modes. The inventory data considered in the evaluation consisted primarily of horizontal and vertical curvatures; vertical clearances; pavement, median, and outside shoulder widths; and the widths and characteristics of any unoccupied portions of the freeway right-of-way adjacent to the freeway pavements and shoulders. The physical and operating requirements of the various primary transit modes considered in the evaluation included absolute and desirable maximum criteria for horizontal and vertical alignment, and absolute and desirable minimum criteria for horizontal and vertical clearances as reported in SEWRPC Technical Report No. 24, State-of-the-Art of Primary Transit System Technology, and summarized in Table 107 of this chapter. Also, for the assessment of reserved bus lane primary transit feasibility, the existing traffic volumes on the freeway were considered, including directional imbalances.

In general, the most critical obstacles to the accommodation of primary transit guideways or reserved lanes in the Milwaukee area freeway system are the constraints imposed by the characteristics of the freeway-to-freeway interchanges; freeway-to-arterial street interchanges; freeway overpasses of streets, railways, and watercourses; and freeway underpasses of streets and railways. Freeway medians and outside shoulders are sometimes not provided through under- and overpasses, or if provided are generally narrower than the medians or shoulders of freeway segments between such under- or overpasses. And even more importantly, medians or shoulders cannot be physically continued through interchanges, because either the medians or the shoulders must cross freeway-to-freeway ramps or freeway entrance and exit ramps at the interchanges.

This problem of ramp crossings at freeway interchanges by potential primary transit alignments in particular hinders the use of the freeway outside shoulders, the nonroadway portion of the right-of-way, and reserved lanes located adjacent to the outside shoulders. This is because most of the ramps on the Milwaukee freeway system are associated with arterial street interchanges, and the overwhelming number of these ramps enter or exit from the right-hand side of the freeway as shown on Map 65. At freeway-to-freeway interchanges, ramps generally enter and exit on both the right-hand and left-hand sides of the freeway in equal numbers. There are a limited number of arterial street interchanges served by left-hand ramps, as shown on Map 66.

Grade separation of primary transit alignments is required at freeway-to-freeway ramps and freeway exit ramps. With respect to freeway entrance ramps, it may be possible to modify the freeway entrance ramp signalization that is presently a part of the limited freeway operational control system in effect in Milwaukee County, utilizing that signalization to eliminate conflicts between transit vehicles operating over exclusive lanes or alignments and automobile traffic entering the freeway system.

There are a limited number of alternatives for grade-separating freeway-to-freeway ramps and freeway exit ramps from primary transit alignments in the freeway right-of-way. One alternative is the reconstruction of interchanges so that along any segment of freeway with a primary transit alignment, all ramps enter from the side of the freeway opposite the primary transit facility location. Because of the prevalence of right-hand entrance ramps, this is a practicable alternative only for primary transit facilities located in the median or in reserved lanes adjacent to the median. Another alternative would involve the construction of an elevated, depressed, or tunneled transit guideway at the ramp to be crossed. The least costly and likely only feasible option with respect to this alternative would be an elevated guideway. However, at ramps located at interchanges with arterial street overpasses, and at freeway-to-freeway ramps overpassing the freeway having the potential to accommodate primary transit alignment, the elevated guideway would have to be constructed to clear the overpasses. A third separation alternative, feasible at some interchanges with arterial streets, would be the closure of the freeway entrance or exit ramps crossed by the primary transit facility alignments. This would likely only be considered in primary transit system alternatives which would use the freeway median or lanes adjacent to the freeway, again because of the limited number of ramps involved.

The alternatives calling for the reconstruction of freeway interchanges or the construction of elevated, depressed, or tunneled guideways are capital intensive. Such alternatives would not provide for primary transit service utilizing a freeway right-of-way at a minimal cost. However, they may offer the potential to provide rapid primary transit facilities at a minimum of community disruption.

Because the objective of this inventory is to identify those primary transit alignments in the Milwaukee area which have the potential to accommodate rapid primary transit service at both a minimum of cost and disruption, it is important to determine the extent to which elevated or tunneled guideway construction at interchanges or interchange reconstruction is necessary to readily accommodate primary transit facilities. Because of the number of freeway ramps crossing the outside shoulders and the remaining portion of the freeway right-of-way, it is likely that only freeway medians and reserved lanes adjacent to the medians will be readily available for the location of fixed guideway primary transit facilities. It should be noted, however, that there are similar problems inherent to both freeway-to-freeway interchanges and arterial street interchanges with left-hand freeway entrance and exit ramps; these problems require special solutions in order to accommodate fixed guideway facility locations in medians and reserved lane locations adjacent to medians.

Map 65

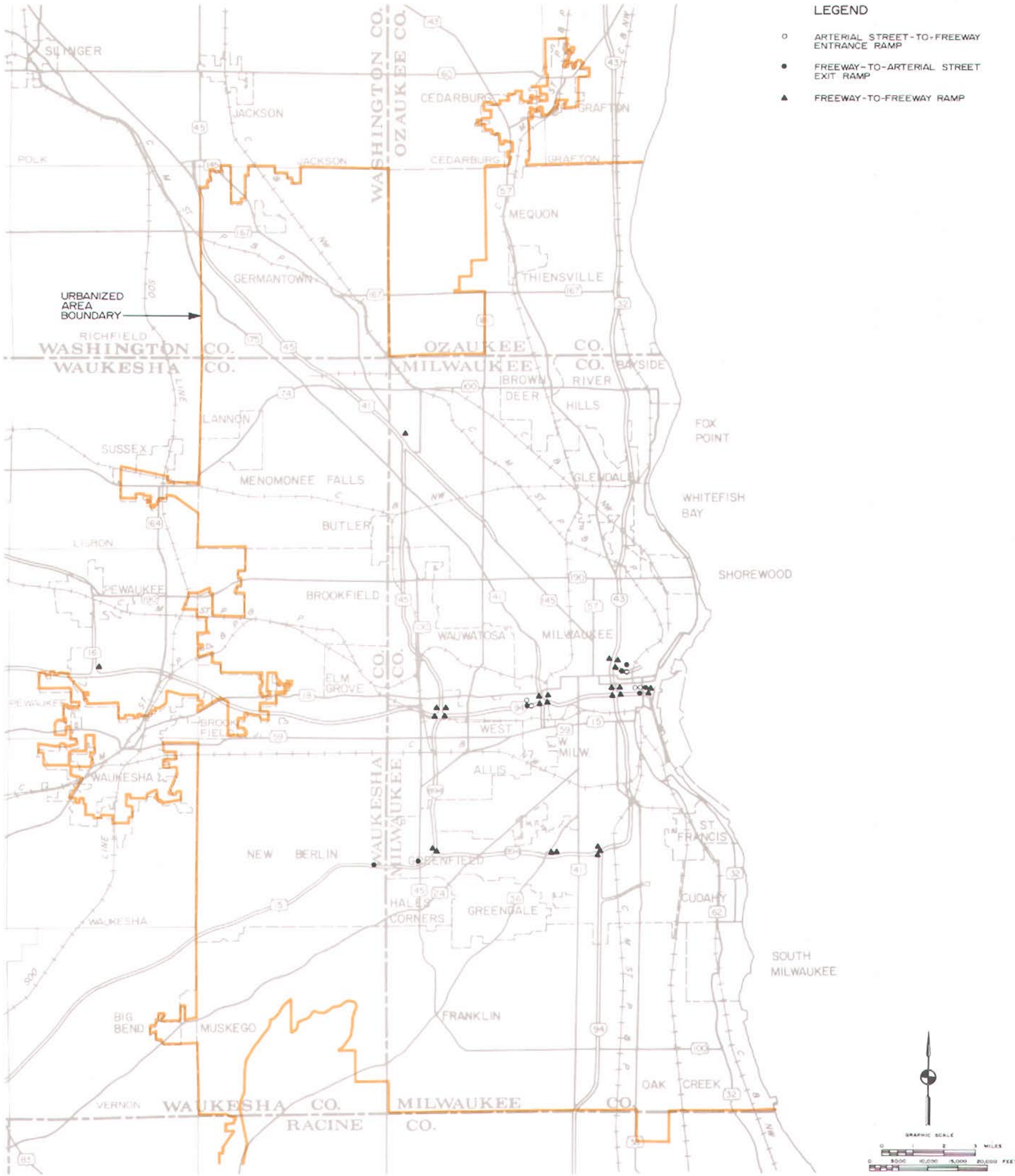
LOCATION OF RIGHT-HAND OR OUTSIDE SHOULDER RAMPS ON THE MILWAUKEE AREA FREEWAY SYSTEM

The problem of ramp crossings at freeway interchanges by potential primary transit alignments located on the freeway right-of-way hinders the use of the freeway outside shoulders, the nonroadway portion of the freeway right-of-way, and, for reserved busways, the lanes located adjacent to the outside shoulders. This is because most of the ramps on the Milwaukee freeway system are associated with arterial street interchanges, and the overwhelming number of these ramps enter or exit from the right-hand side of the freeway.

Source: SEWRPC.

Map 66

LOCATION OF LEFT-HAND OR MEDIAN RAMPS ON THE MILWAUKEE AREA FREEWAY SYSTEM



There are a limited number of arterial street interchanges served by left-hand ramps on the Milwaukee area freeway system. At freeway-to-freeway interchanges, ramps generally enter and exit on both the right-hand and left-hand sides of the freeway.

Source: SEWRPC.

In the following sections, the feasibility of providing dual guideways for both light rail and heavy rail is explored, and the feasibility of providing either single or dual guideways for motor buses is examined. The feasibility of single guideways in freeway corridors is explored only for a system utilizing buses, because only buses can utilize existing freeway lanes in the nonpeak direction to travel back to the beginning of the primary transit guideway against the peak directional use of the guideway. Freeway medians, outside shoulders, and other parts of the freeway right-of-way are examined as alternative guideway locations for these three primary transit modes. In addition, single reserved freeway lanes for buses in both normal flow and contraflow directions are examined as alternative rapid transit guideways for buses.

The median, shoulder, and nonroadway locations of certain segments of the existing freeway system in the Milwaukee area provide no advantage over other possible alignments for guideways in terms of cost or disruption. These segments are eliminated from further consideration in this inventory of potential alignments for primary transit facilities, except with respect to the reservation of existing lanes for buses (see Map 67). These segments include the structure on the North-South Freeway (IH 94) which begins at approximately W. National Avenue on the south and continues into the Marquette Interchange on the north, and the structure on the Lake Freeway (IH 794) which begins at S. Carferry Drive on the south and continues into the Lake Interchange on the north. The median and outside shoulders of these structures are insufficient to carry a dual guideway for light or heavy rail, or a single or dual guideway for motor buses. An elevated dual or single guideway structure could be accommodated in some segments of the median or outside shoulders of these two structures, but its construction would be excessively costly because of the extensive modifications to the existing freeway structures that would be required to provide for the construction of columns to support a primary transit guideway structure.

At-grade or elevated guideway construction also appears to be impractical on the East-West Freeway (IH 794) between the Marquette Interchange and the Lake Interchange (see Map 67). The median and outside shoulders of this structure are not of sufficient width to accommodate dual light or heavy rail guideways or single or dual bus guideways. In addition, the median of this stretch of freeway is used for freeway entrance and exit ramps, which would require that freeway traffic cross any at-grade primary transit facility in the median. An elevated guideway in the median or outside shoulders of the structure appears impractical because of the difficulties which would be encountered in building through or over the Marquette Interchange along the East-West Freeway. In addition, the existing freeway structure would require extensive modification to provide for the construction of columns to support a primary transit elevated guideway structure.

Another freeway segment not suitable for at-grade or elevated guideway construction is the North-South Freeway (IH 43) between the Marquette Interchange and the Hillside Interchange. An at-grade guideway appears impractical because of narrow median and outside shoulder widths and the number of freeway entrance and exit ramps, both in the median and at the outside shoulders of this freeway segment. The use of an elevated guideway would not be possible over the northbound lanes of the North-South Freeway between W. Wells and W. State Streets since the Milwaukee County Courthouse Annex is situated over those lanes.

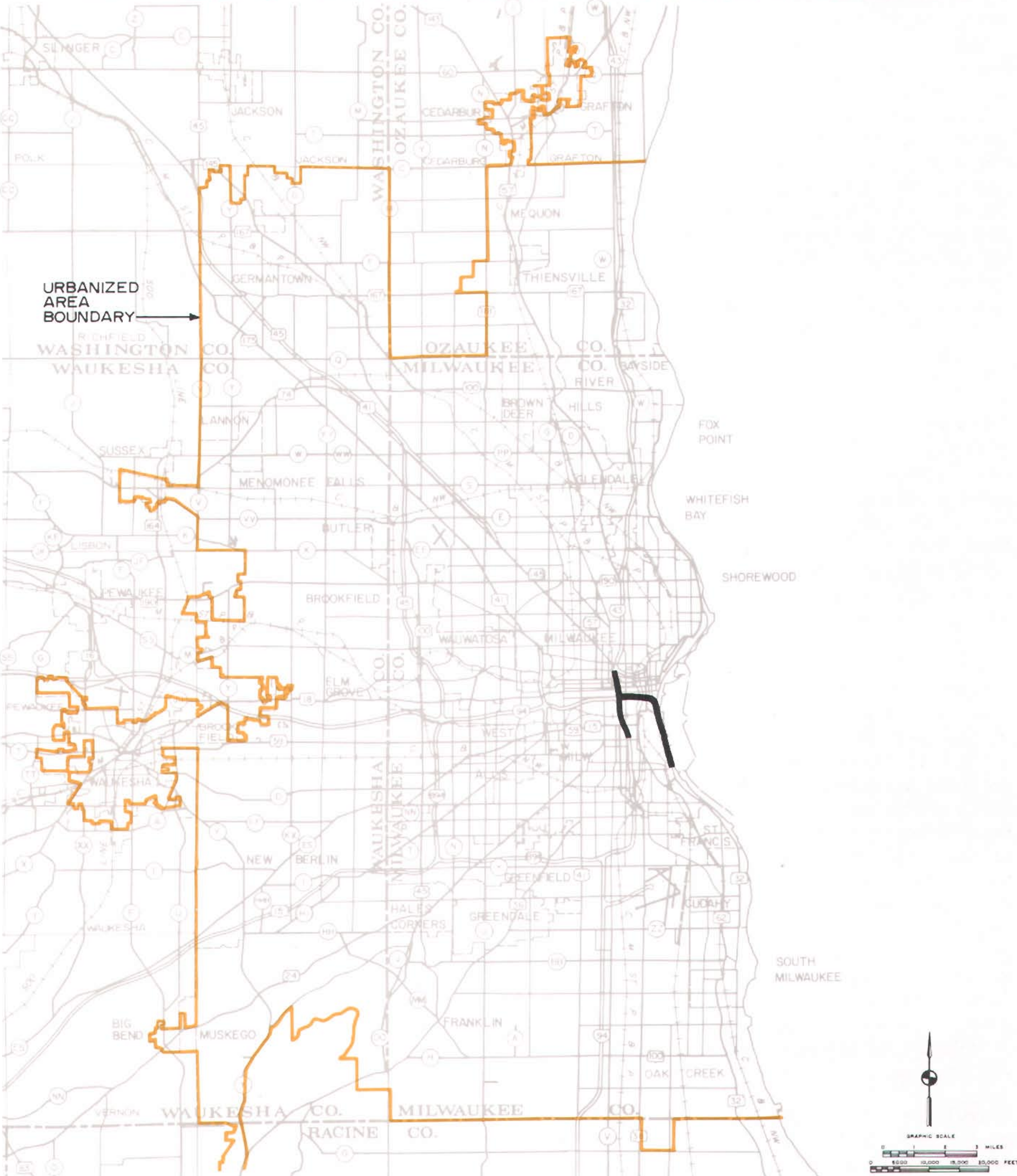
On the basis of this initial screening, a total of about six miles of the freeway system may be eliminated from further consideration as potential locations of at-grade or elevated guideways. The eliminated segments are critical because they include the last sections of three freeways leading into the Milwaukee central business district.

Feasibility of Using Fixed Guideways for Buses: The construction of single or dual guideways for buses in the median, outside shoulders, or nonroadway parts of the freeway right-of-way would not be precluded over any segment of the Milwaukee freeway system by the horizontal or vertical alignment of the freeways. In fact, desirable maximum criteria for vertical alignment of busways are met on all parts of the Milwaukee area freeway system. There are only three locations on the freeway system where desirable horizontal alignment criteria are not met: the East-West Freeway (IH 94) at W. Plainfield Avenue (6^{o}-30' curve), and the North-South Freeway (IH 43) at W. North Avenue (5^{o}-45' curve) and at W. Brown Street (5^{o}-45' curve). These horizontal alignments, however, meet the minimum criteria for busways.

In addition, all of the structures on the freeway system in the Milwaukee area meet the minimum vertical clearance criteria for busways.

Map 67

PORTIONS OF FREEWAY SYSTEM WHERE CONSTRUCTION OF A FIXED TRANSIT GUIDEWAY FOR PRIMARY TRANSIT SERVICE WAS FOUND TO BE NOT FEASIBLE BASED ON INITIAL SCREENING



On the basis of an initial screening, a total of about six miles of the freeway system can be eliminated from further consideration as potential locations for at-grade or elevated guideways for primary transit service. These segments are critical because they include sections of three freeways leading into the central business district of Milwaukee. These segments include the structure on the North-South Freeway (IH 94) which begins at W. National Avenue and continues through the Marquette Interchange; the structure on the Lake Freeway (IH 794) extending from Carferry Drive through the Lake Interchange; the East-West Freeway (IH 794) between the Marquette Interchange and the Lake Interchange; and the North-South Freeway (IH 43) between the Marquette Interchange and the Hillside Interchange. The median and outside shoulders of these structures are not of sufficient width to accommodate dual light or heavy rail lines or single or dual busways.

Source: SEWRPC.

However, some structures do not meet the desirable vertical clearance criteria, particularly those in older freeway segments and in the freeway-to-freeway interchanges.

The only absolute minimum criterion for dual or single bus guideways which is not met on all segments of the freeway system in medians, outside shoulders, and nonroadway portions of the right-of-way is the minimum guideway width. Problems in meeting this criterion are identified in the following sections.

Median Feasibility: The absolute minimum median width assumed to be required to accommodate an at-grade dual busway in a freeway median is 29 feet, and the desirable minimum median width assumed to be required to accommodate such a busway in a freeway median is 39 feet. These minimum widths are seven feet more than the absolute and desirable bus dual guideway widths set forth in Table 107. This is because it is assumed that if busways are constructed in the freeway median, an additional seven feet of width will be required in order to provide barrier walls to separate opposing freeway traffic flows. Preferably, the required barrier walls would be reconstructed at the outside of the median to not only separate opposing freeway traffic, but also separate bus traffic in the median lanes from the freeway traffic flow, particularly where the bus flow is opposite to the direction of the freeway traffic flow.

As shown on Map 68, there are about 27 miles of freeway in the Milwaukee area with a median width sufficient to accommodate a desirable width, at-grade, dual busway. Another 20 miles of freeway have sufficient median width to accommodate a minimum width, at-grade, dual busway. There are about 50 miles of freeway, including three freeways leading to the Milwaukee central business district, with median widths that will not accommodate a minimum width, at-grade, dual busway. Over 12 of these 50 miles have a median width of less than 22 feet, that width being required for an at-grade dual busway without barrier walls. Six miles of freeway in the Milwaukee area were previously identified as being impractical for any guideway development, including such development in the freeway median. Also noted on Map 68 are those 17 locations on the existing freeway system where freeway-to-freeway ramps and freeway entrance and exit ramps cross the freeway median; these locations would require the reconstruction of freeway interchanges or the grade separation of the primary transit guideway and the freeway-to-freeway ramps and exit ramps. Most of the ramps where grade separation would be required, 36 of 38, occur on the 50 miles of freeway where an elevated dual busway would be required regardless because of limited median width.

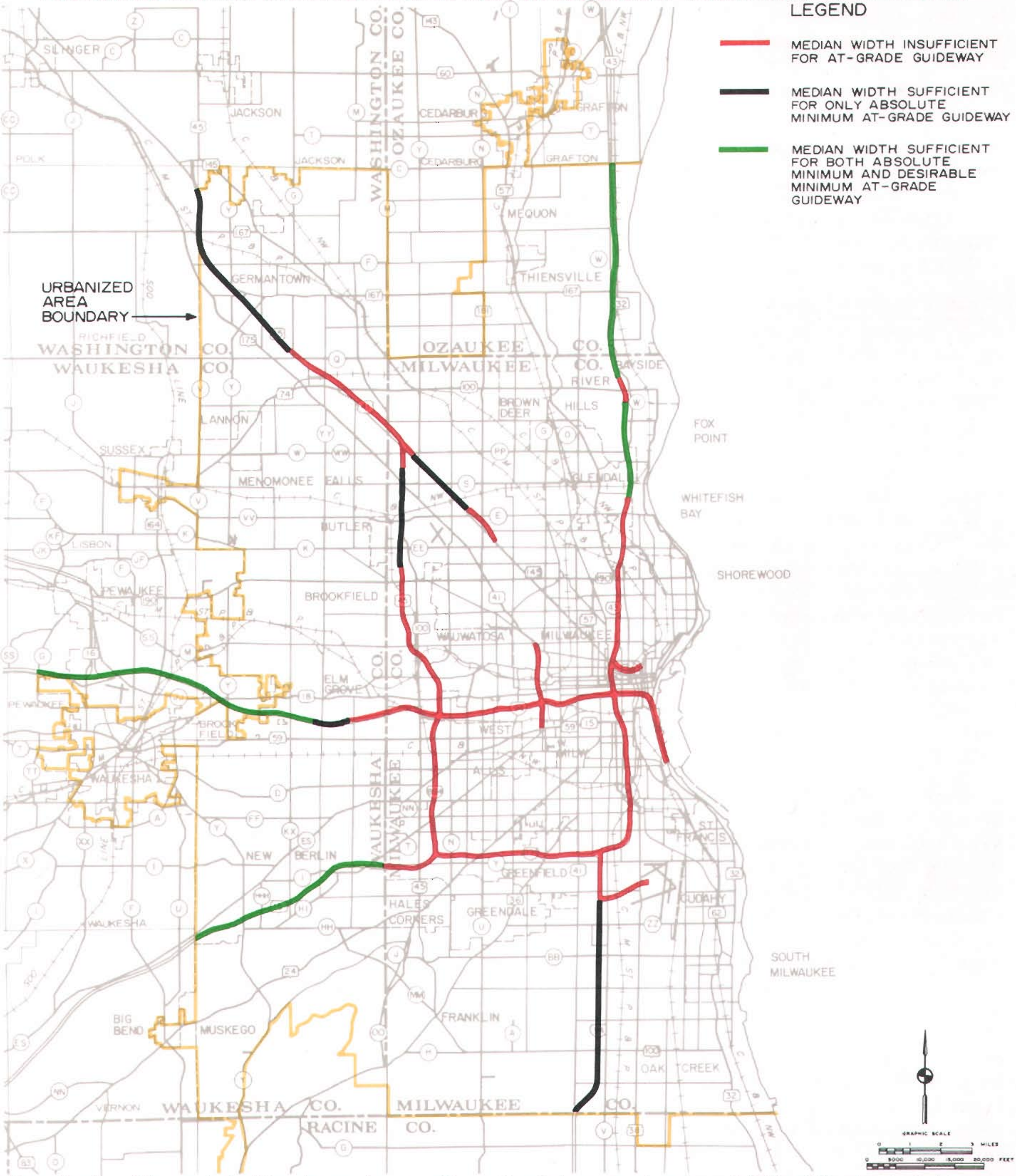
Location of an elevated dual busway in the median of these 50 miles of freeway would, however, provide little economic advantage, particularly as it would likely require either structures high enough to provide adequate clearance at arterial street or railway overpasses to the freeway, or the rebuilding of arterial street overpasses to accommodate at-grade crossings of the bus guideway. There are 129 arterial street or railway overpasses on these 50 miles of freeway, as shown on Map 68. It should be noted that, in addition, over these 50 miles of freeway an elevated busway would need to be constructed through, over, or around the Zoo, Stadium, Hale, Airport, Marquette, and Hillside Interchanges. As an alternative the interchanges could be reconstructed to move all merging and diverging lanes to the outside freeway shoulder, as shown in Figure 25. However, such an alternative would likely be unattractive because of cost, effect on capacity, and freeway traffic disruption during construction.

To accommodate an absolute minimum width, at-grade, single busway, a median width of 18 feet is required. A median width of 27 feet would be required to accommodate a desirable width, at-grade, single busway. Again, seven feet has been added to the absolute minimum and desirable minimum widths in order to provide for median barrier walls.

As shown on Map 69, there are about 46 miles of freeway in the Milwaukee area with a median width sufficient to accommodate a desirable width, at-grade, single bus guideway. Another three miles of freeway have sufficient median width to accommodate a minimum width, at-grade, single bus guideway. There are about 48 miles of freeway, including three freeways leading to the Milwaukee central business district, with median widths that will not accommodate a minimum width, at-grade bus guideway. On 35 of these 48 miles, the median width is insufficient only at the 90 freeway underpasses along these 35 miles. Six miles of freeway in the Milwaukee area were previously identified as being impractical for any guideway development, including such development in the freeway median.

Map 68

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF DUAL BUSWAY IN THE MEDIAN

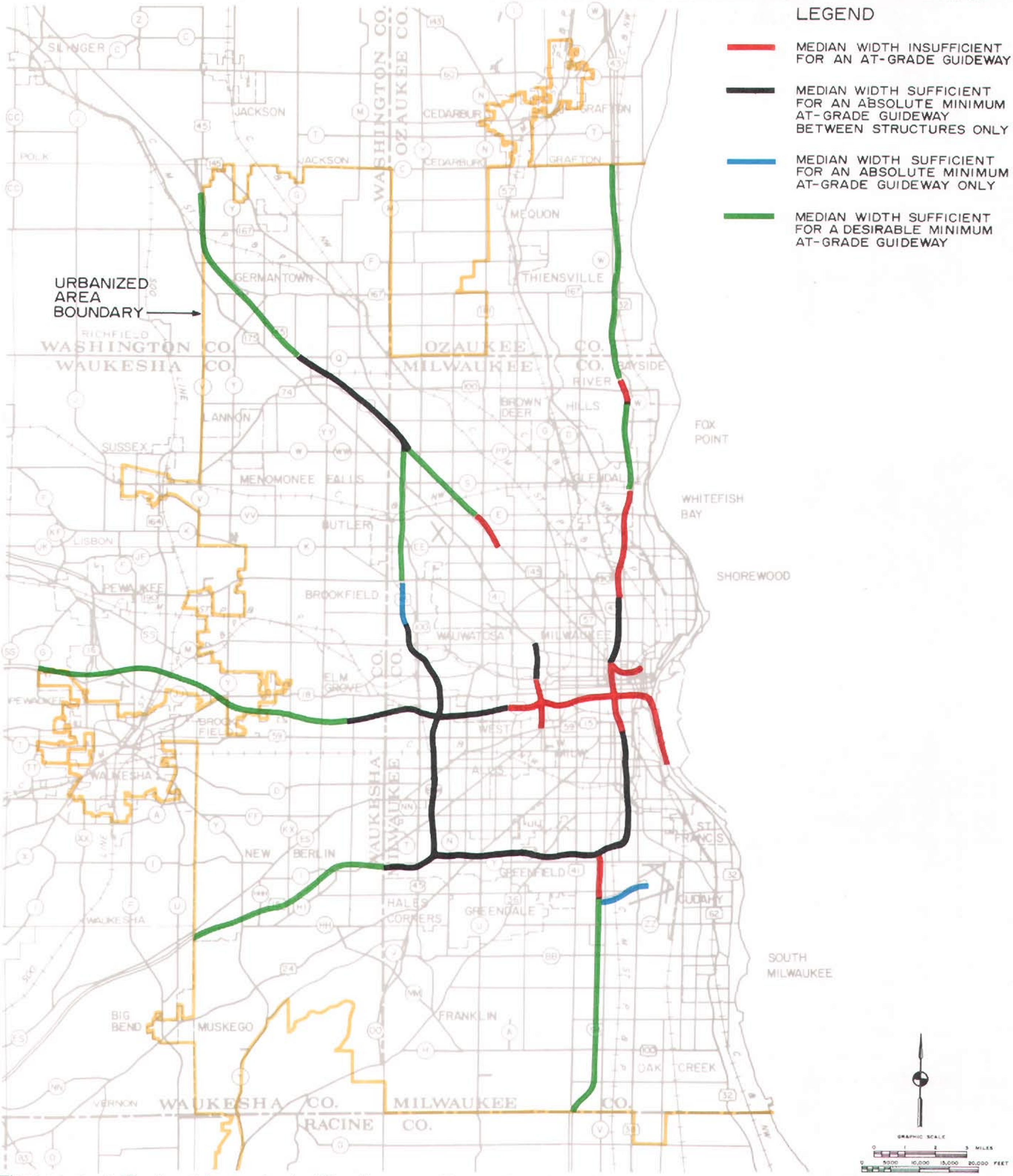


About 27 miles of freeway in the Milwaukee area have a median width sufficient to accommodate a desirable width, at-grade, dual busway; 20 miles have median width sufficient to accommodate a minimum width, at-grade, dual busway; and about 50 miles have a median width which could only accommodate a dual busway if elevated. In addition, there are 17 locations along the freeway system where freeway-to-freeway ramps and freeway entrance and exit ramps cross the freeway median. These locations would require either reconstruction of the interchanges or grade separation of the primary transit guideway. On those portions of the freeway system requiring grade separation of primary transit fixed guideway facilities, a dual busway would require elevated structures high enough to provide adequate clearance at 129 arterial street and railway overpasses.

Source: SEWRPC.

Map 69

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF A SINGLE BUSWAY IN THE MEDIAN

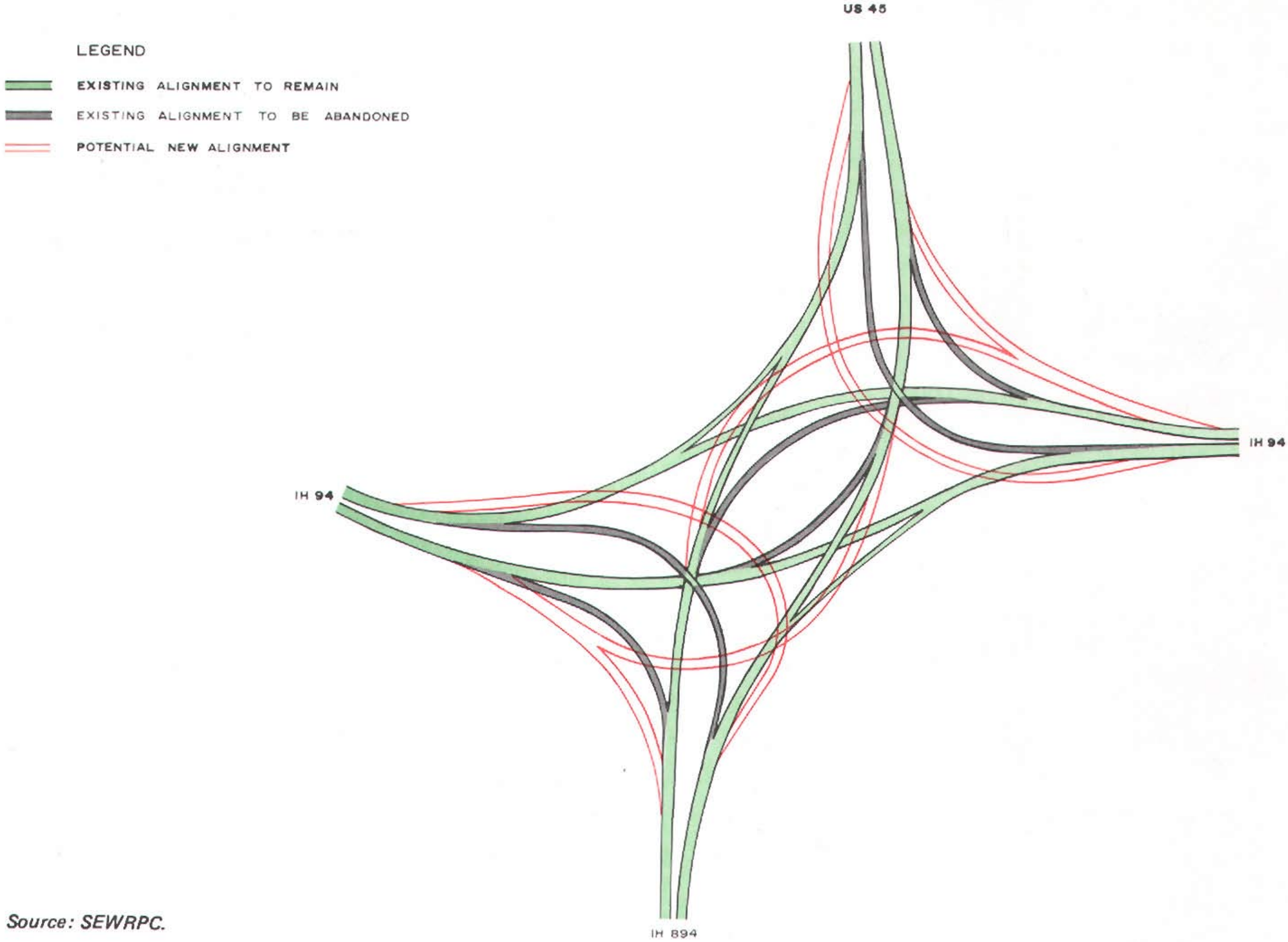


There are about 46 miles of freeway in the Milwaukee area with a median width sufficient to accommodate a desirable width, at-grade, single busway; three miles with a median width sufficient to accommodate a minimum width, at-grade, single busway; and 48 miles of freeway with median widths insufficient to accommodate even a minimum width, at-grade, single busway. In addition, there are 17 locations on the freeway system, most of which are along the 48 miles of freeway with insufficient median widths, where freeway-to-freeway ramps and freeway entrance and exit ramps cross the freeway median. These locations would require either the reconstruction of freeway interchanges or the grade separation of the primary transit guideway and the freeway-to-freeway ramps and freeway exit ramps. On those portions of the freeway system which could not accommodate an at-grade, single busway, location of an elevated single bus guideway would require structures high enough to provide adequate clearance at 112 arterial street and railway overpasses.

Source: SEWRPC.

Figure 25

NECESSARY RECONSTRUCTION OF ZOO INTERCHANGE TO MOVE ALL MERGING AND DIVERGING LANES TO FREEWAY OUTSIDE SHOULDERS



Source: SEWRPC.

Also shown on Map 69 are those 17 locations on the freeway system where freeway-to-freeway ramps and freeway entrance and exit ramps cross the freeway median. These locations would require the reconstruction of freeway interchanges or the grade separation of the primary transit guideway and the freeway-to-freeway ramps and freeway exit ramps. Most of these ramps, 36 of 38, occur either on the 13 miles of freeway where an elevated dual guideway would be required regardless because of limited median width, or on the 35 miles of freeway where an elevated guideway or the reconstruction of freeway underpasses would be required because of insufficient median width at freeway underpasses.

It would be possible to locate an elevated single bus guideway in the median of these 35 miles of freeway, but such an alternative would probably provide little economic advantage, particularly as it would require structures high enough to provide adequate clearance at arterial street and railway overpasses. There are 112 arterial street or railway overpasses on the 48 miles of freeway where an elevated guideway would be necessary, as shown on Map 69. It should be noted that, in addition, over these 48 miles of freeway an elevated guideway would need to be constructed through, over, or around the Zoo, Stadium, Hale, Airport, Marquette, and Hillside freeway interchanges. As an alternative, the interchanges could be reconstructed to move all merging and diverging lanes to the freeway shoulder.

Outside Shoulder Feasibility: An absolute minimum horizontal clearance of 11 feet and desirable width of 20 feet on each side of the freeway is required for the location of a single at-grade busway on each outside shoulder of a freeway, assuming no barrier is provided to separate the busway from the freeway traffic lanes. The absolute minimum width of 11 feet exceeds the shoulder width provided on each side of all freeways in the Milwaukee area. However, right-of-way is generally available to accommodate the absolute or desirable minimum busway width between freeway structures, assuming retaining walls are constructed to accommodate the backslopes. The controlling factor with regard to horizontal clearance in the construction of busways along the outside shoulders of the Milwaukee area freeway system is the horizontal clearance available at freeway underpass and overpass structures. As shown on Map 70, there are only about 26 miles of freeway with sufficient horizontal clearance to accommodate a single busway on each shoulder. On about 60 miles of freeway, the horizontal clearance at freeway underpasses precludes the utilization of the shoulder area on either side of the freeway for an absolute minimum width, at-grade, single busway without the reconstruction of the structure. In addition, on about 11 miles of freeway, the freeway overpasses would require minor reconstruction to accommodate a single guideway on either outside freeway shoulder. These critical freeway underpasses and overpasses are shown on Map 70.

As noted earlier, probably a greater obstacle than the reconstruction of these 319 freeway underpasses and overpasses is the crossing of the outside shoulder by freeway-to-freeway ramps and freeway entrance and exit ramps. Grade separations would need to be provided at 31 freeway-to-freeway ramps and at 145 freeway exit ramps, as shown on Map 70. Freeway on-ramp signalization, presently provided as part of the existing limited freeway operational control system in effect in Milwaukee County, could be used in lieu of grade separation to avoid conflicts between bus traffic on the shoulder busway and automobile traffic entering the freeway.

Nonroadway Right-of-Way Feasibility: One of the constraints on the construction of a busway along the nonroadway portions of the freeway rights-of-way in the Milwaukee area is the limited width of the right-of-way on either side of the freeway. As shown on Map 71, the nonroadway portion of the right-of-way of about 46 miles of freeway is of sufficient width to accommodate the location of a dual at-grade busway. In addition, there are about 46 miles of freeway which could accommodate a dual at-grade busway on the right-of-way assuming the extensive use of retaining walls, which would be required because of the freeway cross-section. Finally, the nonroadway portion of the right-of-way of about 5 miles of freeway is too narrow to accommodate a dual at-grade busway and would require special construction. Similarly, 5 miles of freeway in the Milwaukee area could not accommodate a single at-grade busway, 46 miles of freeway would require extensive use of retaining walls to accommodate a single at-grade busway, and another 46 miles of freeway could readily accommodate a single at-grade busway in the nonroadway portion of its right-of-way.

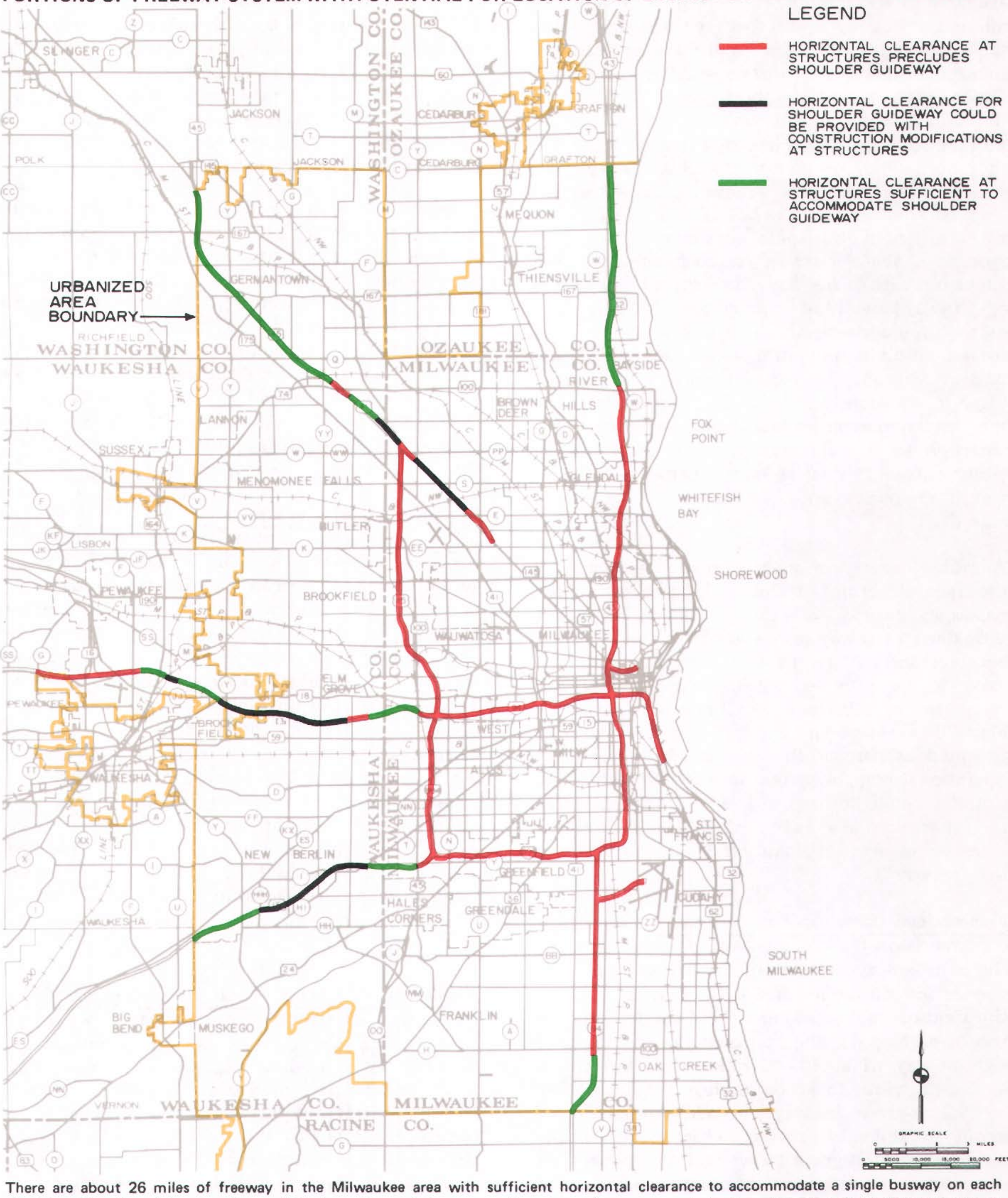
Major obstacles to the use of the nonroadway portion of the freeway right-of-way are the freeway-to-freeway and freeway-to-arterial street interchanges, which make the nonroadway portion of the freeway right-of-way discontinuous. Grade separations through elevated guideways would be required at freeway-to-freeway ramps, at freeway exit ramps, and over arterial streets and railways which pass over the freeway (see Map 71). The use of signalization may be adequate at freeway entrance ramps which cross the busway at nonroadway portions of the right-of-way, as shown on Map 71.

Conclusions for Feasibility of Bus Fixed Guideways: The medians, outside shoulders, and nonroadway portions of the Milwaukee area freeway system cannot be readily used for motor bus single or dual fixed guideways. Particularly on those freeways in the central portion of Milwaukee County, which can be expected to be congested in the future, only elevated busways appear feasible. This is because of not only the limited horizontal clearance available in the medians, shoulders, and nonroadway portions of the rights-of-way, but the need to separate the busway from freeway-to-freeway ramps and freeway entrance and exit ramps which cross the potential busway alignments. The construction of elevated busways would be particularly difficult because of the need to go through, over, or around freeway-to-freeway interchanges, and to go over other overpasses to the freeway.

Feasibility of Using Fixed Guideways for Light Rail: The construction of dual guideways for light rail in the median, outside shoulders, or nonroadway portions of the freeway rights-of-way would not be precluded over any segment of the Milwaukee freeway system by the horizontal or vertical alignment of the freeways. In fact, desirable maximum criteria for horizontal and vertical alignment of light rail guideways are met on all parts of the Milwaukee area freeway system. In addition, all of the structures on the freeway system in the Milwaukee area meet the minimum vertical clearance criteria for light rail guideways.

Map 70

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF BUSWAY ON THE FREEWAY SHOULDER

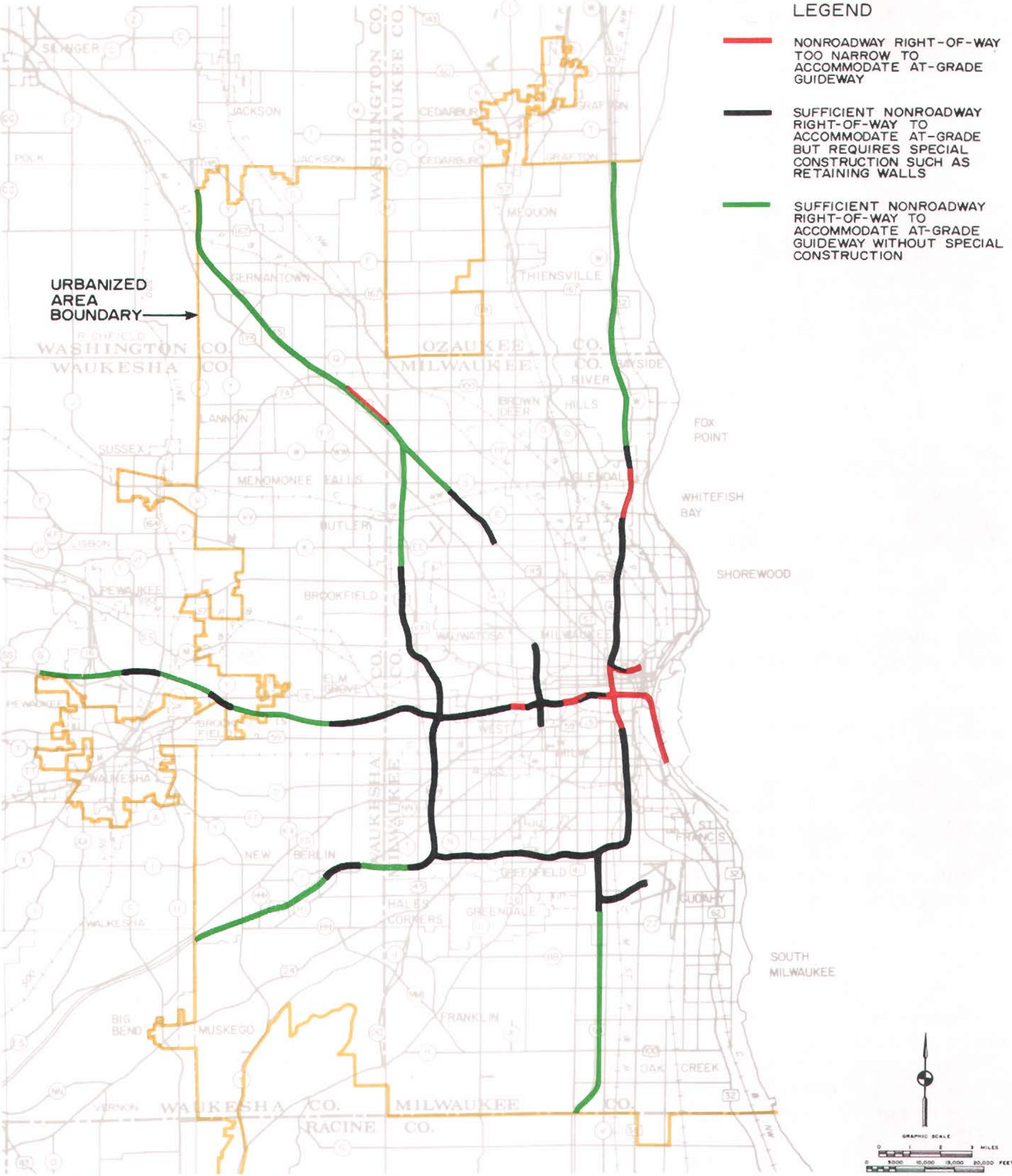


There are about 26 miles of freeway in the Milwaukee area with sufficient horizontal clearance to accommodate a single busway on each shoulder; 60 miles of freeway along which the horizontal clearance at freeway underpasses precludes the utilization of the shoulder area on either side of the freeway for even an absolute minimum width, at-grade, single busway without reconstruction of the structure; and about 11 miles along which freeway overpasses would require minor reconstruction to accommodate a single guideway on either outside shoulder. In addition, grade separation would need to be provided at 31 freeway-to-freeway ramps and at 145 freeway exit ramps where these ramps cross the outside shoulders.

Source: SEWRPC.

Map 71

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF BUSWAY ON THE NONROADWAY AREA OF FREEWAY RIGHT-OF-WAY



On about 46 miles of freeway in the Milwaukee area the nonroadway portion of the right-of-way is of sufficient width to accommodate the location of a dual or single at-grade busway; on about another 46 miles the nonroadway portion could accommodate a dual or single at-grade busway on the right-of-way but would require the use of retaining walls; and on 5 miles the nonroadway portion is too narrow to accommodate a dual or single at-grade busway. The major obstacles to the use of the nonroadway portion of the freeway right-of-way are the freeway-to-freeway and freeway-to-arterial street interchanges, which make the nonroadway portion of the right-of-way discontinuous. Grade separations would be required at freeway-to-freeway ramps, at freeway exit ramps, and over arterial street and railway overpasses.

Source: SEWRPC.

The only absolute minimum criterion for dual light rail guideways which is not met on all segments of the freeway system in medians, outside shoulders, and nonroadway portions of the right-of-way is the minimum guideway width. Problems in meeting this criterion are identified in the following sections.

Median Location Feasibility: Twenty-seven feet has been assumed to be the absolute minimum median width required to accommodate an at-grade, dual, light rail guideway in a freeway median, and 39 feet has been assumed to be the desirable minimum median width required to accommodate such a light rail guideway in a freeway median. These minimum widths are seven feet more than the absolute and desirable light rail dual guideway widths set forth in Table 107. This is because it is assumed, as for busways, that an additional seven feet of width will be required for light rail guideways constructed in the freeway median in order to provide barrier walls to separate opposing freeway traffic flows. Preferably, the required barrier walls would be reconstructed outside the median not only to separate opposing freeway traffic, but also to separate light rail traffic in the median lanes from the freeway traffic flow.

As shown on Map 72, there are about 27 miles of freeway in the Milwaukee area with a median width sufficient to accommodate a desirable width at-grade, dual, light rail guideway. Another 18 miles of freeway have sufficient median width to accommodate a minimum width, at-grade, dual, light rail guideway. There are about 52 miles of freeway, including three freeways leading to the Milwaukee central business district, with median widths that will not accommodate a minimum width, at-grade, light rail guideway. On 30 of these 52 miles, the median width is insufficient only at the 90 freeway underpasses along these 30 miles. Six miles of freeway in the Milwaukee area were previously identified as being impractical for any guideway development, including such development in the freeway median.

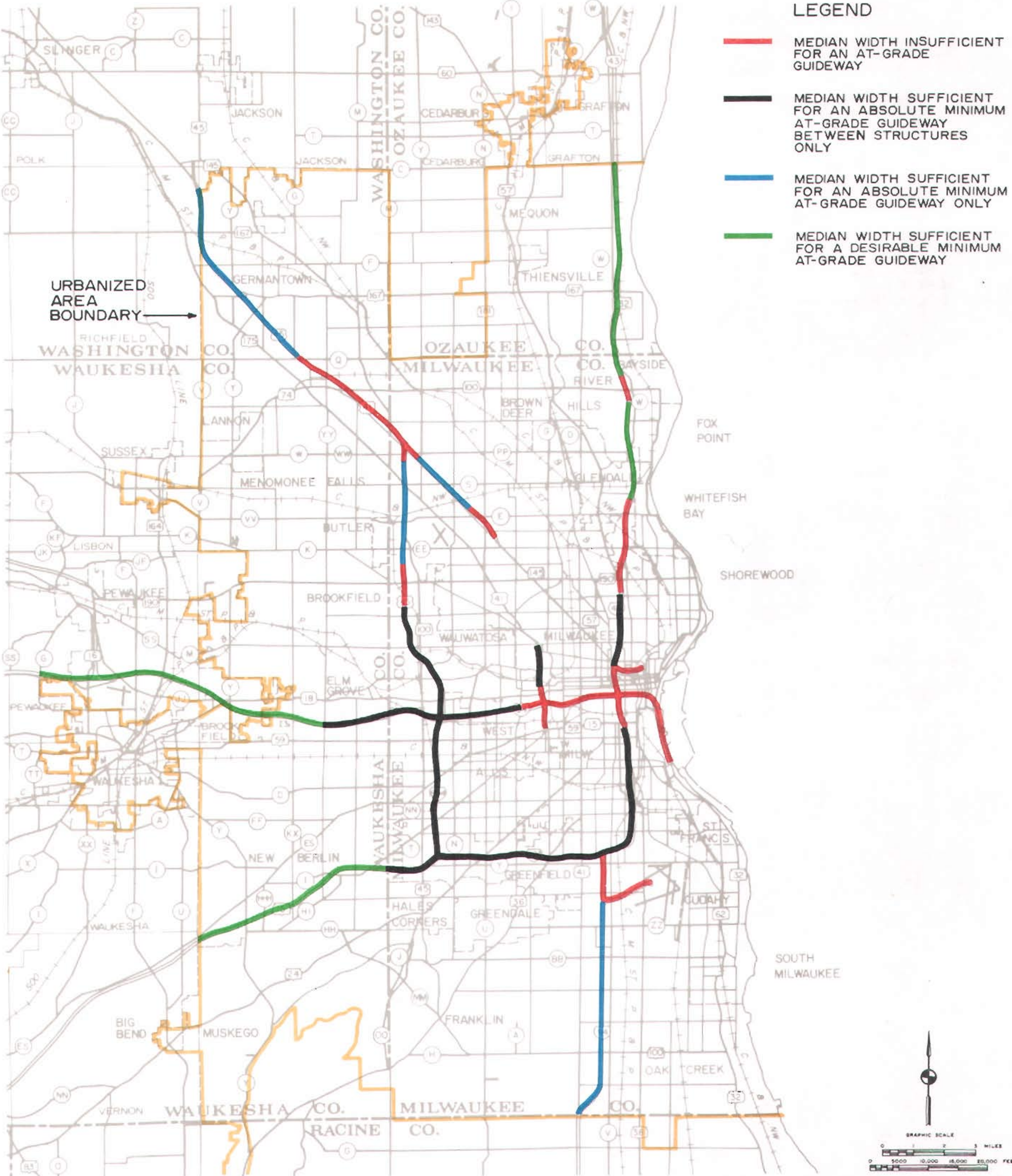
Also noted on Map 72 are those 17 locations on the existing freeway system where freeway-to-freeway ramps and freeway entrance and exit ramps cross the freeway median, and where the reconstruction of freeway interchanges or the grade separation of the primary transit guideway and the freeway-to-freeway ramps and freeway exit ramps would thus be required. Most of these ramps where grade separation would be required, 36 of 38, occur either on the 22 miles of freeway where an elevated dual guideway would be required because of limited median width, or on the 30 miles of freeway where an elevated guideway or the reconstruction of freeway underpasses would be required because of insufficient median width at freeway underpasses.

Location of an elevated light rail guideway in the median of the freeway would, however, probably provide little economic advantage, particularly as it would require structures high enough to provide adequate clearance at arterial street or railway overpasses of the freeway. There are 129 arterial street and railway overpasses on the 52 miles of freeway where an elevated guideway would be necessary, as shown on Map 72. It should be noted that, in addition, over these 52 miles of freeway an elevated guideway would need to be constructed through, over, or around the Zoo, Stadium, Hale, Airport, Marquette, and Hillside Interchanges. As an alternative, the interchanges could be reconstructed to move all merging and diverging lanes to the freeway shoulder.

Outside Shoulder Feasibility: A dual light rail guideway could be located along the outside shoulders of the freeway if single guideways serving opposite directions were provided on opposite shoulders. An absolute minimum horizontal clearance of 10 feet and a desirable width of 20 feet on both sides of the freeway is required for the location of a single at-grade, light rail guideway on each outside shoulder of a freeway, assuming no barrier is provided to separate the guideway from the freeway traffic lanes. As shown on Map 73, there are about 40 miles of freeway with sufficient horizontal clearance to accommodate a single light rail guideway on each shoulder; however, retaining walls would need to be constructed along some segments to maintain the backslopes of the freeway right-of-way. Also, at certain freeway underpasses, barrier walls protecting structure supports would have to be removed to accommodate a minimum width light rail guideway. On about 15 miles of freeway, the horizontal clearance at freeway underpasses precludes the utilization of the shoulder area on either side of the freeway for an absolute minimum width, at-grade, single light rail guideway, even if barrier walls were removed. The reconstruction of 55 structures, or the use of an elevated guideway, would be required along these 15 miles of freeway. In addition, on about 42 miles of freeway, the freeway underpasses or overpasses would require only minor reconstruction to accommodate a single guideway on either outside freeway shoulder. These critical 71 freeway underpasses and 55 freeway overpasses are shown on Map 73.

Map 72

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF LIGHT RAIL TRANSIT FIXED GUIDEWAY IN THE FREEWAY MEDIAN

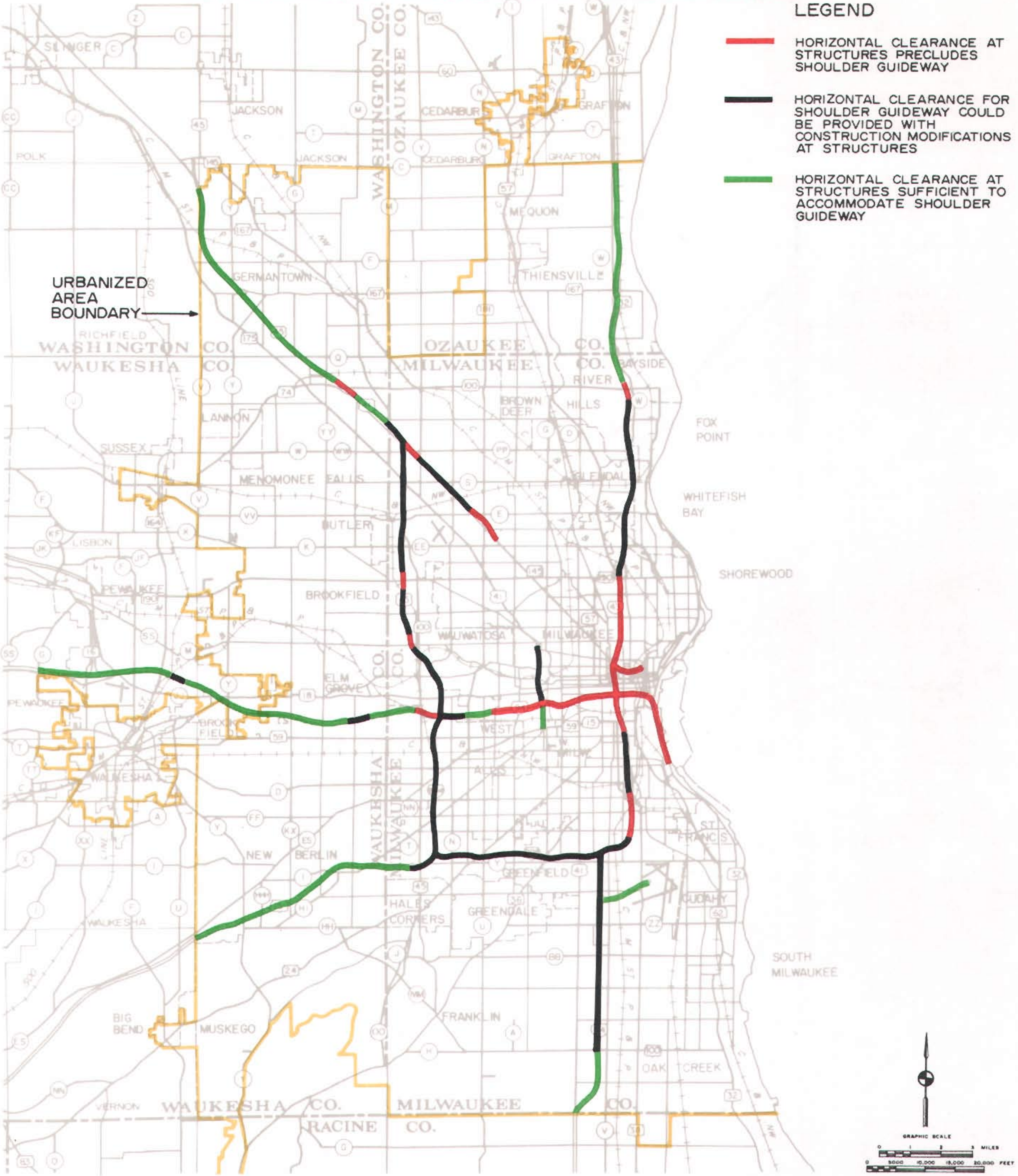


There are about 27 miles of freeway in the Milwaukee area with a median width sufficient to accommodate a desirable width, at-grade, double-track light rail transit guideway in the median; 18 miles of freeway with a median width sufficient to accommodate a minimum width, at-grade, double-track light railway; and about 52 miles of freeway with median widths that will not accommodate even a minimum width, at-grade, double-track light rail transit guideway. There are 17 locations along the freeway system where freeway-to-freeway ramps and freeway entrance and exit ramps cross the freeway median. These locations would require either the reconstruction of freeway interchanges of the grade separation of the primary transit guideway and the freeway-to-freeway ramps and freeway exit ramps. Most of the ramps where grade separation would be required occur either on the 22 miles of freeway where an elevated dual guideway would be required because of limited median width, or on the 30 miles of freeway where an elevated guideway or the reconstruction of freeway underpasses would be required because of insufficient median width. Location of an elevated light rail transit guideway in the median of the freeway would require structures high enough to provide adequate clearance at the 129 arterial street and railway overpasses on the 52 miles of freeway where an elevated guideway would be necessary.

Source: SEWRPC.

Map 73

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF LIGHT RAIL TRANSIT FIXED GUIDEWAY IN THE FREEWAY SHOULDERS



There are about 40 miles of freeway in the Milwaukee area with sufficient horizontal clearance to accommodate a single-track light rail transit guideway on each shoulder, and about 15 miles of freeway along which the horizontal clearance at freeway underpasses precludes the utilization of the shoulder area on either side of the freeway for an absolute minimum width, at-grade, single-track light rail transit guideway. Either the reconstruction of 55 structures or the use of an elevated guideway would be required along these 15 miles of freeway. On about 42 miles of freeway, the structures would require only minor reconstruction to accommodate a single-track railway on either outside freeway shoulder. In addition, grade separation would need to be provided at 31 freeway-to-freeway ramps and at 117 freeway exit ramps where these structures cross the outside shoulders.

Source: SEWRPC.

As noted earlier, probably a greater obstacle than the reconstruction of these 181 freeway underpasses and overpasses is the crossing of the outside shoulder by freeway-to-freeway ramps and freeway entrance and exit ramps. Grade separations would need to be provided at 31 freeway-to-freeway ramps and at 117 freeway exit ramps, as shown on Map 73. Freeway entrance ramp signalization, presently provided as part of the limited freeway operational control system in effect in Milwaukee County, could be used in lieu of grade separation to avoid conflicts between light rail traffic on the shoulder guideway and automobile traffic entering the freeway.

Nonroadway Right-of-Way Feasibility: One of the constraints on the construction of an at-grade light rail guideway along the nonroadway portions of the freeway rights-of-way in the Milwaukee area is the limited width of the right-of-way on either side of the freeway. To accommodate the absolute minimum width, dual, at-grade light rail guideway, 20 feet is required on one side of the freeway, or 10 feet is required on each side of the freeway. As shown on Map 74, the nonroadway portion of the right-of-way of about 46 miles of freeway is of sufficient width to accommodate the location of either type of dual, at-grade, light rail guideway. In addition, there are about 46 miles of freeway that could accommodate an at-grade, dual light rail guideway on the right-of-way, assuming the extensive use of retaining walls because of the freeway cross-section. Finally, on about 5 miles of freeway, the nonroadway portion of the right-of-way is too narrow to accommodate either type of at-grade, dual, light rail guideway without special construction.

Major obstacles to the use of the nonroadway portion of the freeway right-of-way are the freeway-to-freeway and freeway-to-arterial street interchanges, which make the nonroadway portion of the freeway right-of-way discontinuous. Grade separations through elevated guideways would be required at freeway-to-freeway ramps and freeway exit ramps and over arterial streets which pass over the freeway (see Map 74). As shown on Map 74, the use of signalization may be adequate to avoid traffic conflicts at freeway entrance ramps which cross the light rail guideway at nonroadway portions of the right-of-way.

Conclusions for Feasibility of Light Rail Guideways: The medians, outside shoulders, and nonroadway portions of the Milwaukee area freeway system cannot readily be used for the location of light rail dual guideways. Particularly on those freeways in the central portion of Milwaukee County, which may be expected to be congested in the future, only elevated guideways appear feasible. This is due not only to the limited horizontal clearance available in the medians, shoulders, and nonroadway portions of the rights-of-way, but to the need to separate the light rail guideway from freeway-to-freeway ramps and freeway entrance and exit ramps which cross the potential light rail guideway alignments. The construction of elevated guideways in the freeway right-of-way would be particularly difficult because of the need to go through, over, or around freeway-to-freeway interchanges, and to go over other overpasses to the freeway.

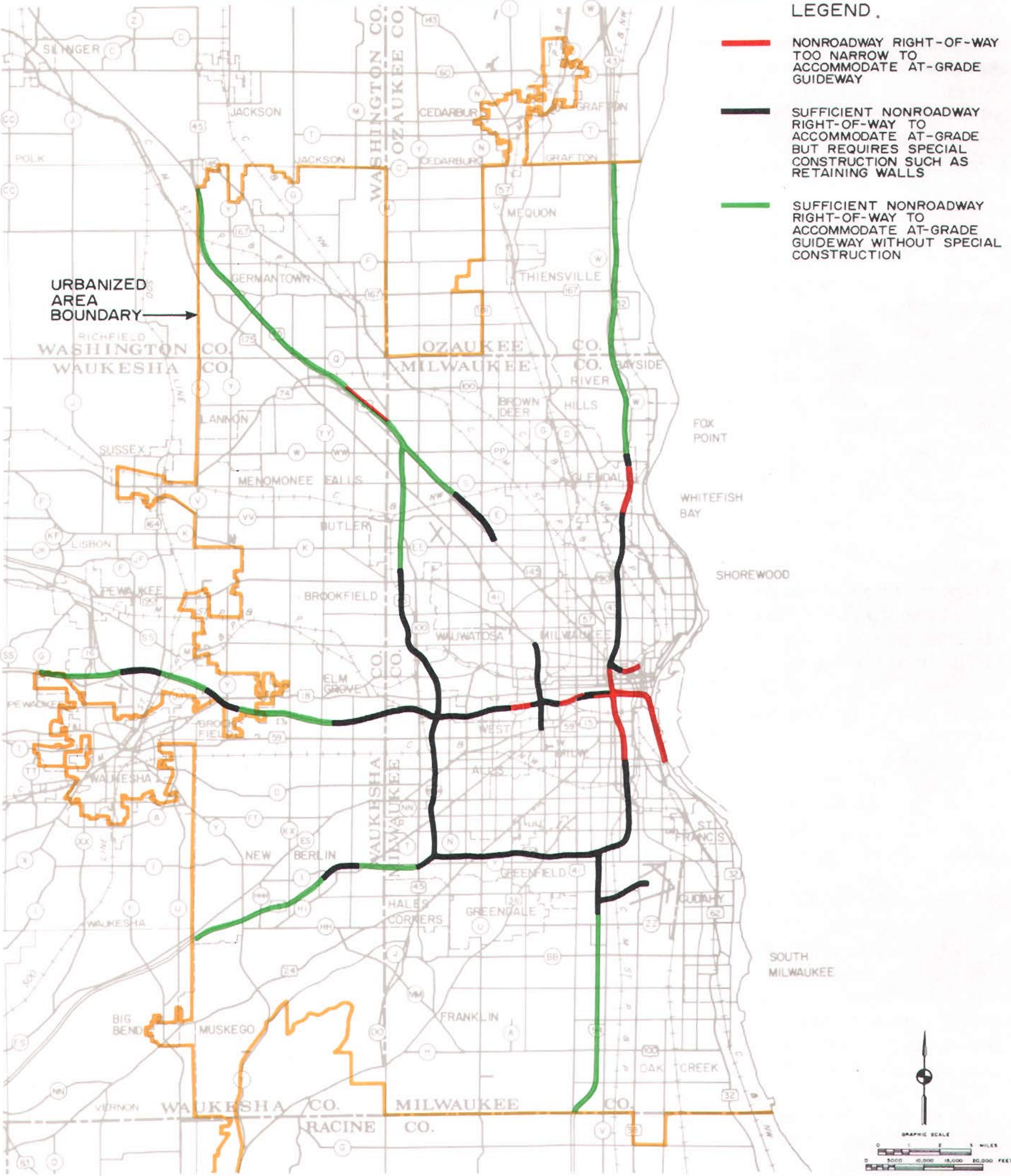
Feasibility of Using Fixed Guideways for Heavy Rail: The construction of dual guideways for heavy rail in the median, outside shoulders, or nonroadway parts of the freeway right-of-way would generally not be precluded over any segment of the Milwaukee freeway system by the horizontal or vertical alignment of the freeways. In fact, desirable maximum criteria for vertical alignment of heavy rail guideways are met on all parts of the Milwaukee area freeway system except on the East-West Freeway (IH 94) west of N. Sunny Slope Road, where the vertical grade of the freeway approaches 3.7 percent. There are no locations on the freeway system where desirable horizontal alignment criteria are not met. In addition, all of the structures on the freeway system in the Milwaukee area meet the minimum vertical clearance criteria for heavy rail guideways.

The only absolute minimum criterion for dual heavy rail guideways which is not met on all segments of the freeway system in medians, outside shoulders, and nonroadway portions of the right-of-way is the minimum guideway width. Problems in meeting this criterion are identified in the following sections.

Median Feasibility: An absolute minimum median width of 31 feet and a desirable minimum width of 45 feet have been assumed to be required to accommodate an at-grade, dual, heavy rail guideway in a freeway median. These minimum widths are seven feet more than the absolute and desirable heavy rail dual guideway widths set forth in Table 107. This is because it is assumed, as for busways and light rail guideways, that if heavy rail guideways are constructed in the freeway

Map 74

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF LIGHT RAIL TRANSIT FIXED GUIDEWAY ON THE NONROADWAY AREA

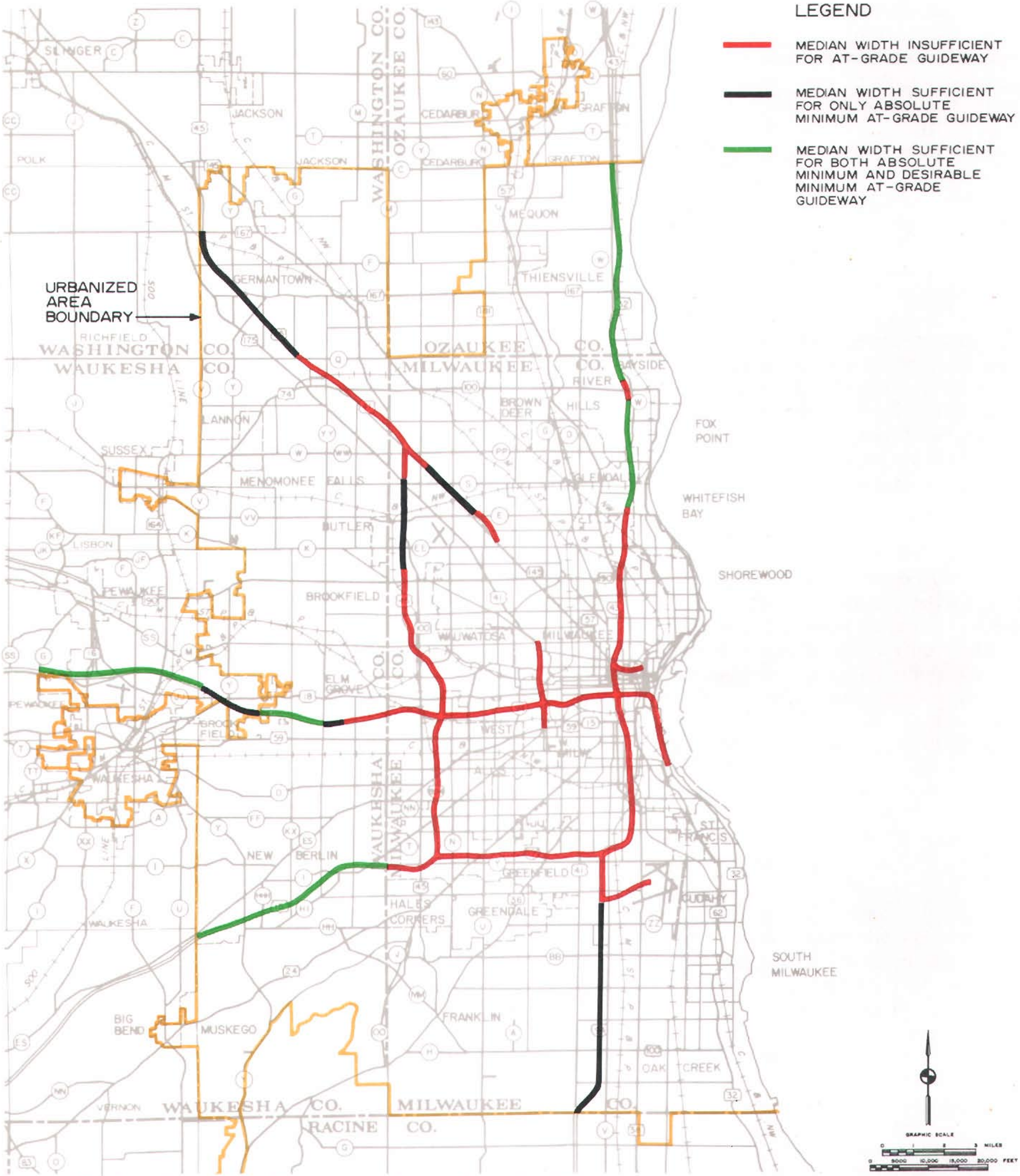


On about 46 miles of freeway in the Milwaukee Area, the nonroadway portion of the right-of-way is of sufficient width to accommodate the location of an at-grade, double-track light rail transit guideway; on about another 46 miles of freeway, the nonroadway portion of the right-of-way could accommodate an at-grade, double-track light rail transit guideway; on the right-of-way, but would require the use of retaining walls; and on about 5 miles of freeway, the nonroadway portion is too narrow to accommodate an at-grade, double-track light rail transit guideway. Grade separations would be required at freeway-to-freeway ramps, at freeway exit ramps, and over arterial street overpasses. Signalization may be adequate to avoid traffic conflicts at freeway entrance ramps which cross the light rail transit guideway or nonroadway portions of the right-of-way.

Source: SEWRPC.

Map 75

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF HEAVY RAIL RAPID TRANSIT FIXED GUIDEWAY IN THE FREEWAY MEDIAN



There are 25 miles of freeway in the Milwaukee area with a median width sufficient to accommodate a desirable width, at-grade, dual heavy rail guideway in the median; 22 miles of freeway with a median width sufficient to accommodate a minimum width, at-grade, dual heavy rail guideway; and about 50 miles of freeway with median widths insufficient to accommodate even a minimum width, at-grade, dual heavy rail guideway. There are 17 locations where freeway-to-freeway ramps and freeway entrance and exit ramps cross the freeway median, and where, because of heavy rail's third rail power takeoff, reconstruction of the freeway interchanges or grade separation of the primary transit guideway and all freeway ramps would be required. Most of these ramps occur in the 50 miles of freeway where an elevated dual guideway would be required because of limited median width. Location of an elevated dual heavy rail guideway in the median of the freeway would require structures high enough to provide adequate clearance at the 129 arterial street and railway overpasses on the 50 miles of freeway where an elevated guideway would be necessary.

Source: SEWRPC.

median, an additional seven feet of width will be required in order to provide barrier walls to separate opposing freeway traffic flows. Preferably, the required barrier walls would be reconstructed at the outside of the median to not only separate opposing freeway traffic, but also separate heavy rail traffic in the median lanes from the freeway traffic flow.

As shown on Map 75, there are about 25 miles of freeway in the Milwaukee area with a median width sufficient to accommodate a desirable width, at-grade, dual, heavy rail guideway. Another 22 miles of freeway have sufficient median width to accommodate a minimum width, at-grade, dual guideway. There are about 50 miles of freeway, including three freeways leading to the Milwaukee central business district, with median widths that will not accommodate a minimum width, at-grade, dual, heavy rail guideway. Six miles of freeway in the Milwaukee area were previously identified as being impractical for any guideway development, including such development in the freeway median.

Also noted on Map 75 are those 17 locations on the existing freeway system where freeway-to-freeway ramps and freeway entrance and exit ramps cross the freeway median. Because of heavy rail's third rail power source, the reconstruction of freeway interchanges or the grade separation of the primary transit guideway and all ramps would be required at these 17 locations. Most of these ramps, 36 of 38, occur on the 50 miles of freeway where an elevated dual guideway would be required because of limited median width.

Location of an elevated, dual, heavy rail guideway in the median of the freeway would, however, probably provide little economic advantage, particularly as it would require structures high enough to provide adequate clearance at arterial street and railway overpasses to the freeway. There are 129 arterial street and railway overpasses on the 50 miles of freeway where an elevated guideway would be necessary, as shown on Map 75. It should be noted that, in addition, over these 50 miles of freeway an elevated heavy rail guideway would need to be constructed through, over, or around the Zoo, Stadium, Hale, Airport, Marquette, and Hillside Interchanges. As an alternative, the interchanges could be reconstructed to move all merging and diverging lanes to the freeway shoulder.

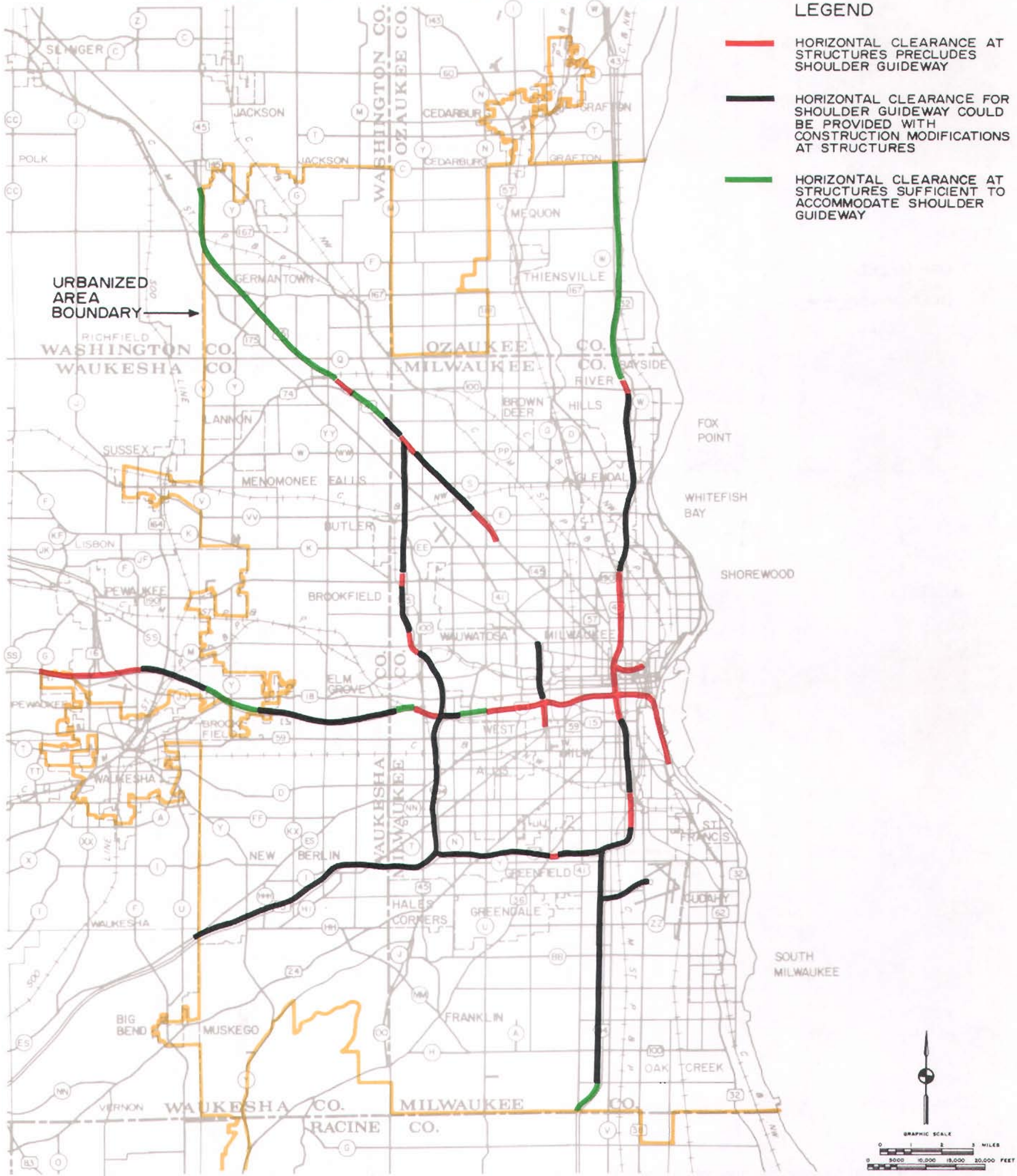
Outside Shoulder Feasibility: A dual heavy rail guideway could be located along the outside shoulders of the freeway if single guideways serving opposite directions were provided on opposite shoulders. An absolute minimum width of 12 feet and a desirable width of 24 feet on each side of the freeway is required for the location of a single, at-grade, heavy rail guideway on each outside shoulder of a freeway, assuming no barrier other than fencing is provided to separate the guideway from the freeway traffic lanes. As shown on Map 76, there are about 20 miles of freeway with sufficient horizontal clearance to accommodate the absolute or desirable minimum width heavy rail guideway, assuming retaining walls are constructed to maintain right-of-way backslopes and shoulder barrier walls at freeway underpasses are removed to accommodate a minimum width heavy rail guideway. On about 19 miles of freeway, the horizontal clearance at freeway underpasses precludes the utilization of the shoulder area on either side of the freeway for an absolute minimum width, at-grade, single, heavy rail guideway, even if barrier walls protecting structure supports were removed. The reconstruction of 59 structures or the use of an elevated guideway would thus be required along these 19 miles of freeway. In addition, on about 58 miles of freeway, freeway overpasses or underpasses would require minor reconstruction to accommodate a single guideway on either outside freeway shoulder. These critical 73 freeway underpasses and 120 critical freeway overpasses are shown on Map 76.

Nonroadway Right-of-Way Feasibility: One of the constraints on the construction of an at-grade heavy rail guideway along the nonroadway portions of the freeway rights-of-way in the Milwaukee area is the limited width of the right-of-way on either side of the freeway. To accommodate the absolute minimum dual, at-grade heavy rail guideway, 24 feet is required on one side of the freeway or 12 feet is required on each side of the freeway. As shown on Map 77, the nonroadway portion of the right-of-way is of sufficient width to accommodate the location of either type of dual, at-grade, heavy rail guideway. In addition, there are about 46 miles of freeway which could accommodate an at-grade, dual, heavy rail guideway on the right-of-way assuming the extensive use of retaining walls because of the freeway cross-section. Finally, on about five miles of freeway, the nonroadway portion of the right-of-way is too narrow to accommodate a dual, at-grade, heavy rail guideway, and would thus require special construction.

Major obstacles to the use of the nonroadway portion of the freeway right-of-way are the freeway-to-freeway and freeway-to-arterial street interchanges,

Map 76

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF HEAVY RAIL RAPID TRANSIT FIXED GUIDEWAY IN THE FREEWAY SHOULDERS

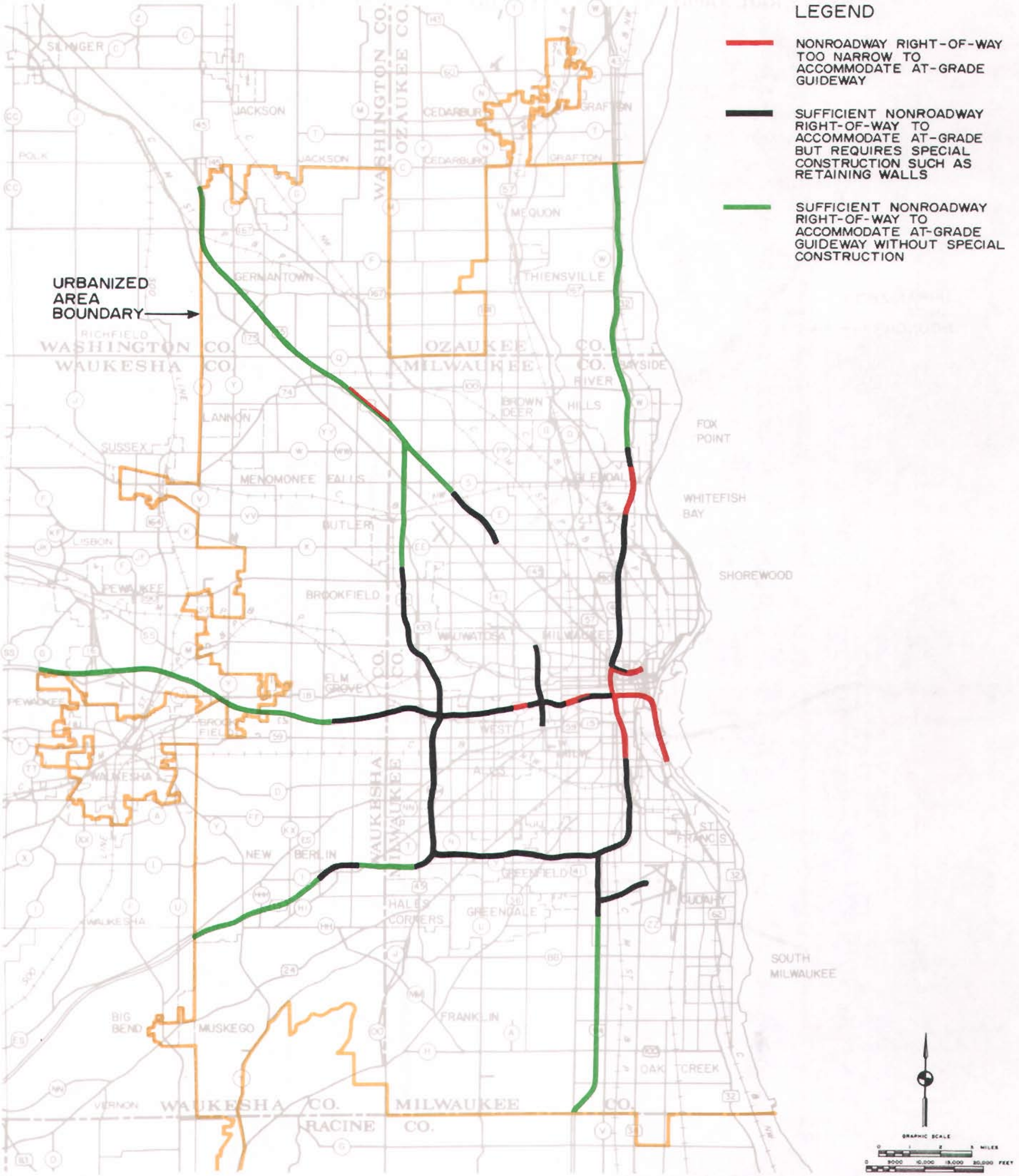


There are about 20 miles of freeway in the Milwaukee area with sufficient horizontal clearance to accommodate a minimum width, at-grade, single-track heavy rail guideway on the shoulders; about 19 miles of freeway along which the horizontal clearance at freeway underpasses precludes the utilization of the shoulder area on either side of the freeway for an absolute minimum width, at-grade, single-track heavy rail guideway without the reconstruction of 59 structures or the use of an elevated guideway; and 58 miles of freeway where freeway overpasses and underpasses would require minor reconstruction to accommodate a single-track guideway on either outside shoulder. In addition, grade separations would need to be provided at 293 freeway-to-freeway ramps and freeway entrance and exit ramps which cross the outside shoulder.

Source: SEWRPC.

Map 77

PORTIONS OF FREEWAY SYSTEM WITH POTENTIAL FOR LOCATION OF HEAVY RAIL RAPID TRANSIT FIXED GUIDEWAY ON THE NONROADWAY AREA



On about 46 miles of freeway, the nonroadway portion of the right-of-way is of sufficient width to accommodate the location of an at-grade, double-track, heavy rail guideway; on another 46 miles of freeway the nonroadway portion could accommodate an at-grade, double-track heavy rail guideway on the right-of-way, but would require the use of retaining walls; and on 5 miles of freeway, the nonroadway portion of the right-of-way is too narrow to accommodate an at-grade, double-track, heavy rail guideway. Along those sections of freeway that could accommodate a double-track heavy rail fixed guideway, grade separations would be required at freeway-to-freeway ramps, at freeway entrance and exit ramps, and over arterial streets or highways which pass over the freeway.

Source: SEWRPC.

which make the nonroadway portion of the freeway right-of-way discontinuous. Grade separations through elevated guideways would be required at freeway-to-freeway ramps and freeway entrance and exit ramps and over arterial streets and railways which pass over the freeway (see Map 77).

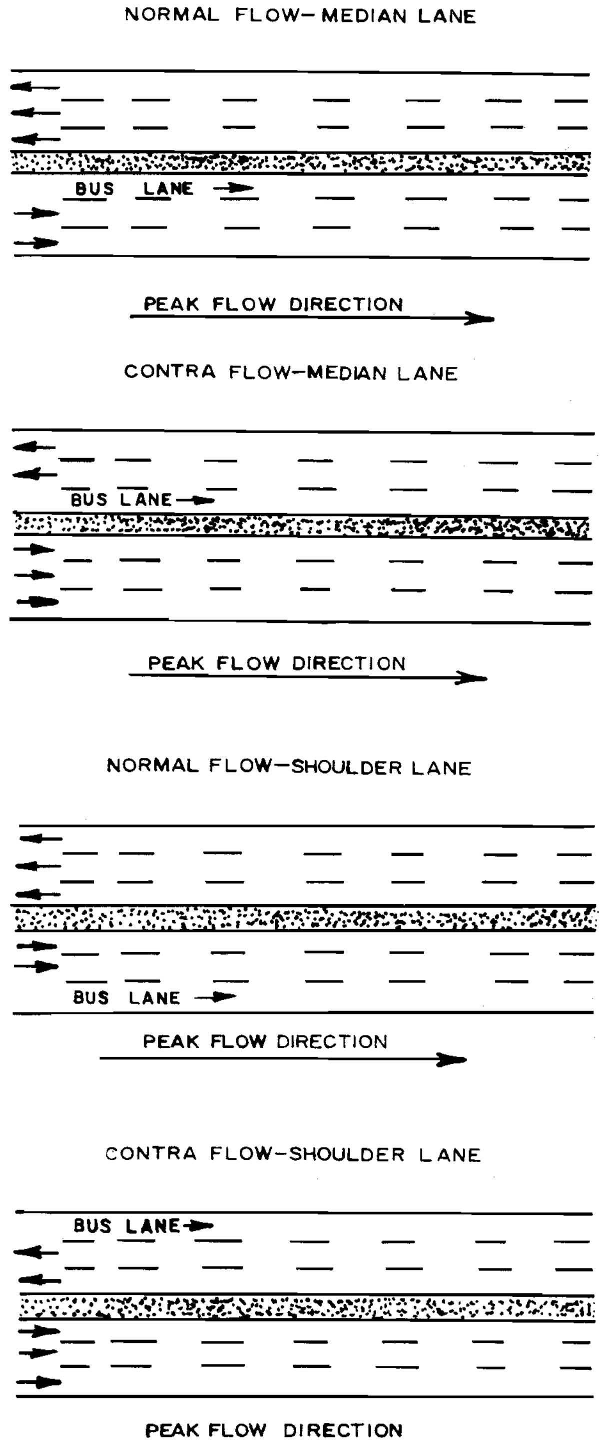
Conclusions for Feasibility of Heavy Rail Fixed Guideways: The medians, outside shoulders, and nonroadway portions of the Milwaukee area freeway system cannot readily be used for heavy rail dual guideways. Particularly on those freeways in the central portion of Milwaukee County, which can be expected to be congested in the future, only elevated guideways appear feasible. This is due not only to the limited horizontal clearance available in the medians, shoulders, and nonroadway portions of the rights-of-way, but to the need to separate the heavy rail guideway from freeway ramps which cross the potential heavy rail guideway alignments. The construction of elevated guideways in the freeway right-of-way will be particularly difficult because of the need to go through, over, or around freeway-to-freeway interchanges, and to go over other overpasses to the freeway.

Feasibility of Using Reserved Lanes for Buses: Another way to provide rapid primary transit service within the existing Milwaukee area freeway system is to reserve an existing freeway lane for motor buses. Such reservation would only need to be done during peak travel periods and in the peak direction of travel, because at other times of the day, or in the opposite direction during the peak travel period, motor buses can generally travel in mixed traffic on freeways at speeds equal to, or approaching, those achieved on exclusive lanes.

There are two ways to reserve an existing freeway lane for the exclusive operation of motor buses during peak travel periods in the peak direction. Either a lane can be reserved from those lanes which serve vehicles headed in the peak direction, as shown in Figure 26, creating a normal flow reserved lane, or a lane can be reserved from the lanes which serve the nonpeak direction, as shown in Figure 26, creating a "contraflow" reserved lane. Also as shown in Figure 26, the lane adjacent to the median can be reserved for exclusive use by motor buses, or the lane adjacent to the outside shoulder of the freeway can be reserved. Only the lanes either at the far outside or inside of the freeway can be considered for reservation, because the reservation of middle lanes would require the mixing of automobile traffic with the reserved lane in order for the automobiles to use all available nonreserved lanes.

Figure 26

NORMAL FLOW AND CONTRAFLOW RESERVED LANES



Source: SEWRPC.

Reservation of a lane for motor bus rapid transit on any part of the Milwaukee area freeway system would not be limited by necessary horizontal or vertical alignment, or by horizontal or vertical clearances. In addition, desirable maximum criteria for horizontal and vertical clearance would be met on the existing freeways, and desirable minimum criteria would be met for vertical clearance. All existing freeway lanes adjacent to either the freeway median or shoulder would be of sufficient width to meet absolute minimum horizontal clearance criteria. In no instance, however, would desirable width reserved lanes be provided, unless part of the median or shoulder was taken and added to the reserved lane.

Freeway Design Problems: Probably the greatest obstacle to the implementation of reserved lanes for motor buses on the Milwaukee area freeway system is the configuration of the system and, in particular, the design of its freeway-to-freeway and freeway-to-arterial street interchanges. The configuration of the system represents a problem in reserving lanes in that the freeways of the area are connected through a number of major freeway-to-freeway interchanges. The design of the system interchanges presents a problem in that these interchanges and the freeway-to-arterial street interchanges of the system have entrance and exit ramps which connect to either the right-hand and left-hand lanes of the freeway, and sometimes to both. This variety of freeway ramp locations results in freeway traffic being required to cross potential reserved lanes located either in the shoulder or in the median. Thus, reserved lanes can only be provided over segments of the freeway system shoulder or median unless interchanges are closed or reconstructed or an elevated or tunneled busway between reserved lane segments is constructed. The elevated or tunneled guideway would need to begin and end in the median or shoulder as appropriate, with a necessary transition provided from the reserved lane.

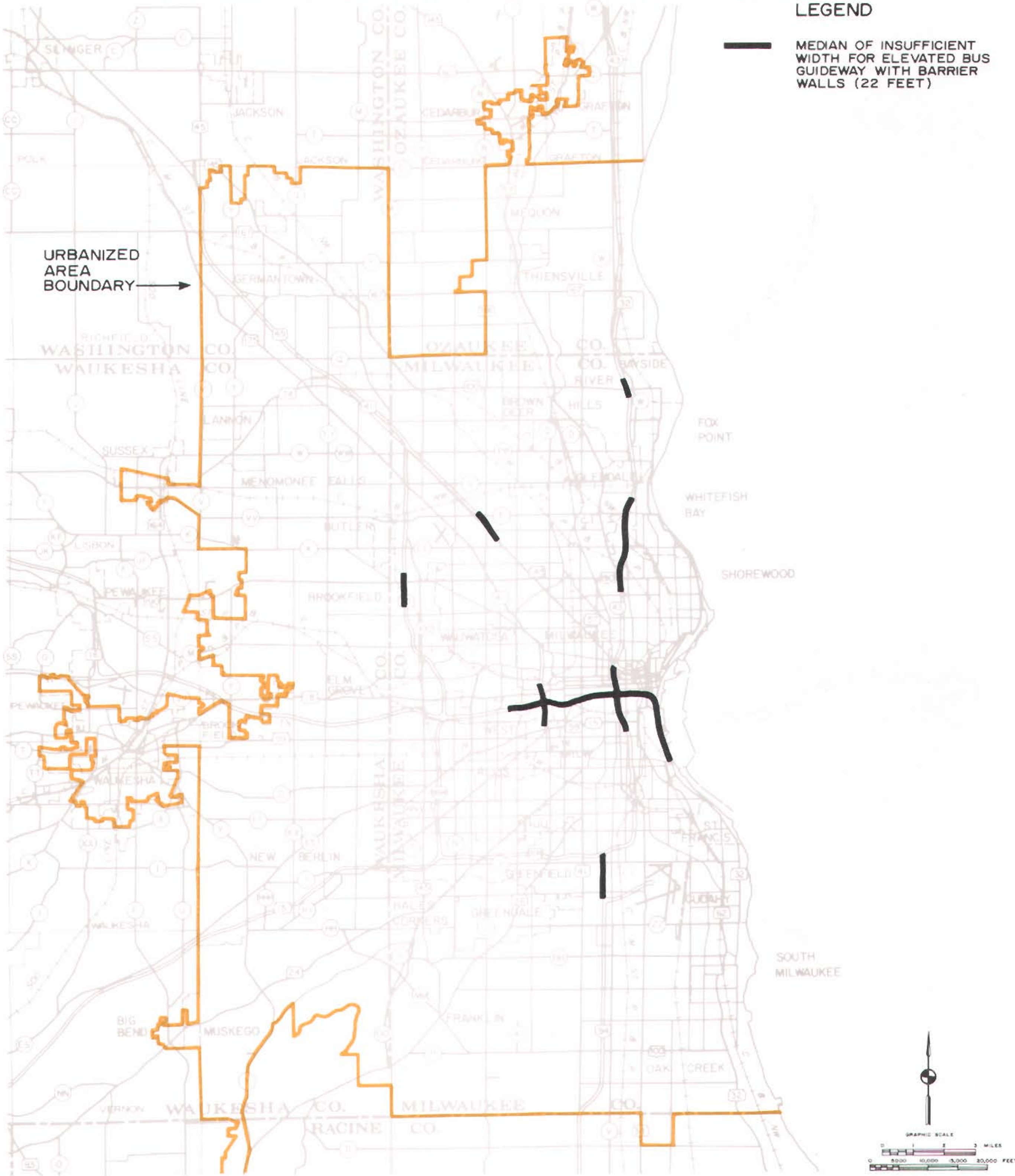
However, normal flow reserved lanes could be provided in discontinuous segments if sufficient distances of a shared lane, rather than a reserved lane, were provided for the merging of freeway traffic, including both automobiles and trucks, into the reserved lanes prior to exit ramps adjacent to the reserved lanes, and if sufficient distances were provided for the diverging of traffic from the reserved lane to the remaining freeway lanes. Beyond the actual distances required for such merging and diverging of freeway traffic in the reserved lane at entrance ramps and exit ramps adjacent to the lane, additional distances would be required before and after the lane is shared with mixed traffic for motor bus deceleration from and acceleration to the reserved lane operating speed. Contraflow lanes could not be provided in this discontinuous manner because the freeway traffic merging into and diverging from the reserved lane would be opposing the direction of the motor buses. Further, it would not be desirable and may be impractical to institute discontinuous normal flow reserved lanes. The differences in speed between the motor buses in exclusive lanes and the freeway traffic which would be merging from the reduced-capacity freeway into those shared reserved lanes, or from the reserved lanes into the remaining freeway lanes, may be too great to allow safe operation of a discontinuous reserved lane. Difficulties in the merging of freeway traffic into, and the diverging of freeway traffic out of, the normal flow reserved lane may also be expected when that lane is shared because of the density of traffic in the remaining freeway lanes.

The freeway-arterial street entrance and exit ramps and freeway-to-freeway entrance and exit ramps that would present these problems are located at the right-hand side or outside shoulder of the freeway at 293 locations, as shown on Map 65. Only 38 such ramps are provided on the left-hand side or median of the freeway, as shown on Map 66. The use of a contraflow lane in a shoulder location would thus require substantial freeway reconstruction or new guideway construction. Less reconstruction or new construction would be necessary for contraflow lanes in a median lane. Similarly, normal flow reserved lanes to be fully separated from freeway traffic would require substantial freeway reconstruction or new guideway construction if located over the shoulder lanes, and less reconstruction or new construction if located over the median lanes. However, the potential to provide for grade-separated reserved lanes is constrained for normal or contraflow median lanes by the limited width of freeway medians in certain freeway segments. As shown on Map 78, the width of the freeway median is less than that needed for an elevated, single lane busway for 11 miles, importantly including parts of all four freeways of the Marquette Interchange. A grade-separated guideway could not begin or end in the median and connect with a reserved lane over those 11 miles of freeway.

Map 79 shows where reserved lanes could be provided in normal flow on the freeway if no separation were provided from the reserved lanes and the freeway ramps, but instead the reserved lane ended at that point where all freeway traffic must use the lane to merge into or diverge from the freeway. As shown on Map 79, only the median

Map 78

PORTIONS OF FREEWAY SYSTEM WITH MEDIAN WIDTHS INSUFFICIENT TO PROVIDE TRANSITION TO A GUIDEWAY FROM A RESERVED MEDIAN LANE

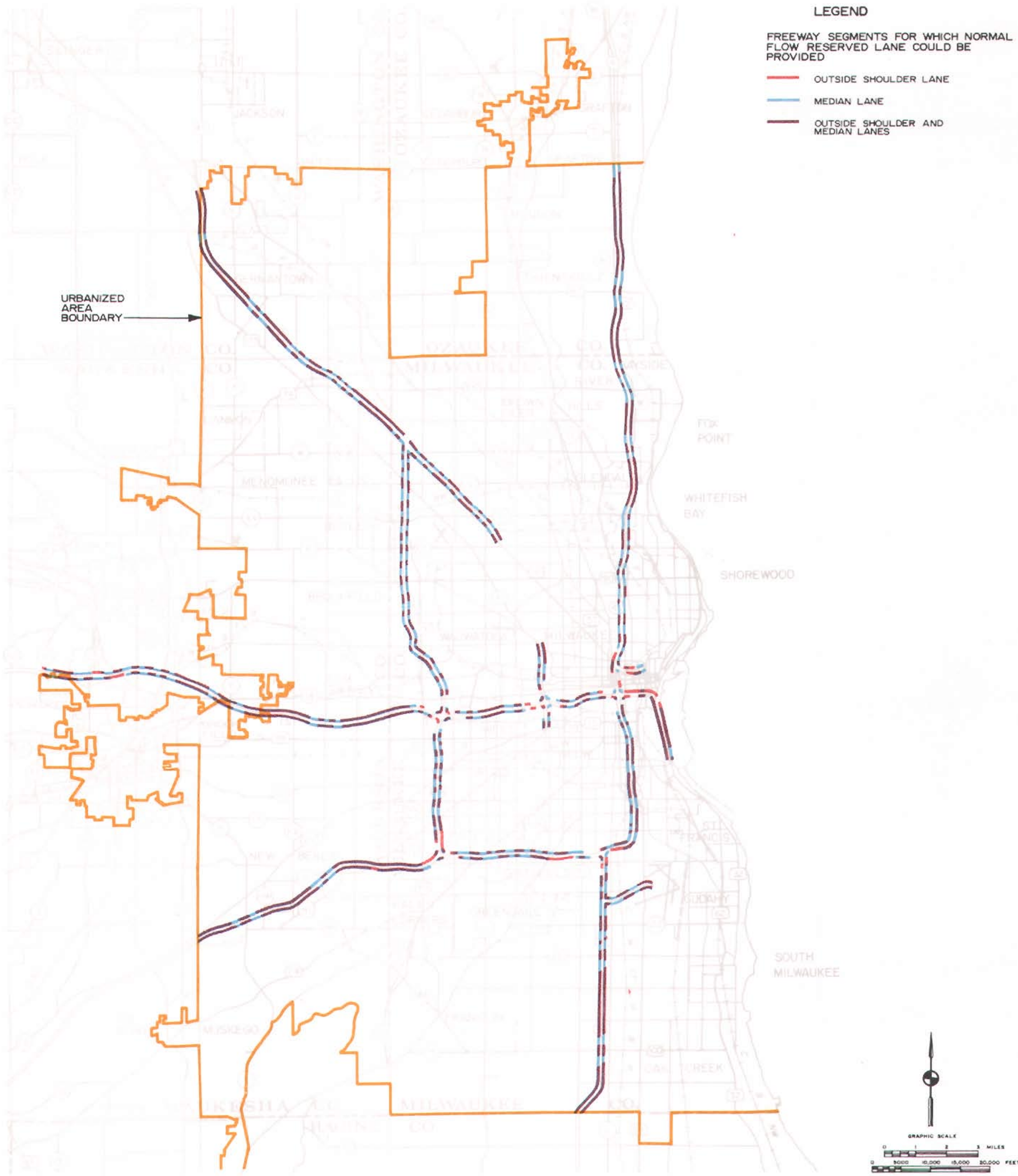


The potential to provide for grade-separated reserved lanes for bus operation is constrained for normal or contraflow median lanes because of the limited width of freeway medians along certain freeway segments. The width of the freeway median is less than that needed for an elevated single lane busway along 11 miles of freeway, including parts of all four freeways entering the Marquette Interchange. A grade-separated busway could not begin or end in the median and connect with a reserved lane over those 11 miles of freeway.

Source: SEWRPC.

Map 79

PORTIONS OF FREEWAY SYSTEM WHICH COULD ACCOMMODATE NORMAL FLOW RESERVED BUS LANE



Certain segments of the freeway could accommodate a reserved lane for the operation of buses in the normal flow direction if no grade separation were provided at freeway ramps, but instead the reserved lane ended where all freeway traffic must use the lane to merge into or diverge from the freeway. Only the median lane could serve as such a reserved lane.

Source: SEWRPC.

lane provides such an option. Map 80 shows where reserved contraflow lanes could be provided if no grade separation were provided at freeway ramps, but instead the reserved lane traffic were moved back through the median into mixed traffic in the normal flow direction so that freeway traffic is able to use the reserved lane to merge into or diverge from the freeway.

Traffic Congestion Problems: Posing perhaps as great an obstacle to the institution of reserved bus lanes on the Milwaukee area freeway system as freeway configuration and interchange design are the impacts on the existing freeway traffic volumes and conditions of removing one freeway lane during the peak travel period. As noted earlier, the direction of a contraflow lane is opposite the peak direction, whereas a normal flow lane operates in the peak direction. The implications for existing freeway traffic volumes and conditions are consequently greater for normal flow lanes than for contraflow reserved bus lanes.

The implementation of normal flow reserved bus lanes on the Milwaukee area freeway system during morning and evening peak hours may be expected not only to cause traffic congestion on the freeways, but to result in significant numbers of vehicles being required to seek alternatives to the freeway including surface arterial streets. Removing a mixed traffic lane from the freeway for use as a normal flow, reserved bus lane would reduce the capacity of the freeway to a point where it could not accommodate freeway traffic volume. Map 81 indicates that if normal flow reserved lanes were implemented, major portions of the East-West Freeway (IH 94), North-South Freeway (IH 94 and IH 43), Airport Freeway (IH 894), and Zoo Freeway (USH 45) would not have sufficient capacity to accommodate existing traffic volumes. Nearly 41 miles in the morning peak hour and 44 miles in the evening peak hour—totaling 40 and 43 percent of the existing freeway system—could be expected to operate under severely congested conditions. In addition, diversion of between 1,000 to 1,900 vehicles from these stretches of freeway would be required during the two peak travel hours.

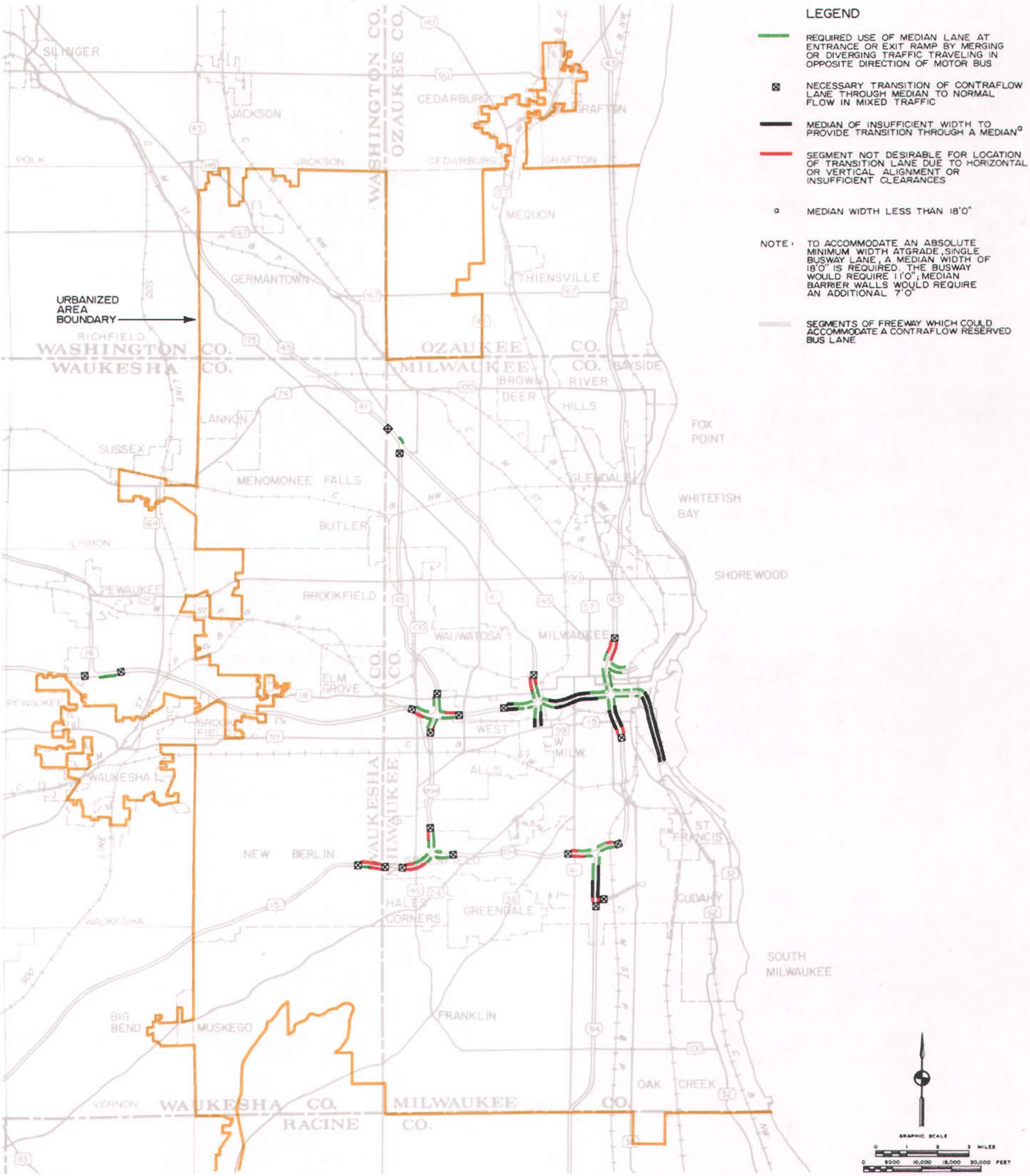
On an additional 28 miles of freeway in the morning peak hour and 19 miles of freeway in the evening peak hour, traffic volumes are such that, if a normal flow reserved bus lane were implemented, traffic conditions would approach unstable flow, with operating speeds at or below 40 miles per hour. Operating conditions on freeways with unstable flow might vary from fairly uniform speeds to intermittent stop and go conditions, with traffic flow and speed controlled by the more severe restrictions on the freeway. The level of service on these sections of freeway could be expected to be at or below "D," meaning traffic volumes are over the accepted design capacity of the freeway.

Contraflow lanes pose less severe problems with respect to the elimination of an existing lane for use by mixed traffic. As shown on Map 82, only five miles of freeway in the morning peak hour and eight miles of freeway in the evening peak hour, all on the East-West Freeway (IH 94) and Zoo Freeway (USH 45), would not have sufficient capacity to accommodate existing off-peak direction traffic volumes if a freeway lane were reserved in the contraflow direction for the exclusive use of buses. An additional 14 miles of freeway in the morning peak hour and nine miles of freeway in the evening peak hour could be expected to operate at or over level of service "D" if contraflow lanes were implemented, including major parts of the East-West Freeway (IH 94), North-South Freeway (IH 43), and Zoo Freeway (USH 45). (See Map 82).

Conclusions for Feasibility of Bus Reserved Lanes: There are two major obstacles to the provision of a system of reserved bus lanes on the Milwaukee area freeway system. One is the configuration of the system and the design of its interchanges, which results in freeway entrance and exit ramps connecting to the right- and left-hand lanes of the freeway where reserved lanes for buses could be provided. Because of the number of such ramps connecting to the right-hand side of the freeway, it may be concluded that only median lanes should be considered for use as either normal flow or contraflow reserved bus freeway lanes in the Milwaukee area. A total of about 90 miles, or 88 percent of the Milwaukee freeway system leading to the Milwaukee central business district, could physically accommodate normal flow, reserved median lanes (see Map 78). The stretches where median lanes could be used for contraflow reserved bus lanes are limited to about 80 miles, or 78 percent of the system (see Map 79). Unfortunately, the portion of the East-West Freeway in Milwaukee County (IH 94 and IH 794) and the portions of the North-South Freeway (IH 94 and IH 43) approaching the central business district of Milwaukee do not lend themselves to development as reserved contraflow bus lanes. Normal flow reserved lanes, however, could be physically provided over parts of the East-West Freeway in Milwaukee County, and over a greater portion of segments of the North-South

Map 80

PORTIONS OF FREEWAY SYSTEM WHICH COULD ACCOMMODATE A CONTRAFLOW RESERVED BUS LANE

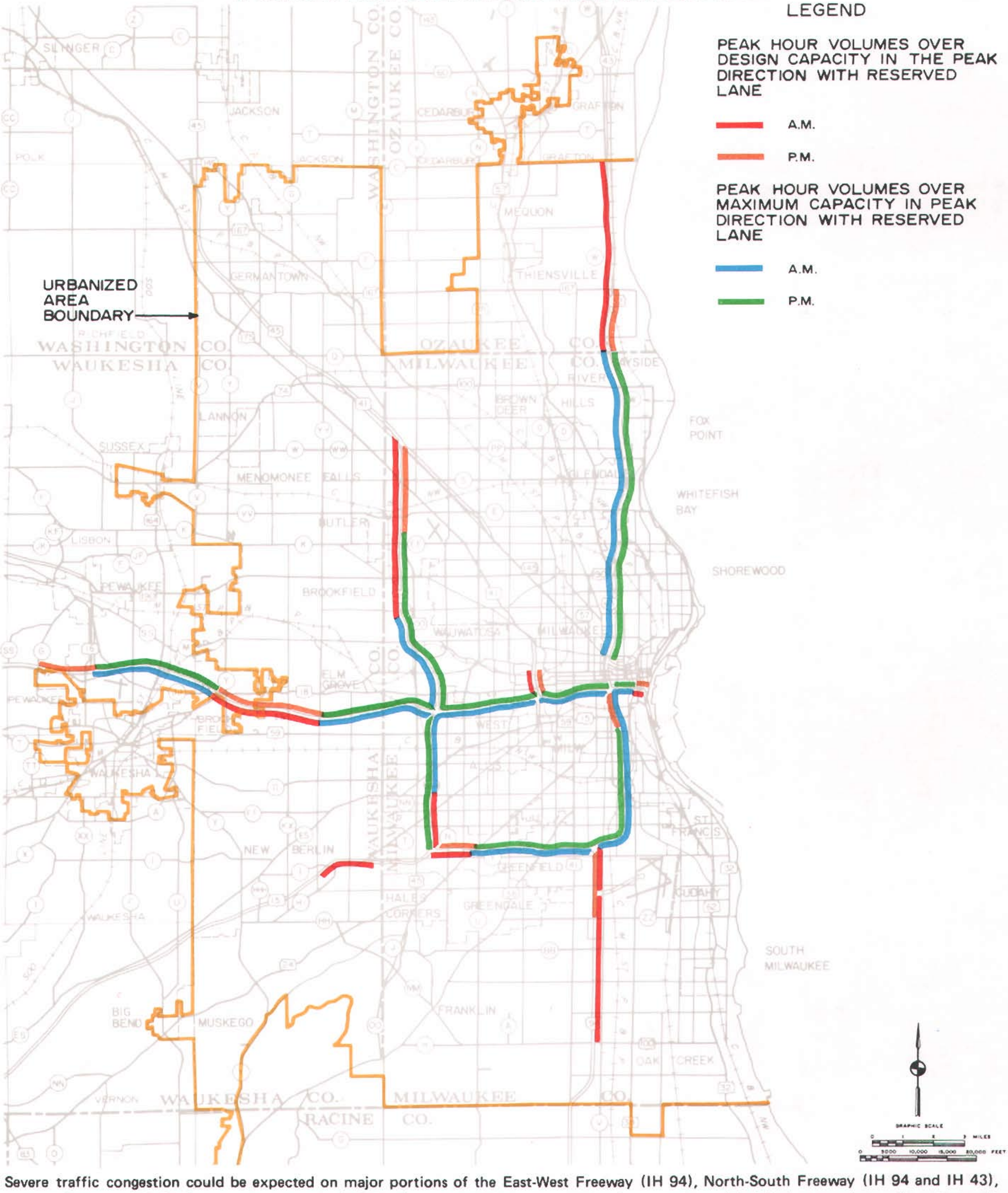


A few segments of the Milwaukee area freeway system could accommodate a reserved contraflow lane for the operation of buses if no grade separation were provided at freeway ramps, but instead the reserved lane traffic were moved back through the median into mixed traffic in the normal flow direction so that freeway traffic could use the lane formerly reserved for contraflow operation to merge or diverge from the freeway.

Source: SEWRPC.

Map 81

PORTIONS OF FREEWAY SYSTEM WHICH COULD BE CONGESTED IF NORMAL FLOW RESERVED BUS LANES WERE PROVIDED

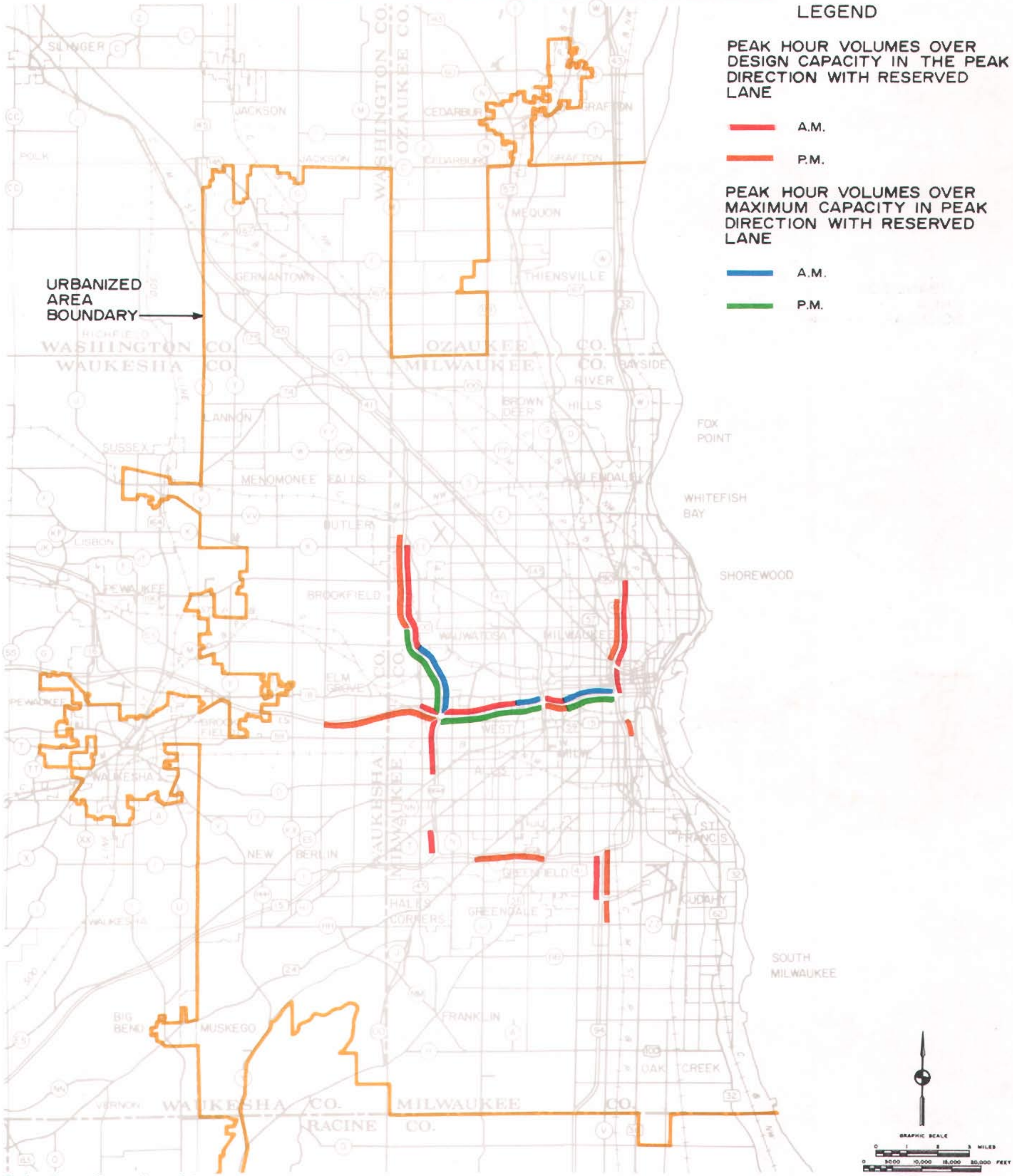


Severe traffic congestion could be expected on major portions of the East-West Freeway (IH 94), North-South Freeway (IH 94 and IH 43), Airport Freeway (IH 894), and Zoo Freeway (USH 45) if normal flow reserved bus lanes were provided during morning and evening peak hours. These freeways would be required to carry the maximum traffic volumes possible, and, in addition, divert some existing freeway traffic to surface streets, transit, or other times of the day. The traffic flow on these freeways—totaling 41 miles in the morning peak hour and 44 miles in the evening peak hour—would be unstable, with stop-and-go driving and operating speeds at or below 30 to 35 miles per hour. The necessary diversion of existing freeway traffic would range from 1,000 to 1,900 vehicles on some freeway segments, such as the East-West and Zoo Freeways. Another 28 miles of freeway in the morning peak hour and 19 miles of freeway in the evening peak hour would be required to carry traffic volumes approaching the maximum possible if normal flow reserved bus lanes were provided. Traffic conditions on these segments of freeway would approach unstable flow, with operating speeds at or below 40 miles per hour.

Source: SEWRPC.

Map 82

PORTIONS OF FREEWAY SYSTEM WHICH COULD BE CONGESTED IF CONTRAFLOW RESERVED BUS LANES WERE PROVIDED



Only about five miles of freeway in the morning peak hour and eight miles of freeway in the evening peak hour would have insufficient capacity to accommodate existing traffic volumes in the nonpeak direction if contraflow reserved bus lanes were implemented. These freeways would be required to carry their maximum volumes under severe congestion and, in addition, divert some existing freeway traffic to surface streets, transit, or other times of the day. The remainder of the Milwaukee area freeway system would have sufficient capacity to accommodate existing freeway traffic volumes if contraflow reserved bus lanes were implemented. However, 14 miles of these freeways in the morning peak hour and nine miles in the evening peak hour would be required to carry near maximum volumes, and would thus experience traffic conditions approaching unstable flow with operating speeds at or below 40 miles per hour.

Source: SEWRPC.

Freeway leading to the Milwaukee central business district.

The other major obstacle to implementing reserved freeway lanes on the Milwaukee area freeway system is the traffic congestion which could be caused by reserving an existing lane for exclusive bus use. This obstacle is more severe with normal flow bus lanes than contraflow bus lanes. Most of the Milwaukee area freeway system—about 65 miles, or 58 percent—is now carrying traffic volumes that would exceed the peak-hour design capacity of the freeway facilities concerned if reserved bus lanes in the peak-flow direction were implemented. Even more importantly, the central portions of the Milwaukee area freeway system—totaling about 40 miles, or 39 percent of the system—would not have sufficient capacity with a reduced number of lanes to accommodate the existing freeway traffic volumes. Diversion of between 1,000 to 1,900 vehicles would be required during the morning and evening peak hour on parts of the East-West Freeway (IH 94), North-South Freeway (IH 43 and IH 94), Zoo Freeway (USH 45), and Airport Freeway (IH 894) to accommodate reservation of a normal flow bus lane.

The traffic congestion problem caused by reserving an existing freeway lane for buses is less severe for contraflow reserved bus lanes. Only about six miles of the East-West Freeway (IH 94) and the Zoo Freeway (USH 45) would have insufficient capacity with reduced lanes in the nonpeak direction to accommodate existing peak-hour traffic volumes. An additional 12 miles of the Milwaukee area freeway system, primarily small segments of the North-South Freeway (IH 43) and Airport Freeway (IH 894), would operate over design capacity with existing traffic volumes if a traffic lane were reserved for a contraflow bus lane.

Thus it would appear that, based upon the configuration and design of the Milwaukee area freeway system and the existing traffic volumes carried on that system, reserved bus lanes could be developed in a contraflow direction only over parts of the system, including nearly all freeway segments outside Milwaukee County and, within Milwaukee County, some segments of the North-South Freeway (IH 43 and IH 94), Airport Freeway (IH 894), and Zoo Freeway (USH 45) between freeway-to-freeway interchanges. Normal flow, reserved bus lanes could only be readily developed on the Lake Freeway (IH 794), the Fond du Lac Freeway (USH 41 and USH 45), and the Rock Freeway (USH 15).

Summary and Conclusions on Feasibility of Using Freeways for Rapid Primary Transit: The medians, outside shoulders, and nonroadway portions of the Milwaukee area freeway system cannot readily be used for fixed guideway systems for motor buses or light rail or heavy rail primary rapid transit systems. A major obstacle is the width available for guideway development, particularly in the median, but also in the freeway shoulders and nonroadway portions of the right-of-way, as shown in Table 128.

Table 128

CLASSIFICATION OF MILWAUKEE AREA FREEWAY SYSTEM POTENTIAL TO PROVIDE SUFFICIENT HORIZONTAL CLEARANCE FOR AT-GRADE GUIDEWAYS

Type of Primary Transit System	Sufficient Width for Desirable Guideway (miles)	Sufficient Width for Absolute Minimum Guideway (miles)	Sufficient Width with Minor Reconstruction or Construction (miles)	Insufficient Width at Freeway Structure Only (miles)	Insufficient Width (miles)
Bus					
Median-Dual	27	20	- -	- -	56
Median-Single	46	3	- -	35	19
Outside Shoulder	26	- -	11	60	6
Nonroadway Right-of-Way	46	- -	46	- -	11
Light Rail					
Median	27	18	- -	30	28
Outside Shoulder	40	- -	42	15	6
Nonroadway Right-of-Way	46	- -	46	- -	11
Heavy Rail					
Median	25	22	- -	- -	56
Outside Shoulder	20	- -	58	19	6
Nonroadway Right-of-Way	46	- -	46	- -	11

Source: SEWRPC.

This problem is most severe on those parts of the freeway system in the central portions of Milwaukee County. Vertical clearance, and vertical and horizontal alignment of the medians, shoulders, and nonroadway portions of the right-of-way, presents no problems. Another major obstacle, however, is the frequency with which freeway-to-freeway ramps and freeway entrance and exit ramps would cross the primary transit guideway alignments in the freeway right-of-way. This problem would be particularly severe with regard to the freeway shoulders and nonroadway portions of the right-of-way, as there would be a need to grade-separate the guideways from the freeway ramps which cross the potential guideway alignments. The construction of elevated guideways in the freeway right-of-way because of limited horizontal clearance or the presence of freeway ramps may be expected to be particularly difficult since the elevated guideway would need to be constructed through, over, or around freeway-to-freeway interchanges, and over other overpasses to the freeway.

There are two freeway corridors in the Milwaukee urbanized area that have been cleared in anticipation of freeway construction, and are in the "upper tier" of the adopted regional transportation system plan. These two freeways are the Park Freeway-East and the Stadium Freeway-South, as shown on Map 83. The segment of cleared right-of-way for the Stadium Freeway-South is, in fact, considered part of the stub end of that freeway, and is recommended for construction under the "lower tier" of the regional transportation plan. The Stadium Freeway-South cleared corridor is about 0.8 mile long. Its cleared right-of-way, which is approximately 260 feet wide, should be able to accommodate a primary transit fixed guideway of any mode as well as the six-lane freeway recommended to be constructed within the corridor. The Park Freeway-East corridor is cleared for a distance of about 0.8 mile, and is approximately 260 to 400 feet wide. This corridor should also be sufficiently wide to accommodate a primary transit guideway and its recommended four-lane freeway facility.

There is one more cleared freeway corridor in the Milwaukee area, that of the no longer-recommended Park West Freeway (see Map 83). This corridor is approximately 2.2 miles long and 320 to 420 feet wide, and could accommodate primary transit fixed guideways.

ACTIVE AND ABANDONED RAILROAD RIGHTS-OF-WAY

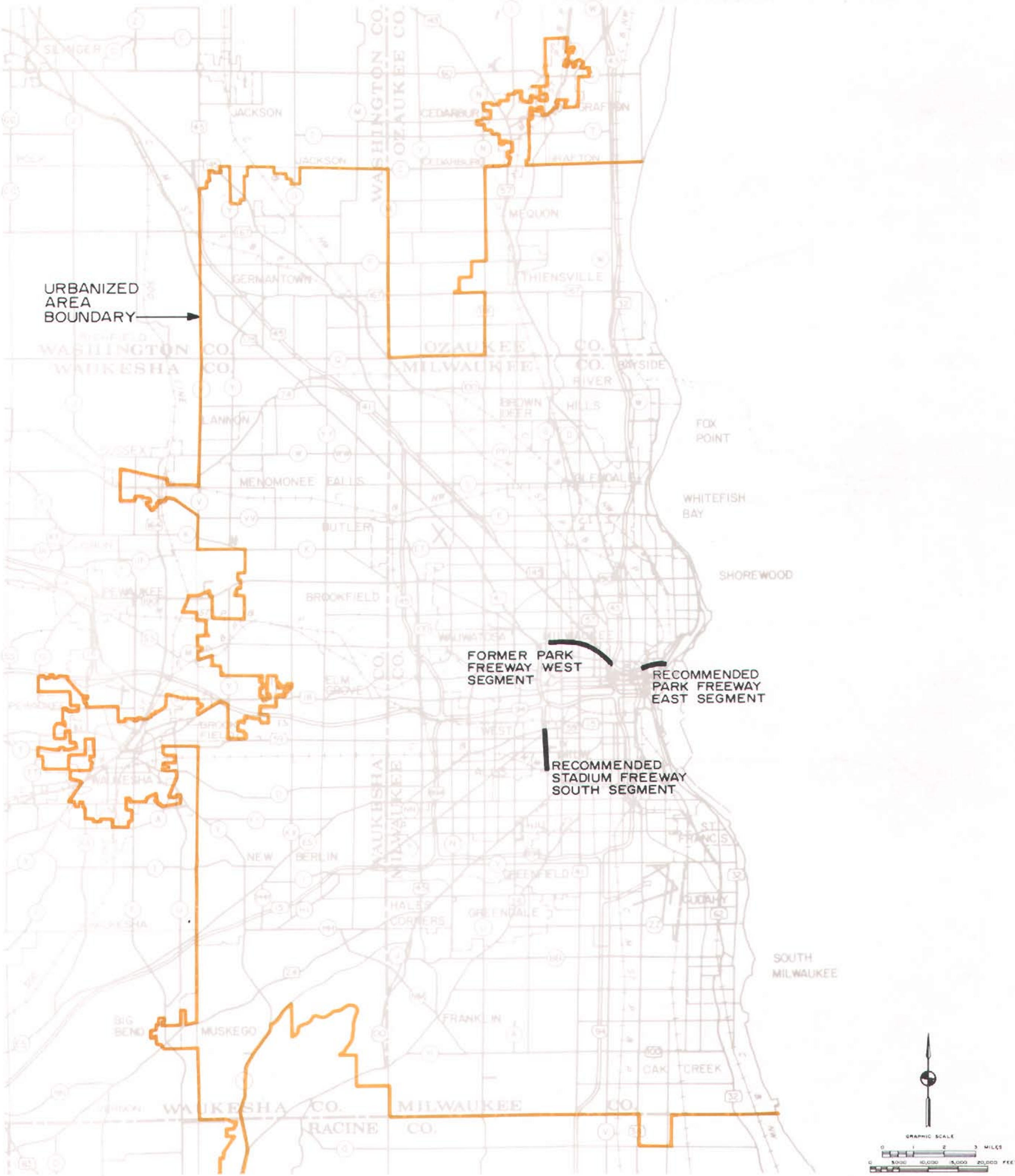
As indicated at the beginning of this chapter, it has been suggested that there is a potential for the development of light rail transit, heavy rail rapid transit, and busway facilities on active and abandoned railroad rights-of-way in the Milwaukee urbanized area. This suggestion assumes that appropriately designed fixed guideway facilities can be developed on such railroad rights-of-way more cheaply and with less community disruption and detrimental environmental impact than on lands which are currently used for other purposes. Also contributing to the potential for primary transit facilities to be developed on railroad rights-of-way is the fact that railroad rights-of-way are apt to provide horizontal and vertical alignments that meet or exceed the requirements for primary transit fixed guideway facilities.

The active or abandoned railroad rights-of-way in the Milwaukee area within which fixed guideway transit could be implemented consist of mainline and branchline railroad facilities currently or historically owned and operated for freight and passenger service by the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road), the Chicago & North Western Transportation Company, and the Soo Line Railroad Company. A number of present and former railroad rights-of-way emanate in a radial fashion from downtown Milwaukee, as indicated on Map 84. It should be noted that portions of the above railroad system which are located outside the Milwaukee urbanized area are not included within this assessment since they are outside the study area. For the purposes of this assessment, the railroad system in the Milwaukee urbanized area was divided into 23 right-of-way segments based primarily upon the operating divisions and subdivisions currently in effect on the three railroads.

All of the active railroad right-of-way segments pertinent to this inventory and assessment that are operated by the Milwaukee Road are part of that railroad's operating unit known as the Wisconsin Division. As shown on Map 85, these segments include: 1) the First Subdivision between the Milwaukee passenger station and the City of Brookfield; 2) the Fifth Subdivision between North Milwaukee Station and the Village of Grafton; 3) the Twelfth Subdivision between North Milwaukee Station and the Village of Germantown;

Map 83

CORRIDORS CLEARED IN ANTICIPATION OF FREEWAY CONSTRUCTION

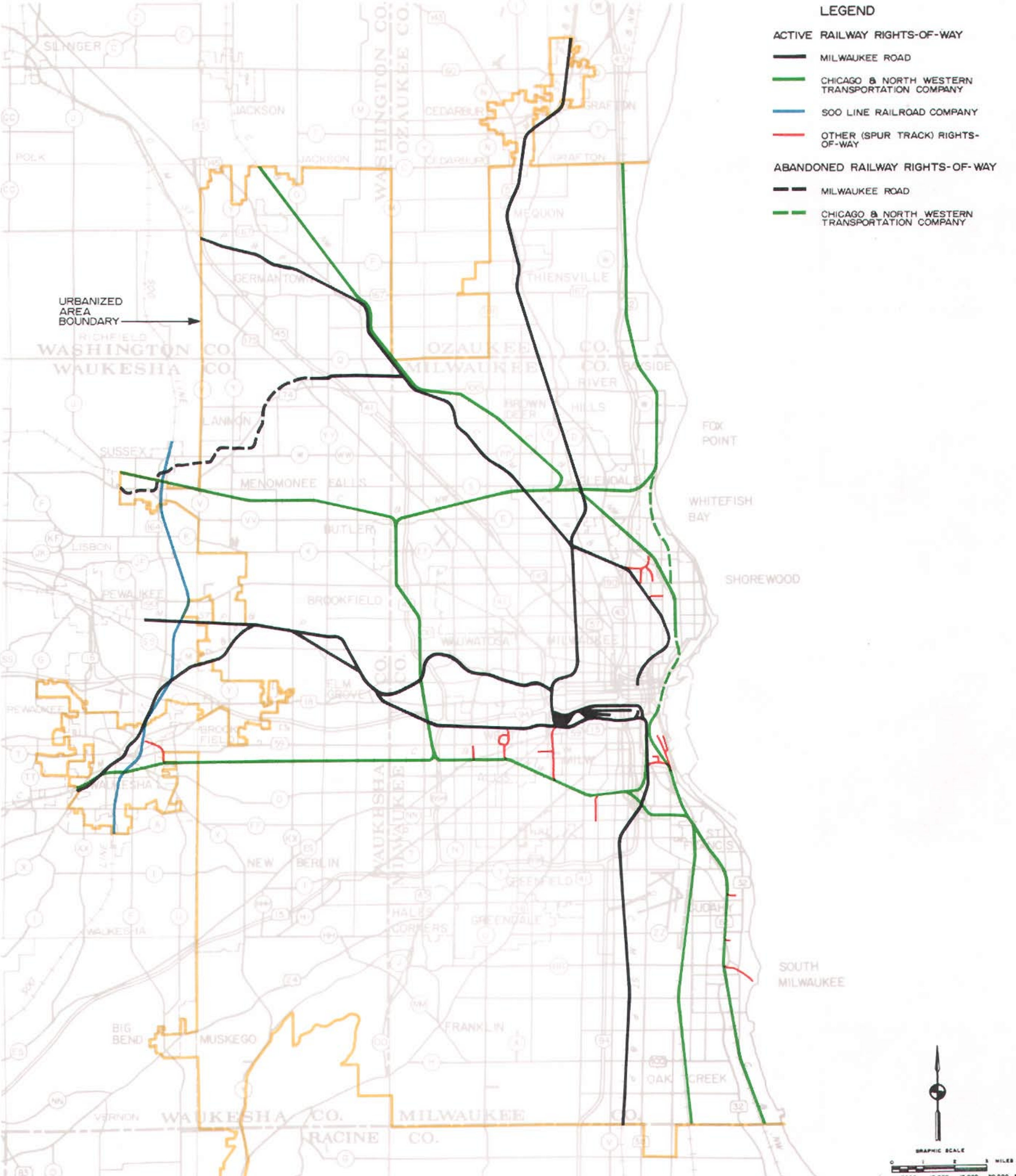


There are two freeway corridors in the Milwaukee area that have been cleared in anticipation of freeway construction, but within which actual freeway construction is not recommended to occur for a period of at least a decade under the adopted regional transportation system plan. These two corridors are the Park Freeway-East and the Stadium Freeway-South corridors. A third cleared freeway corridor, the Park West Freeway, has been cleared, but the construction of the freeway is no longer recommended under the adopted regional transportation system plan.

Source: SEWRPC.

Map 84

ACTIVE AND ABANDONED RAILROAD RIGHTS-OF-WAY WITHIN THE MILWAUKEE AREA

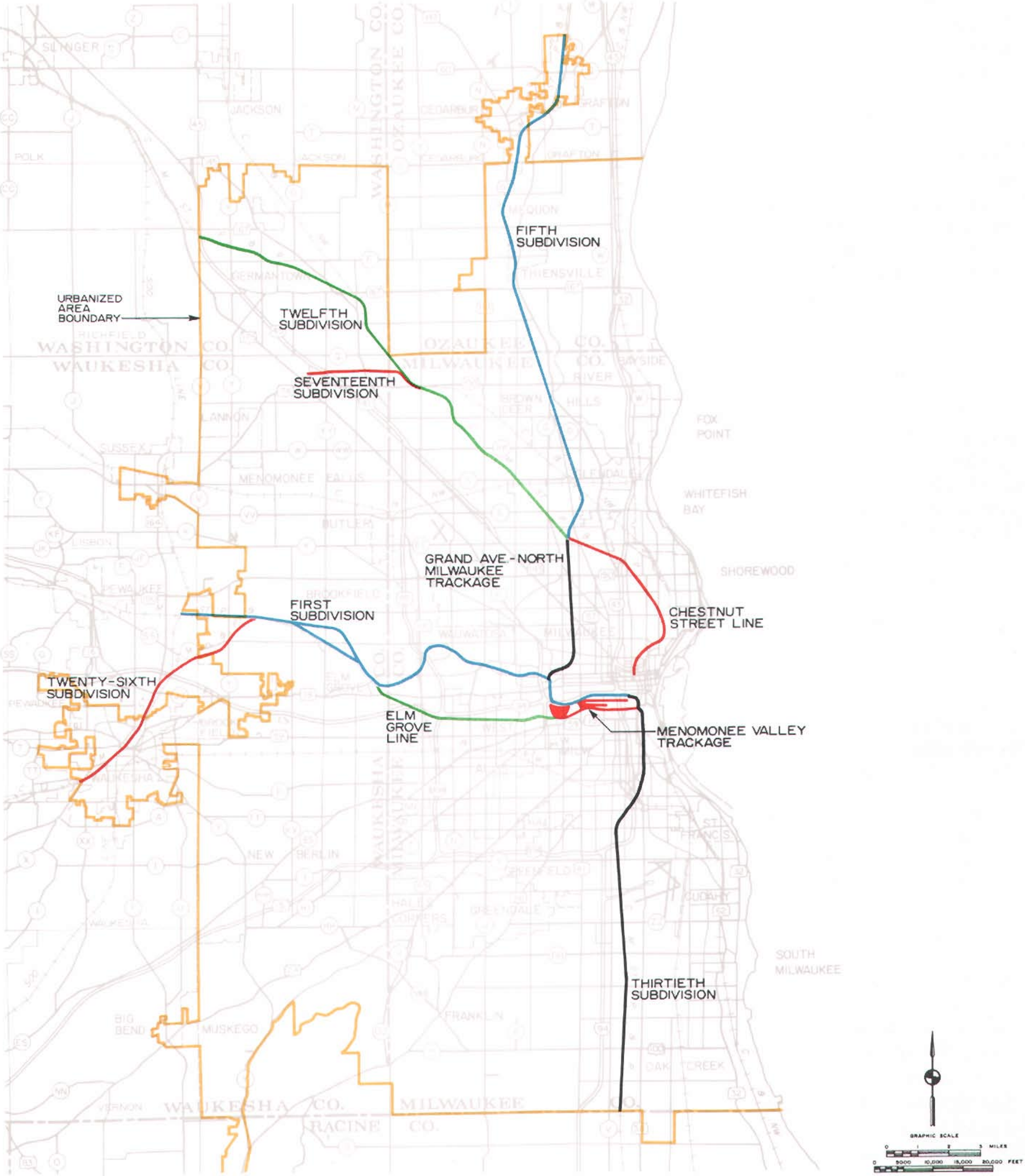


The active and abandoned railway rights-of-way in the Milwaukee area along which fixed guideway primary transit facilities could be provided emanate in a radial fashion from downtown Milwaukee and consist of both mainline and branchline railways currently or historically owned and operated for freight and passenger service by the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road), the Chicago & North Western Transportation Company, and the Soo Line Railroad Company.

Source: SEWRPC.

Map 85

SUBDIVISIONS OF THE WISCONSIN DIVISION OF THE MILWAUKEE ROAD IN THE MILWAUKEE AREA



The active railway right-of-way segments operated by the Milwaukee Road as part of that railroad's operating unit known as the Wisconsin Division consist of the First Subdivision between the Milwaukee passenger station and the City of Brookfield; the Fifth Subdivision between North Milwaukee Station and the Village of Germantown; the Seventeenth Subdivision between Granville Station and the Village of Menomonee Falls; the Twenty-Sixth Subdivision between Brookfield Station and the City of Waukesha; and the Thirtieth Subdivision between the Milwaukee passenger station and the City of Oak Creek. Trackage between Grand Avenue Junction and North Milwaukee Station, the Chestnut Street Line, the Elm Grove Line, and yard trackage in the Menomonee River Valley are used primarily for switching operations, but in some situations are also used to gain access into classification yards for mainline freight movements.

Source: SEWRPC.

4) the Seventeenth Subdivision between Granville Station and the Village of Menomonee Falls; 5) the Twenty-Sixth Subdivision between Brookfield Station and the City of Waukesha; and 6) the Thirtieth Subdivision between the Milwaukee passenger station and the City of Oak Creek.[6]

Additional railroad lines are operated by the Milwaukee Road in the Milwaukee terminal area principally as switching trackage, but in some situations are also used to gain access into classification yards for mainline freight movements. These segments include: 1) trackage between Grand Avenue Junction and North Milwaukee Station; 2) the Chestnut Street Line between North Milwaukee Station and the Cherry Street yard; 3) the Elm Grove Line between Elm Grove Station and the west end of Air Line Yard; and 4) yard trackage in the Menomonee River Valley.

All of the active railroad right-of-way segments pertinent to this inventory and assessment that are operated by the Chicago & North Western Transportation Company are part of that railroad's operating unit known as the Wisconsin Division. As shown on Map 86, these segments include: 1) the Shoreline Subdivision between Wiscona Junction and the City of Mequon; 2) the Air Line Subdivision between Butler Junction and Germantown; 3) the Adams Subdivision between Butler Yard and the Village of Sussex; 4) the New Line Subdivision between Butler Yard and the City of Oak Creek; 5) the Waukesha Subdivision between Belton Junction and the City of Waukesha; and 6) the Kenosha Subdivision between St. Francis Tower and the City of Oak Creek.

There are three additional railroad segments operated by the Chicago & North Western in the Milwaukee urbanized area that are principally used to serve local industries. These right-of-way segments include: 1) the Capitol Drive spur track between Wiscona Junction and E. North Avenue; 2) the Chase spur track between Chase Junction and E. Washington Street; and 3) the National Avenue spur track between St. Francis Tower and the Milwaukee station. All three of these rights-of-way terminate in the City of Milwaukee.

The railroad right-of-way segment pertinent to this inventory and assessment that is operated by the Soo Line Railroad Company is part of that railroad's operating unit known as the Eastern Division. As shown on Map 87, this segment includes that portion of the First Subdivision within the City of Waukesha and the Village of Sussex.

It should be recognized that additional railroad spur track rights-of-way other than those identified above do exist in the Milwaukee urbanized area. Those which have been identified above are included within this inventory and assessment because they are composed largely of former main lines. These types of rights-of-way may be expected to have right-of-way characteristics adequate to accommodate primary transit system guideways. Many other spur track rights-of-way, however, cannot be expected to have such potential since the alignment is generally between or through heavy industrial areas, with lateral clearances generally permitting the location and operation of only a single switching track. Examples of this type of spur track right-of-way are the Chicago & North Western/Soo Joint Belt Line in the City of Waukesha, the Allis Chalmers spur in the City of West Allis, the Menomonee Belt Line, and the Bay View spur. Such spur tracks are usually relatively short in length and are usually constructed with sharp curvatures. Because of these reasons, these rights-of-way are not identified as being potentially suitable for primary transit system guideway location.

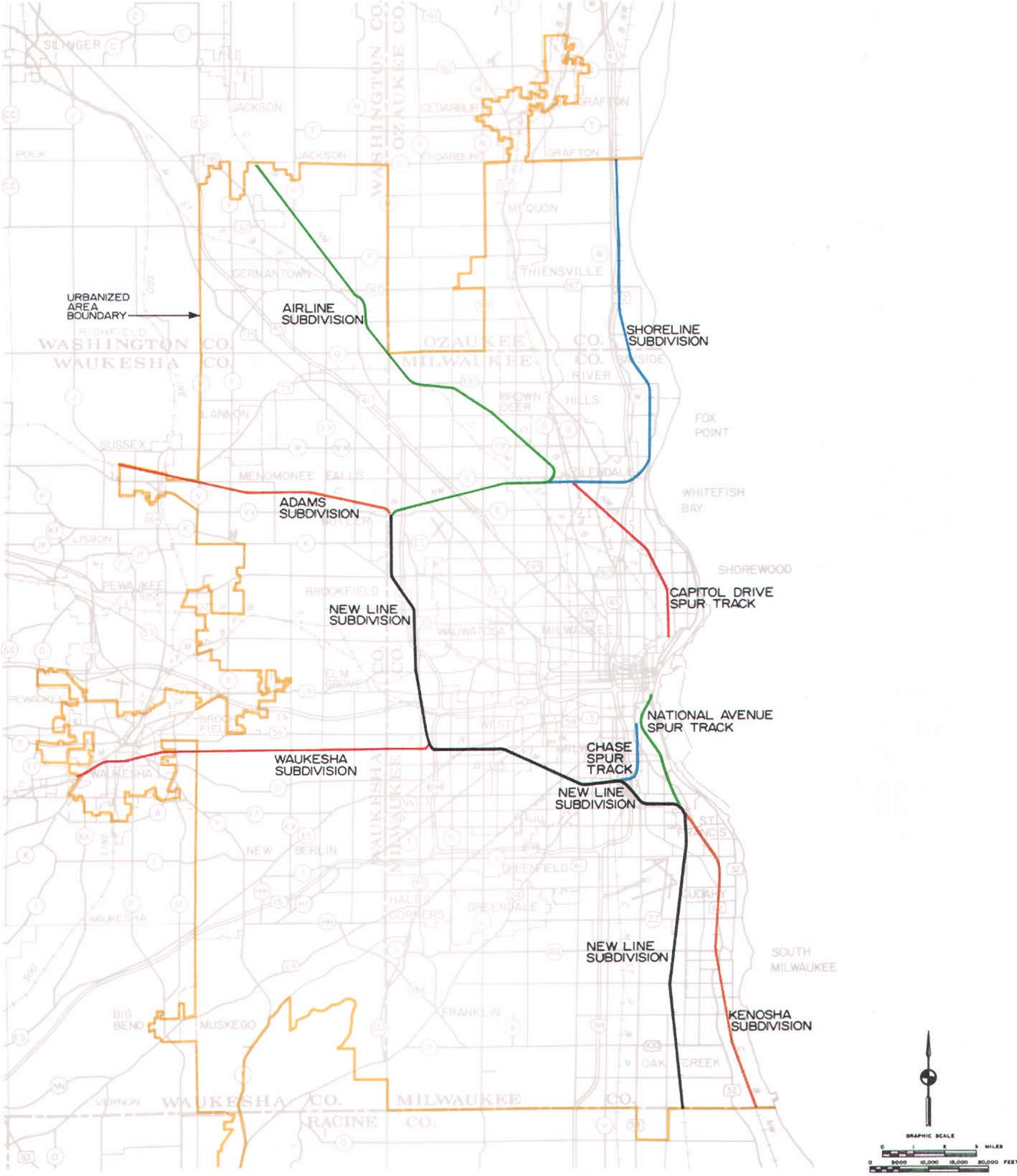
In addition, three abandoned railroad right-of-way segments have been identified as having potential for development as a primary transit system fixed guideway. As shown on Map 82, these segments include: 1) the former Chicago & North Western Lakefront main line within the City of Milwaukee; 2) the former Milwaukee Road North Lake branch line between the Villages of Menomonee Falls and Sussex; and 3) the former Chicago & North Western Whitefish Bay main line between the Villages of Shorewood and Fox Point.

An inventory of these active and abandoned railway rights-of-way and attendant facilities is presented herein. This inventory documents the physical characteristics important in assessing the potential use of such rights-of-way for alternative light rail transit, heavy rail rapid transit, and exclusive busway alignments. The potential for use of the active and abandoned mainline and branchline railroad rights-of-way for fixed guideway transit operations is further assessed through the identification of problems that may be expected to be encountered in utilization of these rights-of-way for primary transit use. Railroad segments without

[6] *The numbers in the subdivision titles are arbitrarily assigned by the railway company and have no significance other than to designate a particular railway line segment.*

Map 86

SUBDIVISIONS OF THE WISCONSIN DIVISION OF THE CHICAGO & NORTH WESTERN RAILWAY IN THE MILWAUKEE AREA

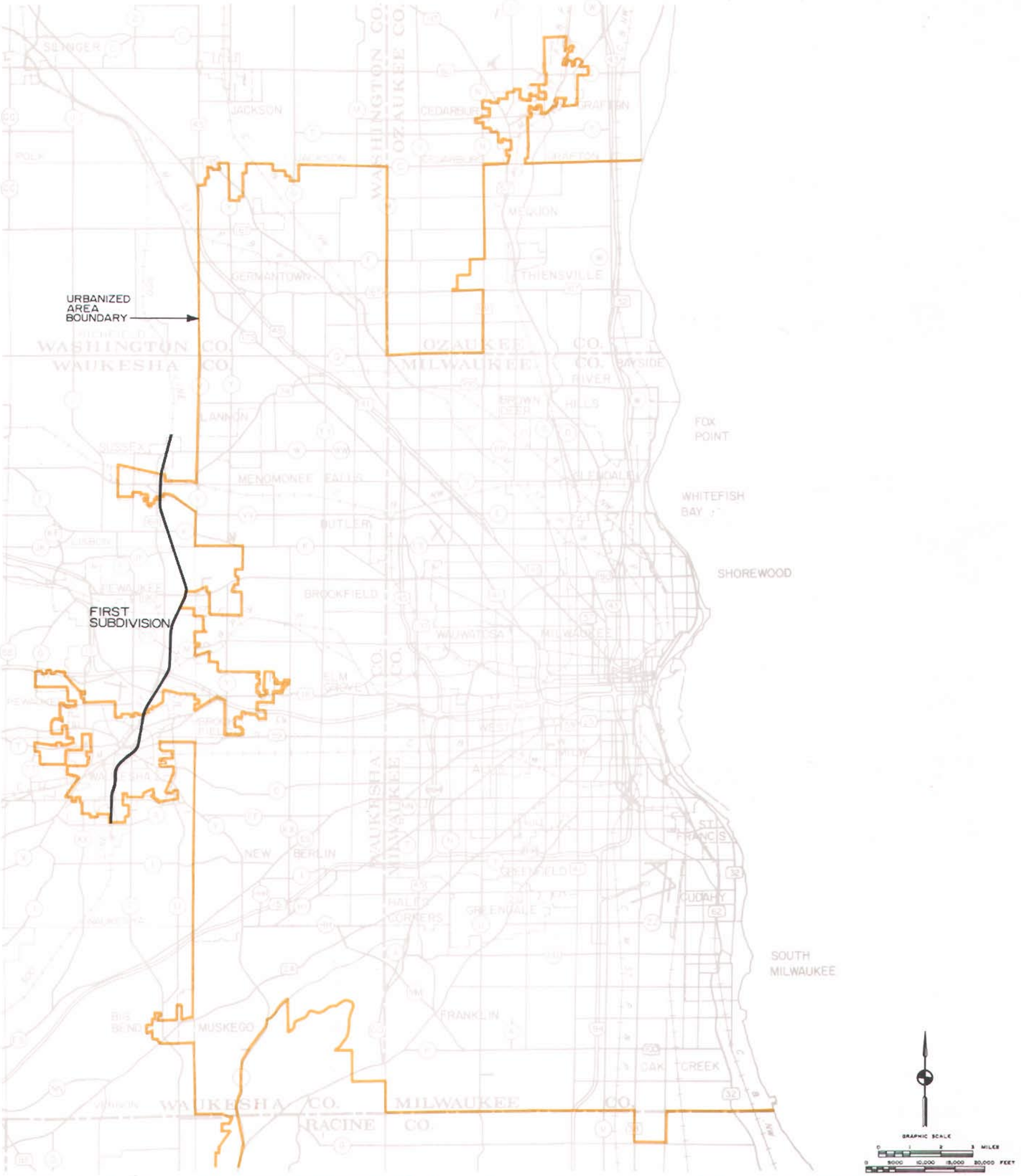


The active railway right-of-way segments operated by the Chicago & North Western Transportation Company as part of that railroad's operating unit known as the Wisconsin Division consist of the Shoreline Division between Wiscona Junction and the City of Mequon; the Air Line Subdivision between Butler Junction and Germantown; the Adams Subdivision between Butler Yard and the Village of Sussex; the New Line Subdivision between Butler Yard and the City of Oak Creek; the Waukesha Subdivision between Belton Junction and the City of Waukesha; and the Kenosha Subdivision between St. Francis Tower and the City of Oak Creek. The Capitol Drive spur track, Chase spur track, and National Avenue spur track all primarily serve as spur tracks for local industries.

Source: SEWRPC.

Map 87

IDENTIFICATION OF SOO LINE RAILROAD RIGHT-OF-WAY IN THE MILWAUKEE AREA



The active railway right-of-way segment operated by the Soo Line Railroad Company is part of that railroad's operating unit known as the Eastern Division. This segment includes that portion of the First Subdivision operating within the city limits of Waukesha and within the village limits of Sussex.

Source: SEWRPC.

width, clearance, vertical configuration, or crossing problems are identified as having the greatest potential for the location of primary transit facilities. Those railroad segments unsuitable for the location of fixed guideway transit service are also identified, and the type and extent of the problems presented by such segments, and possible solutions to these problems, are identified.

A thorough knowledge of the existing conditions within and adjacent to the right-of-way is required in order to analyze railroad right-of-way characteristics. Data on present ownership, length and general orientation in the study area, track layout, operational status of the railroad rights-of-way, and physical characteristics are all important to the assessment of the potential of the rights-of-way to serve as a fixed guideway. The physical characteristics that are important include the right-of-way width; the position of the trackage within the right-of-way, where present; the number and location of sidings; the horizontal and vertical alignment; and the number and location of highway, railroad, and watercourse crossings. In addition, a general description of the land uses that border the railroad rights-of-way is useful to an assessment of the potential to expand the rights-of-way.

Existing conditions within and adjacent to each railroad right-of-way were ascertained from engineering and operating data obtained from the railroad companies. The inventory of right-of-way widths, siding locations, and highway, railroad, and watercourse crossings was compiled from railroad engineering plat maps. Geometric design parameters, including degree of curvature and right-of-way gradients, were obtained from railroad profile maps. Station locations were obtained from railroad operating timetables. Regional Planning Commission aerial photographs provided data on existing land use conditions adjacent to each existing right-of-way.

It should be noted that, in assessing the potential of each active and abandoned railroad right-of-way to serve as a location for fixed guideway primary transit facilities, it was assumed that separate facilities for railroad and transit operations would be provided within the same right-of-way. This assumption is important to the prevention of the serious operational and safety problems that are inherent in mixing light rail transit or heavy rail rapid transit with existing railroad freight and passenger service. It should also be noted that fixed guideway primary transit facilities can be developed more cheaply on active or abandoned rights-of-way than on other rights-of-way only if the transit facilities are located without making major changes to the railroad alignment.

The Milwaukee Road—First Subdivision

The First Subdivision of the Milwaukee Road's Wisconsin Division consists of a 92.5-mile-long railway main line extending from the Milwaukee passenger station in downtown Milwaukee to the City of Portage. The 15.7-mile segment pertinent to this right-of-way inventory and assessment consists of that portion between the Milwaukee passenger station and N. Springdale Road in the Town of Pewaukee. The First Subdivision is part of the Milwaukee Road's Chicago to Twin Cities main line, the railroad's primary route through the Milwaukee urbanized area. Referred to in the past as the La Crosse Division main line, this railroad line is used by National Railroad Passenger Corporation (Amtrak) passenger trains. As shown on Map 88, the route segment under consideration passes through the communities of Milwaukee, Wauwatosa, Elm Grove, and Brookfield.

The First Subdivision is a double-track line along the 15.7-mile length within the study area except at Grand Avenue Junction, where only a single track exists for approximately 0.1 mile. Generally, both tracks share the same right-of-way, which is located at-grade. The right-of-way is approximately 80 feet wide between N. Springdale Road at the western limits of the Milwaukee urbanized area and a point 0.2 mile west of N. Brookfield Road. At the junction with the Milwaukee Road's Twenty-Sixth Subdivision branch line, just west of N. Brookfield Road, the right-of-way begins to widen from 80 feet to approximately 250 feet at N. Brookfield Road. The right-of-way then begins to taper, narrowing to 150 feet east of N. Brookfield Road and remaining 150 feet wide for 0.7 mile to a point 0.3 mile west of N. Calhoun Road in the City of Brookfield. Between N. Calhoun Road and W. Juneau Boulevard in the City of Elm Grove, the mainline right-of-way is located on two separate rights-of-way for a distance of about four miles. The right-of-way along the westbound main line is generally 66 feet wide, while the right-of-way along the eastbound main line is generally 100 feet wide. The remainder of the right-of-way between W. Juneau Boulevard and the Milwaukee passenger station is generally 80 feet wide.

The distance between centerlines of the eastbound and westbound tracks is approximately 14 feet on the double-track portions of the right-of-way, which provides less than adequate horizontal clearance for the development of dual- or single-track or lane-fixed guideway primary transit facilities between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

The width available along the outside portion of the right-of-way ranges from 10 feet to 45 feet along the eastbound main line and 10 feet to 35 feet along the westbound main line. Between N. Springdale and N. Barker Roads, the outside clearance is generally 15 feet eastbound and 35 feet westbound. The outside clearance along the eastbound portion remains 15 feet between N. Barker Road and a point 0.3 mile west of N. Calhoun Road. The clearance westbound, however, is reduced to 15 feet because of the provision of a third track used as a passing siding.

The available width of the right-of-way section that is separated averages 45 feet on either side of the eastbound main line and 30 feet on either side of the westbound main line. The right-of-way clearances between W. Juneau Boulevard and N. 124th Street are generally 15 feet eastbound and 30 feet westbound. Between N. 124th Street and a point 0.2 mile west of W. Harwood Avenue in the City of Wauwatosa, the outside clearances in both directions average 30 feet. A third track, used as a passing siding, is provided along the westbound portion of the railway between W. Harwood Avenue and N. Hawley Road in Wauwatosa, reducing the outside clearance to 10 feet in both the eastbound and westbound directions. The outside clearances between N. Hawley Road and the Stadium Freeway (USH 41) Interchange are generally 25 feet in the eastbound direction and 15 feet in the westbound direction. Along the remaining portion of this railway segment, that between the Stadium Freeway Interchange and the Milwaukee passenger station, horizontal clearances in both directions are generally less than 10 feet wide.

The horizontal alignment of the railroad grade is generally limited to curvatures with large radii. There are 38 horizontal curves on the line, most of which have a curvature of less than $2^{\circ}00'$. The sharpest horizontal curves occur in that segment between Grand Avenue Junction and the Stadium Freeway (USH 41) Interchange, where the alignment follows a set of reverse curves with curvatures of $3^{\circ}45'$ and $3^{\circ}30'$. The horizontal alignment contains short stretches of tangent track between curves along this segment.

The vertical alignment is characterized by relatively flat gradients, generally less than 1 percent. The steepest grade westbound, 0.6 percent, occurs between Mileposts 95.5 and 97.5, located from Elm Grove Station to the City of Brookfield. Eastbound, the steepest grades are 0.9 percent, which occurs between Mileposts 96.0 and 96.7 located in the City of Brookfield, and 1.3 percent, which occurs between Mileposts 95.5 and 96.0 located just west of Elm Grove Station.

As indicated on Map 88, there are a total of 49 street, railroad, and watercourse crossings on this railroad segment. Included in this total are 31 public street and highway crossings, of which 16 are at-grade and 15 are grade-separated; six private at-grade residential, industrial, or farm crossings; one grade-separated railroad crossing; four at-grade railroad junctions; and seven watercourse crossings.

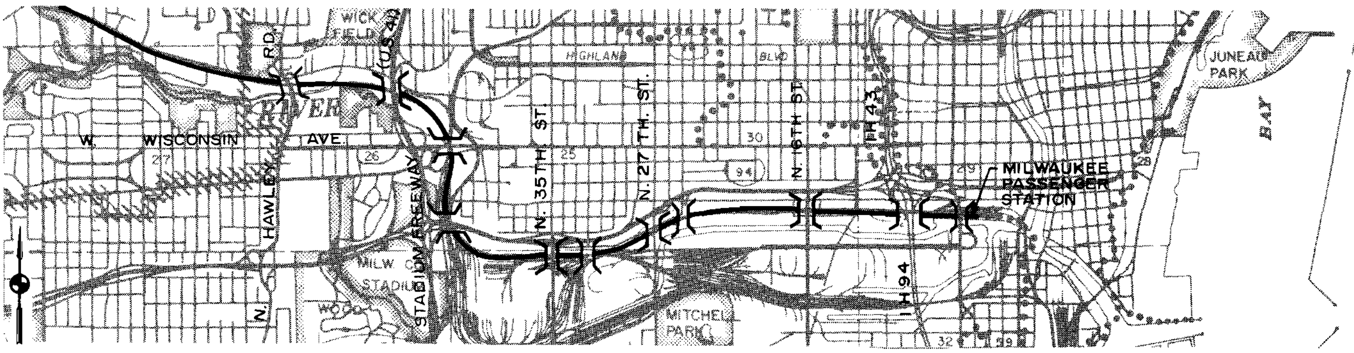
As indicated earlier, passing sidings are provided at two locations along the 15.7 miles of mainline trackage. The first passing siding is a third track located directly adjacent to the westbound mainline track that is situated between Barker Road and a point 0.3 mile west of N. Calhoun Road, a distance of 1.8 miles. The second passing siding is also a third track, and is located directly adjacent to the westbound mainline track located between W. Harwood Avenue and N. Hawley Road in the City of Wauwatosa, a distance of 1.0 mile. The third track along this portion of the railway segment is also used to connect with industrial sidings located along the right-of-way. There are a total of 14 industrial sidings or lead tracks along the westbound main line and 13 along the eastbound main line. Such trackage is concentrated on the portion of the right-of-way between the Milwaukee passenger station and W. Harwood Avenue. The remaining portion of the right-of-way has few industrial sidings, with these few being located at stations. In addition, east of Grand Avenue Junction additional yard and terminal trackage is located along the southern edge of the right-of-way to serve locomotive servicing facilities, freight yards, and the Milwaukee passenger station.

Land use development directly adjacent to this railroad segment is varied. Between the Milwaukee passenger station and Grand Avenue Junction, the land is primarily devoted to either additional railroad or industrial development. The land along the westbound track of the right-of-way from the Stadium Freeway to W. Harwood Avenue is right-of-way for W. State Street, and along the eastbound track is characterized by industrial and park

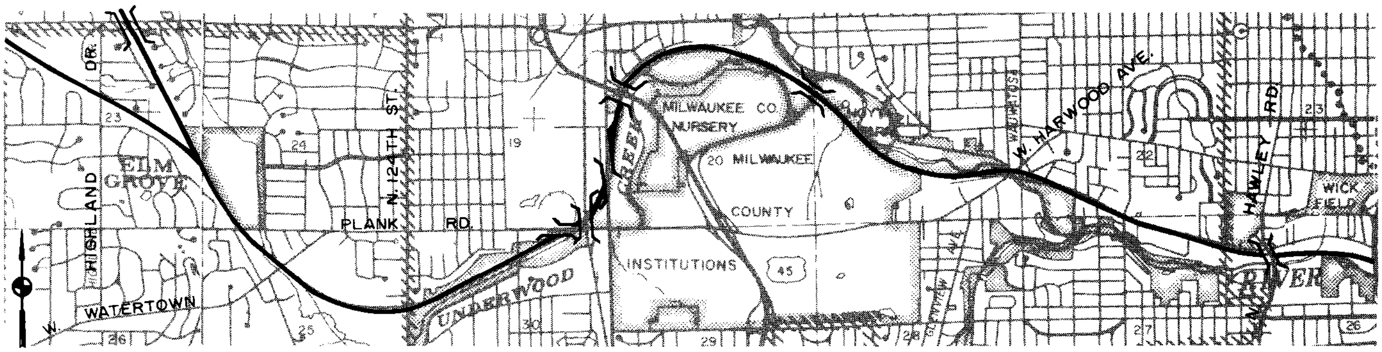
Map 88

ALIGNMENT OF THE MILWAUKEE ROAD'S WISCONSIN DIVISION FIRST SUBDIVISION WITHIN THE MILWAUKEE AREA

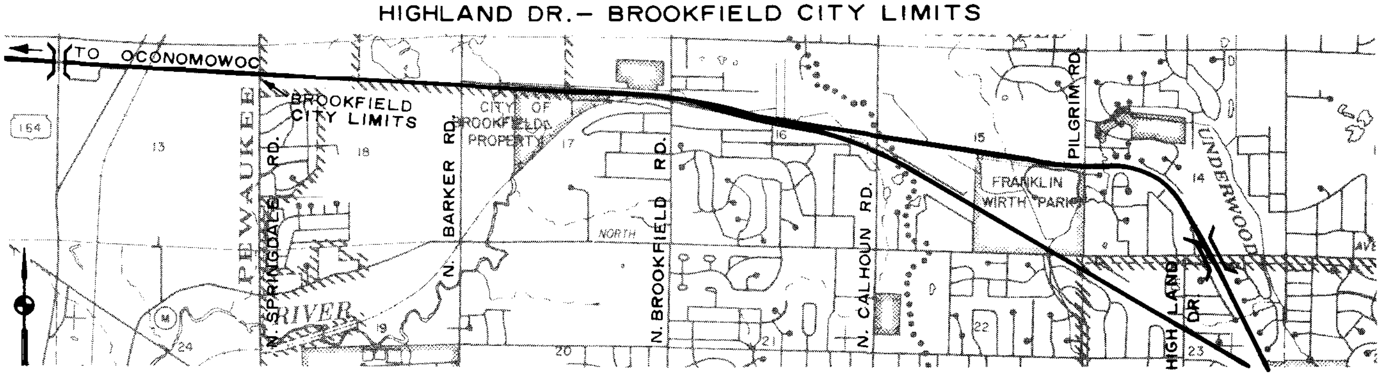
MILWAUKEE PASSENGER STATION — N. HAWLEY ROAD



N. HAWLEY ROAD—HIGHLAND DR.



HIGHLAND DR.— BROOKFIELD CITY LIMITS



LEGEND

RIGHT-OF-WAY — OVERPASS — UNDERPASS — GRAPHIC SCALE 0 2000 4000 FEET

The portion of the First Subdivision of the Milwaukee Road's Wisconsin Division within the Milwaukee area consists of a 15.7-mile segment extending from the Milwaukee passenger station to N. Springdale Road in the Town of Pewaukee. The First Subdivision is part of the Milwaukee Road's Chicago to Twin Cities main line and is used by the National Railroad Passenger Corporation (Amtrak) passenger trains. Passing through the communities of Milwaukee, Wauwatosa, Elm Grove, and Brookfield, the right-of-way has 31 street and highway crossings, of which 16 are at-grade and 15 are grade-separated; six private at-grade crossings, one grade-separated railway crossing, four at-grade railway junctions, and seven watercourse crossings. Insufficient horizontal clearance and the presence of numerous industrial sidings generally preclude ready development of an at-grade primary transit fixed guideway along this railway right-of-way.

Source: SEWRPC.

development. Between W. Harwood Avenue and W. Watertown Plank Road, the right-of-way parallels the Menomonee River Parkway, bordering Hoyt Park on the north and the Milwaukee County Institutions on the south. Beginning at W. Watertown Plank Road, the right-of-way parallels Underwood Parkway to N. 124th Street. The portion between N. 124th Street and N. Brookfield Road is bounded primarily by residential development, with some light industrial development. From N. Brookfield Road to N. Springdale Road, the land adjacent to the right-of-way is principally in agricultural and other rural open uses.

Feasibility Conclusion: The sections of this right-of-way within the study area that are east of the Stadium Freeway (USH 41) Interchange would appear to have poor or no potential for the location of light rail transit, heavy rail rapid transit, or exclusive busway facilities. Although this portion of the right-of-way has access to the Milwaukee central business district, it is not suitable for primary transit fixed guideway development because of the large number of industrial sidings on the outsides of the right-of-way, the presence of other railroad trackage for yards or terminals in the right-of-way, and the intensive urban development immediately adjacent to the right-of-way requiring disruption for any right-of-way expansion.

The portions of this right-of-way west of the Stadium Freeway Interchange also appear to have poor or no potential for the location of primary transit fixed guideway facilities. Specifically, the location of an inexpensive light rail transit, heavy rail rapid transit, or exclusive bus guideway on this right-of-way is precluded by the large number of industrial sidings located between the Stadium Freeway Interchange and W. Harwood Avenue in the City of Wauwatosa, and inadequate outside clearances along a large portion of the remaining railway segment to N. Springdale Road in the Town of Pewaukee. In most instances, fixed guideway facility location along this railway portion would require existing track to be shifted, industrial spur leads to be rearranged, and large portions of the right-of-way to be widened in order to provide adequate outside clearance.

Another problem is the large number of crossings along this railway segment, many of which are located at-grade. This places a more serious constraint on heavy rail rapid transit, but, in some instances, is also an important consideration for light rail transit and exclusive busway development. While heavy rail rapid transit requires grade separation of all crossings, light rail transit and exclusive busways, in general, do not. However, because grade separations are desirable at those locations with extensive industrial or yard trackage or inadequate outside clearances, and at highway crossings with potential traffic conflicts, this problem becomes an important consideration for light rail transit and exclusive busway systems as well. Thus, it would appear that grade separations constitute the most serious limitation to the development of this right-of-way for primary transit facilities, as well as the greatest capital cost consideration.

In general, it may be concluded that the First Subdivision right-of-way of the Milwaukee Road has poor or no potential for use in the development of a primary transit guideway. Although the physical characteristics of the right-of-way, including horizontal and vertical alignment, would allow for primary transit development along certain portions of this segment, ready development of primary transit fixed guideway facilities on this railroad right-of-way would generally be precluded by insufficient horizontal clearance, industrial sidings and trackage requiring complete grade separation, and the need to acquire additional right-of-way with attendant community disruption. Furthermore, while primary transit fixed guideway facilities could be developed along minimal portions of the right-of-way west of the Stadium Freeway, such development would not allow the railway line to be used for such facilities as a whole.

The Milwaukee Road—Fifth Subdivision

The Fifth Subdivision of the Milwaukee Road's Wisconsin Division consists of a 103.8-mile-long railway main line extending from North Milwaukee Station located at N. 33rd Street and W. Cameron Avenue to the City of Green Bay via Grafton and Saukville. The 16.5-mile segment pertinent to this right-of-way inventory and assessment includes that portion between North Milwaukee Station and Cedar Creek Road in the Village of Grafton. The Fifth Subdivision, referred to in the past as the Superior Division, is a main line of the Milwaukee Road. As shown on Map 89, the route segment under consideration passes through the communities of Milwaukee, Glendale, Brown Deer, Mequon, Thiensville, Cedarburg, and Grafton.

The Fifth Subdivision is a single-track railway line along the 16.5-mile length within the study area except at the six railway stations along the line, where additional track is provided for the passing and storage of railroad cars. Generally, the main track is centered in the right-of-way which, for the most part, is located at-grade. The right-of-way is approximately 100 feet wide at North Milwaukee Station, located between W. Cameron Avenue and W. Villard Avenue. Between W. Villard Avenue and Canco Station, located 0.1 mile south of the Chicago & North Western crossing, the right-of-way narrows to 66 feet wide. The right-of-way widens again at Canco Station to 100 feet and remains 100 feet wide to Milepost 95.8, located one mile north of Canco Station. From Milepost 95.8 to W. Good Hope Road, the right-of-way narrows again to 66 feet wide. Immediately north of the W. Good Hope Road crossing, a triangular portion of the right-of-way, including approximately a 600-foot length of the track alignment, has been sold in part to a private developer and in part to Milwaukee County. The Milwaukee Road retains an easement of sufficient width for the track alignment. The right-of-way along the remainder of the line, from 0.2 mile north of W. Good Hope Road to Cedar Creek Road in the Village of Grafton, is generally 66 feet wide, with single track centered within the right-of-way.

The potential to locate primary transit on this railway segment is dependent on the outside clearances along the right-of-way measured from the outside edge of the track to the outside edge of the railway right-of-way. On those portions of the right-of-way where the width is 100 feet, the outside clearances on each side of the right-of-way are generally 47 feet. Where the right-of-way is 66 feet wide, the outside clearances on each side of the right-of-way are generally 30 feet. Because of additional track placed in the right-of-way, the outside clearances at North Milwaukee Station between W. Cameron Avenue and W. Villard Avenue are 15 feet on the western portion of the right-of-way and 35 feet on the eastern portion. At Brown Deer Station, additional railroad trackage reduces the outside clearance to 15 feet on both sides of the right-of-way. The outside clearance along the west portion of the right-of-way at Thiensville Station is also 15 feet. In the vicinity of Cedarburg Station, additional trackage between Hamilton Road and a point 0.4 mile north of Cedarburg reduces the outside clearance to 10 feet except at the station, where the right-of-way width widens to approximately 250 feet to accommodate station facilities. Finally, at Grafton Station between STH 57 and STH 60, additional railroad trackage reduces the outside clearances on the eastern portion of the right-of-way to 15 feet.

The horizontal alignment of the railroad grade is marked by long stretches of tangent between large radius curves. There are eight horizontal curves along the line, all of which have a curvature of less than $2^{\circ}30'$. The sharpest horizontal curve occurs in that segment between W. Villard Avenue and W. Cameron Avenue at North Milwaukee Station, where the alignment follows a circular curve with a curvature of $2^{\circ}30'$.

The vertical alignment is marked by minor grades, all of which are of little consequence to primary transit operation. In general, the vertical alignment is characterized by flat gradients of less than 1 percent. The steepest grade of 1.1 percent occurs between Mileposts 94.8 and 95.4, located from the Chicago & North Western railway crossing north of North Milwaukee Station to a point approximately 0.2 mile north of Mill Road.

As indicated on Map 89, there are a total of 51 street, railroad, and watercourse crossings on this railroad segment. Included in this total are 25 public at-grade highway crossings, four public grade-separated highway crossings, 14 private at-grade residential, industrial, or farm crossings, two grade-separated railroad crossings, one at-grade railroad junction, and five watercourse crossings.

There are a total of 10 industrial sidings or lead tracks along the eastern portion of the right-of-way and 15 along the western portion of the right-of-way. Such trackage is concentrated on the portion of the right-of-way between North Milwaukee Station at W. Cameron Avenue and a point approximately one mile north of Canco Station, for a distance of about 2.4 miles. The remaining portion of the right-of-way—that between W. Good Hope Road and Cedar Creek Road in the Town of Grafton—has few industrial sidings, and the few that do exist are generally located at the stations along the line.

Land use development directly adjacent to this railroad segment is varied. Between North Milwaukee Station and W. Good Hope Road, the adjacent land west of the right-of-way is primarily devoted to additional transportation or commercial and industrial development, while land on the east side of the right-of-way is devoted to residential and park development. The portion of the right-of-way between W. Good Hope Road and Hamilton Road is bounded by residential uses and by agricultural and other rural open uses, with some industrial development located west of the right-of-way near Mequon Road and Boniwell Road. The right-of-way of the Milwaukee Northern Division of the former Milwaukee Electric Lines electric interurban railway system is located immediately adjacent to the east side of the right-of-way between Canco Station and the Mequon substation of the Wisconsin Electric Power Company, which is located between Highland and Boniwell Roads in the City of Mequon. The former interurban right-of-way parallels the Fifth Subdivision for approximately 9.7 miles. The land use directly adjacent to both sides of the right-of-way between Hamilton Road and Northern Road at Cedarburg Station is principally residential. North of Cedarburg Station from Northern Avenue to STH 57, the right-of-way is bounded primarily by agricultural and other rural open uses except at STH 57, where residential development flanks the east side of the right-of-way. Between STH 57 and STH 60, the land uses adjacent to both sides of the right-of-way are characterized by industrial, commercial, and residential development. Finally, the land use adjacent to both sides of the right-of-way from STH 60 to Cedar Creek Road in the Town of Grafton is characterized by sparse industrial, commercial, and residential development.

Feasibility Conclusion: In general, it may be concluded that the Fifth Subdivision right-of-way of the Milwaukee Road has fair potential for the location of a primary transit guideway. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, would allow for primary transit development along this railway segment. However, the section of the Fifth Subdivision right-of-way between North Milwaukee Station and a point approximately one mile north of Canco Station in the City of Milwaukee is not readily suitable for at-grade, primary transit fixed guideway development, primarily because of the presence of industrial and railroad trackage in the right-of-way and industrial development immediately adjacent to the right-of-way.

The portion of this right-of-way west of Milepost 95.8, which is situated approximately one mile north of Canco Station, has good potential for the location of at-grade primary fixed guideway facilities. Fixed guideway facility location along this portion would not require many changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way to provide adequate outside clearances. It should be noted, however, that the outside clearances north of Good Hope Road are insufficient, since an approximately 600-foot portion of the railway right-of-way on both sides of the track has been sold to a private developer. As a consequence, this section of right-of-way would not be suitable for at-grade, primary transit fixed guideway development unless additional right-of-way were purchased or an elevated primary transit facility were provided. Outside clearances at stations, while reduced because of the location of additional railroad trackage, do not appear to pose a severe limitation to the development of fixed guideway facilities along this portion.

The large number of at-grade crossings along this segment is important to the consideration of development of this segment for primary transit facilities. Such crossings place a more serious constraint on heavy rail rapid transit location than on light rail transit and exclusive busway location. While heavy rail rapid transit requires the grade separation of all crossings, light rail transit and exclusive busways do not. However, because grade separations are desirable at those locations where there are extensive industrial or railroad trackage or inadequate outside clearances, or at highway crossings with potential traffic conflicts, the number of crossings becomes an important consideration for light rail transit and exclusive busway system development as well. Thus, it would appear that grade separations constitute the most serious limitation to development of this right-of-way for primary transit facilities, as well as the greatest capital cost consideration.

The Milwaukee Road—Twelfth Subdivision

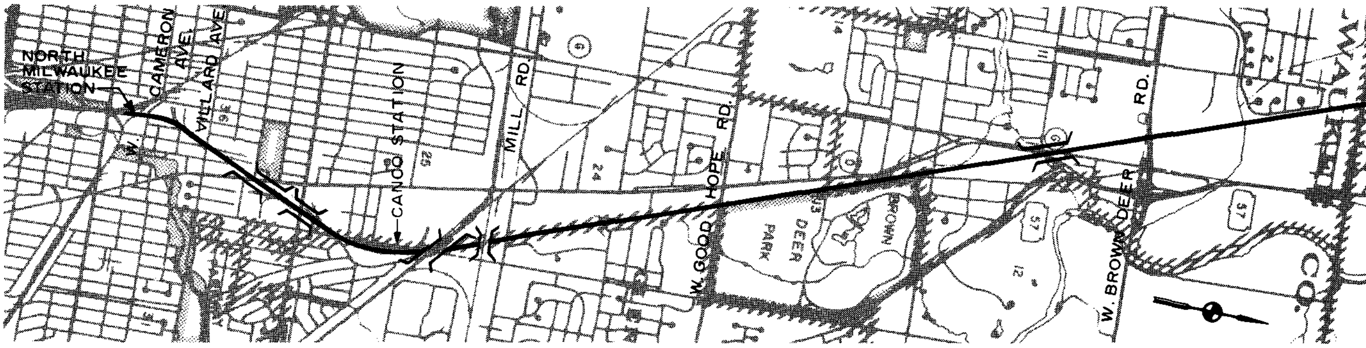
The Twelfth Subdivision of the Milwaukee Road's Wisconsin Division, referred to in the past as the Northern Division, consists of a 94.9-mile-long branchline railway extending from North Milwaukee Station located at N. 33rd Street and W. Cameron Avenue in the City of Milwaukee to the City of Oshkosh in Outagamie County. The 15.8-mile segment pertinent to this right-of-way inventory and assessment includes that portion between North Milwaukee Station and the USH 41 and 45 in the Village of Germantown. As shown on Map 90, the route segment under consideration passes through the communities of Milwaukee, Menomonee Falls, and Germantown.

The Twelfth Subdivision is a single-track railway line along the 15.8-mile length within the study area except between Granville Station and Milepost 101.1, where there is a second track to the

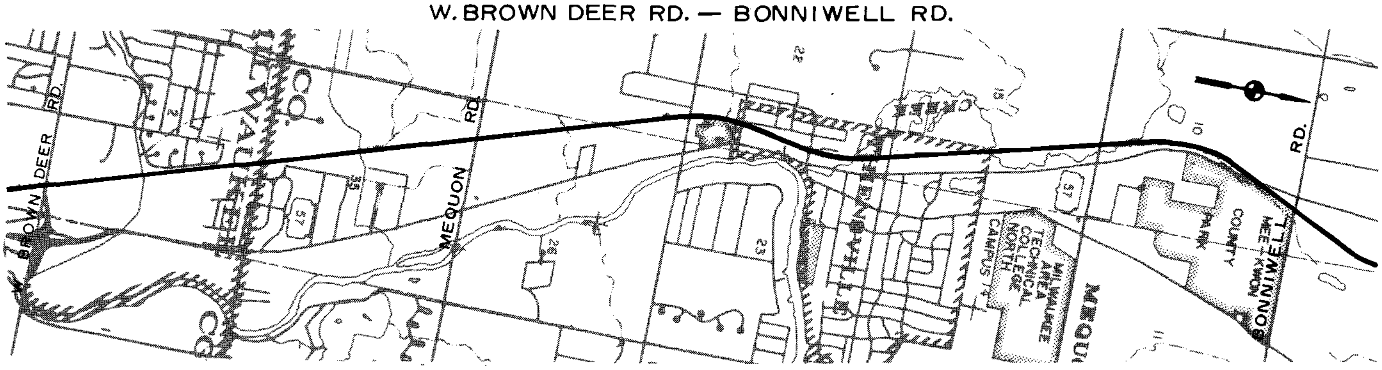
Map 89

ALIGNMENT OF THE MILWAUKEE ROAD'S WISCONSIN DIVISION FIFTH SUBDIVISION WITHIN THE MILWAUKEE AREA

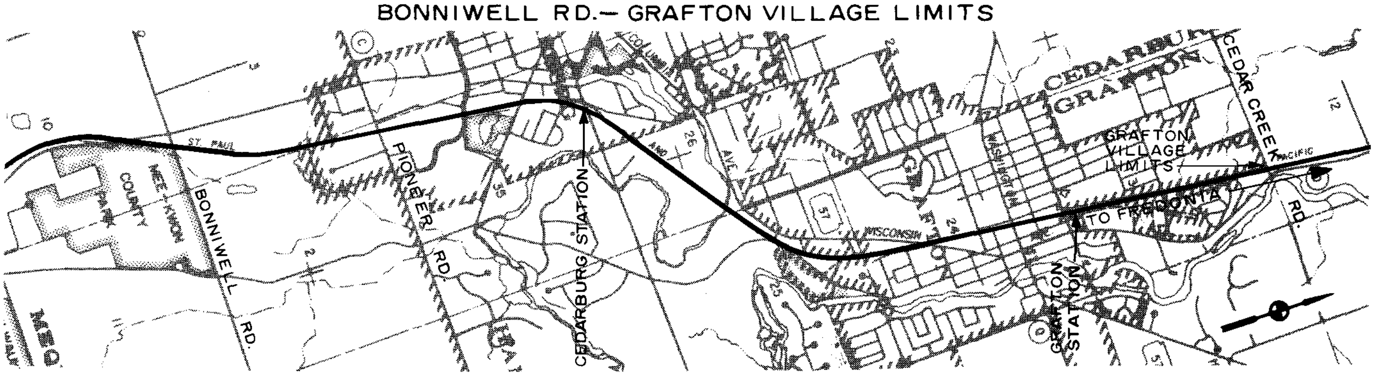
NORTH MILWAUKEE STATION—W. BROWN DEER RD.



W. BROWN DEER RD. — BONNIWELL RD.



BONNIWELL RD.— GRAFTON VILLAGE LIMITS



LEGEND

RIGHT-OF-WAY

OVERPASS

UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

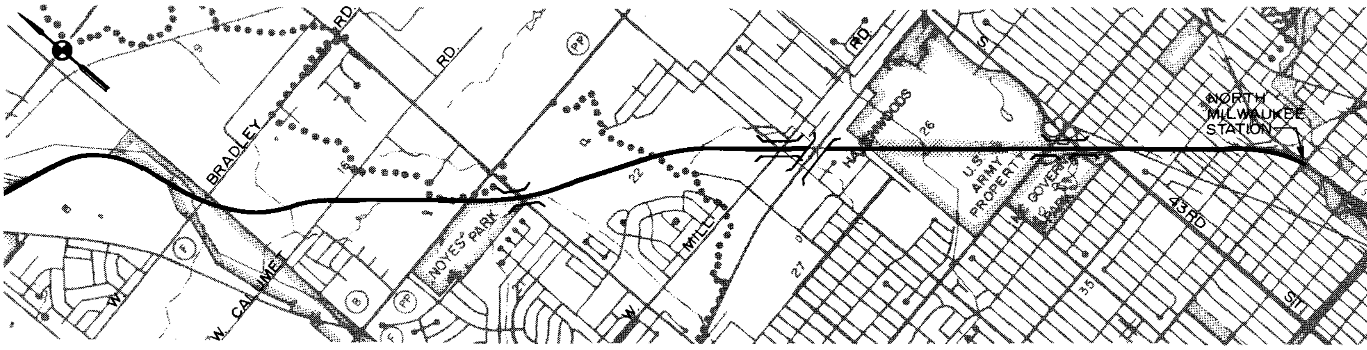
The portion of the Fifth Subdivision of the Milwaukee Road's Wisconsin Division within the Milwaukee area consists of a 24.8-mile segment extending from North Milwaukee Station to Cedar Creek Road in the Village of Grafton. Passing through the communities of Milwaukee, Glendale, Brown Deer, Mequon, Thiensville, Cedarburg, and Grafton, the right-of-way has 25 at-grade highway crossings, four grade-speareted highway crossings, 14 private crossings, two grade-separated railway crossings, one at-grade railroad junction, and five watercourse crossings. In general, the portion of this right-of-way west of Canco Station in the City of Milwaukee has good potential for the location of at-grade primary transit facilities. The section of the right-of-way between North Milwaukee and Canco Stations, however, is generally not suitable for the location of an at-grade primary transit fixed guideway because of the presence of industrial sidings and additional trackage in the right-of-way and of industrial development immediately adjacent to the right-of-way.

Source: SEWRPC.

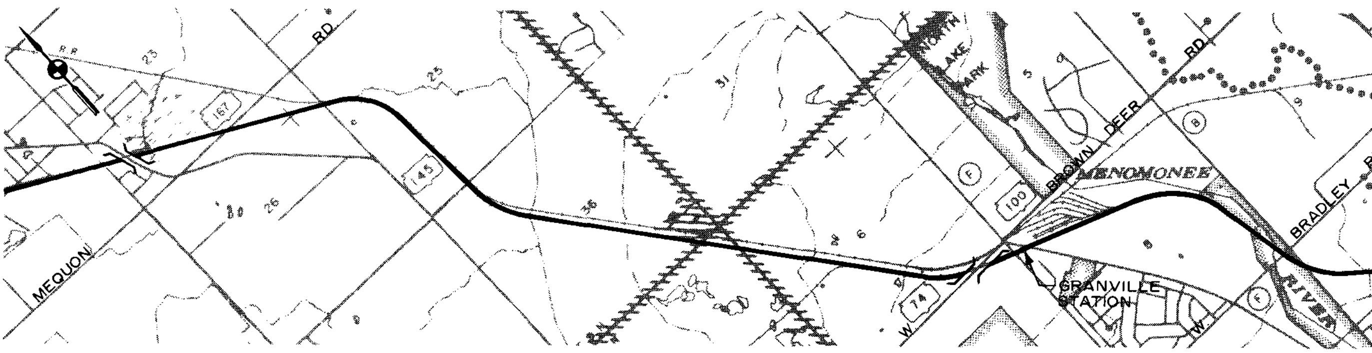
Map 90

ALIGNMENT OF THE MILWAUKEE ROAD'S WISCONSIN DIVISION TWELFTH SUBDIVISION WITHIN THE MILWAUKEE AREA

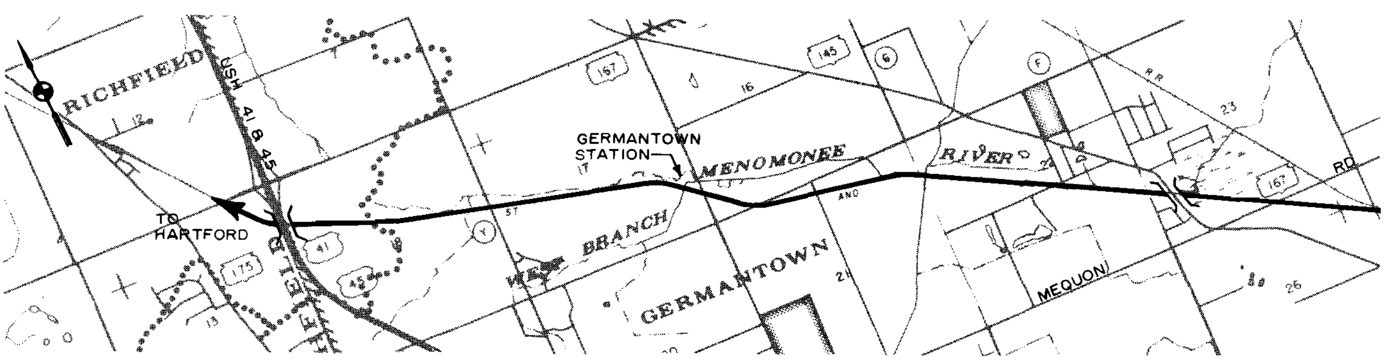
NORTH MILWAUKEE STATION — W. BRADLEY RD.



W. BRADLEY RD. — MEQUON RD.



MEQUON RD. — USH 41 & 45



LEGEND

RIGHT-OF-WAY

FORMER OVERPASS

FORMER UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The portion of the Twelfth Subdivision of the Milwaukee Road's Wisconsin Division within the Milwaukee area consists of a 15.8-mile segment extending between North Milwaukee Station and the USH 41/45 crossing in the Village of Germantown. Passing through the communities of Milwaukee, Menomonee Falls, and Germantown, the right-of-way has 23 at-grade highway crossings, six grade-separated highway crossings, seven private at-grade crossings, one grade-separated railway crossing, and two watercourse crossings. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, all would allow for the ready location of an at-grade primary transit guideway, except between S. 43rd Street and W. Hampton Avenue, where the presence of industrial sidings and additional railroad and industrial trackage within the right-of-way would require grade separation of primary transit facilities.

Source: SEWRPC.

south of the branchline track for approximately 0.9 mile. Generally, the track is centered in the right-of-way which, for most of its length, is located at-grade. The right-of-way is 99 feet wide along its entire length.

The potential to develop the right-of-way for at-grade primary transit facilities is dependent on the outside clearances along the right-of-way measured from the outside edge of the track to the outside edge of the railway right-of-way. In general, a width of 47 feet is available along the outside portion of the right-of-way on both sides of the track. However, additional track at Granville Station and at Germantown Station serves to reduce the outside clearance to the north of the track to 15 feet and 20 feet, respectively. In addition, additional railroad trackage at North Milwaukee Station reduces the available width on both sides of the track to approximately 10 feet.

The horizontal alignment of the railroad grade is generally marked by large radius curves connecting short stretches of tangent track. There are 12 curves on the line, most of which have a curvature of less than $2^{o}30'$. The sharpest curvatures occur in that segment between Milepost 103.5, located approximately 2.5 miles west of Granville Station, and Milepost 103.8, where the alignment follows a compound curve with curvatures of $3^{o}05'$, $3^{o}30'$, and $1^{o}45'$.

The vertical alignment is characterized by relatively flat gradients of less than 1 percent. The steepest grade, 0.87 percent, occurs between Milepost 98 and Milepost 98.3, located near Calumet Road in the City of Milwaukee, for a distance of 0.3 mile.

As indicated on Map 90, there are a total of 39 street, railway, and watercourse crossings on this railway line. Included in this total are 23 public at-grade highway crossings, six grade-separated highway crossings, seven private at-grade residential, industrial, or farm crossings, one grade-separated railway crossing, and two watercourse crossings.

There are a total of 13 industrial sidings, or lead tracks, along the northern portion of the right-of-way and 13 along the southern portion of the right-of-way. In addition, two spur tracks are located along the north side of the branchline trackage. Such trackage is concentrated on the 1.2-mile portion of the right-of-way between W. Hampton Avenue and N. 43rd Street in the City of Milwaukee and on the 0.4-mile portion between Mill Road and the Menomonee River crossing just west of Germantown Station at Milepost 105.8. The remaining portions of the right-of-way have three industrial sidings, all located at or near Granville Station.

Land directly adjacent to this railroad segment is primarily in agricultural, park, and other rural uses, except along the right-of-way at North Milwaukee and Granville Stations. For a distance of about 1.0 mile east and west of each station, the land on both sides of the right-of-way is generally devoted to either additional railway development or industrial development. Between North Milwaukee and Granville Stations, scattered industrial development is located adjacent to the right-of-way. In the vicinity of Germantown Station, the 0.7-mile portion of the right-of-way between STH 145 and a point 0.25 mile northwest of Main Street in Menomonee Falls is devoted primarily to residential and commercial use to the north of the right-of-way and to open land to the south. Between Brown Deer Road and Country Aire Road, a distance of approximately 40 miles, the Twelfth Subdivision right-of-way closely parallels the Chicago & North Western Transportation Company's right-of-way to Fond du Lac.

Feasibility Conclusion: In general, it may be concluded that the Twelfth Subdivision railway right-of-way has good potential for use in the location of a primary transit fixed guideway facility. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, all allow for ready, at-grade primary transit development along this railway segment. However, the 1.2-mile portion of right-of-way located at North Milwaukee Station, specifically between N. 43rd Street and W. Hampton Avenue, is not well suited for at-grade, primary transit fixed guideway development because of the additional railroad and industrial trackage in the right-of-way and the industrial development located immediately adjacent to the right-of-way. The location of primary transit fixed guideway facilities along this section of railway right-of-way would require either the relocation of existing track and industrial spurs or the elevation of fixed guideway facilities.

Important to the consideration of the use of this railway segment for primary transit fixed guideway location are its 29 street and highway crossings, all except six of which are located at-grade. These crossings place a serious constraint on the use of the right-of-way for heavy rail rapid transit, but must also be considered for the use of the right-of-way for light rail transit and exclusive busway development. While heavy rail rapid transit requires fully grade-separated facilities at all crossings, both light rail transit and exclusive busway systems generally do not. However, because grade separations are desirable at those locations where there is extensive industrial or station trackage, and at street and highway crossings with potential traffic conflicts, these crossings become an important consideration for the development of light rail transit and exclusive busway systems as well. Thus, grade separations would appear to constitute the most serious limitation to the development of this right-of-way for primary transit facilities, as well as the greatest capital cost consideration.

The Milwaukee Road—Seventeenth Subdivision

The Seventeenth Subdivision of the Milwaukee Road Wisconsin Division consists of a 3.8-mile-long railway branch line extending from Granville Station located at the intersection of N. 107 Street (STH 100) and N. Granville Road in Milwaukee County to Menomonee Falls Station, located at E. Water Street in the City of Menomonee Falls. Referred to in the past as the North Lake Branch Line, this railroad line lies entirely within the study area. As shown on Map 91, the route segment under consideration passes through the communities of Milwaukee and Menomonee Falls.

The Seventeenth Subdivision is a single-track railway line along its 3.8-mile length except between Milepost 101.1, approximately 0.3 mile east of Boundary Road, and Granville Station, where there is a second track in the southern portion of the right-of-way for a distance of 0.3 miles. The track is centered within the right-of-way, which is generally located at-grade. The right-of-way is approximately 100 feet wide between Granville Station and Milepost 101.1 where the right-of-way narrows to 60 feet wide. The right-of-way remains 60 feet wide to the Village of Menomonee Falls.

The potential to develop primary transit facilities within the Seventeenth Subdivision right-of-way is dependent on the outside clearances along the right-of-way measured from the outside edge of the track to the outside edge of the railway right-of-way. Generally, the outside portion of the right-of-way is approximately 27 feet wide along both sides of the track. Between Granville Station and Milepost 101.1 the second track, located on the south side of the existing branchline track for a distance of approximately 0.3 mile, reduces the outside clearance to approximately 15 feet. Furthermore, additional trackage at both Granville Station and Menomonee Falls Station reduces the right-of-way available on the northern portion of the right-of-way to less than 10 feet.

The horizontal alignment of the railroad grade is marked by numerous large radius curves between short segments of tangent track. There are eight horizontal curves on the line, most of which have a curvature of less than 2°30'. The sharpest horizontal curves occur at Milepost 101.1, where the alignment follows a circular curve with a curvature of 9°48".

The vertical alignment is marked by minor grades, all of which are of little consequence to primary transit operation. In general, the vertical alignment is characterized by flat gradients of less than 2 percent. The steepest grade, 2.6 percent, occurs between Milepost 102.3 and Milepost 102.4, for a distance of 0.1 mile.

As indicated on Map 91, there are a total of eight street, highway, railroad, and watercourse crossings on this railway line. Included in this total are four public at-grade street or highway crossings, two grade-separated public highway crossings, one private at-grade farm crossing, and one watercourse crossing.

Industrial sidings are located at several places along the 3.8 miles of branchline trackage. One industrial siding is located along the northern portion of the right-of-way and four are located along the southern portion of the right-of-way. Such trackage is concentrated in a 0.75-mile-long portion of the right-of-way between CTH YY and E. Water Street in the Village of Menomonee Falls. The remaining portion of the right-of-way, that between CTH YY and Granville Station, has only one industrial siding.

Between Granville Station and a point 0.5 mile west of the station, land on both sides of the right-of-way is primarily devoted to industrial development. From that point to Boundary Road, land on both sides of the right-of-way is generally in agricultural and other rural open uses. The portion of the right-of-way between Boundary Road and STH 145 traverses primarily agricultural land, with scattered residential and commercial development. Between STH 145 and USH 41/45, the land is devoted to industrial development on the south side of the right-of-way, while on the north side it is devoted to agricultural and other rural open uses. Finally, between USH 41/45 and Menomonee Falls Station at E. Water Street, land use is primarily industrial and commercial on both sides of the right-of-way.

Feasibility Conclusion: In general, it may be concluded that the Seventeenth Subdivision railway right-of-way has good potential for use in the development of a primary transit fixed guideway facility. In general, the physical characteristics of the right-of-way, including horizontal and vertical alignment and curvature and right-of-way width, do not place severe constraints on the location of primary transit facilities along this railroad segment. It should be noted, however, that the horizontal curvature at Milepost 101.1 exceeds the minimum design criteria for horizontal curvature of fixed guideway primary transit facilities. Consequently, the location of primary transit fixed guideway facilities along this portion of railway right-of-way would require additional right-of-way.

Crossings with public streets and industrial trackage pose the most serious limitation to the use of this right-of-way for the location of fixed guideway facilities, placing a more serious constraint on heavy rail rapid transit development than on light rail or exclusive busway development. While heavy rail rapid transit requires grade-separated facilities at all crossings, both light rail transit and exclusive busway systems can tolerate the small number of grade crossings along this railway segment without severe operating impediments to either primary transit service or existing railroad operations.

In addition, the outside clearances on both sides of this railway segment would appear to allow for the development of primary transit fixed guideway facilities within the right-of-way except at Granville Station and Menomonee Falls Station, where the outside clearances are reduced because of additional trackage in the right-of-way.

The Milwaukee Road—Twenty-Sixth Subdivision

The Twenty-Sixth Subdivision of the Milwaukee Road's Wisconsin Division, referred to in the past as the Prairie du Chien Division, consists of a 50.0-mile-long, light-density, railway branch line extending from Brookfield Station in the City of Brookfield to Milton Junction in the City of Milton in Rock County. From an historical point of view, the portion of this railway line from Waukesha to Milton Junction is significant since it is part of the first railroad line constructed in the State of Wisconsin, providing transportation service to the communities of Waukesha, Genesee Depot, Eagle, Palmyra, Whitewater, Lima Center, and Milton Junction. In March 1978, the Milwaukee Road initiated an application for abandonment of the portion of this line beginning at Milepost 23.0 near Waukesha and extending in a southwesterly direction to Milepost 48.9 near Whitewater. In May 1979, the Interstate Commerce Commission approved the abandonment petition, relieving the Milwaukee Road from the burden of continued operation of the line. The line is presently being operated as a shortline railroad west of the Chicago & North Western railway crossing in the City of Waukesha to Milton Junction by the Wisconsin Central Railroad Company.[7] The 7.4-mile segment pertinent to this right-of-way inventory and assessment is still being operated by the Milwaukee Road and consists of that portion of the line between Brookfield Station in the City of Brookfield and the Chicago & North Western railway crossing at Milepost 23.0 in the City of Waukesha. As shown on Map 92, the route segment under consideration passes through the communities of Brookfield and Waukesha, as well as the Town of Pewaukee.

The Twenty-Sixth Subdivision branch line is a single-track railway line along the 7.4-mile length within the study area. The track is generally centered in the right-of-way, which is generally located at-grade. The right-of-way is 66 feet wide along the entire railway segment except at Waukesha and Brookfield Stations, where the right-of-way width increases to 80 feet between W. Broadway and Mary Street in the City of Waukesha and to about 250 feet between the junction of this railway segment with the Milwaukee Road's First Subdivision at Brookfield Station and N. Brookfield Road in the City of Brookfield.

The potential to develop primary transit facilities on this railroad segment is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside

[7] *For a complete description of the condition of the line and of its traffic and operation, an estimate of the cost of rehabilitating the line for continued freight service, and a description of the alternative plans for the provision of needed freight service in the corridor, see SEWRPC Community Assistance Report No. 30, Whitewater Area Rail Service Plan.*

edge of the railway right-of-way. Generally, the outside portion of the right-of-way is 31 feet wide on both sides of the track. A second track, used as a passing siding, is provided along the north side of the right-of-way between a point just west of the Soo Line railway crossing and Milepost 16.9, a distance of about 0.4 mile, reducing the outside clearance on the north side to about 15 feet. An additional track is also provided for about 0.4 mile along the north side from approximately Milepost 17.5 to Milepost 17.9, reducing the outside clearance in this segment to 15 feet. Finally, additional track is also provided in the vicinity of Waukesha Station between W. Broadway Street and Mary Street, reducing the outside clearance on both sides of the track to approximately 10 feet.

The horizontal alignment of the railroad grade is marked by numerous large radius curves between short segments of tangent track. There are 15 curves on the line, most of which have a curvature of less than $2^{\circ}00'$. The sharpest curvatures occur in that segment between Watertown Road in the Town of Pewaukee and a point just east of N. Springdale Road, where the alignment follows a reverse curve with curvatures of $2^{\circ}30'$ and $2^{\circ}00'$.

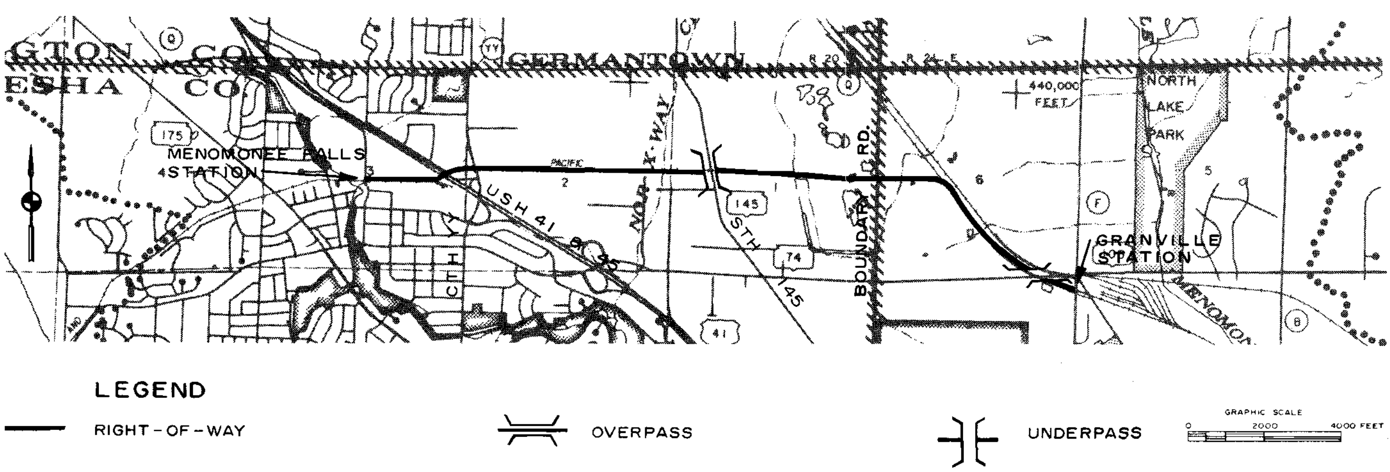
The vertical alignment is marked by minor grades, all of which are of little consequence to primary transit operation. In general, the vertical alignment is characterized by flat gradients of less than 0.2 percent. The steepest grade, 0.27 percent, occurs in the City of Waukesha between Waukesha Station at Milepost 19.5 and a point east of Union Street at Milepost 18.9, a distance of 0.6 mile.

As indicated on Map 92, there are a total of 27 street, highway, railroad, and watercourse crossings on this railway segment. Included in this total are 11 public at-grade street or highway crossings, four public grade-separated highway crossings, four private at-grade residential, industrial, or farm crossings, two at-grade railway crossings, and two watercourse crossings.

As indicated earlier, passing sidings are located at two locations along the 7.4 miles of branchline trackage. The first passing siding is a second track located directly adjacent to the mainline track on the north side of the right-of-way beginning at a point just west of the Soo Line railway crossing and continuing westward for a distance of 0.4 mile. The second passing siding is a second track located directly adjacent to the mainline

Map 91

ALIGNMENT OF THE MILWAUKEE ROAD'S WISCONSIN DIVISION SEVENTEENTH SUBDIVISION WITHIN THE MILWAUKEE AREA



The portion of the Seventeenth Subdivision of the Milwaukee Road's Wisconsin Division within the Milwaukee area consists of a 3.8-mile segment extending from Granville Station in Milwaukee County to Menomonee Falls Station. Passing through the communities of Milwaukee and Menomonee Falls, the right-of-way has four at-grade highway crossings, two grade-separated public highway crossings, one at-grade farm crossing, and one watercourse crossing. The physical characteristics of the right-of-way do not pose any severe constraints on the location of at-grade primary transit facilities.

Source: SEWRPC.

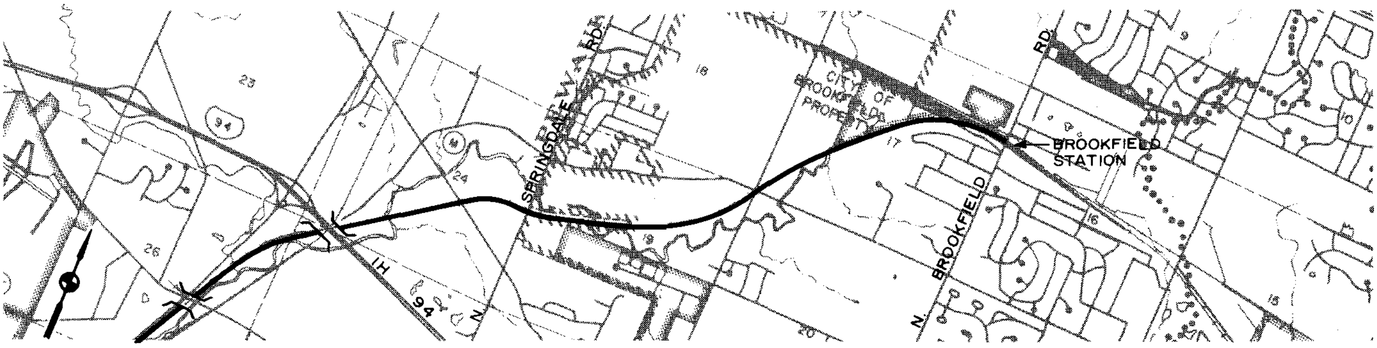
track on the north side of the right-of-way between Mileposts 17.5 and 17.9. These two passing sidings are also used to connect with industrial sidings located along the right-of-way. There are a total of seven industrial sidings, or lead tracks, along the north side of the railway right-of-way and five along the south side of the right-of-way. These lead tracks are concentrated along the portion of the right-of-way between the Chicago & North Western Railway crossing in the City of Waukesha and the Soo Line Railroad crossing at IH 94, a distance of approximately 3.8 miles. The remaining portion of the right-of-way, that between the Soo Line crossing and Brookfield Station, has no industrial sidings.

Land use development directly adjacent to this railroad segment is varied. Between the Chicago & North Western Railway crossing and the Soo Line Railroad crossing, the land on both sides of the

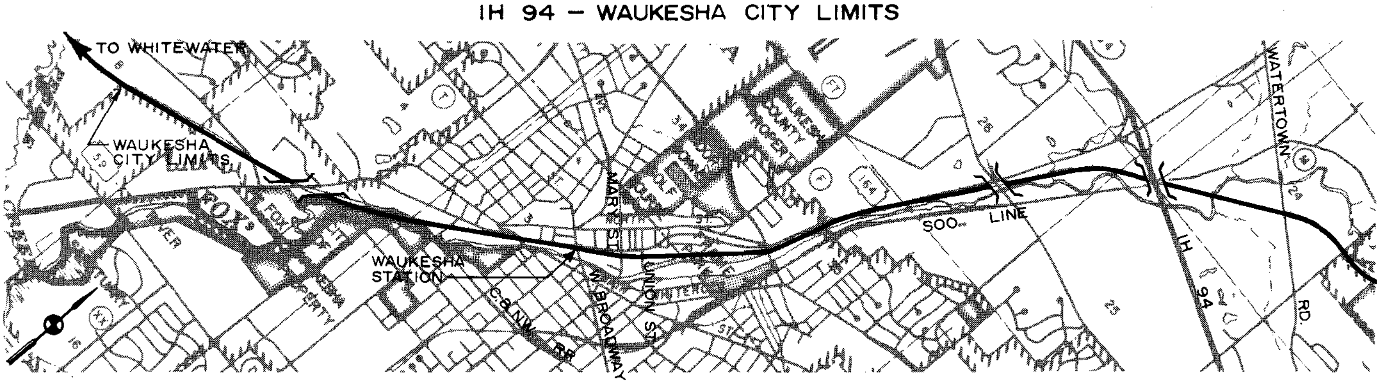
Map 92

ALIGNMENT OF THE MILWAUKEE ROAD'S WISCONSIN DIVISION TWENTY-SIXTH SUBDIVISION WITHIN THE MILWAUKEE AREA

BROOKFIELD STATION – IH 94



IH 94 – WAUKESHA CITY LIMITS



LEGEND

RIGHT-OF-WAY — OVERPASS — UNDERPASS — GRAPHIC SCALE 0 2000 4000 FEET

The portion of the Twenty-Sixth Subdivision of the Milwaukee Road's Wisconsin Division within the Milwaukee area consists of a 7.4-mile segment extending from Brookfield Station to the Chicago & North Western Transportation Company railway crossing in the City of Waukesha. Passing through the communities of Brookfield and Waukesha, the right-of-way has 11 at-grade highway crossings, four grade-separated highway crossings, four private at-grade crossings, two at-grade railway crossings, and two watercourse crossings. The physical characteristics of the right-of-way would allow for the ready location of at-grade primary transit development except between the C&NW Railway crossing and the Soo Line Railroad crossing, where the presence of additional railroad trackage in the right-of-way and of industrial development immediately adjacent to the right-of-way would preclude such development.

Source: SEWRPC.

right-of-way is primarily devoted to railroad and industrial development. The remaining portion of the right-of-way, that between the Soo Line Railroad crossing and Brookfield Station, is principally in agricultural and other rural open uses, with some scattered residential development. The Fox River parallels this railway segment along its south side for most of its length.

Feasibility Conclusion: Overall, it may be concluded that the Twenty-Sixth Subdivision right-of-way of the Milwaukee Road has modest potential for use as the location of a primary transit guideway. The physical characteristics of the right-of-way, including horizontal alignment and curvature, vertical alignment and curvature, and right-of-way width, would all allow for ready primary transit development. However, the section of right-of-way between the Chicago & North Western Railway crossing and Soo Line Railroad crossing within and directly north of the City of Waukesha is not well suited for primary transit fixed guideway development because of the additional railroad trackage in the right-of-way and the industrial development located immediately adjacent to the right-of-way.

The portion of this right-of-way east of the Soo Line Railroad crossing to Brookfield Station has good potential for the location of at-grade, primary fixed guideway facilities. Fixed guideway facility location along this portion of right-of-way would not require many changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way to provide adequate outside clearances.

Important to the consideration of the use of this railway segment for primary transit fixed guideway location is the number of street and highway crossings, all except four of which are located at-grade. These crossings place a serious constraint on the use of the right-of-way for heavy rail rapid transit, but must also be considered for the use of the right-of-way for light rail transit and exclusive busway development. While heavy rail rapid transit requires the grade separation of all crossings, light rail transit and exclusive busways generally do not. However, because grade separations are desirable at those locations where there is extensive industrial or station trackage, and at street and highway crossings with potential traffic conflicts, these crossings become an important consideration for light rail transit and exclusive busway systems as well. Thus, grade separations would appear to constitute the most serious limitation to the development of this right-of-way for primary transit facilities, as well as the greatest capital cost consideration.

The Milwaukee Road—Thirtieth Subdivision

The Thirtieth Subdivision of the Milwaukee Road's Wisconsin Division, referred to in the past as the "C&M Line" (Chicago and Milwaukee Line), consists of a 52.7-mile-long railway main line extending from the Milwaukee passenger station located at the intersection of S. 5th Street and W. St. Paul Avenue in downtown Milwaukee to the station at Rondout, Illinois. The 14.8-mile segment pertinent to this right-of-way inventory and assessment includes that portion between the Milwaukee passenger station and the Milwaukee-Racine County line located in the City of Oak Creek. As shown on Map 93, the route segment under consideration passes through the communities of Milwaukee and Oak Creek.

The Thirtieth Subdivision is operated as a double-track railway line along the 14.8-mile length within the study area. Both tracks are centered in the right-of-way, which is generally located at-grade. The right-of-way is generally 100 feet wide for the entire length of the railway segment. The right-of-way widens to more than 100 feet, however, at those locations where additional track is provided for station facilities and industrial trackage, and at those locations with passing and storage facilities. Specifically, the right-of-way widens to about 200 feet at Lake Station between W. Grange Avenue and W. Rawson Avenue and to 150 feet at Oakwood Station between W. Oakwood Road and the Milwaukee-Racine County line.

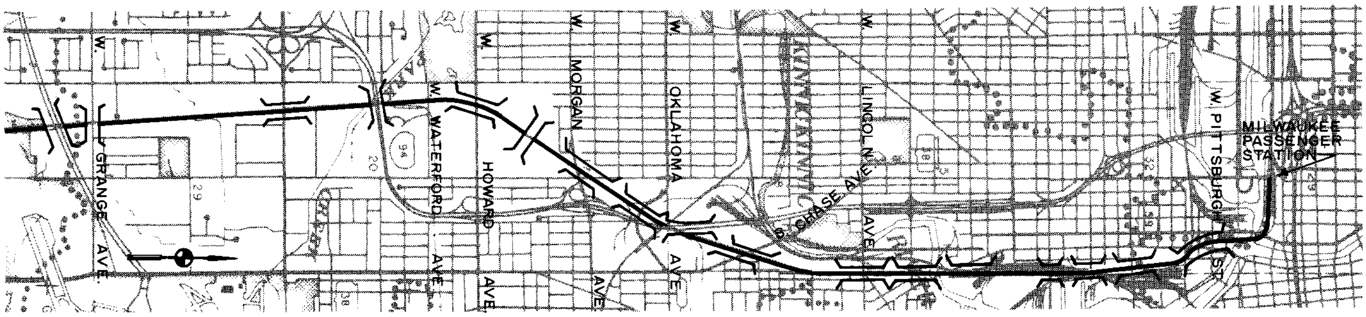
There is an approximately 14-foot distance between the centerlines of the northbound and southbound tracks along the entire portion of the right-of-way, thus precluding the location of fixed guideway primary transit facilities between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

In general, approximately 38 feet is available along the outside portion of both the northbound and southbound mainline track. Where additional track is provided in the right-of-way, particularly at the four railway stations located along this segment and at industrial siding locations and other locations that provide passing and railway storage facilities, the right-of-way width available for

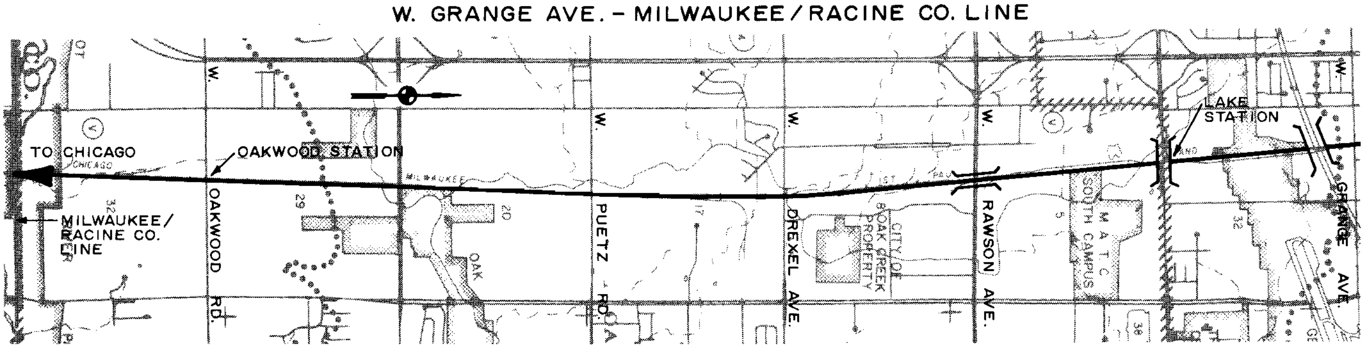
Map 93

ALIGNMENT OF THE MILWAUKEE ROAD'S WISCONSIN DIVISION THIRTIETH SUBDIVISION WITHIN THE MILWAUKEE AREA

MILWAUKEE PASSENGER STATION – W. GRANGE AVE.



W. GRANGE AVE. – MILWAUKEE/RACINE CO. LINE



LEGEND

RIGHT-OF-WAY — OVERPASS — UNDERPASS — GRAPHIC SCALE 0 2000 4000 FEET

The portion of the Thirtieth Subdivision of the Milwaukee Road's Wisconsin Division within the Milwaukee area consists of a 14.8-mile segment located between the Milwaukee passenger station and the Milwaukee-Racine County line. Passing through the communities of Milwaukee and Oak Creek, the right-of-way has seven at-grade highway crossings, 24 grade-separated highway crossings, four private at-grade crossings, one private grade-separated crossing, two grade-separated railway crossings, and three watercourse crossings. The right-of-way south of W. Drexel Avenue has good potential for the location of at-grade fixed guideway facilities, while the portion north of W. Drexel Avenue has poor potential because of the concentration of industrial sidings and of the railway trackage within the right-of-way for passing, storage, and station facilities.

Source: SEWRPC.

primary transit fixed guideway development is, in some cases, reduced. The additional track located in the right-of-way between W. Lincoln Avenue and W. Oklahoma Avenue, W. Waterford Avenue and W. Layton Avenue, and W. Grange Avenue and W. Rawson Avenue reduces the outside clearances on both sides of the right-of-way to approximately 15 feet.

The horizontal alignment of the railroad grade is generally marked by large radius curves connecting long stretches of tangent track, except that segment between the Milwaukee passenger station and W. Waterford Avenue, a distance of 5.0 miles, which is marked by short tangents between curves. There are 10 horizontal curves on the line, most of which have a curvature of less than $2^{o}00'$. The sharpest horizontal curves occur in that segment between W. Pittsburgh Avenue and W. National Avenue in the vicinity of the Milwaukee passenger station, where the alignment follows a reverse curve with curvatures of $3^{o}45'$ and $9^{o}30'$.

The vertical alignment is characterized by flat gradients, generally less than 0.5 percent. The steepest grade occurs between Milepost 81.2 and Milepost 82.8, located from W. Morgan Avenue to a point 0.3 mile north of Chase Avenue, where, for a distance of 1.6 miles, the grade averages 0.66 percent.

As indicated on Map 93, there are a total of 41 street, railway, and watercourse crossings on this railroad segment. Included in this total are seven public at-grade highway crossings, twenty-four public grade-separated highway crossings, four private at-grade residential, industrial, or farm crossings, one private grade-separated crossing, two grade-separated railway crossings, and three watercourse crossings, two of which are movable drawbridges.

As indicated earlier, additional trackage is provided at several locations along the 14.8 miles of mainline trackage. In most instances, this additional trackage is located at the four stations along the right-of-way and serves as access to industrial sidings and as storage and passing facilities for railroad movements along this railway segment. There are 16 industrial sidings, or lead tracks, along the southbound main line and 15 along the northbound main line. Such trackage is concentrated on the 9.4-mile portion of the right-of-way between the Milwaukee passenger station and W. Drexel Avenue. The remaining portion of the right-of-way, that between W. Drexel Avenue and the Milwaukee-Racine County line, has three industrial sidings, two of which are located south of Oakwood Station.

Land use development directly adjacent to this railroad segment is varied. Between the Milwaukee passenger station and W. Oklahoma Avenue, the land on both sides of the right-of-way is characterized by intensive industrial and commercial development. From W. Oklahoma Avenue to W. Layton Avenue, the right-of-way is flanked primarily by open land uses along the eastern edge of the right-of-way, is bounded by cemetery on both sides of the right-of-way between W. Morgan and W. Howard Avenues, and is flanked by industrial development along the western edge of the right-of-way between W. Howard and W. Layton Avenues. Between W. Layton Avenue and W. Drexel Avenue the land on both sides of the right-of-way is primarily devoted to additional railway or industrial development. Finally, from W. Drexel Avenue to the Milwaukee-Racine County line, the land adjacent to the right-of-way is principally in agricultural and other rural open uses except between W. Drexel and W. Puetz Road on the east side of the right-of-way, where there is some industrial development.

Feasibility Conclusion: The sections of the Thirtieth Subdivision right-of-way within the study area that are north of W. Drexel Avenue (Milepost 75.6) in South Milwaukee would appear to have little or no potential for the location of light rail transit, heavy rail rapid transit, or exclusive busway facilities. This portion of the right-of-way does have access to the Milwaukee central business district and, in general, the physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, would allow for primary transit development . However, the concentration of industrial sidings on the outsides of the right-of-way, the presence of other railway trackage for passing, storage, and station facilities in the right-of-way, and the major waterway crossings attendant to this right-of-way make the location of at-grade light rail transit, heavy rail rapid transit, or exclusive bus guideway on this portion of the right-of-way impractical.

The remaining portion of this right-of-way, that 5.4-mile portion south of W. Drexel Avenue to the Milwaukee-Racine County line, has good potential for the location of at-grade primary transit fixed guideway facilities. Fixed guideway facility location along this railway portion would not require changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way or facility grade separation to provide adequate outside clearances.

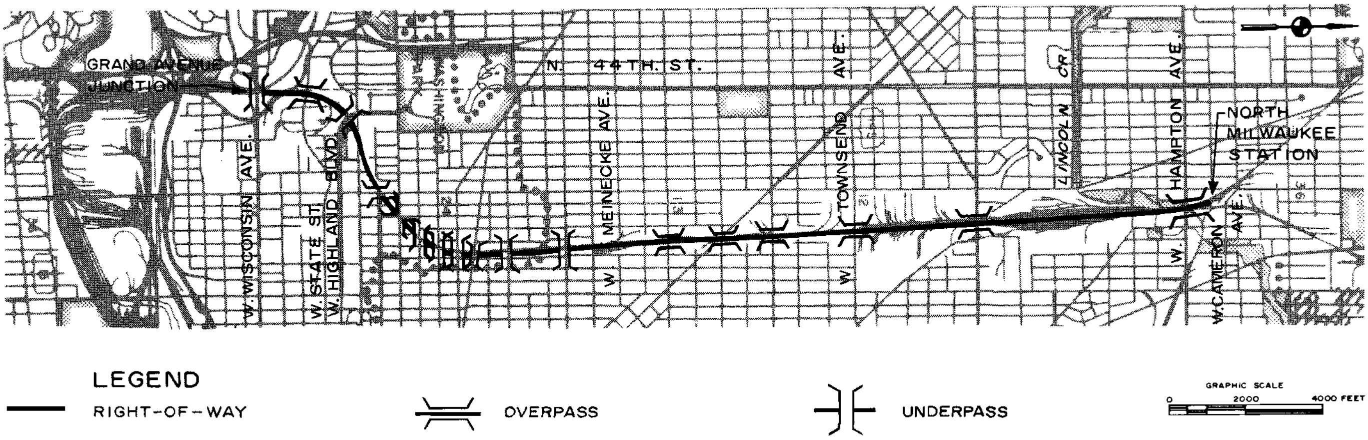
The Milwaukee Road Railroad— Trackage Between Grand Avenue Junction and North Milwaukee Station

The trackage between Grand Avenue Junction and North Milwaukee Station is part of the Fifth Subdivision of the Milwaukee Road's Wisconsin Division, referred to in the past as the "Northern Division." The 5.2-mile segment pertinent to this right-of-way inventory and assessment includes that portion located between the intersection of W. Wisconsin Avenue and N. 44th Street and North Milwaukee Station, which is situated at the intersection of W. Cameron Avenue and N. 33rd Street in the City of Milwaukee. As shown on Map 94, the route segment under consideration lies entirely within the City of Milwaukee.

This portion of the Fifth Subdivision is a double-track railway line along the 5.2-mile length within the study area. The double track is centered on the right-of-way, which is located in a cut section referred to as the "depression," between Grand Avenue Junction and W. Meinecke Avenue, a distance of 2.3 miles, and on a fill section from W. Meinecke Avenue to North Milwaukee Station, a distance of 3.3 miles. The right-of-way is approximately 100 feet wide between Grand Avenue Junc-

Map 94

ALIGNMENT OF THE MILWAUKEE ROAD'S FIFTH SUBDIVISION BETWEEN GRAND AVENUE JUNCTION AND NORTH MILWAUKEE STATION



The Milwaukee Road's trackage between Grand Avenue Junction and North Milwaukee Station, a distance of 5.2 miles, is part of the Fifth Subdivision of the Milwaukee Road's Wisconsin Division, and extends from the intersection of W. Wisconsin Avenue and N. 44th Street to North Milwaukee Station. This segment of trackage lies entirely within the City of Milwaukee and has one at-grade highway crossing, 19 grade-separated highway crossings, and two watercourse crossings. Because of the large number of industrial sidings and of the additional railroad trackage in the right-of-way, the portion of this railway segment north of W. Meinecke Avenue has poor potential for the location of at-grade, fixed guideway primary transit facilities. The portion of the right-of-way south of W. Meinecke has good potential for the location of fixed guideway facilities.

Source: SEWRPC.

tion and W. Capitol Drive. Between W. Capitol Drive and the northern terminus of Glendale Yard, located at W. Glendale Street, the right-of-way increases to about 400 feet to accommodate additional railroad and industrial trackage. The remainder of the right-of-way to North Milwaukee Station between Lincoln Creek and Cameron Avenue is generally 100 feet wide.

The distance between centerlines of the northbound and southbound tracks is approximately 14 feet, which does not allow for the development of any dual or single fixed guideway primary transit facilities. The potential, then, to develop such facilities is dependent upon the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

In general, the outside portion of the right-of-way on both sides of the track between Grand Avenue Junction and W. Meinecke Avenue is approximately 38 feet except between W. Highland Boulevard and W. State Street, where, for a distance of 0.4 mile, additional track located in the right-of-way reduces the outside clearance to 10 feet on both sides of the track. Between Meinecke Avenue and the northern terminus of Glendale Yard at Lincoln Creek, the outside clearances along the northbound portion and southbound portion are reduced to approximately 10 feet. Additional passing and storage track north of Lincoln Creek to W. Cameron Avenue at North Milwaukee Station reduces the right-of-way to approximately 20 feet on each side of the track.

The horizontal alignment of the railroad grade is limited generally to large radius curves connecting short stretches of tangent track between curves from Milepost 88.0 to Milepost 90.0, and to long stretches of tangent track between curves from Milepost 90.0 to Milepost 93.4. There are six horizontal curves on the line, all of which have a curvature of less than $4^{o}00'$. The sharpest horizontal curves occur in that segment between Milepost 88.0 located at Grand Avenue Junction and Milepost 88.5, where the alignment follows a reverse curve with curvatures of $3^{o}45'$ and $2^{o}30'$.

The vertical alignment is characterized by relatively flat gradients, generally less than 1.0 percent. The steepest grade, 1.67 percent, occurs between Mileposts 88.5 and 88.7 located just north of Grand Avenue Junction in the City of Milwaukee.

As indicated on Map 94, there are a total of 22 street and watercourse crossings on this railway line. Included in this total are one public at-grade highway crossing, 19 public grade-separated highway crossings, and two watercourse crossings. There are no crossings with other railway lines.

As mentioned earlier, additional track is provided within the right-of-way at several locations along the 5.2 miles of railway trackage. In general, this additional track is used to connect with industrial sidings located along the right-of-way. There are a total of 31 industrial sidings, or lead tracks, along the northbound main line and 21 along the southbound main line. Such trackage is concentrated on the portion of the right-of-way between W. Meinecke Avenue and North Milwaukee Station. In addition, north of W. Capitol Drive the right-of-way widens to accommodate the Glendale Yard trackage.

Land use on both sides of the track between Grand Avenue Junction and North Milwaukee Station is primarily devoted to additional railway or industrial development. It should be noted that there are numerous buildings and warehouses located along the entire length of the line, immediately adjacent to the right-of-way. This type of development is particularly prominent between Grand Avenue Junction and W. Meinecke Avenue, where the railroad right-of-way is located in a cut section referred to as the "depression."

Feasibility Conclusion: The sections of this right-of-way that are north of W. Meinecke Avenue would appear to have poor potential for the location of light rail transit, heavy rail rapid transit, or exclusive busway facilities. Specifically, the large number of industrial sidings on the outsides of the right-of-way between Meinecke Avenue and Glendale Yard, the presence of other railroad trackage for yards or terminals in the right-of-way, and the intensive industrial development located immediately adjacent to the right-of-way make the ready location of at-grade, primary transit fixed guideway facilities on the right-of-way unlikely.

The portions of this right-of-way south of W. Meinecke Avenue appear to have good potential for the location of primary transit fixed guideway facilities. In general, the physical characteristics of the right-of-way, including horizontal and vertical curvature and right-of-way width, do not place severe constraints on the location of primary transit facilities along this railway segment. Crossings with industrial lead tracks pose the most serious limitation to the use of this portion of the right-of-way for the location of fixed guideway facilities, placing a more serious constraint, however, on heavy rail rapid transit development than on light rail transit or exclusive busway development. While heavy rail rapid transit requires grade-separated facilities at all crossings, both light rail transit and exclusive busway systems can tolerate the small number of industrial crossings along this portion without severe operating impediments to either primary transit service or existing railroad operations.

The outside clearances on both sides of this railway segment south of Meinecke Avenue would allow for the development of a primary transit facility except between W. Highland Boulevard and W. State Street, where, for a distance of 0.4 mile, the outside clearances are reduced because of additional trackage located in the right-of-way.

The Milwaukee Road—Chestnut Street Line

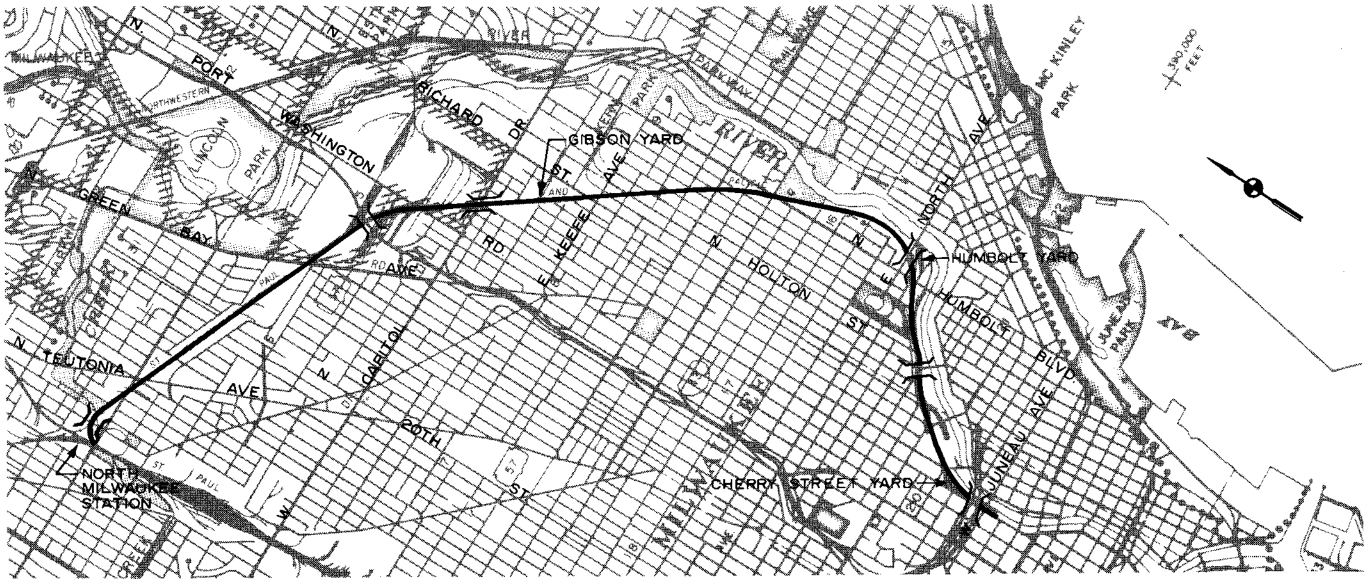
The Chestnut Street Line, also referred to as the "Beer Line," consists of a 6.3-mile-long branchline railway extending from North Milwaukee Station located at W. Cameron Avenue and N. 33rd Street in the City of Milwaukee to the end of the track located south of W. Juneau Avenue in the City of Milwaukee. The entire 6.3-mile segment is pertinent to this right-of-way inventory and assessment. The Chestnut Street Line is operated by the Milwaukee Road as a switching facility, providing access to industries located along the right-of-way. As shown on Map 95, the route segment under consideration lies entirely within the City of Milwaukee.

The Chestnut Street Line is a single-track railway line along its entire 6.3-mile length. The track is generally centered in the right-of-way, which is located at-grade. The right-of-way is 50 feet wide along the entire railway segment except between E. North Avenue and W. Juneau Avenue; the right-of-way widens to about 400 feet at E. North Avenue, tapers to approximately 70 feet at N. Holton Street, and remains 70 feet to W. Juneau Avenue to accommodate additional railroad and industrial trackage and other railroad facilities.

The potential to develop at-grade primary transit facilities on this segment is dependent solely on the outside clearances along the right-of-way as measured from the outside edge of the track to the outside edge of the railway right-of-way. Because there is additional railroad trackage within the right-of-way along the entire length of this railway

Map 95

ALIGNMENT OF THE MILWAUKEE ROAD'S CHESTNUT STREET LINE



LEGEND

RIGHT-OF-WAY

OVERPASS

UNDERPASS

GRAPHIC SCALE
0 2000 4000 FEET

The Milwaukee Road's Chestnut Street Line, also referred to as the "Beer Line," is a 6.3-mile branchline railway extending from North Milwaukee Station to the end of the track located along N. 3rd Street south of W. Juneau Avenue in the City of Milwaukee. The Chestnut Street Line is operated by the Milwaukee Road as a switching facility, providing access to industries located along the right-of-way. Located entirely within the City of Milwaukee, the right-of-way has 25 at-grade highway crossings, six grade-separated highway crossings, one footbridge crossing, and one watercourse crossing. Because of the large number of industrial sidings, the additional railroad trackage in the right-of-way for yards or stations, and the intensive industrial development located immediately adjacent to the right-of-way, this railway segment is not suitable for at-grade primary transit fixed guideway development.

Source: SEWRPC.

segment, outside clearances on both sides of the right-of-way are generally less than 20 feet. The outside clearance on both sides of the right-of-way is generally about 15 feet between North Milwaukee Station and N. Green Bay Avenue except between N. Teutonia Avenue and N. 20th Street, where the outside clearance is five feet along the west side of the right-of-way. Between N. Green Bay Avenue and a point 300 feet north of Port Washington Road, additional railroad trackage, including passing, yard, and industrial trackage, reduces the outside clearance on both sides of the right-of-way to five feet. The outside clearance is 15 feet from N. Port Washington Road to W. Capitol Drive, where it narrows to five feet on both sides of the right-of-way. The outside clearance remains five feet to E. Keefe Avenue. Between E. Keefe and E. North Avenue, the outside clearances along the east and west sides of the right-of-way are 23 feet and 15 feet, respectively. The remainder of the right-of-way, that between E. North Avenue and the north end of the Cherry Street yard, is generally characterized by outside clearances of 10 feet on both sides .

The horizontal alignment of the railroad grade is generally marked by large radius curves connecting relatively long stretches of tangent track. There are 10 curves on this railroad segment, most of which have a curvature of less than 4°00'. The sharpest horizontal curves occur at the terminal points of this railway segment—specifically, at North Milwaukee Station between Mileposts 93.7 and 94, where the alignment follows a circular curve with a curvature of 10°00'. Near the southern terminal point north of the Cherry Street yard, the alignment follows a set of reverse curves with curvatures of 4°00' between Mileposts 99 and 99.4, located approximately between N. Holton Street and N. Palmer Street.

The vertical alignment is characterized by relatively flat gradients, generally less than 1 percent. The steepest grade of 1.3 percent occurs in the railway's approach to the Cherry Street yard between N. Palmer Street and E. Walnut Street for a distance of approximately 0.1 mile.

As indicated on Map 95, there are a total of 33 street and watercourse crossings on this railway segment. Included in this total are 25 public at-grade highway crossings, six public grade-separated highway crossings, one public footbridge crossing, and one watercourse crossing. There are no railway crossings on this line.

Additional trackage is provided within the right-of-way along the entire 6.27 miles of branchline trackage. In general, this trackage is used to store and classify railroad cars, and to connect with industrial sidings located along the right-of-way. There are a total of 40 industrial sidings, or lead tracks, along the east side of the right-of-way and 25 along the west side of the right-of-way. Such trackage is distributed uniformly along the entire Chestnut Street Line. Three active freight car classification yards are located along this railway segment; their location shown is on Map 84. These include the Gibson yard, Humboldt yard, and Cherry Street yard.

Land use directly adjacent to this railroad segment is primarily industrial. Between North Milwaukee Station and the Cherry Street yard, the land is primarily devoted to additional railroad or industrial development. There is, however, a portion of right-of-way between N. Richard Street and N. Humboldt Boulevard where, for a distance of 1.1 miles, the right-of-way is bounded by mixed residential, commercial, and industrial development.

Feasibility Conclusion: In general, it may be concluded that the Chestnut Street railway right-of-way has poor potential for use in the development of a primary transit guideway. The principal characteristics of the right-of-way, including horizontal and vertical curvature and right-of-way width, would allow for primary transit development along most portions of this railway segment. However, because of the large number of industrial sidings on the outsides of the right-of-way, the presence of other railroad trackage for yards or stations in the right-of-way, and the intensive industrial development located immediately adjacent to the right-of-way, this railway segment is not suitable for at-grade primary transit fixed guideway development. Fixed guideway facility location along this right-of-way would require grade separations at those locations where there is extensive industrial or yard trackage or inadequate outside clearances, and at arterial street crossings with potential traffic conflicts. Thus, grade separations would appear to constitute the most serious limitation to the development of this right-of-way for primary transit facilities, as well as the greatest capital cost consideration.

The Milwaukee Road—Elm Grove Line

The Elm Grove Line consists of a 6.0-mile-long railway branch line extending from Elm Grove Station in the City of Elm Grove to the west end of Air Line Yard in the Menomonee River Valley. Sometimes referred to as the "Air Line," the entire six-mile segment is pertinent to this right-of-way inventory and assessment. The Elm Grove Line is operated by the Milwaukee Road in the Milwaukee terminal area principally as industrial and switching trackage. As shown on Map 96, the route segment under consideration passes through the communities of West Milwaukee, West Allis, and Elm Grove.

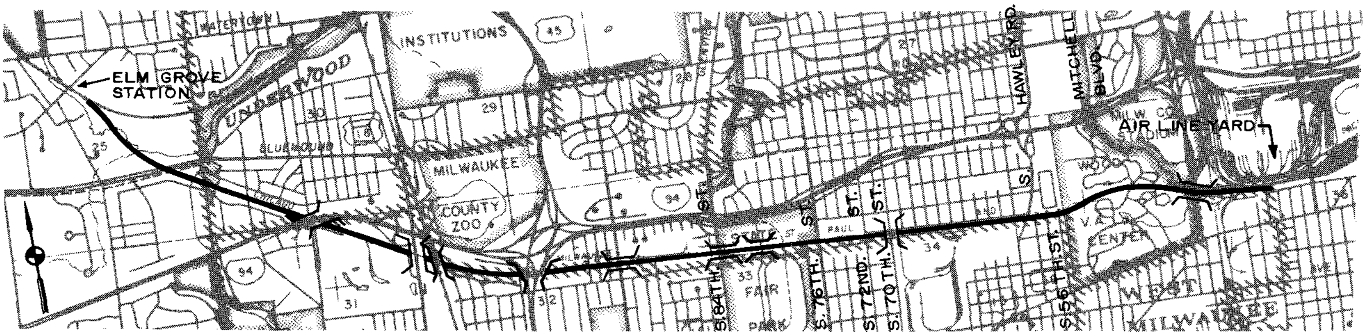
The Elm Grove Line is a single-track railway line. The track is generally centered in the right-of-way, which is generally located at-grade. The right-of-way is 100 feet wide except at those locations where it widens to accommodate industrial trackage. Between S. 84th Street and S. 76th Street, the right-of-way widens to 400 feet. East of S. 76th Street the right-of-way tapers to 100, and remains 100 feet to 72nd Street. Between 72nd Street and a point 600 feet east of S. 70th Street, the right-of-way widens to 160 feet. East of S. 70th Street to the west end of Air Line Yard, the right-of-way is again 100 feet wide.

The potential to develop primary transit fixed guideway facilities along this railway line is dependent on the outside clearances along the right-of-way measured from the outside edge of the track to the outside edge of the railway right-of-way. Generally, the outside portion of the right-of-way is approximately 47 feet wide on both sides of the track.

The horizontal alignment of the railroad grade is generally marked by large radius curves between segments of tangent track. There are eight curves on the line, most of which have a curvature of less than 2°00'. The sharpest horizontal curves occur

Map 96

ALIGNMENT OF THE MILWAUKEE ROAD'S WISCONSIN DIVISION: ELM GROVE LINE



LEGEND

RIGHT-OF-WAY

OVERPASS

UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The Elm Grove Line is operated by the Milwaukee Road in the Milwaukee terminal area principally as industrial and switching trackage, and consists of a 6.0-mile branch line extending from Elm Grove Station to the west end of Air Line Yard in the Menomonee River Valley. Passing through the communities of West Milwaukee, West Allis, and Elm Grove, the right-of-way has seven at-grade street or highway crossings, 10 grade-separated highway crossings, three private at-grade crossings, and one grade-separated railroad crossing. The physical characteristics of this right-of-way would allow for primary transit development along the entire length of this railway segment.

Source: SEWRPC.

in that segment between Elm Grove Station and W. Bluemound Road, where the alignment follows a reverse curve with curvatures of $2^{\circ}00'$. The alignment follows a second reverse curve between Hawley Road and Mitchell Boulevard, also with curvatures of $2^{\circ}00''$.

The vertical alignment is characterized by relatively flat gradients, generally less than 1 percent. The steepest grade, 0.91 percent, occurs between S. 70th Street and S. 44th Street, a distance of 1.8 miles.

As indicated on Map 96, there are a total of 21 street, highway, and railroad crossings on this railroad segment. Included in this total are seven public at-grade street or highway crossings, 10 public grade-separated highway crossings, three private at-grade residential, industrial, or farm crossings, and one grade-separated railroad crossing.

The one passing siding along the six miles of mainline trackage is a second track located on the south side of the mainline track between S. 76th Street and S. Hawley Road, a distance of 1.1 mile. Besides serving as a siding, this track is used to connect with industrial sidings located along the right-of-way. There are a total of seven industrial sidings, or lead tracks, along the northern portion of the main line and 18 along the southern portion of the main line. Such trackage is concentrated in the portion of the right-of-way between Elm Grove Station and S. Hawley Road, and is generally to the south of the right-of-way. The remaining portion of the right-of-way, that between S. Hawley Road and S. 44th Street, has one industrial siding, this being located on the north side of the right-of-way.

Land use directly adjacent to this railroad segment is primarily industrial. Between Elm Grove Station and S. 84th Street, the land is characterized by industrial development, with scattered residential development on both sides of the right-of-way. Between S. 84th Street and S. 76th Street, the railroad right-of-way is bounded on both sides by Wisconsin State Fair Park fairgrounds. The portion of the right-of-way between S. 76th Street and S. Hawley Road is bounded on the south by industrial development and on the north by public street right-of-way. The portion of the right-of-way between S. Hawley Road and S. 56th Street is flanked by residential development. Finally, between 56th Street and 44th Street the right-of-way is bounded on both sides by the U. S. Veteran's Administration Center.

Feasibility Conclusion: In general, it may be concluded that the Elm Grove Line right-of-way has good potential for the development of primary transit fixed guideway facilities. The physical characteristics of this railway right-of-way, including horizontal and vertical alignment and curvature and right-of-way width, would allow for primary transit development along the entire length of this railway segment. Because of the small number of sidings and lead tracks and the adequate outside clearances on the north side of the right-of-way, this side would appear to lend itself more readily to fixed guideway development than the south side.

Important to the consideration of the development of this right-of-way for primary transit facilities is the need for grade separations at street and highway crossings along this railway segment. While light rail transit and exclusive busway development along this railway segment could tolerate at-grade crossings, such crossings would place a serious constraint on the location of heavy rail rapid transit, which requires grade separations at all crossings.

Milwaukee Road—Menomonee Valley Railway Trackage

The "Menomonee Valley" is generally defined as an approximately one-mile-wide strip of land extending three miles westerly from the Milwaukee River to S. 44th Street and the Stadium Freeway (USH 41). On the north, the edge of the valley is formed by a bluff, along which is located the East-West Freeway (IH 94). On the south, the edge of the valley is formed by a bluff located immediately north of Mitchell Park and W. Pierce Street. The valley is traversed by six north-south road crossings, five of which consist of the 6th Street, 13th Street, 27th Street, 35th Street, and North-South Freeway (IH 94) viaducts. The fifth consists of Muskego Avenue, which is located at-grade within the valley east of S. 13th Street. The major east-west street located within the valley is Canal Street, located between the 35th Street viaduct and W. Greves Street, and between N. 26th Street and the 6th Street viaduct. There are also numerous short public street segments, private drives, and alleys located in the valley that serve the industrial and railroad facilities of the valley.

The Menomonee Valley is a highly industrialized area, being the location of heavy manufacturing facilities, wholesale establishments, and warehouse and storage facilities. The City of Milwaukee is currently engaged in an effort to revitalize and redevelop the valley as a major employment center. Transportation facilities owned by the Milwaukee Road constitute the predominant land use in the valley.

As shown on Map 97, three distinct rights-of-way operated by the Milwaukee Road can be identified in the valley: 1) the Milwaukee Road's First Subdivision railway line; 2) the Canal Street switching spur; and 3) the Plankinton spur. Other land in the valley owned by the Milwaukee Road is used for freight car classification and storage yards and for locomotive and car repair shops and locomotive servicing facilities. The largest of these tracts is occupied by West Milwaukee Shops and is located between S. 44th Street and the S. 35th Street viaduct. As shown on Map 97, 15 other yards, including Lapham Yard, Air Line Yard, Adams Yard, Muskego Yard, Blue Mound Yard, Soldiers Home Yard, Merrill Park Yard, Davies Yard, Plankinton Yard, the Canal Street yard, the grain yard, the stock yard, the Reed Street yard, and two storage yards, are located between S. 44th Street and S. 2nd Street south of the Milwaukee Road's First Subdivision main line. Principally, this railway yard trackage is used for freight or classification and storage purposes, but also serves locomotive servicing facilities, and is used to gain access into commercial and industrial development within the valley. Railway tracks in the various yards generally extend to the limits of the rights-of-way, providing outside clearances of about 10 feet. In many instances, warehouses and storage facilities are located directly adjacent to the rights-of-way, precluding the location of fixed guideway facilities. Because of the nature of the railroad shops and yards, inadequate outside clearances, and intensive industrial development located directly adjacent to railroad property lines, the railroad rights-of-way in the Menomonee River Valley have poor potential for the location of primary transit fixed guideway facilities.

The Milwaukee Road's First Subdivision main line, located along the northern portion of the Menomonee River Valley between the Stadium Freeway and the Milwaukee passenger station, is the first of three distinguishable rights-of-way within the valley which may be considered for the location of primary transit fixed guideway facilities. This railway segment has been inventoried and assessed in the section of this technical report entitled "The Milwaukee Road—First Subdivision." It was determined in that assessment that this railway segment

Map 97

ALIGNMENT OF THE MILWAUKEE ROAD'S MENOMONEE VALLEY TRACKAGE

Three distinct rights-of-way are operated by the Milwaukee Road in the Menomonee Valley: 1) the Milwaukee Road's First Subdivision railway line; 2) the Canal Street switching spur; and 3) the Plankinton spur. Other land in the valley owned by the Milwaukee Road is used for freight car classification and storage yards, and for locomotive and car repair and servicing facilities. Because of the concentration of industrial sidings along the outside portion of the rights-of-way and the inadequate outside clearances, the Menomonee Valley railway trackage, including the Canal Street switching line and Plankinton spur track rights-of-way, has poor potential for the location of at-grade, fixed guideway primary transit facilities.

Source: SEWRPC.

was not suitable for primary transit fixed guideway development because of the large number of industrial sidings on the outsides of the right-of-way, the presence of other railroad trackage for yards and terminals, and the intensive urban development located directly adjacent to the right-of-way.

The right-of-way of the Canal Street switching line, a 2.0-mile-long railway line located between N. 30th Street and the South Menomonee Canal, east of S. 6th Street, also has potential for the location of primary transit fixed guideway facilities. The Canal Street switching line is a double-track railway line along its entire length. The tracks are centered in the right-of-way, which is located at-grade. From the western end of the line at N. 30th Street to S. 20th Street, the railway line is located within its own right-of-way, which is generally 65 feet wide. The portion of the railway line between S. 20th Street and the South Menomonee Canal, however, is located within a 35-foot-wide easement in the center of Canal Street. This easement was granted by the City of Milwaukee to the Milwaukee Road.

The potential to develop primary transit fixed guideway facilities along this railway segment is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way. In general, 20 feet in width is available on both sides of the track along the outside portion of the right-of-way west of S. 20th Street. Additional trackage within the right-of-way, however, reduces the outside clearance in some places to about 10 feet. There is no right-of-way available along the outside portions of the right-of-way east of S. 20th Street because the easement granted by the City of Milwaukee to the Milwaukee Road to operate this switching spur within the Canal Street right-of-way does not extend beyond the existing track zone.

There are a total of 13 industrial sidings, or lead tracks, along the northern track on the right-of-way and 16 along the southern track. These sidings are uniformly distributed along the entire length of the segment. Land directly adjacent to this railway segment is principally devoted to additional railroad or industrial development, except between S. 20th Street and S. Menomonee Canal where it is right-of-way for Canal Street.

The third distinguishable right-of-way in the Menomonee River Valley is the Plankinton spur track, located between S. 20th Street and Muskego Avenue. The Plankinton spur track is a double-track line along its 0.4-mile length. The tracks are centered in the right-of-way, which is located at-grade. West of the 16th Street viaduct, the right-of-way is 50 feet wide. The portion of this railway segment east of the 16th Street viaduct was sold to a private company. In general, the outside clearance along each side of the right-of-way is 16 feet. There are four industrial lead tracks located along the westbound portion of the right-of-way, and three along the eastbound portion. Land directly adjacent to this railway segment is devoted to additional railroad and industrial development.

Feasibility Conclusion: In general, it may be concluded that all Menomonee Valley railway trackage, including the Canal Street switching line and Plankinton spur track rights-of-way, have poor potential for the location of at-grade light rail transit, heavy rail rapid transit, or exclusive busway facilities. Specifically, the concentration of sidings along the outside portion of the rights-of-way and inadequate outside clearances make the location of fixed guideway transit facilities on either the Canal Street right-of-way or the Plankinton spur right-of-way impractical.

The Chicago & North Western Transportation Company—Shoreline Subdivision

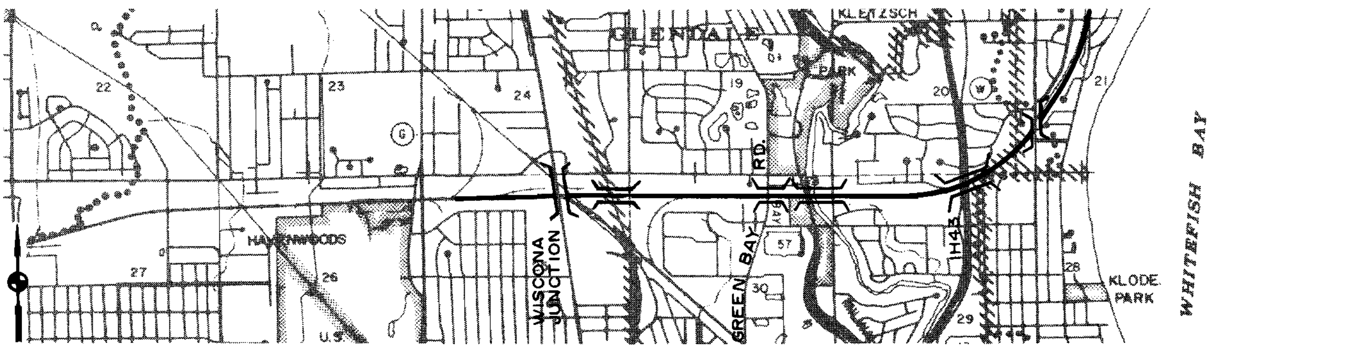
The Shoreline Subdivision of the Chicago & North Western Transportation Company's Wisconsin Division consists of a 116.9-mile-long railway main line extending from Wiscona Junction located near the intersection of Teutonia Avenue and Mill Road in the City of Milwaukee to the City of Green Bay. The 12.9-mile segment pertinent to this right-of-way inventory and assessment includes that portion between Wiscona Junction and Pioneer Road in the City of Mequon. As shown on Map 98, the route segment under consideration passes through the communities of Milwaukee, Glendale, Whitefish Bay, Fox Point, Bayside, and Mequon.

The Shoreline Subdivision is a single-track railway line along the 12.9-mile length within the study area. The track is centered within the right-of-way, which is located at-grade except on the 1.7-mile segment between Wiscona Junction and N. Port Washington Road, where the grade is located on a fill. The right-of-way is approximately 200 feet wide between Wiscona Junction and N. Port Washington Road. At N. Port Washington Road, the right-of-way narrows to 150 feet and remains this width to W. Green Tree Road. The portion of the right-of-way between W. Green Tree Road and a point approximately 1,200 feet north of Donges

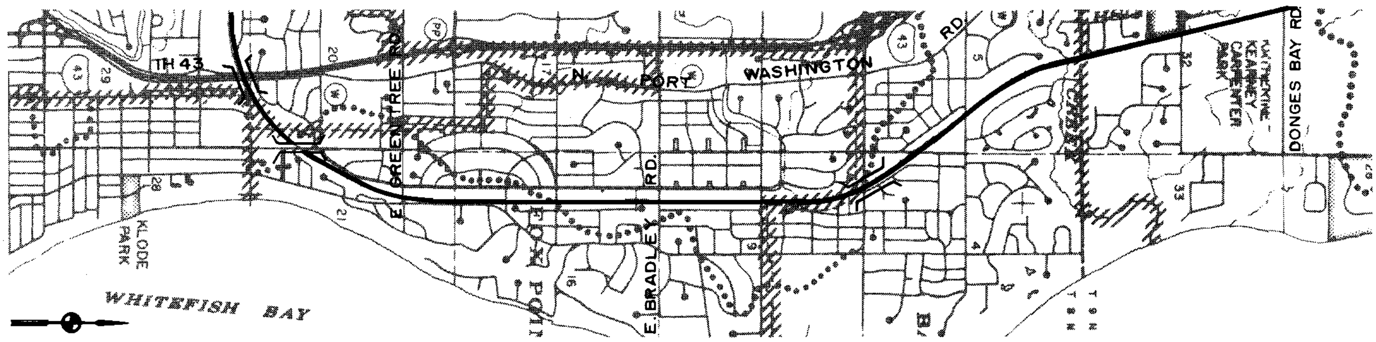
Map 98

ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S WISCONSIN DIVISION: SHORELINE SUBDIVISION WITHIN THE MILWAUKEE AREA

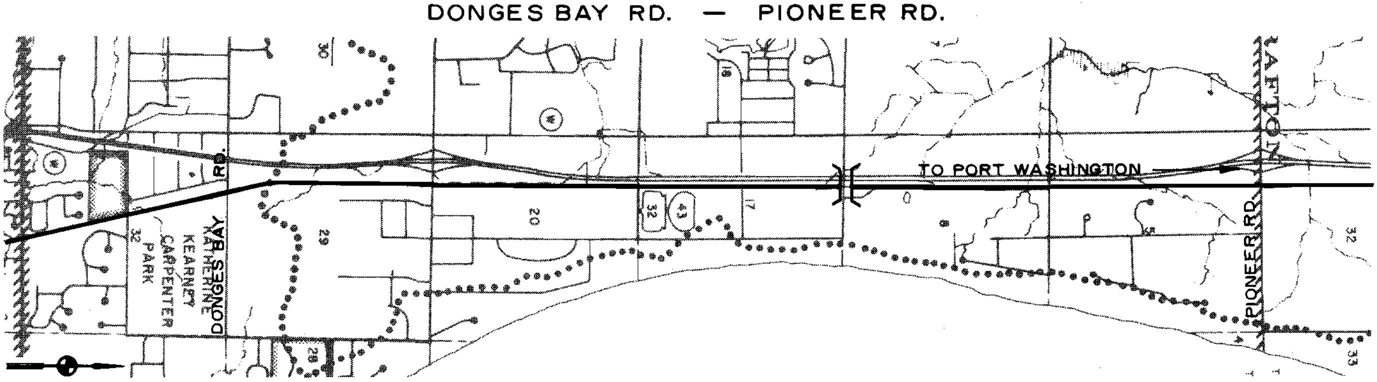
WISCONA JUNCTION — IH 43



IH 43 — DONGES BAY RD.



DONGES BAY RD. — PIONEER RD.



LEGEND

RIGHT-OF-WAY

OVERPASS

UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The portion of the Shoreline Subdivision of the C&NW's Wisconsin Division within the Milwaukee area consists of a 12.9-mile segment extending from Wiscona Junction to Pioneer Road in the City of Mequon. Passing through the communities of Milwaukee, Glendale, Whitefish Bay, Fox Point, Bayside, and Mequon, the right-of-way has 11 at-grade highway crossings, seven grade-separated highway crossings, two *private* at-grade crossings, one grade-separated railroad crossing, and two watercourse crossings. In general, the physical characteristics of the right-of-way would allow for at-grade primary transit development except west of N. Port Washington Road, where substantial earthwork would be required to obtain an adequate cross-sectional area to locate at-grade, primary transit fixed guideway facilities.

Source: SEWRPC.

Bay Road is 66 feet wide. North of Donges Bay Road, the right-of-way widens to 99 feet and remains this width to a point approximately 1,200 feet south of Pioneer Road, a distance of 4.5 miles.

The potential to develop fixed guideway transit facilities within the Shoreline Subdivision right-of-way is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way. Generally, approximately 96 feet is available along the outside portion of the right-of-way on each side of the track between Wiscona Junction and Port Washington Road. Between Port Washington Road and W. Green Tree Road, the outside clearance on each side of the track is approximately 71 feet. The outside clearance between W. Green Tree Road and Donges Bay Road is approximately 29 feet on each side of the track. Approximately 45 feet is available along the outside portion of the right-of-way north of Donges Bay Road to Pioneer Road on each side of the track except between Mequon Road and a point 900 feet south of Glen Oaks Lane, where a passing track on the east side of the right-of-way reduces the outside clearance to 20 feet.

The horizontal alignment of the railroad grade is marked by long stretches of tangent track between large radius curves. There are five horizontal curves along the line, all of which have a curvature of less than $2^{o}00'$. The sharpest horizontal curve occurs in that segment between Milepost 6.5 and Milepost 7.2, where the alignment follows a compound curve having $1^{o}35'$ and $1^{o}26'$ curvatures.

The vertical alignment is marked by minor grades, all of which are of little consequence to primary transit operation. In general, the vertical alignment is characterized by flat gradients of less than 0.5 percent. The steepest grade of 0.57 percent occurs between Milepost 5.4 and Milepost 6.0.

As indicated on Map 98, there are a total of 23 street, railroad, and watercourse crossings on this railroad segment. Included in this total are 11 public at-grade highway crossings, seven grade-separated highway crossings, two private at-grade residential, industrial, or farm crossings, one grade-separated railroad crossing, and two watercourse crossings.

As indicated earlier, a passing siding is provided at one location along the 12.9 miles of mainline trackage. This track is located directly adjacent to the mainline track between Mequon Road and a point 900 feet south of Glen Oaks Lane, a distance of 0.9 mile. There are no industrial sidings, or lead tracks, along this railway segment.

Land use directly adjacent to this segment between Wiscona Junction and W. Donges Bay Road is residential except between Wiscona Junction and N. Green Bay Road, where, for a distance of 1.5 miles, the land use is industrial along both sides of the track. The right-of-way between E. Green Tree Road and E. Bradley Road is bordered on the west by governmental, municipal, institutional, and commercial land uses. The remaining portion of the right-of-way—that between W. Donges Bay Road and W. Pioneer Road—is bounded by agricultural and other rural open uses on the east and by the North-South Freeway (IH 43) on the west.

Feasibility Conclusion: In general, it may be concluded that the Shoreline Subdivision railway right-of-way has good potential for use in the development of a primary transit fixed guideway facility east of N. Port Washington Road. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, would allow for primary transit development along the entire length of this railway segment.

West of N. Port Washington Road, the right-of-way has a somewhat poorer potential for guideway location since the railway grade is located on a fill. The location of a primary transit guideway on the fill section would require substantial earthwork to obtain an adequate cross-sectional area.

Crossings with public streets and highways pose the most serious limitation to the use of this right-of-way for the location of fixed guideway facilities, placing a more serious constraint, however, on heavy rail rapid transit development than on light rail or exclusive busway development. While heavy rail rapid transit requires grade-separated facilities at all crossings, both light rail transit and exclusive busway systems can tolerate the relatively small number of grade crossings along this railway segment without severe operating impediments to either primary transit service or existing railroad operations.

The Chicago & North Western Transportation Company—Air Line Subdivision

The Air Line Subdivision of the Chicago & North Western Transportation Company's Wisconsin Division consists of a 63.9-mile-long railway main line extending from Butler Junction in the City of Milwaukee to the Village of North Fond du Lac. The 19.5-mile segment pertinent to this right-of-way inventory and assessment includes that portion between Butler Junction and Cedar Lane in the unincorporated village of Rockfield. As shown on Map 99, the route segment under consideration passes through the communities of Milwaukee, Menomonee Falls, Germantown, and Rockfield.

The Air Line Subdivision is a single-track railway line along its 19.5-mile length within the study area except between Butler Junction and the west switch of the junction at Wiscona, where, for a distance of 4.6 miles, the line is double track. The tracks are centered within the right-of-way, which is generally located at-grade. The right-of-way is generally 100 feet wide except between a point 0.2 mile west of the Little Menomonee River crossing and N. 91st Street, where it widens to 150 feet, and between N. 76th Street and N. 64th Street, where the right-of-way is 20 feet wide.

The distance between centerlines of the eastbound and westbound tracks is approximately 14 feet, precluding the development of fixed guideway primary transit facilities between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

Approximately 47 feet is available along the outside portion of the right-of-way on each side of the track between Butler Junction and USH 45. Between USH 45 and Wiscona Junction, the outside clearance along both sides of the track is generally 65 feet. The outside clearance along the remaining portion of the right-of-way—that between Wiscona and Cedar Lane in the unincorporated village of Rockfield—is approximately 47 feet on each side of the track. However, additional track along the south side of the right-of-way between a point 0.5 mile west of N. 60th Street and W. Bradley Road reduces the outside clearance to 10 feet on the south side of the right-of-way for a distance of 1.1 miles. Additional track located at the Rockfield station between Division Street and a point 0.5 mile east of Cedar Lane reduces the right-of-way on the north side of the track to 25 feet for a distance of 0.6 mile.

The horizontal alignment of the railroad grade is generally marked by large radius curves connecting relatively long stretches of tangent track. There are 10 curves on this railroad segment, most of which have a curvature of less than 3°00'. The sharpest horizontal curvature occurs at Wiscona Station between Mileposts 92.4 and 93.1, where the alignment follows a circular curve with a curvature of 4°00'.

The vertical alignment is characterized by relatively flat gradients, generally less than 0.5 percent. The steepest grade of 0.93 percent occurs at Granville station between Milepost 98.5 and Milepost 98.7.

As indicated on Map 99, there are a total of 53 street, railroad, and watercourse crossings on this railway segment. Included in this total are 21 public at-grade highway crossings, eleven public grade-separated highway crossings, 14 private at-grade farm crossings, one grade-separated railroad crossing, two at-grade railroad junctions, and four watercourse crossings.

There are a total of 14 industrial sidings, or lead tracks, along the north side of the right-of-way and 10 along the south side of the right-of-way. Such trackage is concentrated on the portion of the right-of-way between the junctions at Butler and Wiscona. The remaining portion of the right-of-way has five industrial sidings, generally located at or near Granville and Rockfield Stations.

Land directly adjacent to the railway segment between Butler Junction and W. Bradley Road is principally devoted to industrial and commercial development except between N. 115th Street and USH 41, where, for a distance of 1.1 miles, the right-of-way is bounded on both sides by park and institutional development. The remaining portion of the right-of-way—that between W. Bradley Road and Cedar Lane—traverses land that is principally in agricultural and other rural open uses. It should be noted that between W. Brown Deer Road and Country Aire Road, the Air Line Subdivision railway line parallels the Milwaukee Road's Twelfth Subdivision railway line for a distance of 9.8 miles.

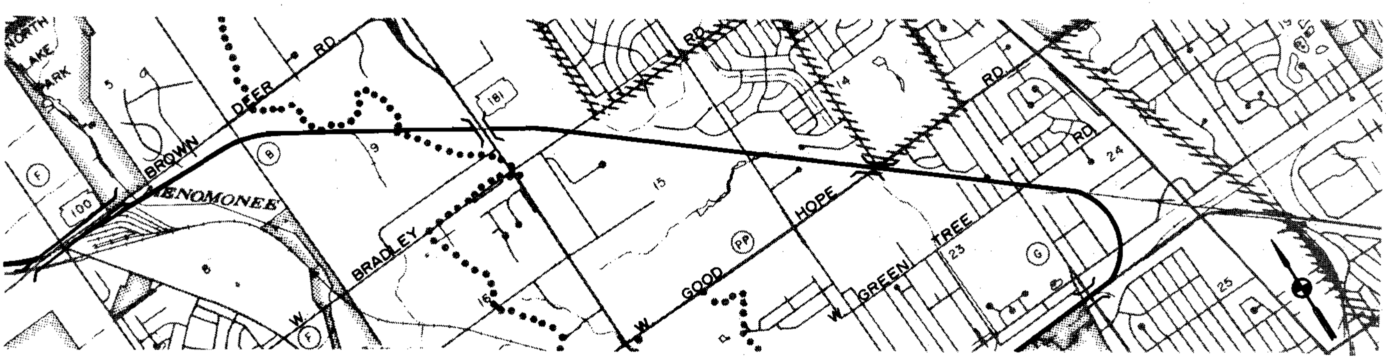
Feasibility Conclusion: In general, it may be concluded that the Air Line Subdivision railway has good potential for use in the location of a primary transit fixed guideway facility. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, all allow for ready, at-grade, primary transit development. However, the 2.8-mile portion of the right-of-way between USH 45 and Wiscona Junction is not well suited for at-grade, primary transit fixed guideway development because of the railroad and

Map 99

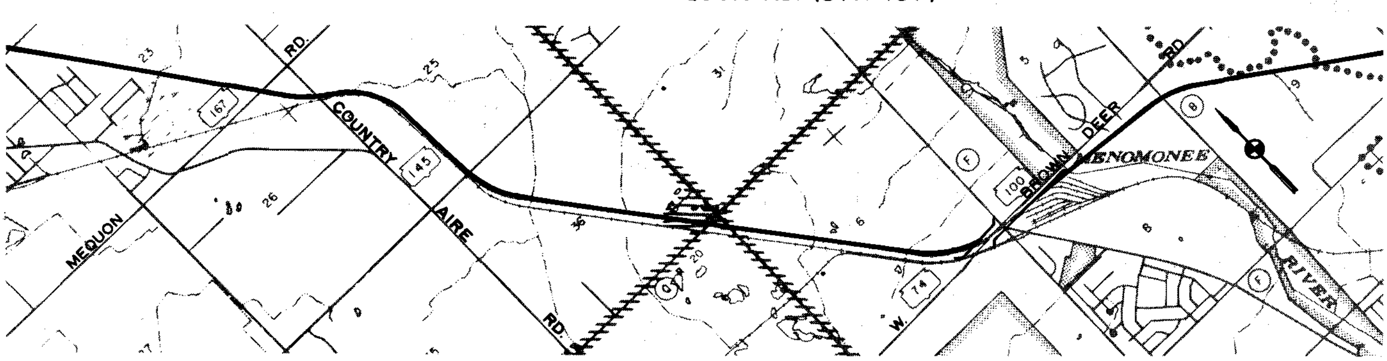
ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S WISCONSIN DIVISION: AIR LINE SUBDIVISION WITHIN THE MILWAUKEE AREA

BUTLER JUNCTION — W. GREEN TREE RD.

W. GREEN TREE RD. — W. BROWN DEER RD.



W. BROWN DEER RD. — MEQUON RD. (STH 167)

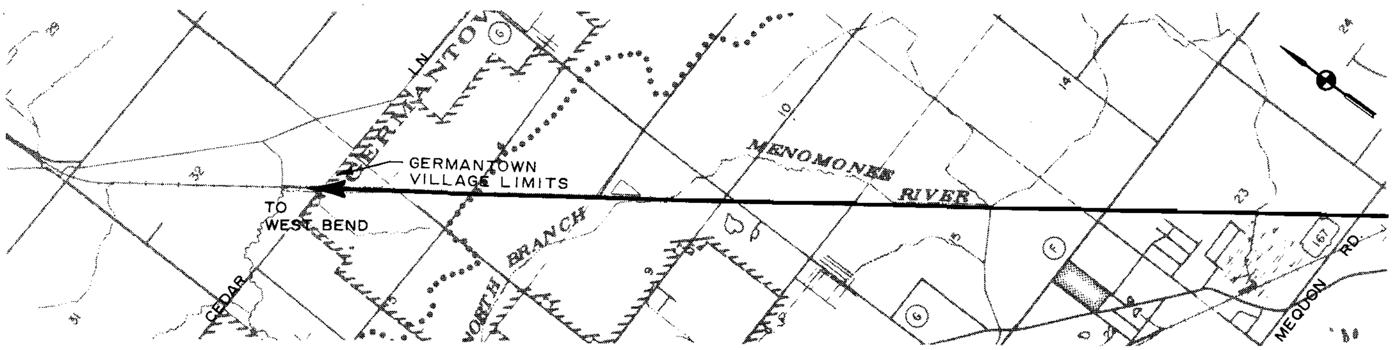


industrial trackage in the right-of-way and industrial development located immediately adjacent to the right-of-way. The location of primary transit fixed guideway facilities along this 2.8-mile section would require either the relocation of existing track and industrial spurs or the elevation of fixed guideway facilities.

Crossings with public streets and highways pose the most serious limitation to the use of this right-of-way for the location of fixed guideway facilities, placing a more serious constraint, however, on heavy rail rapid transit development than on light rail or exclusive busway development. While heavy rail rapid transit requires grade-separated

Map 99 (continued)

MEQUON RD. (STH 167) – GERMANTOWN VILLAGE LIMITS



LEGEND

RIGHT-OF-WAY

OVERPASS

UNDERPASS

GRAPHIC SCALE
0 2000 4000 FEET

The portion of the Air Line Subdivision of the C&NW's Wisconsin Division within the Milwaukee area consists of a 19.5-mile segment extending from Butler Junction to Cedar Lane in the unincorporated village of Rockfield in Washington County. Passing through the communities of Milwaukee, Menomonee Falls, Germantown, and Rockfield, the right-of-way has 21 at-grade highway crossings, 11 grade-separated highway crossings, 14 at-grade farm crossings, one grade-separated railraod crossing, two at-grade railroad junctions, and four watercourse crossings. The physical characteristics of the right-of-way would allow for at-grade primary transit development except between USH 45 and Wiscona Junction, where the presence of additional railroad and industrial trackage in the right-of-way precludes the location of at-grade primary transit development.

Source: SEWRPC.

facilities at all crossings, both light rail transit and exclusive busway systems can tolerate the relatively small number of grade crossings along this railway segment without severe operating impediments to either primary transit service or existing railroad operations.

The Chicago & North Western Transportation Company—Adams Subdivision

The Adams Subdivision of the Chicago & North Western Transportation Company's Wisconsin Division consists of a 112.8-mile-long railway main line extending from Butler Yard located in the City of Milwaukee to the City of Adams. The 9.3-mile segment pertinent to this right-of-way inventory and assessment includes that portion between Butler Yard and CTH J, located northwest of the Village of Sussex. As shown on Map 100, the route segment under consideration passes through the communities of Milwaukee, Menomonee Falls, and Sussex.

The Adams Subdivision is a double-track railway line between Butler Yard and Milepost 18.0, located 0.9 mile east of CTH Y, except between a point about 800 feet north of the Menomonee River crossing and Milepost 14.0 at the junction of the Air Line Subdivision railway main line, where the line is single track for 0.7 mile. The remaining portion of the right-of-way, which runs between Milepost 18 and CTH J, a distance of 4.9 miles, is single track. The track is centered in the right-of-way except along the double-track portions, where it is offset along the west side of the right-of-way. This right-of-way is generally located at-grade, but there are some short sections constructed on fill.

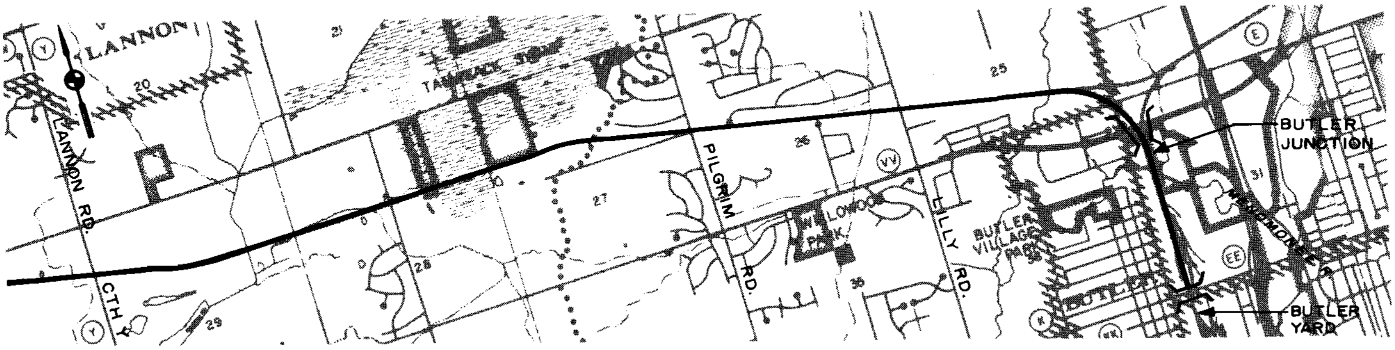
The right-of-way between Butler Yard and a point south of Butler Junction, a distance of approximately 0.8 mile, is composed of railway freight yard facilities and is generally 725 feet wide. At the northern end of Butler Yard, the right-of-way narrows to 200 feet and remains this width to Butler Junction. Here the right-of-way narrows to 150 feet wide, and it remains 100 feet wide to Lily Road. The remainder of the right-of-way—that from Lilly Road to CTH J—is 100 feet wide except from a point 300 feet east of STH 74 to the former Milwaukee Road North Lake branch line underpass, where the right-of-way widens to 200 feet, and from Maple Avenue to a point 0.5 mile east of CTH J, where the right-of-way is 300 feet wide to accommodate passing and industrial tracks and station facilities.

The distance between centerlines of the tracks is approximately 14 feet, precluding the development of fixed guideway primary transit facilities

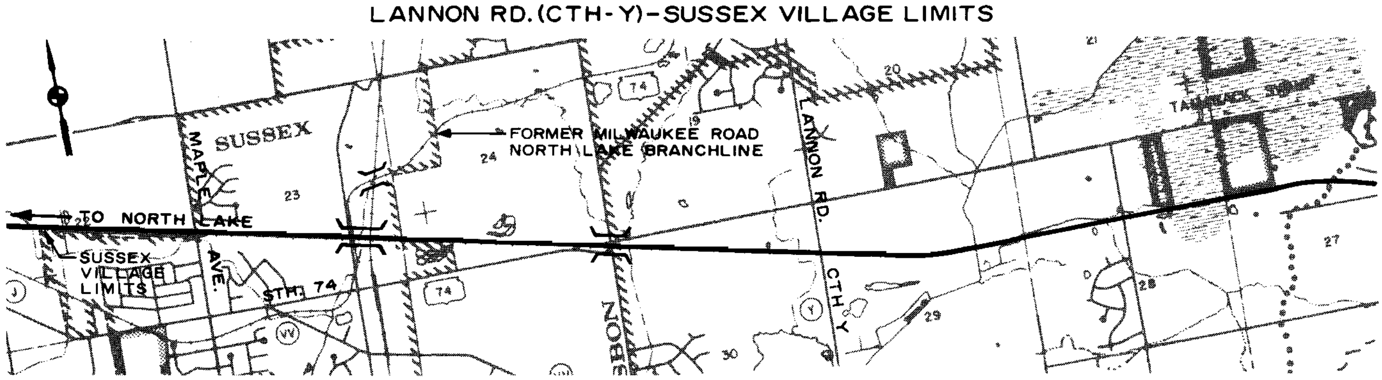
Map 100

ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S WISCONSIN DIVISION: ADAMS SUBDIVISION WITHIN THE MILWAUKEE AREA

BUTLER YARD – LANNON RD.(CTH-Y)



LANNON RD.(CTH-Y)–SUSSEX VILLAGE LIMITS



LEGEND

RIGHT–OF–WAY　OVERPASS　UNDERPASS　GRAPHIC SCALE 0 2000 4000 FEET

The portion of the Adams Subdivision of the C&NW's Wisconsin Division within the Milwaukee area consists of a 9.3-mile segment extending from Butler Yard to CTH J located northwest of the Village of Sussex. Passing through the communities of Milwaukee, Menomonee Falls, and Sussex, the right-of-way has six at-grade highway crossings, four grade-separated highway crossings, two at-grade farm crossings, two grade-separated railway crossings, and eight watercourse crossings. The physical characteristics of the right-of-way would allow for at-grade primary transit development along the entire segment.

Source: SEWRPC.

between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

The width available along the outside portion of the right-of-way ranges from 10 feet to 97 feet along the north or east side and from 33 feet to 170 feet along the south or west side. Because of additional railroad trackage and other railroad facilities located in the right-of-way, the outside clearances at Butler Yard are 50 feet along the west side of the right-of-way and approximately 10 feet along the east side. Between the northern end of Butler Yard and Butler Junction, the outside clearance on each side of the right-of-way is approximately 90 feet. The outside clearance between Butler Junction and Lilly Road is generally 72 feet along the north side and 58 feet along the south side of the right-of-way. Between Lilly Road and a point 0.9 mile east of CTH Y, the outside clearance is 47 feet along the north side and 33 feet along the south side of the right-of-way east of CTH Y to CTH J, the outside clearance is 47 feet on each side of the track except between STH 74 and the former Milwaukee Road North Lake branchline crossing, where the outside clearance is 97 feet on each side of the track, and between Maple Avenue and a point 1.2 miles east of CTH J, where the outside clearance is 80 feet along the north side of the track and 170 feet along the south side.

The horizontal alignment of the railway grade is marked by large radius curves connected by relatively long stretches of tangent track. There are three circular curves on the line, with curvatures of $1^{o}00'$, $1^{o}02'$, and $3^{o}00'$.

The vertical alignment is characterized by relatively flat gradients, generally less than 0.6 percent. The steepest grade on the right-of-way, 0.70 percent, occurs at three places: between Mileposts 13.9 and 14.7 located between Butler Junction and a point east of Lilly Road; between Mileposts 15.2 and 16.6; and between CTH Y at Milepost 18.8 and the Soo Line Railroad crossing at Milepost 21.1.

As indicated on Map 100, there are a total of 22 street, highway, railroad, and watercourse crossings on this railway segment. Included in this total are six public at-grade highway crossings, four grade-separated public highway crossings, two at-grade farm crossings, two grade-separated railway crossings, and eight watercourse crossings.

There are a total of four industrial sidings, or lead tracks, along the north side of the right-of-way and five along the south side. Such trackage is concentrated on the portion of the right-of-way at Butler Yard and between Butler Junction and Lilly Road. The remaining portion of the right-of-way has one industrial siding, located at Sussex Station.

Land directly adjacent to this railroad segment is principally in agricultural and other rural open uses except at Butler Yard and between Butler Junction and Pilgrim Road, a distance of 1.8 miles, where industrial development borders both sides of the right-of-way.

Feasibility Conclusion: In general, it may be concluded that the Adams Subdivision right-of-way has good potential for the location of light rail transit, heavy rail rapid transit, or exclusive busway facilities. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, all allow for at-grade primary transit development along this railway along this section of the right-of-way would not require changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way to provide adequate outside clearances.

Crossings with public streets and watercourses pose the most serious limitation to the use of this right-of-way for the location of at-grade fixed guideway facilities, placing a more serious constraint, however, on heavy rail rapid transit development than on light rail or exclusive busway development.

The Chicago & North Western Transportation Company—New Line Subdivision

The New Line Subdivision of the Chicago & North Western Transportation Company's Wisconsin Division consists of a 94.9-mile-long railway main line extending from the freight classification yard at Butler near the W. Hampton Avenue overpass in the City of Milwaukee to Proviso Yard near the City of Chicago, Illinois. The 25.1-mile segment pertinent to this right-of-way inventory and assessment includes that portion between Butler Yard and the Milwaukee-Racine County line. As shown on Map 101, the route segment under consideration passes through the communities of Wauwatosa, Milwaukee, West Allis, West Milwaukee, St. Francis, Cudahy, and Oak Creek. For the purposes of this assessment, this railway segment has been divided into four sections: 1) Butler Yard to Belton Junction; 2) Belton Junction to Chase Junction; 3) Chase Junction to St. Francis; and 4) St. Francis to the Milwaukee-Racine County line.

Butler Yard to Belton Junction: The portion of the New Line Subdivision between Butler Yard and Belton Junction is a double-track railway line along its entire 6.4-mile length within the study area. The tracks are centered in the right-of-way, which is located at-grade except between W. North Avenue and W. Potter Road and between the East-West Freeway (IH 94) and Belton Junction, where, for a distance of approximately 1.2 miles and 1.1 miles, respectively, the right-of-way is located on a fill.

The right-of-way is 100 feet wide along this railway segment except at those locations where it widens to accommodate additional railroad and industrial trackage and station facilities. At Butler Yard the right-of-way widens to 725 feet from a point just south of the Menomonee River crossing. It remains this width to approximately 600 feet north of W. Capitol Drive, where it narrows again to 100 feet. The right-of-way widens to 200 feet between W. Watertown Plank Road and the Milwaukee Road railway crossing, a distance of 1.7 miles. Finally, between the Milwaukee Road underpass and Belton Junction, a distance of 0.9 mile, the right-of-way widens to approximately 150 feet.

The distance between centerlines of the eastbound and westbound tracks is approximately 14 feet, precluding the development of fixed guideway primary transit facilities between the tracks. The potential, then, for the location of such facilities is dependent on the outside clearances along the right-of-way measured from the outside edge of the track to the outside edge of the railway right-of-way. In general, on those portions of the railway line where the right-of-way is 100 feet wide, the outside clearance on each side of the right-of-way is 38 feet. Where the right-of-way is 150 feet wide, the outside clearance on each side of the right-of-way is generally 76 feet. Because of additional railroad trackage and other railroad facilities located in the right-of-way, the outside clearances at Butler Station between the Menomonee River crossing and W. Capitol Drive are 50 feet along the westbound portion of the right-of-way and approximately 10 feet along the eastbound portion. Between W. Capitol Drive and W. Burleigh Street, additional track within the right-of-way reduces the outside clearance to 20 feet along the westbound portion of the right-of-way and 40 feet along the eastbound portion.

The horizontal alignment of the railway grade is marked by large radius curves connecting long tangent sections of track. There are four horizontal curves on this railway section, most of which have a curvature of less than $3^{o}00'$. The sharpest horizontal curve occurs at Belton Junction between Milepost 9.8 and Milepost 10.2, where the alignment follows a circular curve with curvature of $6^{o}00'$.

The vertical alignment is characterized by relatively flat gradients, generally less than 0.5 percent. The steepest grade of 0.66 percent occurs between Milepost 10.6 and Milepost 11.0 in the City of West Allis.

As indicated on Map 101, there are a total of 19 street, railroad, and watercourse crossings on this railway segment. Included in this total are two public at-grade highway crossings, 12 grade-separated public highway crossings, one private at-grade industrial crossing, one grade-separated industrial crossing, two grade-separated railroad crossings, and one watercourse crossing.

There are a total of 11 industrial sidings, or lead tracks, along the west side of the right-of-way and five along the east side of the right-of-way. Such trackage is concentrated on the portion of the right-of-way between Butler Yard and the Zoo Freeway (USH 45) in the City of Wauwatosa, a distance of 2.6 miles. The remaining portion of the right-of-way—that between W. Watertown Plank Road and the East-West Freeway (IH 94)—has three industrial sidings, all on the east side.

Land directly adjacent to the railway right-of-way between Butler Yard and W. Blue Mound Road is generally characterized by industrial, commercial, or retail development. Between W. Blue Mound Road and Belton Junction, the adjacent land is characterized by a mixture of institutional, commercial, and residential development.

Belton Junction to Chase Junction: The portion of the New Line Subdivision between Belton Junction and the station at Chase Junction is a double-track railway line along its 6.5-mile length. The tracks are centered in the right-of-way except between Belton Junction and S. 84th Street, where, for a distance of 1.0 mile, the track is offset toward the north edge of the right-of-way. Much of the right-of-way is located at-grade, although between Mitchell Yard and S. 6th Street the right-of-way is located in a cut section. The right-of-way is 100 feet wide except between Belton and S. 84th Street, where it is approximately 160 feet wide, and at Mitchell Yard between S. 43rd Street and S. 35th Street, where it is 400 feet wide.

The distance between centerlines of the eastbound and westbound tracks is approximately 14 feet, which precludes the development of fixed guideway primary transit facilities between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

Generally, approximately 40 feet is available along the northside of the outside portion of the right-of-way between Belton Junction and S. 84th Street, and 95 feet is available along the south side. Additional railroad trackage, however, reduces the outside clearances on the south portion of the right-of-way between Belton Junction and S. 92nd Street to 55 feet. Between S. 92nd Street and S. 84th Street additional railroad and industrial trackage, passing sidings, and storage sidings on both sides of the right-of-way reduce the outside clearance along the north portion to 25 feet and along the south portion to 10 feet. The outside clearance along the portion of the right-of-way between S. 84th Street and S. 43rd Street is generally 40 feet on each side . At Mitchell Yard between S. 43rd Street and S. 35th Street, the outside clearance is limited to approximately 10 feet along the south side of the right-of-way and 20 feet along the north side. In addition, additional track between Lincoln Avenue running along the south portion of Mitchell Yard to S. 6th Street, a distance of 3.2 miles, reduces the outside clearance along the south side of the right-of-way to approximately 25 feet. The outside clearance along the north side of the right-of-way along this section is approximately 40 feet.

The horizontal alignment of the railroad grade is marked by large radius curves connecting long stretches of tangent track. There are four horizontal curves on this section of right-of-way, all of which have a curvature of less than $3^{o}00'$. The sharpest horizontal curve occurs in that segment east of Mitchell Yard between Milepost 4.6 and Milepost 4.9, where the alignment follows a circular curve with a curvature of $2^{o}15'$.

The vertical alignment is marked by relatively flat gradients, generally less than 1.0 percent. The steepest grade of 1.03 percent occurs between Mileposts 7.1 and 7.6, located between S. 66th Street and S. 58th Street in the City of West Allis.

As indicated on Map 101, there are a total of 29 street, railroad, and watercourse crossings on this railway segment. Included in this total are 11 public at-grade highway crossings, 14 grade-separated public highway crossings, two grade-separated pedestrian and industrial crossings, and two watercourse crossings.

There are a total of 12 industrial sidings, or lead tracks, along the north side of the right-of-way and 16 along the south side of the right-of-way. Such trackage is concentrated on the portions of the right-of-way at West Allis Station, Mitchell Yard, and Chase Junction.

Land directly adjacent to the railway right-of-way between Belton Junction and Chase Station is principally devoted to industrial and commercial development. However, between S. 73rd Street and S. 68th Street, and between S. 60th Street and W. Electric Avenue, the land directly adjacent to the right-of-way on both sides of the track is occupied by W. Burnham Street and W. Mobile Street, respectively. In addition, along the southern boundary of the right-of-way between S. 43rd Street and S. 35th Street and on both sides of the right-of-way between S. Layton Boulevard and S. 13th Street, land is devoted to park and institutional development.

Chase Junction to St. Francis Junction: The portion of the New Line Subdivision between Chase Junction and St. Francis Junction, referred to as the St. Francis cut-off, is a double-track railway line along the 2.4-mile length within the study area. Between S. 6th Street and S. Whitnall Avenue, the track is centered in the right-of-way. Between S. Whitnall Avenue and St. Francis Station, the track is generally offset toward the south side of the right-of-way. The right-of-way is located at-grade along this portion of the New Line Subdivision except between the North-South Freeway (IH 94) overpass and S. Whitnall Avenue, where it is in a cut. The right-of-way is approximately 150 feet wide between Chase Junction and S. Whitnall Avenue in the City of Milwaukee. At S. Whitnall Avenue the right-of-way width widens to 180 feet and remains this width to S. Pine Avenue. The portion of the right-of-way between S. Pine Avenue and S. Clement Avenue is approximately 275 feet wide. The remainder of the right-of-way—that between S. Clement Avenue and St. Francis Station—is 225 feet wide.

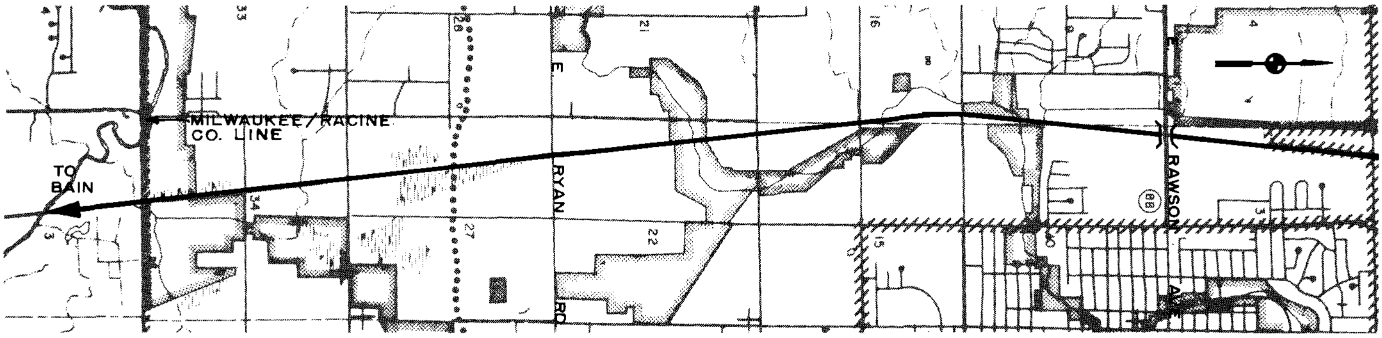
The distance between centerlines of the eastbound and westbound tracks is approximately 14 feet, which precludes the development of fixed guideway primary transit facilities between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way. Generally, approximately 63 feet is available along the outside portion of the right-of-way on each side of the track between S. 6th Street and S. Whitnall Avenue, where the railway is located in a cut. Between S. Whitnall Avenue and S. Pine Avenue, the outside clearance along the westbound portion of the right-of-way is approximately 73 feet and along the eastbound portion, approximately 80 feet. Between S. Pine Avenue and S. Clement Avenue, the outside clearance along the eastbound portion of the right-of-way is 190 feet and along the westbound portion, approximately 50 feet. The outside clearance along the remainder of the right-of-way—that between S. Clement Avenue and St. Francis Station—is approximately 110 feet along the eastbound portion of the right-of-way and 35 feet along the westbound portion.

The horizontal alignment of the railroad grade is marked by large radius curves connecting long stretches of tangent track. There are three hori-

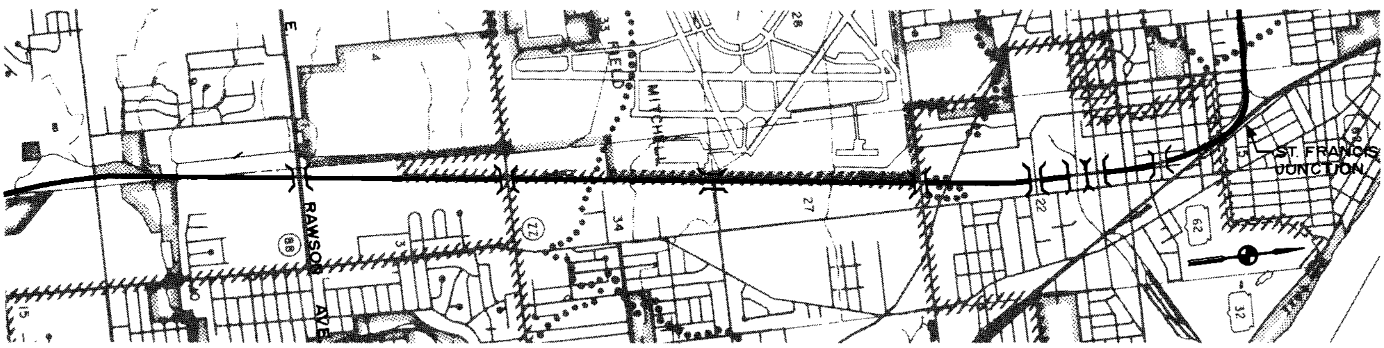
Map 101

ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S WISCONSIN DIVISION: NEW LINE SUBDIVISION WITHIN THE MILWAUKEE AREA

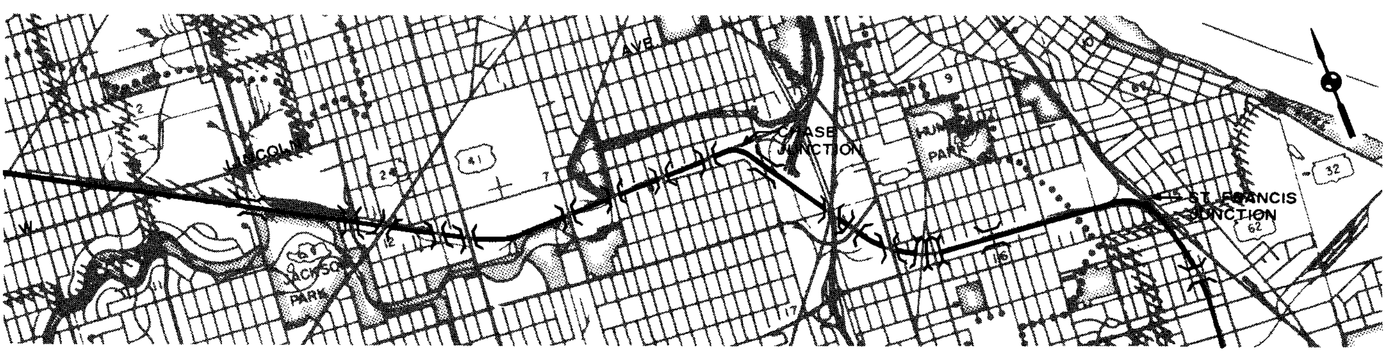
MILWAUKEE/RACINE CO. LINE — E. RAWSON AVE.



E. RAWSON AVE. — ST. FRANCIS JUNCTION



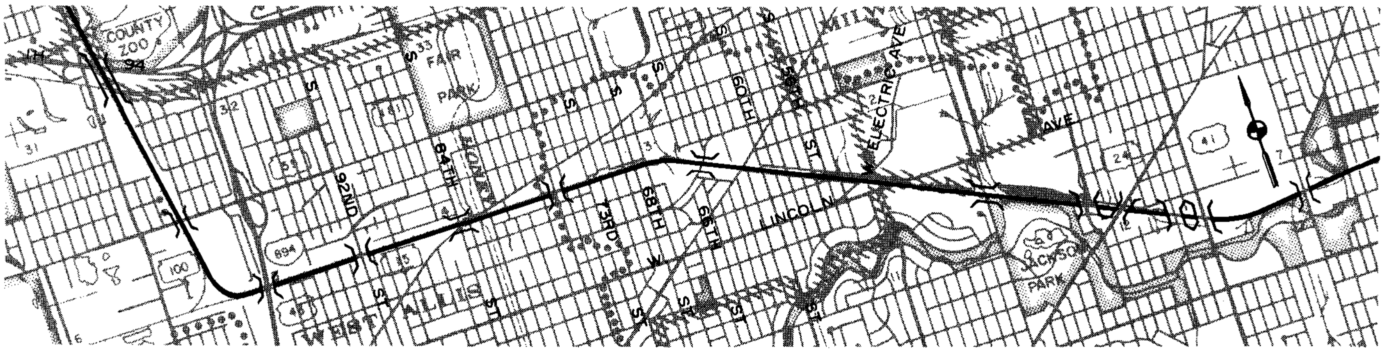
ST. FRANCIS JUNCTION — W. LINCOLN AVE.



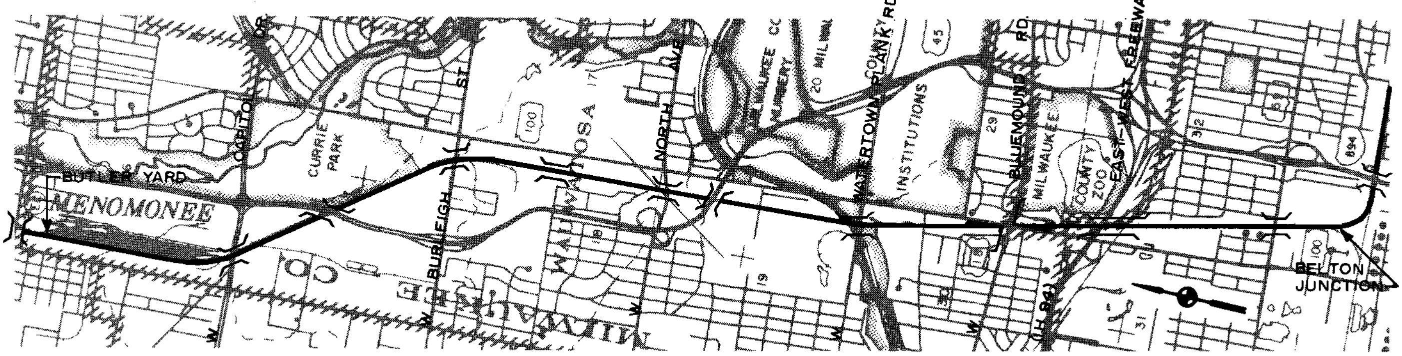
zontal curves on this railway section. The sharpest horizontal curve, having a curvature of 7°00', occurs twice—at Chase Junction between Mileposts 2.5 and 3.1 and at St. Francis Junction between Mileposts 0.0 and 0.2. The vertical alignment is marked by relatively flat gradients, generally less than 0.6 percent. The steepest grade of 0.83 percent occurs between Mileposts 2.0 and 2.2 located east of Chase Junction in the City of Milwaukee.

Map 101 (continued)

W. LINCOLN AVE. — IH 94



IH 94 — BUTLER YARD



LEGEND

RIGHT-OF-WAY | OVERPASS | UNDERPASS | GRAPHIC SCALE 0 2000 4000 FEET

The portion of the New Line Subdivision of the C&NW's Wisconsin Division within the Milwaukee area consists of a 25.9-mile segment extending from Butler Yard to the Milwaukee-Racine County line. Passing through the communities of Wauwatosa, Milwaukee, West Allis, West Milwaukee, St. Francis, Cudahy, and Oak Creek, the right-of-way has 23 at-grade street or highway crossings, 40 grade-separated highway crossings, nine private at-grade crossings, four private grade-separated crossings, two grade-separated railway crossings, and seven watercourse crossings. Because of the concentration of industrial sidings and lead tracks, the additional railroad trackage, and the industrial development located immediately adjacent to the right-of-way, the portions of the right-of-way between Butler Yard and Chase Junction are not suitable for at-grade, primary transit fixed guideway development. The portion of the right-of-way between Chase Junction and the Milwaukee-Racine County line has good potential, however.

Source: SEWRPC.

As indicated on Map 101, there are a total of eight street and highway crossings on this railway segment. Included in this total are one public at-grade highway crossing, six grade-separated public highway crossings, and one grade-separated pedestrian crossing.

There are two industrial sidings, or lead tracks, along the westbound main line and two along the eastbound main line. Such trackage is concentrated on the portion of the right-of-way between Milepost 0.0 and Milepost 1.0. The remaining portion of the right-of-way—that between S. 6th Street and Chase Junction, located at Milepost 3.6—has no industrial sidings. In addition, at St. Francis there is additional trackage within the right-of-way for the junction with the Kenosha Subdivision and National Avenue spur track.

Land use directly adjacent to the St. Francis cut-off west of S. Chase Avenue is primarily industrial, and east of S. Chase Avenue is primarily residential.

St. Francis to Milwaukee-Racine County Line: The portion of the New Line Subdivision between St. Francis and a point 500 feet north of W. College Avenue, a distance of 3.4 miles, is a double-track railway line. North of W. College Avenue to the Milwaukee-Racine County line, a distance of 6.4 miles, the railway is a single-track main line. The track is centered in the right-of-way except between St. Francis Station and a point 500 feet south of E. Cora Avenue, where, for a distance of 0.5 mile, the track is offset toward the west side of the right-of-way. In general, this railway right-of-way is located at-grade.

The right-of-way is generally 150 feet wide between St. Francis Station and E. St. Francis Avenue. From E. St. Francis Avenue to E. Tripoli Avenue, the right-of-way width narrows to 100 feet. The portion of the right-of-way between E. Tripoli Avenue and S. Layton Avenue varies but is generally 150 feet to 240 feet wide. Between S. Layton Avenue and E. Grange Avenue the right-of-way is 150 feet wide. The remaining portion of the right-of-way, that between E. Grange Avenue and the Milwaukee-Racine County line, is generally 100 feet wide.

The distance between centerlines of the eastbound and westbound tracks is approximately 14 feet, which precludes the development of fixed guideway primary transit facilities between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

The outside clearance on each side of the right-of-way along the portion of this railway segment between St. Francis Station and E. Tripoli Avenue is approximately 40 feet except along the westbound track from St. Francis Station to E. St. Francis Avenue, a distance of 0.1 mile, where the outside clearance is about 75 feet. Between E. Tripoli Avenue and S. Layton Avenue, the minimum clearance along each side of the right-of-way is 70 feet. The outside clearance along the eastbound and westbound track from S. Layton Avenue to E. Grange Avenue is 75 feet and 50 feet, respectively. Between E. Grange Avenue a point 500 feet north of E. College Avenue, the outside clearance along each side of the right-of-way is 40 feet. The outside clearance along the remaining portion of the right-of-way—that north of E. College Avenue to the Milwaukee-Racine County line—is approximately 47 feet on each side of the track except between a point south of E. Oakwood Road and E. Elm Road, where, for a distance of 0.6 mile, a passing track along the eastbound track reduces the outside clearance to about 30 feet.

The horizontal alignment of the railroad grade is marked by large radius curves connecting long stretches of tangent track. There are three horizontal curves on this railway section, the sharpest of which is a circular curve with a curvature of $1^{o}00'$ that occurs south of St. Francis Station between Mileposts 79.5 and 80.1.

The vertical alignment is characterized by relatively flat gradients, generally less than 0.2 percent. The steepest grade, 0.5 percent, occurs south of St. Francis Station between Mileposts 78.7 and 80.1.

As indicated on Map 101, there are a total of 29 street, railroad, and watercourse crossings on this railway segment. Included in this total are nine public at-grade highway crossings, eight grade-separated public highway crossings, eight private at-grade farm crossings, and four watercourse crossings. There is one industrial siding, or lead track, along the eastbound main line located near E. Grange Avenue.

Land directly adjacent to this portion of the New Line Subdivision is in agricultural and other rural open uses except between E. Layton Avenue and E. College Avenue, where the right-of-way is bounded by General Mitchell Field along the west side and industrial development along the east side.

Feasibility Conclusion: The section of the New Line Subdivision between Butler Yard and Belton Junction has poor potential for the location of at-grade light rail transit, heavy rail rapid transit, or exclusive busway facilities. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, would all allow for primary transit fixed guideway development. However, because of the concentration of industrial sidings and lead tracks, the presence of other railroad trackage, and the industrial development located immediately adjacent to the right-of-way, the portion of the right-of-way between Butler Station and USH 45 is not suitable for at-grade primary transit fixed guideway development. Furthermore, those portions of this section between W. North Avenue and W. Potter Road and between the East-West Freeway and Belton Junction have poor potential because the railroad grade is located on a fill, and thus substantial earthwork would be required to obtain sufficient cross-sectional area for the location of primary transit fixed guideway facilities.

The section of the New Line Subdivision between Belton Junction and Chase Junction also appears to have poor potential for the location of primary transit fixed guideway facilities. Specifically, the large number of industrial sidings located at West Allis Station, Mitchell Yard, and Chase Station make the location of at-grade light rail transit, heavy rail rapid transit, or exclusive bus guideway on the right-of-way impractical. In most instances, fixed guideway facility location along this section would require either the relocation of industrial spur leads or the elevation of fixed guideway facilities.

Most of the remaining portion of the New Line Subdivision within the study area—that between Chase Junction and the Milwaukee-Racine County line—has good potential for use in the location of a primary transit guideway. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, would all allow for at-grade primary transit development. In addition, fixed guideway facility location along this section of the right-of-way would not require changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way to provide adequate outside clearances.

With respect to the entire railway segment, crossings with public streets and industrial trackage pose the most serious limitation to the use of this right-of-way for the location of fixed guideway facilities, placing a more serious constraint, however, on heavy rail rapid transit development than on light rail or exclusive busway development. While heavy rail rapid transit requires grade-separated facilities at all crossings, light rail transit and exclusive busway systems generally do not. However, because grade separations are desirable at those locations having extensive industrial lead or station trackage and at highway crossings with potential traffic conflicts, the number of crossings becomes an important consideration for light rail transit and exclusive busway systems as well. Thus, it would appear that grade separations constitute the most serious limitation to development of this right-of-way for primary transit facilities, as well as the greatest capital cost consideration.

The Chicago & North Western Transportation Company—Waukesha Subdivision

The Waukesha Subdivision of the Chicago & North Western Transportation Company's Wisconsin Divisions consists of a 71.6-mile-long main line extending from Belton Junction in the City of West Allis to Madison. The 11.0-mile segment pertinent to this right-of-way inventory and assessment includes that portion between Belton Junction, located 0.4 mile east of STH 100 in the City of West Allis, and STH 59 in the City of Waukesha. As shown on Map 102, the route segment under consideration passes through the communities of West Allis, New Berlin, and Waukesha.

The Waukesha Subdivision is a single-track line along the 11.0-mile length within the study area. The track is centered within the right-of-way, which is located at-grade west of S. 124th Street. East of S. 124th Street, the railway grade is situated on a fill to Belton Junction, a distance of approximately 1.5 miles. The right-of-way is approximately 100 feet wide along the entire railway segment except between E. Broadway Street in the City of Waukesha and a point 0.2 mile west of West Avenue in the City of Waukesha, where, for a distance of 1.1 miles, it ranges from 50 feet to 200 feet.

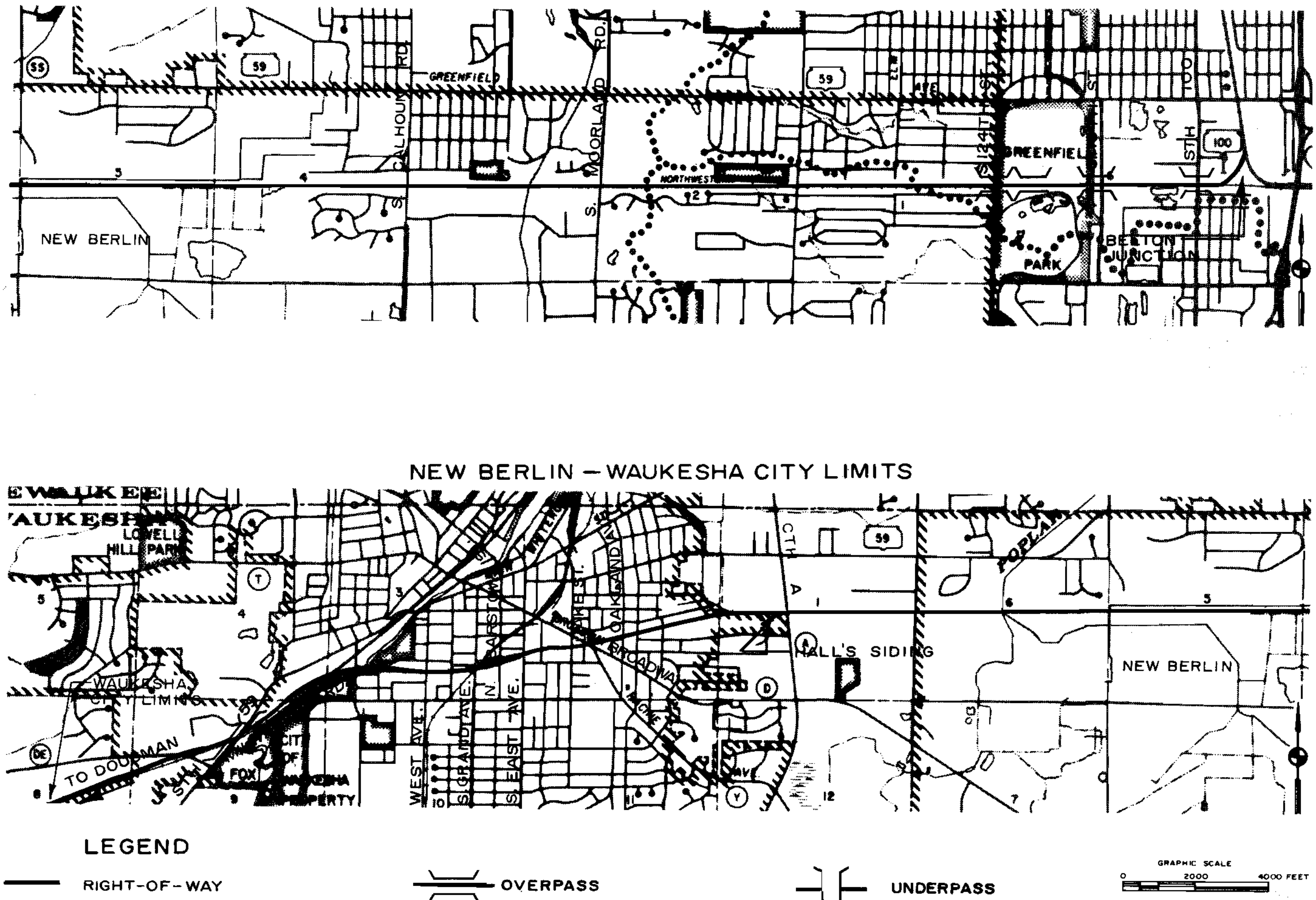
The potential to develop primary transit facilities along this railway right-of-way is dependent on the outside clearances, measured from the outside edge of the track to the outside edge of the railway right-of-way. Generally, approximately 47 feet is available along the outside portion of the right-of-way on both sides of the track. A second track used as a passing siding is provided along the north side of the right-of-way at New Berlin Station, reducing the outside clearance on the north side of the right-of-way to about 10 feet for 0.3 mile. Additional trackage is also provided on both sides of the track between N. Grand Avenue and N. Barstow Avenue, a distance of about 0.4 mile, in the vicinity of the Waukesha station, reducing the outside clearance on both sides to approximately 15 feet. Finally, an open drainage channel on the south side of the right-of-way between Oakland Street and Lake Street in the Town of Waukesha reduces the available right-of-way width to approximately 20 feet for 0.7 mile.

The horizontal alignment of the railroad grade is marked by large radius curves connecting long tangent sections of track. There are eight horizontal curves on the line, most of which have a curvature of less than $3^{o}00'$. The sharpest horizontal curves occur at Waukesha Station, where the alignment follows a reverse curve with curvatures of $6^{o}00'$.

Map 102

ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S WISCONSIN DIVISION: WAUKESHA SUBDIVISION WITHIN THE MILWAUKEE AREA

BELTON JUNCTION—NEW BERLIN



The portion of the Waukesha Subdivision of the C&NW's Wisconsin Division within the Milwaukee area consists of an 11.0-mile segment extending from Belton Junction to STH 59 in the City of Waukesha. Passing through the communities of West Allis, New Berlin, and Waukesha, the right-of-way has 18 at-grade street or highway crossings, one highway overpass crossing, five grade-separated highway crossings, three private at-grade crossings, two railway at-grade crossings, and two watercourse crossings. The industrial lead tracks and other railroad trackage in the right-of-way precludes the location of at-grade, primary transit fixed guideway facilities along this segment between S. East Avenue and the Milwaukee Road railway crossing in the City of Waukesha.

Source: SEWRPC.

The vertical alignment is characterized by relatively flat gradients, generally less than 1 percent. The steepest grade, 1.06 percent, occurs between Milepost 11.1 and Milepost 12.3 in the City of West Allis, a distance of 1.2 miles.

As indicated on Map 102, there are a total of 30 street, highway, railroad, and watercourse crossings on this section of railway line. Included in this total are 18 public at-grade highway crossings, five grade-separated public highway crossings, three private at-grade industrial or farm crossings, two railway at-grade crossings, and two watercourse crossings.

There are a total of 10 industrial sidings, or lead tracks, along the south side of the right-of-way and four along the north side. Such trackage is concentrated on the portion of the right-of-way between Halls Siding located just west of CTH A in the City of Waukesha, and the Milwaukee Road railway crossing in the City of Waukesha, a distance of

2.7 miles. The remaining portion of the right-of-way—that between Halls Siding and Belton—has only four industrial sidings, all located on the south side of the right-of-way at the New Berlin industrial park.

Land use directly adjacent to this railway line is varied. Between Belton Junction and the west end of Halls Siding in the City of Waukesha, the land to the south of the right-of-way between Belton and S. 116th Street is in industrial use; between S. 116th Street and S. 124th Street, the land is parkland; between S. 124th Street and S. Moorland Road, the land is in residential use; between S. Moorland and S. Calhoun Roads, the land is in industrial use; and between S. Calhoun Road and Halls Siding, the land is primarily vacant or in agricultural uses. The land immediately north of the right-of-way between Belton Junction and the west end of Hall's Siding, is part of the Watertown Division of the former Milwaukee Electric Lines electric interurban railway system. The former interurban railway right-of-way parallels the Waukesha Subdivision for approximately 8.5 miles. Between Halls Siding and the N. Barstow Avenue crossing in the City of Waukesha, the right-of-way is bounded on both sides primarily by residential development. West of N. Barstow Avenue, the adjacent land is in mixed commercial and industrial uses.

Feasibility Conclusion: It may be concluded that the Waukesha Subdivision right-of-way has modest potential for use in the location of a primary transit guideway. The physical characteristics of the right-of-way, including horizontal and vertical alignment and the right-of-way width, would allow for at-grade primary transit fixed guideway development. However, the section of right-of-way between S. East Avenue and the Milwaukee Road crossing within the City of Waukesha is not well suited for such development because of the industrial lead tracks along the right-of-way, the other railroad trackage in the right-of-way, and the industrial and commercial development immediately adjacent to the right-of-way. The location of primary transit facilities along this section of right-of-way would require the provision of an elevated primary transit facility or the acquisition of additional right-of-way, with attendant urban disruption. Outside clearances at New Berlin Station, while reduced because of the additional railroad trackage within the right-of-way, would not place a severe constraint on the development of fixed guideway facilities at this location. Finally, that portion of the railway line between Belton Junction and S. 124th Street has poor potential for fixed guideway development because the railway grade is situated on a fill. The location of a primary transit guideway on this right-of-way would require substantial earthwork so that sufficient cross-sectional area could be obtained.

Important to the consideration of the use of this railway segment for primary transit fixed guideway location is the large number of street and highway crossings, most of which are located between CTH A and STH 59 in the City of Waukesha, a distance of 2.8 miles. These crossings particularly hinder the use of this right-of-way for heavy rail rapid transit, but must also be considered in the use of the right-of-way for light rail transit and exclusive busway development. While heavy rail rapid transit requires grade separation of all crossings, light rail transit and exclusive busways generally do not. However, because grade separations are desirable at those locations having extensive industrial or station trackage and at street and highway crossings with potential traffic conflicts, the number of crossings becomes an important consideration for light rail transit and exclusive busway systems as well. Thus, it would appear that grade separations constitute the most serious limitation to the development of this right-of-way for primary transit facilities, as well as the greatest capital cost consideration.

Chicago & North Western Transportation Company—Kenosha Subdivision

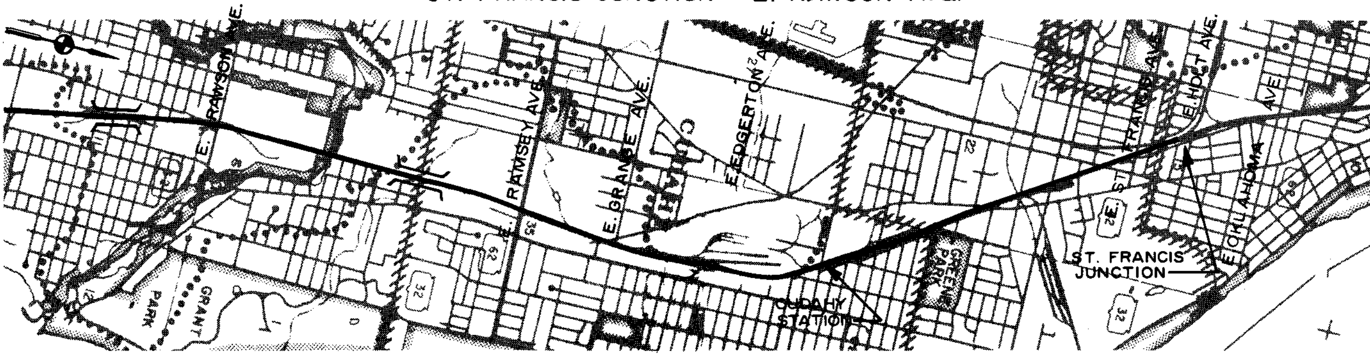
The Kenosha Subdivision of the Chicago & North Western Transportation Company's Wisconsin Division consists of a 66.0-mile-long railway main line extending from St. Francis Station located at E. Holt Avenue to Wilmette, Illinois. Sometimes referred to as the "Old Line," the 10.0-mile segment pertinent to this right-of-way inventory and assessment includes that portion between St. Francis Station and the Milwaukee-Racine County line in the City of Oak Creek. As shown on Map 103, the route segment under consideration passes through the communities of St. Francis, Cudahy, South Milwaukee, and Oak Creek.

The Kenosha Subdivision is a double-track railway line along the 10.0-mile length within the study area. The tracks are generally centered in the right-of-way, which is located at-grade. The right-of-way is approximately 100 feet wide along the entire railway segment except between E. Oklahoma Avenue and E. St. Francis Avenue, where it widens to between 115 feet and 160 feet to accommodate additional railroad trackage and station facilities. In addition, the right-of-way widens to

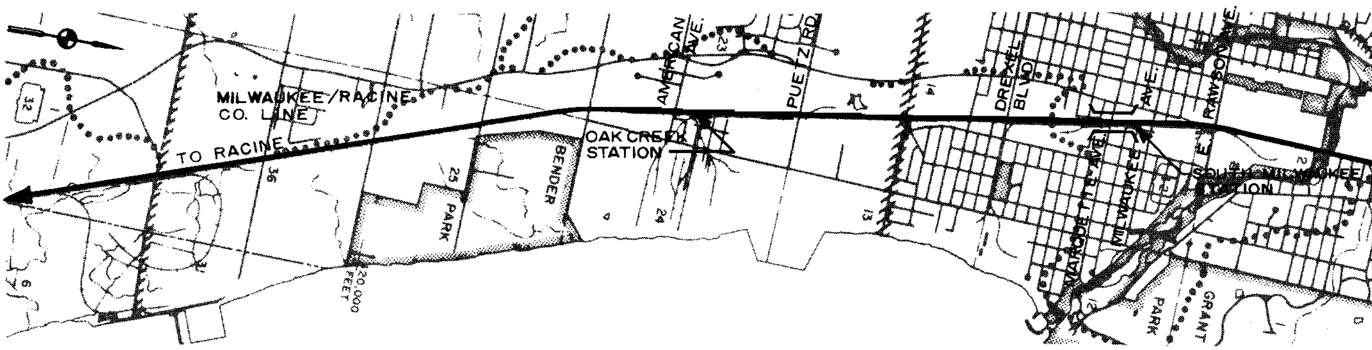
Map 103

ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S WISCONSIN DIVISION: KENOSHA SUBDIVISION WITHIN THE MILWAUKEE AREA

ST. FRANCIS JUNCTION – E. RAWSON AVE.



E. RAWSON AVE. – MILWAUKEE RACINE CO. LINE



LEGEND

RIGHT-OF-WAY — OVERPASS — UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The portion of the Kenosha Subdivision of the C&NW's Wisconsin Division within the Milwaukee area consists of a 10.0-mile segment extending from St. Francis Station to the Milwaukee-Racine County line. Passing through the communities of St. Francis, Cudahy, South Milwaukee, and Oak Creek, the right-of-way has 17 at-grade highway crossings, two grade-separated highway crossings, one at-grade industrial crossing, and three watercourse crossings. The physical characteristics of the right-of-way generally would allow for the location of at-grade, primary transit fixed guideway facilities along the entire segment.

Source: SEWRPC.

approximately 180 feet between E. Edgerton Avenue and a point 0.1 mile north of E. Grange Avenue, where it is used primarily for additional industrial track. Between Marquette Avenue and E. Drexel Road, the right-of-way width increases to about 120 feet. Finally, between E. Puetz Road and the north end of Oak Creek Station the right-of-way width increases to 200 feet.

The distance between centerlines of the eastbound and westbound tracks is approximately 14 feet, thus precluding the development of fixed guideway primary transit facilities between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

Between E. Oklahoma Avenue and E. St. Francis Avenue, the outside clearance is generally 45 feet on the east side of the track and 30 feet on the west side. The outside clearance along both the east and west sides is about 38 feet between E. St. Francis Avenue and the north end of Cudahy Station. The clearance on the west side of the track, however, is reduced by 20 feet at Cudahy Station because of additional railroad trackage.

Between E. Ladish Avenue and E. Ramsey Avenue, a third track located on the east side of the right-of-way reduces the outside clearance approximately 25 feet for 0.4 mile. Additional track on the east side of the right-of-way between E. Rawson Avenue and Milwaukee Avenue reduces the right-of-way to 20 feet for 0.3 mile. In addition, station facilities at South Milwaukee Station south of the Milwaukee Avenue crossing reduce the right-of-way width to less than 10 feet for approximately 450 feet. Additional track on the west side of the mainline track between E. Rawson Avenue and a point 0.2 mile south of Marquette Avenue reduces the right-of-way width to 10 feet. The outside clearance between Puetz Road and the Milwaukee-Racine County line is about 38 feet on each side of the right-of-way except between Oak Creek Station and E. American Avenue, where the right-of-way width is reduced to 40 feet on the west side.

The horizontal alignment of the railroad grade is generally marked by large radius curves connected by relatively long stretches of tangent track. There are 10 horizontal curves on the line, most of which have a curvature of less than $1^{o}00'$. The sharpest horizontal curves occur in that segment at St. Francis Station between Milepost 79.8 and Milepost 80, where the alignment follows a set of reverse curves with curvatures of $1^{o}58'$ and $3^{o}48'$.

The vertical alignment is characterized by relatively flat gradients, generally less than 0.75 percent. The steepest grade, 0.78 percent, occurs north of Cudahy Station between Milepost 78.1 and Milepost 79.5, for a distance of 1.4 miles. In addition, a grade of 0.75 percent occurs at the southern end of Cudahy Station for a distance of approximately 1.3 miles.

As indicated on Map 103, there are a total of 23 street and watercourse crossings on this railroad segment. Included in this total are 17 public at-grade highway crossings, two grade-separated public highway crossings, one private at-grade industrial crossing, and three watercourse crossings. There are no railway crossings on this line.

There are a total of 11 industrial sidings, or lead tracks, along the west side of the main line and 14 along the east side. Such trackage is concentrated on the portion of the right-of-way at Cudahy Station, South Milwaukee Station, and Oak Creek Station. The remaining portion of the right-of-way—that between railroad stations—has a total of only four industrial sidings on both sides of the right-of-way. In addition, there is additional trackage within the right-of-way at St. Francis Station for the junction with the New Line Subdivision and the National Avenue spur track.

Land directly adjacent to this railroad segment is primarily in industrial use. Between St. Francis Station and Puetz Road, the land east and west of the right-of-way is devoted to industrial and railway development except between the E. Norwich Street crossing and E. Layton Avenue, where it parallels S. Kinnickinnic Avenue on the east side, and between E. Grange Avenue and E. Ramsey Avenue, where commercial development borders both sides. In addition, between E. College Avenue and E. Rawson Avenue, park development is located on the west side of the right-of-way. The portion of the right-of-way between Puetz Road and the Milwaukee-Racine County line is bounded principally by agricultural and other rural open use development.

Feasibility Conclusion: In general, it may be concluded that the Kenosha Subdivision railway right-of-way has good potential for use in the development of a primary transit fixed guideway facility. The physical characteristics of the right-of-way, including horizontal and vertical curvature and right-of-way width, would allow for at-grade primary transit development along this railway segment.

Crossings with public streets and industrial trackage pose the most serious limitation to the use of this right-of-way for the location of fixed guideway facilities, placing a more serious constraint on heavy rail rapid transit development than on light rail or exclusive busway development. While heavy rail rapid transit requires grade-separated facilities at all crossings, both light rail transit and exclusive busway systems generally do not. However, because grade separations are desirable at those locations where there is extensive industrial lead or station trackage, or at highway crossings with potential traffic conflicts, the number of crossings becomes an important consideration for light rail transit and exclusive busway system development as well. Thus, it would appear that grade separations constitute the most serious limitation to the development of primary transit facilities on this right-of-way, as well as the greatest capital cost consideration.

The outside clearances on both sides of this railway segment would allow for the development of primary transit fixed guideway facilities except at Cudahy Station, South Milwaukee Station, and Oakwood Station, where they are reduced by the industrial lead track located on the outsides of the right-of-way.

The Chicago & North Western Transportation Company—Capitol Drive Spur Track

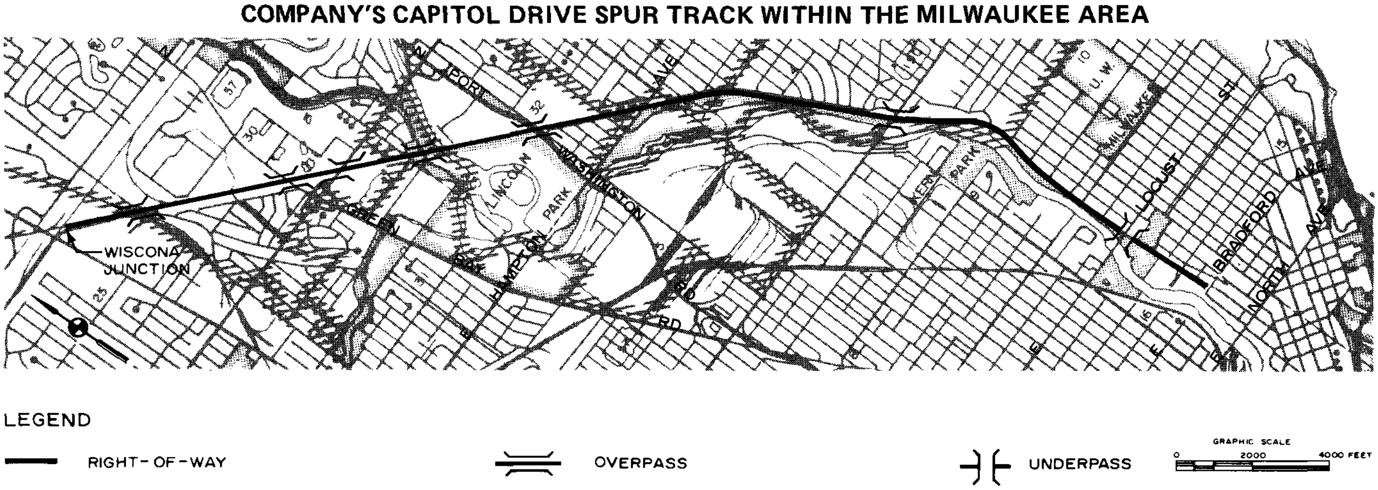
The Capitol Drive spur track was once a part of the lakefront main line of the Chicago & North Western Railway, a 9.4-mile-long mainline route extending from Washington Street, south of downtown Milwaukee, to Wiscona Junction. The portion of the former lakefront main line between E. Bradford Avenue and E. Erie Street has been abandoned and is owned and used by Milwaukee County for a public bicycle trail. The 5.7-mile segment pertinent to this inventory and assessment includes that portion between Wiscona Junction and E. Bradford Avenue, wholly within the City of Milwaukee. Map 104 shows this segment of railway line.

The Capitol Drive spur track is a single-track railway line along the 5.7-mile length within the study area. Between E. Locust Street and E. Bradford Avenue, a second track is in place to connect with industrial sidings. In general, the track is centered in the right-of-way between Wiscona Junction and N. Port Washington Road. The right-of-way over this segment is on fill, while the remaining portion of this right-of-way segment is generally at-grade. The right-of-way is 100 feet wide along the entire length of the segment except between Wiscona Junction and N. Green Bay Avenue, where it is approximately 160 feet wide.

The potential to develop primary transit facilities on this railroad segment is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way. In general, the width available along the outside portion of the right-of-way on each side of the track between Wiscona Junction and N. Green Bay Avenue is approximately 77 feet. The outside clearance between N. Green Bay Avenue and E. Hampton Road is generally 47 feet on each side of the track. The section of the right-of-way between E. Hampton Road and E. North Avenue is owned by Milwaukee County and is currently being used as a bicycle trail. However, the Chicago & North Western Railway maintains an easement along this portion of right-of-way to serve several industrial sidings in the vicinity of E. Bradford Avenue.

Map 104

ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S CAPITOL DRIVE SPUR TRACK WITHIN THE MILWAUKEE AREA



The Capitol Drive spur track was once part of the lakefront main line of the C&NW Railway, and consists of a 5.7-mile segment extending from Wiscona Junction to E. Bradford Avenue wholly within the City of Milwaukee. The right-of-way has two at-grade highway crossings, nine grade-separated highway crossings, four grade-separated pedestrian crossings, one grade-separated railroad crossing, and six watercourse crossings. This railway segment has good potential for the location of at-grade, primary transit fixed guideway facilities. The portion of the right-of-way between E. North Avenue and E. Hampton Road, however, would require the removal of a bicycle trail located in the right-of-way.

Source: SEWRPC.

The horizontal alignment of the railroad grade is marked by large radius curves between short segments of tangent track. There are five curves on the line, most of which have a curvature of less than $3^{o}00'$. The sharpest curve occurs in that segment between E. North Avenue and E. Park Place, where the alignment follows a circular curve with a curvature of $3^{o}15'$.

The vertical alignment is marked by minor grades, all of which are of little operating consequence. In general, the vertical alignment is characterized by flat gradients of less than 1.0 percent. The steepest grade, 1.1 percent, occurs between the Milwaukee Road crossing at Wiscona Junction and a point about 300 feet south of Wiscona Junction.

As indicated on Map 104, there are a total of 22 street, highway, railroad, and watercourse crossings on this railway segment. Included in this total are two public at-grade street crossings, nine grade-separated public street and highway crossings, four grade-separated pedestrian crossings, one grade-separated railroad crossing, and six watercourse crossings.

There are a total of seven industrial sidings, or lead tracks, along the west side of the railway right-of-way. There are no lead tracks located along the east side of the right-of-way.

The lands immediately adjacent to this right-of-way are almost entirely occupied by public parklands and residential development. There are small amounts of industrial and commercial development in the areas around E. Bradford Avenue and W. Silver Spring Drive. Between E. Locust Street and E. Capitol Drive, the right-of-way follows the eastern bank of the Milwaukee River.

Feasibility Conclusion: The section of this right-of-way between Wiscona Junction and E. Hampton Road has good potential for the location of at-grade, primary transit fixed guideway facilities. Fixed guideway facility location along this railway portion would not require changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way or facility grade separation to provide adequate outside clearances.

The portion of this right-of-way between E. North Avenue and E. Hampton Road has fair to good potential for the location of primary transit system fixed guideway facilities. The outside clearances along both sides of the right-of-way would be adequate for at-grade development if the bicycle trail in the right-of-way were removed. The industrial sidings in the right-of-way in the vicinity of E. Bradford Avenue would also present a problem to at-grade development.

The Chicago & North Western Transportation Company—Chase Spur Track

The Chase spur track operated by the Chicago & North Western Transportation Company consists of a 2.1-mile-long railway line located entirely within the study area. As shown on Map 105, the route segment under consideration extends from Chase Junction to E. Washington Street in the City of Milwaukee.

The Chase spur track is a single-track railway line. The track is centered in the right-of-way except between S. Chase Avenue and a point 500 feet north of S. Chase Avenue, where it is offset along the west side of the right-of-way, and between E. Scott Street and E. Washington Street, where, for a distance of 500 feet, it is offset along the west side of the right-of-way. The right-of-way is approximately 100 feet wide between Chase Junction and the S. Chase Avenue underpass. At S. Chase Avenue the right-of-way narrows to 85 feet; it remains this width to a point 500 feet north of S. Chase Avenue, where it widens to approximately 160 feet. The right-of-way remains 160 feet wide to E. Lincoln Avenue. Between E. Lincoln Avenue and the Kinnickinnic River swingbridge, the right-of-way narrows to 85 feet wide. Along the 350-foot-long Kinnickinnic River swingbridge, the right-of-way is approximately 30 feet wide. The portion of the right-of-way between S. Kinnickinnic Avenue and E. Washington Street is 50 feet wide except between E. Scott Street and E. Washington Street, where, for a distance of 500 feet, the right-of-way widens to approximately 75 feet.

The potential to develop primary transit facilities along this railway right-of-way is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way. Approximately 47 feet is available along the outside portion of the right-of-way on both sides of the track between Chase Junction and S. Chase Avenue. The outside clearance along the east side of the portion of the right-of-way that is 160 feet wide is 50 feet. Additional track within the right-of-way north of S. Chase Avenue to E. Lincoln Avenue reduces the outside clearance along the east and west sides of the right-of-way to 35 feet and 60 feet, respectively. Between E. Lincoln Avenue and W. Becher Street, the outside clearance is four feet along the east side of the right-of-way and 25 feet along the west side. The outside clearance along the portion of the right-of-way between W. Becher Street and the Kinnickinnic River swingbridge is approximately 35 feet along both sides of the right-of-way. The outside clearance along the right-of-way between S. Kinnickinnic Avenue and E. Washington Street is 15 feet along the east side of the right-of-way and 20 feet along the west side. However, additional track within the right-of-way between S. Kinnickinnic Avenue and a point 700 feet north of S. Kinnickinnic Avenue reduces the right-of-way along the west side to 15 feet. Also, additional track between E. Orchard Street and E. Madison Street reduces the outside clearance along the east side of the right-of-way to five feet. Because the track is offset to the west along the portion of the right-of-way between E. Scott Street and E. Washington Street, the outside clearance along the west side is five feet, and the clearance along the east side is 55 feet.

The horizontal alignment of the railroad grade is marked by large radius curves connecting long tangent sections of track. There are four horizontal curves on the line, all of which have a curvature of less than $4^{o}00'$. The sharpest horizontal curve occurs in that segment between W. Becher Street and the Kinnickinnic River swingbridge, where the alignment follows a circular curve with an approximate curvature of $4^{o}00'$.

The vertical alignment is characterized by gradients that are generally level along the entire length of the railway segment.

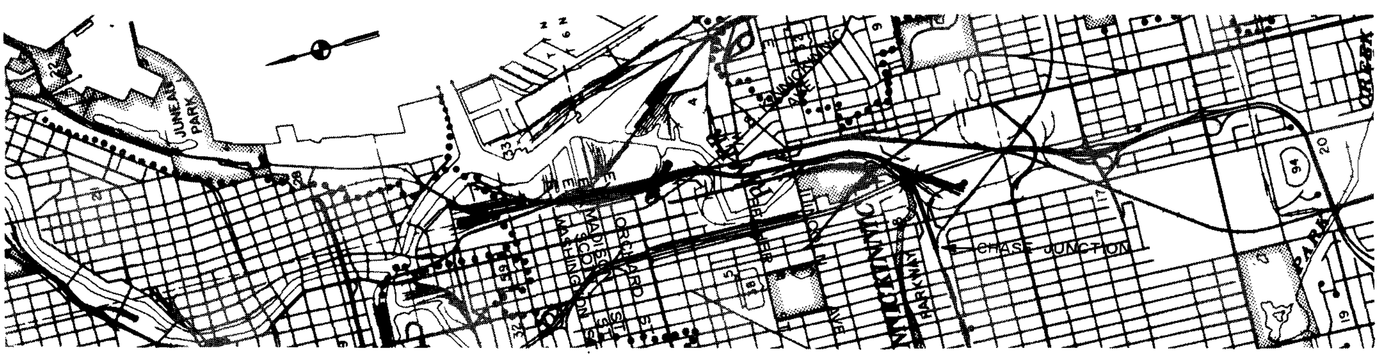
As indicated on Map 105, there are a total of eight street, highway, and watercourse crossings on this section of railway line. Included in this total are seven grade-separated public highway crossings and one watercourse crossing.

There are a total of seven industrial sidings, or lead tracks, along the west side of the right-of-way and two along the east side of the right-of-way. Such trackage is concentrated between E. Lincoln Avenue and E. Washington Street. The remaining portion of the right-of-way, that between Chase Junction and E. Lincoln Avenue, has no industrial sidings.

Land directly adjacent to this railroad segment is primarily devoted to either railway or industrial development. It should be noted that between

Map 105

ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S CHASE SPUR TRACK WITHIN THE MILWAUKEE AREA



LEGEND

RIGHT-OF-WAY

OVERPASS

UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The C&NW Chase spur track consists of a 2.1-mile segment extending from Chase Junction to E. Washington Street in the City of Milwaukee. The right-of-way has seven grade-separated highway crossings and one watercourse crossing. The concentration of sidings, the railroad trackage in the right-of-way for passing and storage, and a major watercourse crossing make the location of fixed guideway facilities along this line impractical north of E. Lincoln Avenue. However, the portion of the right-of-way south of E. Lincoln Avenue has good potential for the development of an at-grade primary transit facility.

Source: SEWRPC.

Chase Junction and E. Lincoln Avenue, the right-of-way follows the Kinnickinnic River, located to the west side of the right-of-way. Between S. Chase Avenue and S. Kinnickinnic Avenue, and S. Kinnickinnic Avenue and E. Washington Street, the right-of-way parallels the Milwaukee Road right-of-way, located to the east.

Feasibility Conclusion: The section of this right-of-way that is north of E. Lincoln Avenue would appear to have poor potential for the location of light rail transit, heavy rail rapid transit, or exclusive busway facilities. Although the physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, would generally allow for primary transit development, the concentration of industrial sidings on the outsides of the right-of-way, the passing and storage track in the right-of-way, and a major watercourse crossing make the location of at-grade light rail transit, heavy rail rapid transit, or exclusive bus guideway on this portion of the right-of-way impractical.

The remaining portion of the right-of-way, that south of E. Lincoln Avenue, has good potential for the location of an at-grade primary transit facility. Fixed guideway facility location along this railway portion would not require changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way or facility grade separation to provide adequate outside clearances.

The Chicago & North Western Transportation Company—National Avenue Spur Track

The National Avenue spur track operated by the Chicago & North Western Transportation Company consists of a 3.5-mile-long railway line, located entirely within the study area. As shown on Map 106, the route segment under consideration extends from St. Francis tower to the Milwaukee station located immediately north of the E. Erie Street crossing in the City of Milwaukee.

The National Avenue spur track is a four-track railway line between a point north of St. Francis tower to E. Linus Street, a distance of 1.4 miles. Prior to 1971, two of the tracks were operated as freight tracks and two were operated as passenger tracks. Currently, all four tracks are used to serve industries along this segment. The remaining portion of the right-of-way—that between E. Linus Street and E. Erie Street—consists of a double-track railway line with a short segment of single track at the Milwaukee Road Bay View spur railway crossing. The tracks are centered in the right-of-way between St. Francis tower and E. Oklahoma Avenue. Between E. Oklahoma Avenue and E. Linus Street, the track is generally offset along the west side of the right-of-way. Along the double-track portion of the right-of-way between E. Linus Street and E. Erie Street, the track is generally centered in the right-of-way.

The right-of-way is approximately 110 feet wide between St. Francis tower and E. Oklahoma Avenue. Between E. Oklahoma Avenue and E. Russell Street the right-of-way is generally 125 feet wide. The portion of the right-of-way between E. Russell Street and the Kinnickinnic River drawbridge is 100 feet wide except between E. Bay Street and the drawbridge, where the right-of-way is 120 feet wide. Between the drawbridge and E. Washington Street the right-of-way width is approximately 100 feet. Between E. Washington Street and E. Erie Street the right-of-way width varies, ranging from 175 feet at E. Washington Street and E. Erie Street to 475 feet between these points for a distance of 2,700 feet.

The distance between the tracks is approximately 14 feet on the four-track and double-track portions of the right-of-way, precluding development of fixed guideway primary transit facilities between the tracks. The potential, then, to develop such facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way.

Approximately 35 feet is available along the outside portion of the right-of-way on each side of the track between St. Francis tower and E. Oklahoma Avenue. Between E. Oklahoma Avenue and E. Pryor Street the mainline track is offset along the west side of the right-of-way, and thus the outside clearance is 25 feet along the west side and 50 feet along the east side. The outside clearance along the portion of the right-of-way between E. Pryor Street and E. Russell Street is 20 feet along the west side of the right-of-way and 60 feet along the east side. Between E. Russell and E. Linus Streets the outside clearance along the east side of the right-of-way is 35 feet and along the west side, 20 feet. Because of additional track within the right-of-way, the clearance along the east side of the right-of-way from E. Linus Street to E. Bay Street is 25 feet, and along the west side, 15 feet.

Between E. Bay Street and the drawbridge, there is virtually no outside clearance on either side since the track is generally located against the right-of-way boundaries. Additional railroad trackage within the right-of-way between the Kinnickinnic River drawbridge and E. Washington Street, used to connect with industrial sidings and storage and passing sidings, provides outside clearances of 10 feet and five feet along the east side and west side of the right-of-way, respectively. Finally, between E. Washington Street and the Milwaukee River crossing, virtually no outside clearances are provided because the track is generally located against the right-of-way.

The horizontal alignment of the railroad grade is marked by large radius curves connecting short tangent sections of track. There are four horizontal curves on the line, all of which have a curvature of less than $3^{\circ}31'$. The sharpest horizontal curve occurs in that segment between E. National Avenue and S. Water Street, where the alignment follows a circular curve with a curvature of $3^{\circ}31'$.

The vertical alignment is characterized by relatively flat gradients, generally less than 0.75 percent. The steepest grade, 0.88 percent, occurs between E. National Avenue and a point about 500 feet south of S. Water Street, a distance of 0.3 mile.

As indicated on Map 106, there are a total of 13 street, highway, and watercourse crossings on this section of railway line. Included in this total are three public at-grade street crossings, seven grade-separated public highway crossings, one at-grade pedestrian crossing, and two watercourse crossings.

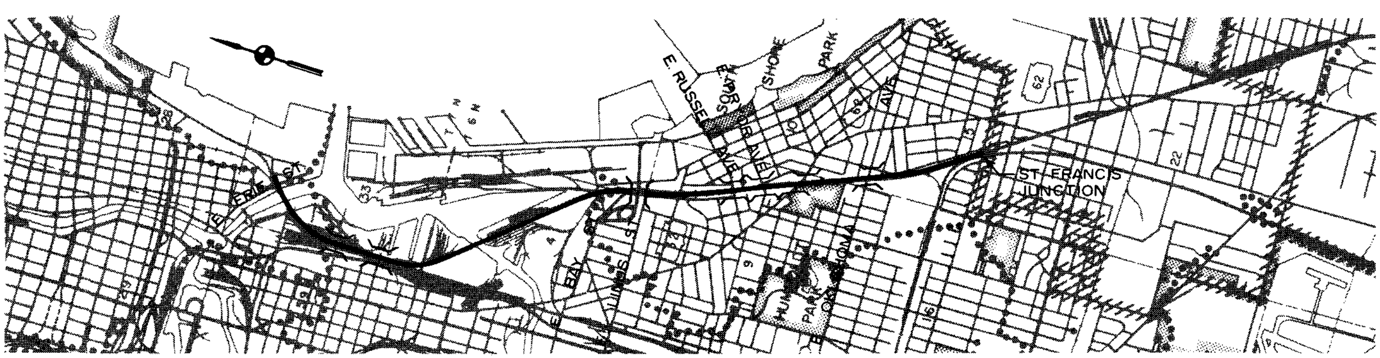
There are a total of eight industrial sidings, or lead tracks, along the west side of the right-of-way and four along the east side. Such trackage is concentrated between E. Lincoln Avenue and E. Erie Street. The remaining portion of the right-of-way, that south of E. Lincoln Street, has only two industrial lead tracks.

Land directly adjacent to this railway segment between St. Francis and E. Russell Avenue is principally devoted to residential and park development. The remaining portion of the right-of-way—that from E. Russell Avenue to E. Erie Street—is bordered by a mixture of industrial, commercial, and transportation development.

Feasibility Conclusion: In general, it may be concluded that the portion of the right-of-way south of E. Linus Street has good potential for use in the location of fixed guideway primary transit facili-

Map 106

ALIGNMENT OF THE CHICAGO & NORTH WESTERN TRANSPORTATION COMPANY'S NATIONAL AVENUE SPUR TRACK WITHIN THE MILWAUKEE AREA



LEGEND

RIGHT-OF-WAY

OVERPASS

UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The National Avenue spur track consists of a 3.5-mile segment extending from St. Francis tower to the Milwaukee station located immediately north of the E. Erie Street crossing in the City of Milwaukee. The right-of-way has three at-grade street crossings, seven grade-separated highway crossings, one at-grade pedestrian crossing, and two watercourse crossings. The portion of the right-of-way south of E. Linus Street has good potential for use in the location of an at-grade, fixed guideway primary transit facility. The right-of-way north of E. Linus Street has poor potential.

Source: SEWRPC.

ties. The right-of-way north of E. Linus Street has poor potential, however. The concentration of industrial sidings on the outsides of the right-of-way, the passing and storage tracks in the right-of-way, and the other railroad facilities in the right-of-way make the location of at-grade light rail transit, heavy rail rapid transit, or exclusive busway facilities on this portion of the right-of-way impractical.

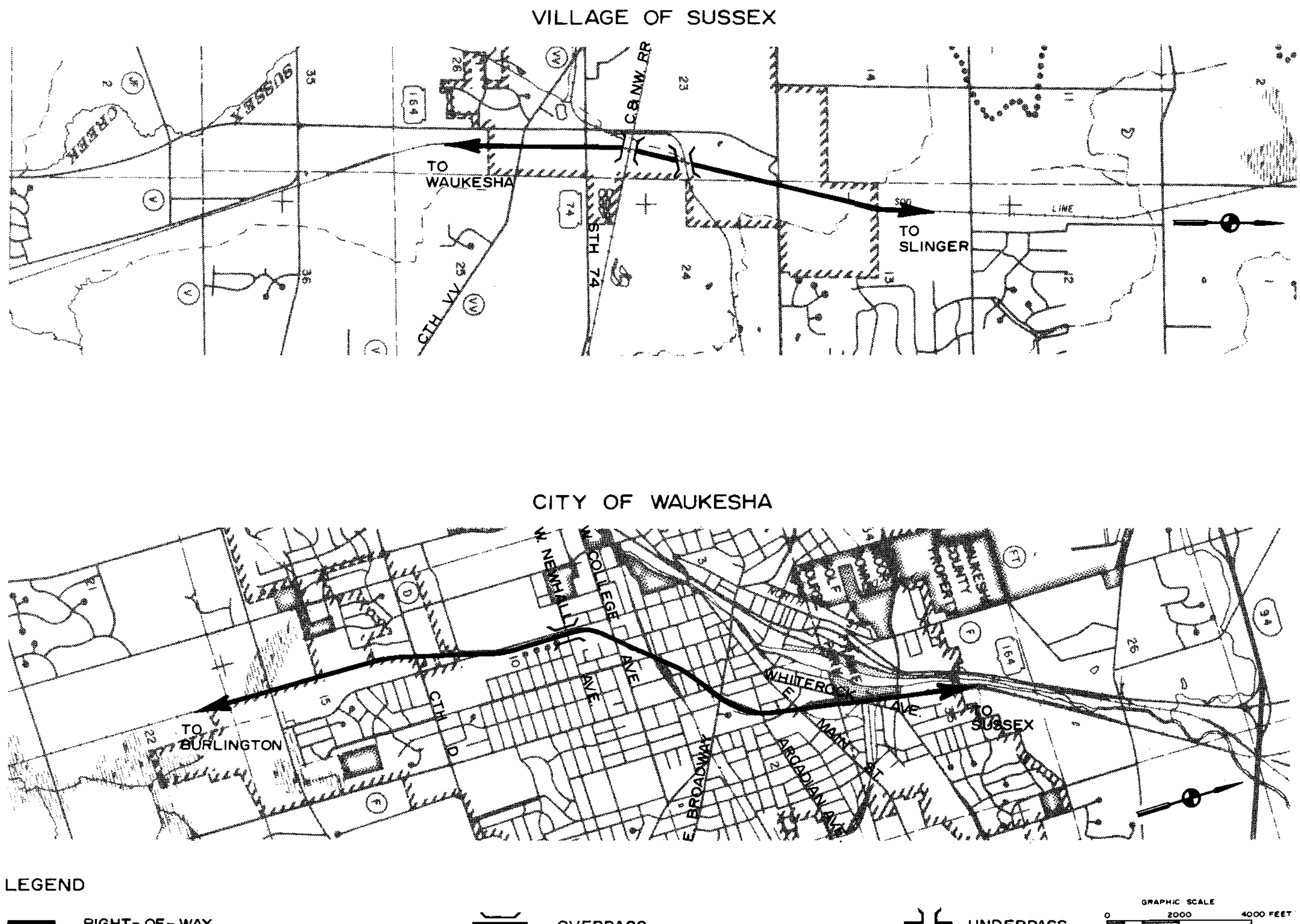
The Soo Line Railroad Company—First Subdivision

The First Subdivision of the Soo Line Railroad Company's Eastern Division consists of a 158.4-mile-long railway main line extending from the City of Chicago to the Village of North Fond du Lac. There are two segments of this subdivision pertinent to this right-of-way inventory and assessment. As shown on Map 107, the first segment is located within the city limits of Waukesha and is approximately 4.2 miles long; and the second is located within the village limits of Sussex and is approximately 1.1 miles long.

The First Subdivision is a single-track railway line along the 4.2-mile length within the city limits of Waukesha and along the 1.1 mile length within the village limits of Sussex. The track is centered

Map 107

ALIGNMENT OF THE SOO LINE RAILROAD'S WISCONSIN DIVISION FIRST SUBDIVISION RIGHT-OF-WAY WITHIN THE MILWAUKEE AREA



The portion of the First Subdivision of the Soo Line Railroad Company's Eastern Division within the Milwaukee area consists of a 4.2-mile segment within the city limits of Waukesha and a 1.1-mile segment within the village limits of Sussex. The right-of-way has 19 at-grade highway crossings, one grade-separated highway crossing, one at-grade railway crossing, one grade-separated railway crossing, and one grade-separated pedestrian crossing. The portion of the First Subdivision railway line in the City of Waukesha has fair potential for the location of primary transit fixed guideway facilities. The portion of the right-of-way located in the Village of Sussex has good potential for the location of at-grade, primary transit fixed guideway facilities.

Source: SEWRPC.

in the right-of-way of both portions of this railway line except in the City of Waukesha between CTH A and CTH D, where it is offset along the west side, and between N. Grand Avenue and E. Moreland Boulevard, where it is offset along the east side. The right-of-way along both portions of this railway segment is generally located at-grade.

The right-of-way between CTH A and W. College Avenue is generally 100 feet wide. The section of the right-of-way between W. College Avenue and the Waukesha city limits north of Moreland Boulevard is 66 feet wide except between E. Broadway Street and E. Arcadian Avenue, where it increases to about 275 feet to accommodate additional railroad and industrial trackage and station facilities for 0.2 mile. In addition, the right-of-way between E. Main Street and Whiterock Avenue increases to 750 feet to accommodate additional railroad facilities. The right-of-way of the section of this railway segment located within the village limits of Sussex is 66 feet wide except at Sussex Station, located south of STH 74, where, for a distance of 600 feet, the right-of-way is 130 feet wide.

The potential to develop at-grade primary transit guideway facilities is dependent on the outside clearances along the right-of-way, measured from the outside edge of the track to the outside edge of the railway right-of-way. Along the outside portion of the right-of-way on each side of the track in the City of Waukesha between CTH A and W. College Avenue, the outside clearance is generally 47 feet. The outside clearance from W. College Avenue to the Waukesha city limits is 30 feet on each side of the right-of-way except between E. Broadway and E. Arcadian Avenues and between E. Main Street and Whiterock Avenue, where, for distances of 0.2 mile and 0.3 mile, respectively, no outside clearances are provided because additional railroad and industrial trackage and railway station and yard facilities are located adjacent to the main line. The outside clearance along each side of the portion of the right-of-way located in the Village of Sussex is about 30 feet except between CTH VV and STH 74, where, for a distance of 500 feet, passing sidings are provided on both sides of the track, reducing the outside clearance on each side of the right-of-way to about 25 feet.

The horizontal alignment of the railroad grade is generally limited to large radius curves. There are five horizontal curves on these two segments of the First Subdivision railway line, all of which have a curvature of less than 4°00'. The sharpest horizontal curve occurs in that segment between W. Newhall Avenue and W. College Avenue in the City of Waukesha, where the alignment follows a circular curve with a curvature of 4°00'.

The vertical alignment is characterized by relatively flat gradients along both railway segments, and would not be expected to place any constraints on the location of a primary transit fixed guideway facility.

As indicated on Map 107, there are a total of 23 street and railway crossings on this railway segment, most of which are located in the City of Waukesha. Included in this total are 19 public at-grade highway crossings, one grade-separated public street crossing, one at-grade railway crossing, one grade-separated railway overpass crossing, and one grade-separated pedestrian crossing. There are no watercourse crossings along this railway segment.

There are a total of four industrial sidings, or lead tracks, along the east side of the right-of-way and two along the west side. Such trackage is concentrated on the portion of the right-of-way in the City of Waukesha between E. Broadway and Whiterock Avenues. The portion of the right-of-way located in the Village of Sussex has no industrial sidings.

Land directly adjacent to both sides of the right-of-way in the City of Waukesha is characterized by residential development except between E. Broadway and Whiterock Avenues, where, for a distance of 0.6 mile, the land is characterized by industrial and commercial development. The portion of this segment located in the Village of Sussex is bounded by agricultural land and land in other rural open uses except between CTH VV and STH 74, where, for a distance of 0.4 mile, both sides of the right-of-way are characterized by commercial and industrial development.

Feasibility Conclusion: In general, it may be concluded that the portion of the First Subdivision railway line located in the City of Waukesha has fair potential for the location of primary transit fixed guideway facilities. The physical characteristics of this portion of the railway right-of-way, including horizontal and vertical alignment, right-of-way width, the small number of sidings and lead tracks, and the outside clearances, would all allow for primary transit development. However, because of the concentration of sidings, the trackage for yards and stations within the right-of-way, and the industrial development immediately adjacent to the right-of-way, the portion of this railway section between E. Broadway and Whiterock Avenues is not suitable for at-grade fixed guideway development.

The portion of the right-of-way located in the Village of Sussex generally has good potential for the development of at-grade primary transit fixed guideway facilities. The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, would allow for ready, at-grade, primary transit development. Fixed guideway location along this segment of railway right-of-way would not require changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way to provide adequate outside clearances.

Important to the consideration of the use of both portions of this segment for primary transit fixed guideway location is the number of street and highway crossings, all except one of which is located at-grade. This problem places a more serious constraint on the use of the right-of-way for heavy rail rapid transit, but is also a consideration in the use of the right-of-way for light rail transit and exclusive busway development. While heavy rail rapid transit requires grade separation of all crossings, light rail transit and exclusive busway generally do not. However, because grade separations are desirable at street and highway crossings with potential traffic conflicts, this becomes an important consideration for light rail transit and exclusive busway system development as well. Thus, it would appear that grade separations constitute the most serious limitation to the development of this right-of-way for primary transit facilities, as well as the greatest capital cost consideration.

Former Chicago & North Western Railway Company Lakefront Main Line

The lakefront main line of the Chicago & North Western Railway (C&NW) consisted of a 9.4-mile-long route extending from Washington Street Station in downtown Milwaukee to Wiscona Junction. Washington Street Station was a former junction between the C&NW main lines to Madison and to Chicago via Racine and Kenosha, and it provided a crossing with the Milwaukee Road main line to Chicago. Wiscona Junction is the location of a former junction with the C&NW main lines to Green Bay via Port Washington, Green Bay via West Bend, and the Twin Cities of Minneapolis and St. Paul, Minnesota. The 2.7-mile segment pertinent to this inventory and assessment includes that portion between E. Bradford Avenue and E. Erie Street, located wholly within the City of Milwaukee. Following the completion of the C&NW's double-track belt line around the City of Milwaukee in 1911, this right-of-way was used primarily for intercity passenger train and local freight and switching movements until its abandonment in 1965. Map 108 shows that segment of the C&NW lakefront mainline right-of-way under consideration.

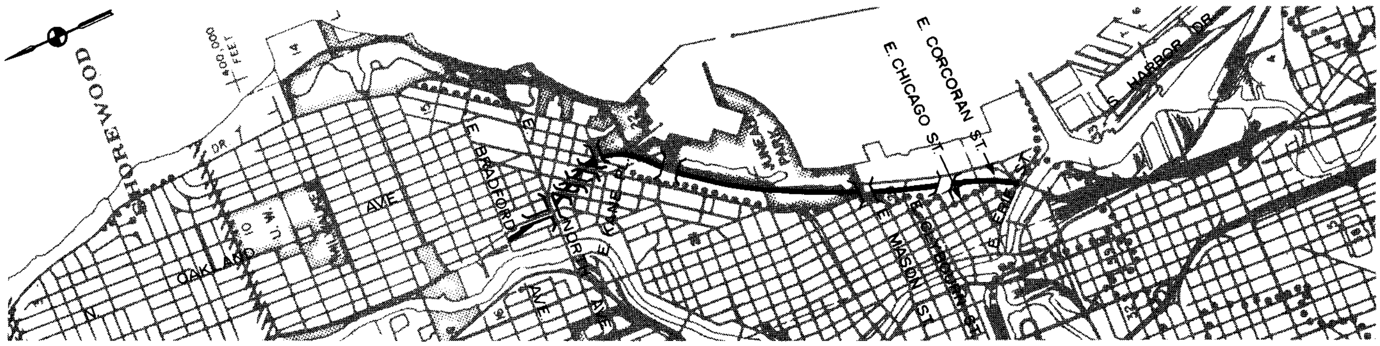
The railway main line was double track over the entire segment. North of E. Kane Place, a third track connected with industrial sidings. South of E. Mason Street, additional yard and terminal trackage served an intercity passenger depot, a passenger coach yard, industrial trackage, and locomotive servicing facilities. Between E. Erie and E. Mason Streets, the right-of-way is at-grade, while the remaining portion of this segment is fully grade-separated.

The width of the right-of-way varies throughout the length of the segment, but is generally 100 feet north of E. Kane Place and 66 feet between E. Kane Place and E. Mason Street. South of E. Mason Street, the right-of-way widens significantly because of the former coach yard and terminal facilities which were located in this area; the right-of-way widens from about 200 feet wide at E. Wisconsin Avenue to about 300 feet wide at E. Clybourn Street and to about 500 feet wide at E. Menomonee Street. The eastern right-of-way limits generally follow the west edge of the former S. Harbor Drive alignment, while the western limits follow an irregular pattern resulting from the adjacent street pattern.

Between E. Erie Street and E. Kane Place, the right-of-way alignment is generally situated between the eastern limits of the Milwaukee central business district and Milwaukee "East Side" high-rise residential development to the west and park and other public lands as well as Lake Michigan to the east. In the area north of E. Mason Street, the alignment is located along the base of the Juneau Park bluff. At E. Kane Place, the right-of-way begins to curve in a northwesterly direction and is aligned on a very gentle reverse curve. The north end of this right-of-way segment at E. Bradford Avenue connects with the C&NW Chase spur track, while the south end at E. Erie Street connects with the C&NW National Avenue spur track.

Map 108

ALIGNMENT OF THE FORMER CHICAGO & NORTH WESTERN RAILWAY COMPANY LAKEFRONT MAIN LINE



LEGEND

RIGHT-OF-WAY   OVERPASS   UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The former C&NW Lakefront main line consists of a 2.7-mile segment of abandoned right-of-way extending from E. Bradford Avenue to E. Erie Street, wholly within the City of Milwaukee. The right-of-way has one freeway crossing, 10 highway crossings, six of which are grade-separated, and one pedestrian walk. North of E. Mason Street, the right-of-way and former railway grade are completely intact, are owned by Milwaukee County, and are presently utilized as a public bicycle trail. South of E. Mason Street, the former track grade is no longer in existence and the right-of-way can no longer be considered intact, although owned by the City and County of Milwaukee. There is good potential for use of the right-of-way north of E. Mason Street for the development of a primary transit system fixed guideway facility. The right-of-way south of E. Mason Street, however, has poor potential for ready development as a primary transit guideway alignment since the land is in the process of being converted to other uses.

Source: SEWRPC.

The right-of-way and former railway grade are completely intact north of E. Mason Street. All public street and pedestrian bridges remain and the original bridge structures at N. Oakland and E. North Avenues have been replaced with new structures. North of E. Kane Place, the former track grade is depressed below street level and bordered on both sides by retaining walls. Throughout this segment, the usable right-of-way width is approximately 60 feet. This section of the right-of-way is owned by Milwaukee County and is presently utilized for a public bicycle trail.

At E. Mason Street, the eastern edge of the right-of-way is bounded by the southbound lanes of N. Lincoln Memorial Drive for about 0.3 mile. The right-of-way width available for a primary transit fixed guideway in this area is therefore reduced to approximately 30 feet.

South of E. Mason Street, the former track grades are no longer in existence and the right-of-way can no longer be considered intact. The right-of-way in this area is owned by the City and County of Milwaukee and, as of January 1980, was either vacant or used for automobile parking lots. From E. Chicago Street to E. Corcoran Avenue, a facility for unloading new automobiles from railroad cars has been constructed across part of the right-of-way. However, most of the right-of-way south of E. Mason Street is now in the process of being redeveloped for park and warehousing, which permits railroad access from the south. Also, E. Michigan Street, E. Clybourn Street, and the Lake Freeway Interchange have been extended across the right-of-way.

Feasibility Conclusion: In general, it may be concluded that there is very good potential for use of the former C&NW lakefront main line north of E. Mason Street as a primary transit system guideway. The largest capital cost consideration appears to be the vertical clearance constraints which may be imposed, depending upon which primary transit mode would be selected, by the construction of new overhead bridge structures at S. Oakland and E. North Avenues. The existing vertical clearances underneath these two bridges are approximately 14 and 15 feet, respectively. The right-of-way south of E. Mason Street possesses poor potential for use as a primary transit guideway alignment since the land is being converted to other uses, and streets cross the right-of-way at-grade. As of January 1980, this right-of-way crossed one freeway, 10 public streets and highways, and one public pedestrian walk.

Former Milwaukee Road North Lake Branch Line

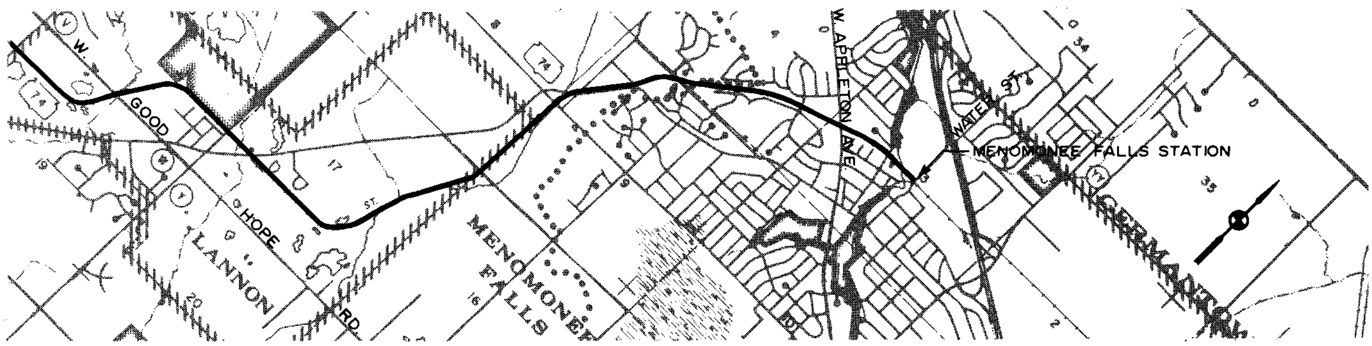
The North Lake branch line of the Milwaukee Road consisted of a 19.6-mile long railway extending from Granville Station, located at the intersection of N. 107th Street (STH 100) and N. Granville Road in Milwaukee County, to the unincorporated community of North Lake in Waukesha County. The 8.7-mile-segment pertinent to this inventory and assessment includes that portion between Water Street in the Village of Menomonee Falls and the western limits of the Village of Sussex on the western fringe of the Milwaukee urbanized area. That portion of the North Lake branch line west of the Village of Sussex has been abandoned, while the portion east of the Village of Menomonee Falls is still in revenue service. As shown on Map 109, the route segment under consideration passes through the communities of Menononee Falls, Lannon, and Sussex.

The North Lake branch line was operated entirely as a single-track railway, and was at-grade except at the Soo Line Railroad Company and Chicago & North Western Transportation Company (C&NW)

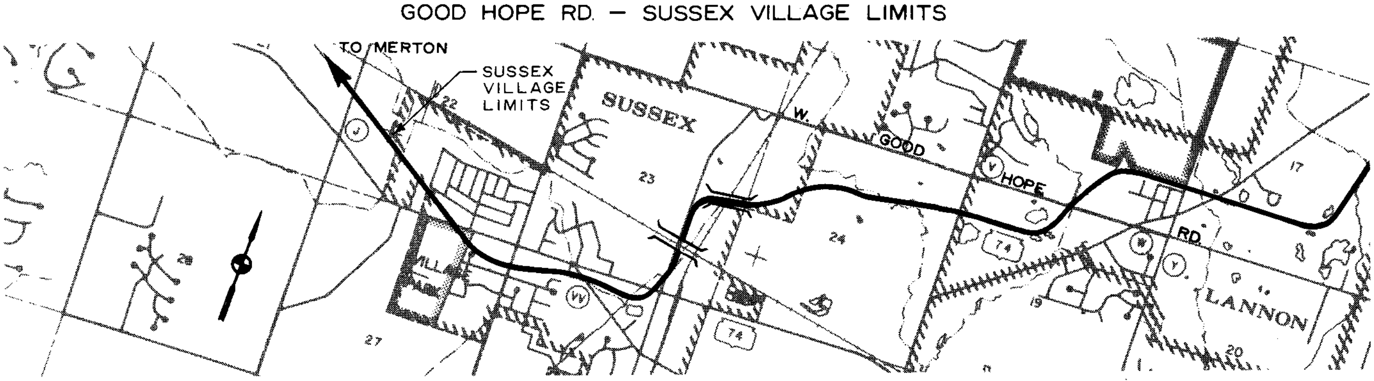
Map 109

ALIGNMENT OF THE FORMER MILWAUKEE ROAD NORTH LAKE BRANCH LINE WITHIN THE MILWAUKEE AREA

MENOMONEE FALLS STATION — GOOD HOPE RD.



GOOD HOPE RD. — SUSSEX VILLAGE LIMITS



LEGEND

RIGHT OF WAY

OVERPASS

UNDERPASS

GRAPHIC SCALE 0 2000 4000 FEET

The portion of the abandoned North Lake branch line of the Milwaukee Road within the Milwaukee area consists of an 8.7-mile segment extending from E. Water Street in the Village of Menomonee Falls to the western limits of the Village of Sussex. Passing through the communities of Menomonee Falls, Lannon, and Sussex, the right-of-way is generally intact. However, because the alignment of the right-of-way is poor, and since a portion of the right-of-way has been acquired by Waukesha County for use as a recreational trail and another portion along with existing trackage in Menomonee Falls has been purchased by private industry, there is poor potential for use of this railway segment in the development of an at-grade, primary transit fixed guideway facility.

Source: SEWRPC.

crossings in the Village of Sussex. The right-of-way is generally 60 feet wide, and follows a meandering alignment through the aforementioned communities.

The right-of-way segment under consideration is generally intact. Following the Milwaukee Road's abandonment of this line, the right-of-way was sold to two different owners. The right-of-way between Water Street and W. Appleton Avenue within the Village of Menomonee Falls—a distance of approximately 0.4 mile—was purchased by Bend Industries, Inc. The track and structures are intact on this portion, and the track is used as an industrial siding. The right-of-way between W. Appleton Avenue and the eastern limits of the Village of Sussex was purchased by Waukesha County. This portion of the right-of-way is being utilized as an alignment for a new sanitary trunk sewer, and thus the original railway grade has been disturbed. Upon completion of the sewer work, this and the remaining portion of the right-of-way owned by Waukesha County is to be used as a recreational trail. The grade separation under the C&NW, the bridge over the Soo Line, and structures over watercourses are all intact.

Feasibility Conclusion: In general, it may be concluded that there is poor or no potential for use of the former Milwaukee Road North Lake branch line in the development of a primary transit system fixed guideway. Purchase of the right-of-way for use as a recreational trail by Waukesha County plus the right-of-way's continually meandering alignment are both impediments to the use of this right-of-way. In addition, the purchase of a portion of the right-of-way along with existing trackage in the Village of Menomonee Falls suggests its long-term continued use for carload freight shipments by railway. This action creates a break in the continuity of the right-of-way.

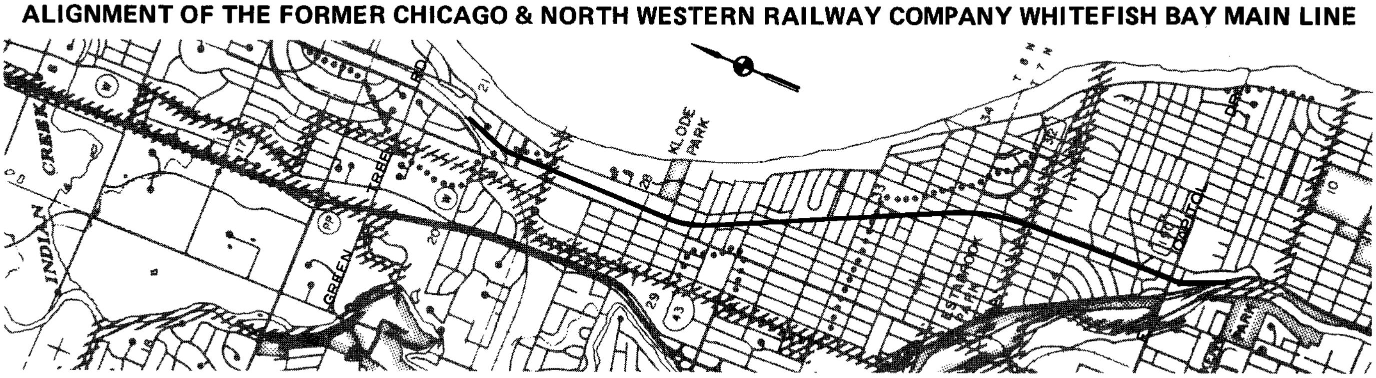
Former Chicago & North Western Railway Whitefish Bay Main Line

The Whitefish Bay main line of the Chicago & North Western Railway Company (C&NW) consisted of a railway segment extending from a connection with the present Capitol Drive spur track near E. Capitol Drive—formerly known as Shoreline Junction—to a connection with the present Shoreline Subdivision of the Wisconsin Division, approximately 0.2 mile south of E. Green Tree Road. The entire 4.3-mile-long segment was considered in this right-of-way inventory and assessment. As shown on Map 110, the route segment under consideration passes through the communities of Shorewood, Whitefish Bay, and Fox Point.

The Whitefish Bay main line was operated entirely as a single-track railway, primarily at-grade. The right-of-way, generally 66 feet in width, followed a general northwest/southeast alignment through

Map 110

ALIGNMENT OF THE FORMER CHICAGO & NORTH WESTERN RAILWAY COMPANY WHITEFISH BAY MAIN LINE



LEGEND

RIGHT- OF- WAY

GRAPHIC SCALE
0 2000 4000 FEET

The former C&NW Whitefish Bay main line consists of a 4.3-mile abandoned right-of-way extending from a connection with the Capitol Drive spur track to a connection with the present Shoreline Subdivision south of E. Green Tree Road. Passing through the communities of Shorewood, Whitefish Bay, and Fox Point, the right-of-way has been obliterated and converted to other uses, including public street rights-of-way and commercial and residential development. Because the right-of-way no longer exists, there is no potential for its use in the development of a primary transit fixed guideway facility.

Source: SEWRPC.

the Village of Whitefish Bay. The existing N. Marlborough Drive is located on a portion of the former right-of-way. This route segment was utilized by all passenger and freight trains between Milwaukee and Green Bay via Port Washington, this route now being referred to as the Shoreline Subdivision.

Following construction of the Fox Point cut-off between Wiscona Junction and the Village of Fox Point in 1928, all trains to and from what is presently known as the Shoreline Subdivision were routed via Wiscona Junction. The Whitefish Bay main line then became a redundant segment of trackage and was abandoned in 1929. Since that time, the former railway grade has been completely leveled and the right-of-way converted to other uses, including public street rights-of-way and commercial and residential development. Because the right-of-way no longer exists, it can be concluded that there is no potential for its use in the development of fixed guideway facilities.

POTENTIAL COMMUTER RAIL ROUTES

Rights-of-way in the Milwaukee area with the potential to be readily developed into commuter rail primary transit routes are, as a practical matter, limited to existing rail lines which are constructed to mainline railway standards; which connect major trip generators and residential areas; and which, preferably, are double-tracked. The use of mainline railway routes, and not branchline routes, is required in order that the commuter rail operations can achieve high speeds with acceptable acceleration and deceleration rates, and thereby maintain a desirable average schedule speed.

Mainline trackage typically is characterized by large radius curves, gentle gradients, wide use of grade separations at highway and railway crossings, automatic protection at other highway and railway crossings, and use of traffic control systems. It is in the best physical condition of any trackage belonging to any particular railroad. These characteristics are normally all present on railway main lines because such lines carry the fastest trains as well as the greatest tonnage. Branch lines do not normally possess these characteristics, and therefore have limited potential for commuter rail operation without significant initial capital investment. Accordingly, an important consideration in the identification of potential commuter rail routes in the Milwaukee area is the classification of the existing railway lines.

The Federal Railroad Administration has developed a classification system for Class I common carrier railways[8] within the United States for the purpose of assisting in the identification of essential rail links and the determination of railway capital needs. The classification system is primarily based on railway traffic densities, as shown in Table 129.

Table 129
FEDERAL RAILROAD ADMINISTRATION CLASSIFICATION SYSTEM FOR CLASS I COMMON CARRIER RAILWAY LINES

Category	Description
A Main Line	20 million or more gross ton-miles per mile per year Major transportation connectivity Essential national defense main line
B Main Line	5 million to 20 million gross ton-miles per mile per year
A Branch Line	1 million to 5 million gross ton-miles per mile per year
B Branch Line	Less than 1 million gross ton-miles per mile per year
Nondesignated Lines	Class II railways Class III railways Private carriers Railway lines in urban areas

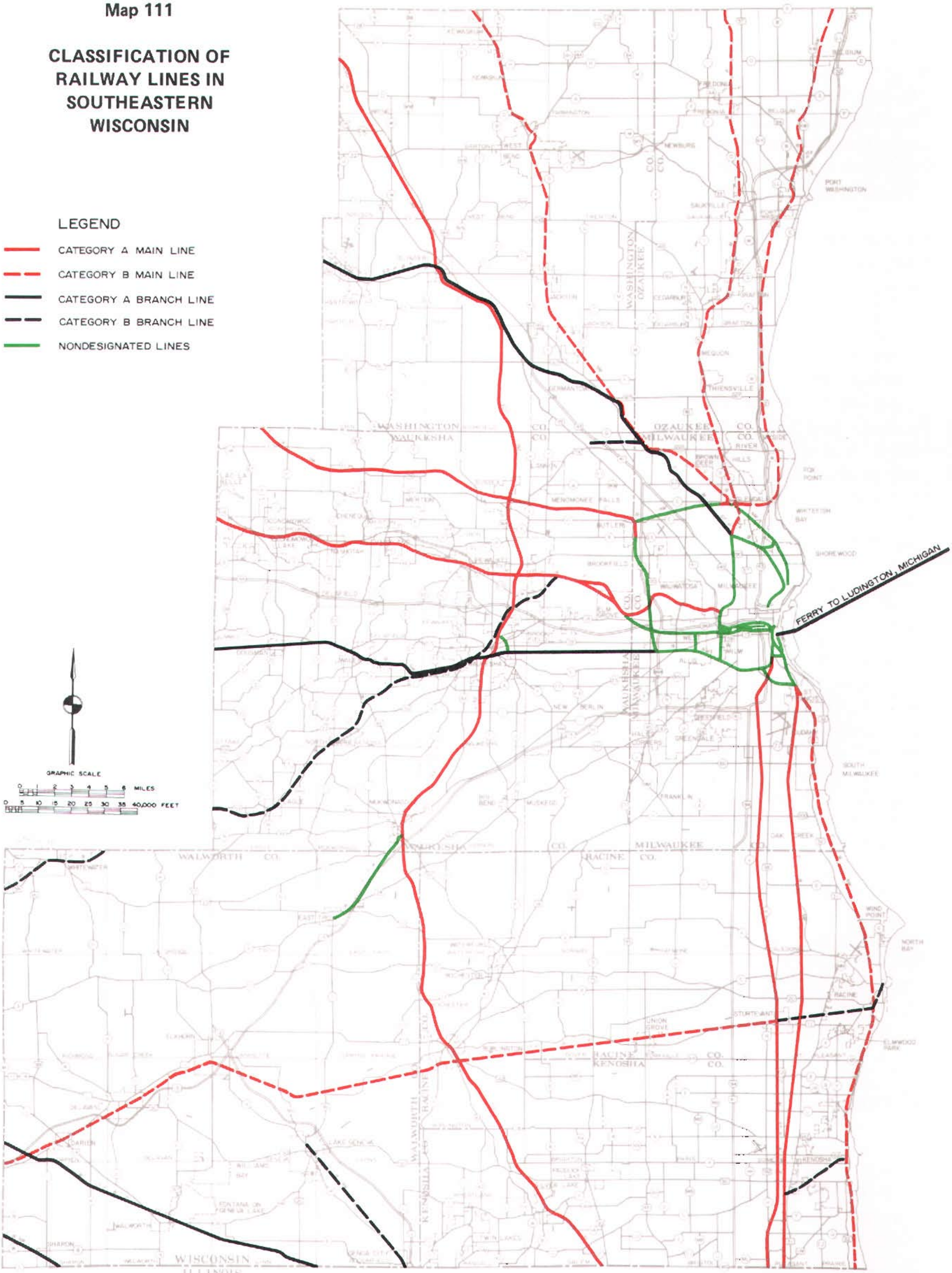
Source: U. S. Department of Transportation, Final Standards Classification and Designation of Lines of Class I Railroads in the United States, Washington, D. C., January 1977.

Based upon this classification system, the railway lines within the seven-county Southeastern Wisconsin Region can be divided into Category A and B main lines, Category A and B branch lines, and nondesignated lines, as shown on Map 111. Railway line segments other than Category A and B main lines, such as Category A and B branch lines, industrial and switching tracks in urban areas, and Class II and III railways, were not considered to be practical for potential commuter rail service.

8 *Class I common carrier railways are defined by the federal Interstate Commerce Commission as railway companies earning in excess of $50 million in gross revenue per year. Class II common carrier railways are defined as railway companies earning between $10 million and $50 million in gross revenue per year. Class III common carrier railways are defined as railway companies earning annual gross revenues of less than $10 million.*

Map 111

CLASSIFICATION OF RAILWAY LINES IN SOUTHEASTERN WISCONSIN



Based upon a classification system developed for Class I common carrier railways by the Federal Railroad Administration, the railway lines within the seven-county Southeastern Wisconsin Region can be divided into Category A and B main lines, Category A and B branch lines, and nondesignated lines. Those railway line segments that are other than Category A and B main lines—Category A and B branch lines, industrial and switching tracks in urban areas, and Class II and III railways—are not considered to be practical for use in commuter rail service.

Source: SEWRPC.

A second consideration important to the identification of potential commuter rail routes in the Milwaukee area is the location of the Category A and B main lines with respect to the Milwaukee central business district, to other major traffic generators, and to concentrations of existing or planned residential development. The concentrations of residential development can be located up to a distance of three miles from the commuter rail line, as commuter rail primary transit systems are generally dependent upon park-ride or feeder bus access. While all commuter rail services in operation in the United States today are oriented toward a large central business district (CBD), this should not preclude consideration of the provision of such service to other major activity centers, particularly if such centers are located along a proposed route to the CBD. Map 112 shows those mainline railway routes which connect the Milwaukee CBD, certain other major activity centers such as the central business districts of Racine and Kenosha, and concentrations of residential development. The railway main lines eliminated from further consideration for commuter rail service are those located through largely rural areas of the Region and which do not pass through or near the Milwaukee CBD or other major activity centers.

The third and last factor to be considered in identifying a basic network of potential commuter rail routes for the Milwaukee area is the existence of double trackage. In order for commuter rail to operate at an acceptable average speed and to maintain reliable schedules, there must be a minimum of interference from other train movements operating on the same railway line. The most serious scheduling conflicts are caused by the "meets" that must take place between trains operating in opposite directions on a single-track railway line. Also, where more than one class of train operates in the same direction within the same time slot, double track will permit faster trains to overtake slower ones, depending upon the particular situation.[9] Double-track railway lines in southeastern Wisconsin are shown on Map 113.

From this basic assessment of all railway lines in southeastern Wisconsin, a basic network of potential available commuter rail routes can be identified. This network includes all mainline railway routes that connect the central business district of Milwaukee with other major trip generators and with outlying residential areas, the routes having a double-track main line being preferred over parallel lines which are single track. As shown on Map 114, these routes radiate from downtown Milwaukee to Port Washington, Saukville, West Bend, Oconomowoc, and Kenosha.[10] In addition, a route between downtown Milwaukee and the City of Waukesha is included. This route does not fully meet the three criteria set forth above; however, certain segments meet the three criteria sufficiently to warrant further examination.[11] This set of alternative routes represents a logical starting point in the inventory and assessment of fixed plant physical condition and operational considerations pertinent to potential commuter rail service to the Milwaukee urbanized area. The following sections provide detailed information on the individual routes that have been identified.

All costs attendant to commuter rail operation have been estimated in terms of the costs which would be incurred if the particular railroad companies concerned carried out the necessary track rehabilitation or construction, grade-crossing-protection improvement, and storage facility construction. If private contractors were to do this work instead, the costs would have to be increased to reflect the contractors profit, overhead, and contingency allocations. All costs are presented in 1980 dollars, so that they can be directly compared with pending loans for rehabilitation works for which the railroads have applied. To make these costs comparable to all other costs developed under this study, which are expressed in 1979

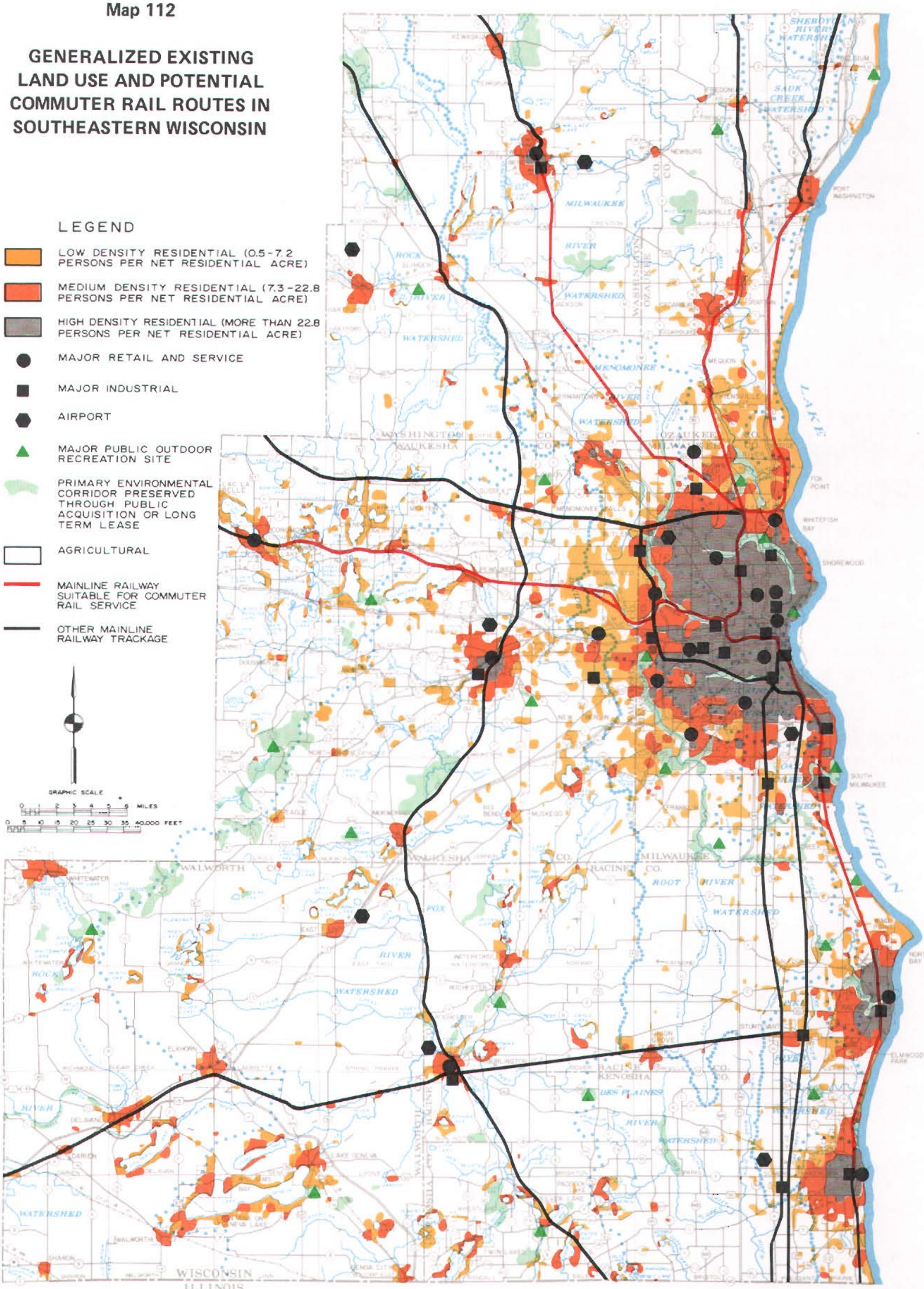
[9] *For scheduling and timetable authority purposes, railways generally denote passenger trains as first class, time freights as second class, and local or way freights as third class. The train of highest classification has superiority when schedules of different trains coincide. Trains of different classification typically have varying operating characteristics such as average speed, level of acceleration, and frequency of stops.*

[10] *Commuter rail systems typically operate at high speeds, have large station spacings, and serve the longest trips within a region. Potential commuter rail routes for the Milwaukee urbanized area can therefore be expected to extend beyond the boundaries of the urbanized area to those of the Region, which encompasses the entire commutershed of the greater Milwaukee area.*

[11] *Specifically, the Waukesha route would operate over double-track main lines for a distance of approximately 8.1 miles of a total 19.6 miles, the remainder being a single-track branch line. The route connects the cities of Waukesha, New Berlin, and West Allis with the Milwaukee CBD.*

Map 112

GENERALIZED EXISTING LAND USE AND POTENTIAL COMMUTER RAIL ROUTES IN SOUTHEASTERN WISCONSIN

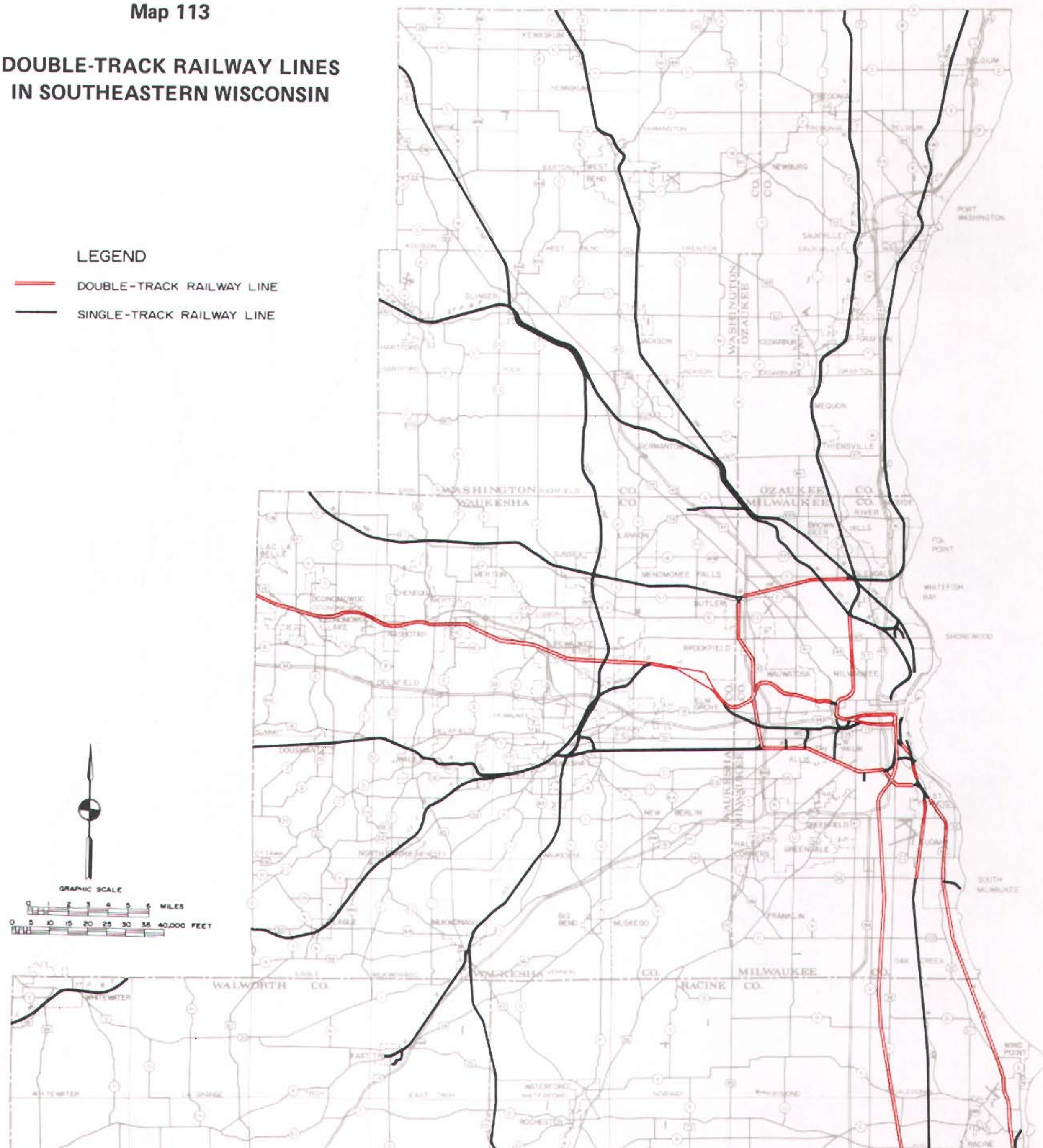


An important consideration in the identification of potential commuter rail routes in the Milwaukee area is the location of Category A and B main lines with respect to the Milwaukee central business district (CBD) and other major traffic generators, and with respect to concentrations of existing or planned residential development. The railway main lines eliminated from further consideration for commuter rail service are those located through largely rural areas of the Region and those which do not pass through or near the Milwaukee CBD or other major activity centers.

Source: SEWRPC.

Map 113

DOUBLE-TRACK RAILWAY LINES IN SOUTHEASTERN WISCONSIN

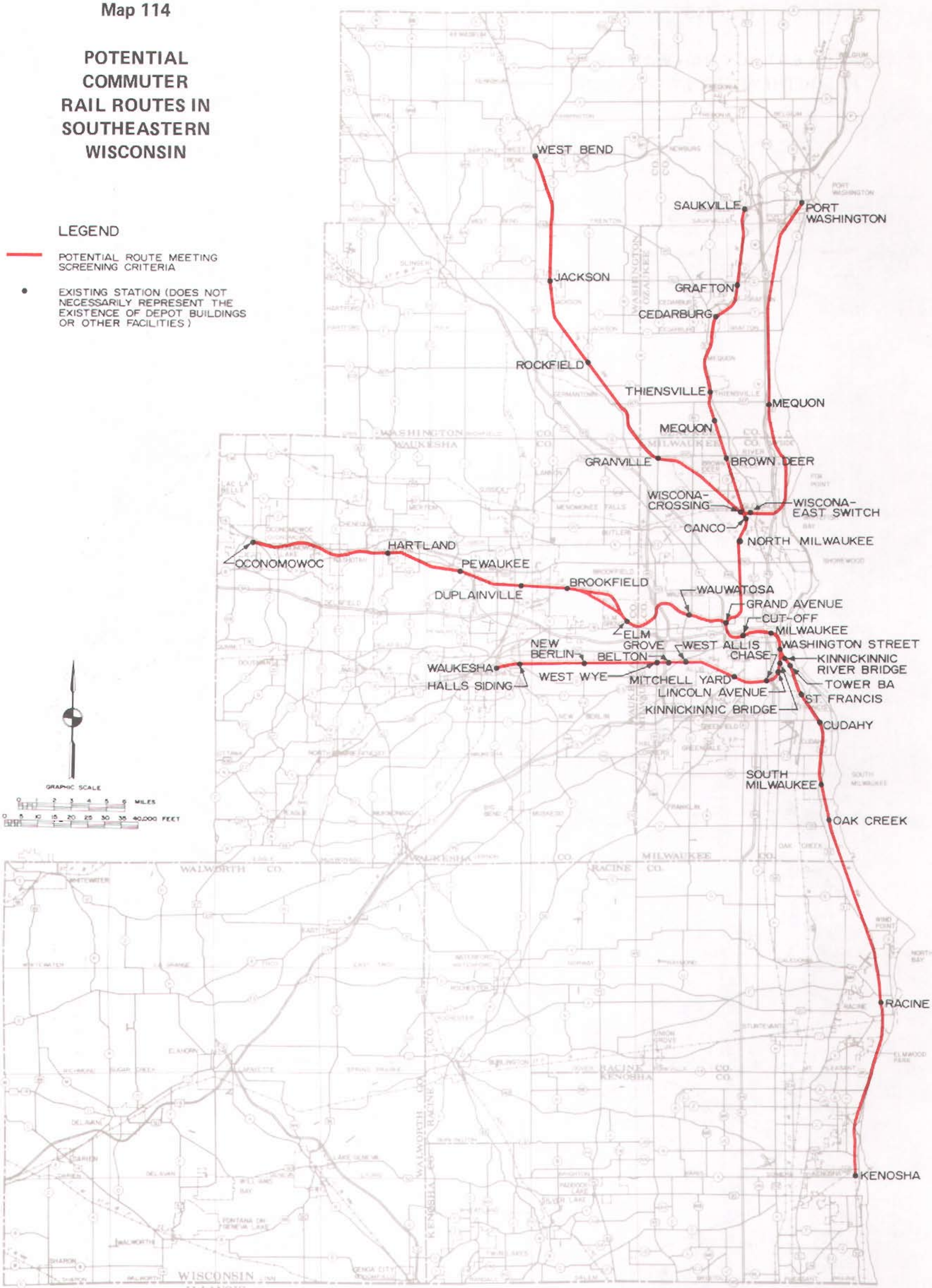


An important consideration in the identification of a basic network of potential commuter rail routes for the Milwaukee area is the existence of double trackage. Double-track railway lines permit commuter rail service to operate at an acceptable average speed, to maintain reliable schedules, and to operate with minimum interference from other train movements operating over the same railway line.

Source: SEWRPC.

Map 114

POTENTIAL COMMUTER RAIL ROUTES IN SOUTHEASTERN WISCONSIN



A basic network of potential commuter rail routes includes all mainline railway routes that connect the central business district of Milwaukee with other major trip generators and with outlying concentrations of residential development. These routes radiate from downtown Milwaukee to Port Washington, Saukville, West Bend, Oconomowoc, Kenosha, and Waukesha.

Source: SEWRPC.

dollars, 1979 being the base year of the study, the 1980 costs presented must be multiplied by a factor of 0.93.

Milwaukee to Port Washington

A potential commuter rail route serving the Milwaukee urbanized area extends from the passenger station located at the intersection of S. 5th Street and W. St. Paul Avenue in downtown Milwaukee to the station at Port Washington located at the W. Grand Avenue crossing in the City of Port Washington. The 29.5-mile-long route would utilize trackage of the Chicago, Milwaukee St. Paul & Pacific Railroad Company (the Milwaukee Road) between Milwaukee Station and Canco Station, a distance of 9.1 miles. Trackage of the Chicago & North Western Transportation Company (C&NW) would be utilized between Wiscona Junction[12] and Port Washington, a distance of 20.4 miles. Within the Milwaukee urbanized area, the route passes through the communities of Milwaukee, Glendale, Whitefish Bay, Fox Point, Bayside, and Mequon. North of the Milwaukee urbanized area, the route passes through the communities of Lakefield and Ulao, both within the Town of Grafton, and Port Washington.

This route is operated as a double-track railway line between the passenger station at Milwaukee and the junction at North Milwaukee, a distance of 7.7 miles. Between North Milwaukee and Port Washington, a distance of 21.8 miles, the railway line is single track. The route consists of portions of the Milwaukee Road's main line between Milwaukee and Green Bay, and one of the C&NW's two main lines between the Cities of Milwaukee and Green Bay. There are eight stations on this route, as listed by milepost in Table 130. The right-of-way is generally 66 feet wide between the passenger station at Milwaukee and the junction at Grand Avenue, and 100 feet wide between Grand Avenue and North Milwaukee. Between North Milwaukee and the station at Port Washington, the width of the right-of-way is typically 66 feet, with short segments of 99-foot-wide right-of-way on the C&NW portion of the route.

The horizontal alignment of the railway grade does not impose any significant limitations on passenger train operation. There are 19 horizontal curves along the entire route. Between Milwaukee and Grand Avenue, there are three curves of 3°00' or greater, in addition to two reverse curves at the west end of the passenger station, one with curvatures of 6°00' and one with curvatures of 2°00'. Between Grand Avenue and Canco Station there are three curves of 3°00' or greater, while all of the curves between Canco Station and Port Washington are generally between 1°00' and 2°00'. On the proposed C&NW station connection track between the Milwaukee Road at Canco Station and the C&NW Port Washington line at the east switch of Wiscona Junction, a curve of 7°40' would be required.

The vertical alignment also imposes no limitations insofar as passenger train operation over the route is concerned. Between the Milwaukee passenger station and Grand Avenue, the grade through the depot and to Cut-Off Junction is generally level or slightly ascending in a westerly direction at an average gradient of 0.26 percent. From Grand Avenue to the W. Center Street overpass, a distance of 2.6 miles, the westbound ascending grade averages about 0.42 percent, with the steepest segment being a 1.67 percent grade for approximately 0.1 mile. From the W. Center Street overpass to the east switch at Wiscona Junction, the only significant grade is a westbound ascending grade of about 1.0 percent on the connection track from the Milwaukee Road track to the C&NW track. West of Wiscona Junction no grade is more than 1.5 miles long. The most severe westbound

Table 130

EXISTING RAILWAY STATIONS ON THE MILWAUKEE TO PORT WASHINGTON COMMUTER RAIL ROUTE

Milepost	Station Name[a]	Distance (miles)
	The Milwaukee Road	
85.7	Milwaukee (passenger station) . .	- -
87.1	Cut-Off	1.4
88.2	Grand Avenue	2.5
93.4	North Milwaukee.	7.7
94.8	Canco	9.1
	The Chicago & North Western	
4.8	Wiscona (east switch)	9.7
13.6	Mequon	17.9
25.2	Port Washington	29.5

[a]Stations are specific locations designated by the operating timetable and do not necessarily denote the existence of depot buildings or other facilities.

Source: *The Chicago, Milwaukee, St. Paul & Pacific Railroad Company and the Chicago & North Western Transportation Company.*

[12] *The stations of Wiscona on the C&NW and Canco on the Milwaukee Road are situated at the geographic location which represents the most logical and economical place to effect the necessary connection between the two railway lines.*

grade is 0.72 percent, and occurs between Milepost 18.4 and Milepost 19.2—a distance of 0.8 mile. Other significant westerly ascending grades are a 0.52 percent gradient of 1.3 miles in length between Milepost 6.4 and Milepost 7.7, and a 0.40 percent gradient of 1.5 miles in length between Milepost 11.1 and Milepost 12.6. The most severe eastbound ascending grade is 0.53 percent, and occurs between Milepost 25.2 at Port Washington Station to Milepost 23.8, a distance of 1.4 miles.

There are no vertical or horizontal clearance restrictions that would prohibit the use of conventional or new commuter train rolling stock over this route. In fact, bi-level gallery coaches have been operated over this entire route in the past.

Most of the route is well located on the natural grade of the surrounding topography. Between W. Highland Avenue and W. Meinecke Avenue—a distance of 1.5 miles—the trackage is located in a cut, while between W. Meinecke Avenue and W. Hampton Avenue—a distance of 3.0 miles—the trackage is located on a fill. Between the east switch at Wiscona Junction and N. Port Washington Road—a distance of 1.7 miles—the trackage is again located on a fill.

There are a total of 63 public street and highway crossings on this route, of which 24 are at-grade and 39 are grade-separated. Of the 24 at-grade crossings, 22 are protected by automatic grade crossing signals, two of which have gates in addition to flashing lights. No public street and highway grade crossings between North Milwaukee and Port Washington are equipped with gates, although such protection would be required for 60-mile-per-hour train operation and would cost an average of $60,000 per crossing.[13] There are a total of 18 private crossings, of which 15 are at-grade and three are grade-separated. There is one grade-separated crossing with another railway line, that being the C&NW North Avenue spur track at Canco Station. There are seven bridges and trestles, none movable, over watercourses. Between the public at-grade crossing, located under the 27th Street viaduct, and the station at North Milwaukee—a distance of 6.6 miles, and between the W. Villard Avenue crossing and E. Green Tree Road—a distance of 4.2 miles, the route is completely grade-separated from all streets and highways.

The entire route is operated by timetable and train order authority, with train spacing assisted by automatic block signals (ABS) except on the proposed C&NW connection track at Wiscona Junction. Train movements between North Milwaukee and Canco Station are governed by centralized traffic control (CTC), controlled by an operator located in the tower at North Milwaukee. The Milwaukee Road, however, is considering deactivation of this CTC installation. Turnouts at the east and west ends of the Milwaukee passenger station and at the junctions at Cut-Off and Grand Avenue are controlled by the operators at the Menomonee River drawbridge and in the tower at Cut-Off Junction, respectively. The turnouts for the existing C&NW connection track at Canco Station are controlled by the operator in the tower at North Milwaukee.

The three passenger depots remaining along this route are located in Milwaukee, North Milwaukee, and Port Washington. The depot building in downtown Milwaukee is currently used by the Milwaukee Road for office space and by Amtrak for passenger facilities. The depot at North Milwaukee is currently used by maintenance-of-way forces. Both of these buildings are owned by the Milwaukee Road. The depot building at Port Washington is owned by the C&NW and used for the storage of tools and materials. The platform in front of the depot has been removed. Approximately 245 feet of concrete platform remains north of the depot but is in poor condition.

Should this route be utilized for commuter rail service, auxiliary trackage as well as facilities for the servicing and overnight storage of commuter train rolling stock would be required at Port Washington Station. The size of such a facility would ultimately depend on the number and size of trains to be serviced and stored; however, for purposes of this assessment, such a facility is assumed to be capable of handling two trains, each train consisting of one diesel locomotive and three bi-level gallery coaches. The storage and servicing facility would hold 850 linear feet of new track, one mainline turnout, one bumper, a building for

[13] *The cost of installing automatic grade-crossing signals with gates ranges from $45,000 to $90,000 per single-track crossing and $130,000 to $180,000 per double-track crossing. The simplest installation would consist of two masts, each with flashing lights and a gate, an electric cabinet, and the necessary wiring and other signal work to create the track circuits for a simple single-track crossing of a two-lane street or highway. The cost of a crossing signal installation would depend on the site-specific needs of each location, such as the need for additional masts, gates, lights, a complex track configuration at the crossing, or coordination with highway traffic signals.*

the storage of supplies, walkways, floodlighting, watering facilities, oil collection pans, and rolling stock electrical connections for heating the coaches and locomotives. The total cost of such an installation would be about $200,000. It is assumed that major repairs, heavy maintenance, and refueling would be handled by the Milwaukee Road at the Milwaukee passenger station and at the West Milwaukee shops.[14]

The following maximum permissible passenger train speeds are designated over this route: 10 miles per hour (mph) through the passenger station at Milwaukee; 40 mph between Milwaukee and Grand Avenue; 35 mph through the junction at Grand Avenue; 25 mph between Grand Avenue and North Milwaukee; 30 mph between North Milwaukee and Milepost 8.2—located within the Village of Fox Point; and 40 mph between Milepost 8.2 and Port Washington. The practical operation of commuter trains over this route would require greater maximum speeds on the segment between Grand Avenue and Port Washington. For the purposes of this inventory and assessment, such desirable speeds are assumed to be 40 mph between Grand Avenue and Canco Station and 60 mph between Canco Station and Port Washington, except on the C&NW connection track at Canco Station. These passenger train speeds would require maintenance of the track to Federal Railroad Administration Class 1 track safety standards through the Milwaukee passenger station and to Class 3 standards over the remainder of the route.[15]

[14] *For purposes of this inventory and assessment, the necessary repair, maintenance, and refueling functions were assumed to be performed by the Milwaukee Road under contract using its existing facilities. Also, adequate daytime storage track space for the equipment used in the service was assumed to be available at the Milwaukee passenger station or nearby yards. The attendant costs would be reflected in the operating costs. The assumed arrangement in this respect should be adequate since a commuter rail system for the Milwaukee area is not expected to require extensive specialized facilities and equipment storage yards in the Milwaukee terminal area. Should an actual commuter rail system for the Milwaukee area entail more than four trains per day over the several routes, then the need for expanded facilities and storage tracks at the Milwaukee passenger station would have to be reassessed along with the attendant costs.*

The existing condition of the track and roadbed east of the junction at Grand Avenue would not permit the designated speeds to be achieved. Because of deferred track maintenance, present operating speeds have temporarily been lowered to 10 mph between Milepost 86.05, located at the Milwaukee passenger station, and Milepost 86.2; 35 mph between Mileposts 86.2 and 87.1; 25 mph between Mileposts 87.1 and 87.2; and 35 mph between Mileposts 87.2 and 88.2 (at Grand Avenue). Both mainline tracks between Milwaukee and Grand Avenue are laid with 130-pound, 131-pound, and 132-pound sections of rail,[16] installed between 1930 and 1966. During the 1980 working season, this trackage is scheduled for complete rehabilitation, including cross-tie replacement, installation of new crushed rock ballast, and relaying of the existing rail with 132-pound continuous welded rail (CWR). This work, including the grade-crossing protection renewal work projected to be necessary, will cost $1,991,000 (see Table 131). The track work may be expected to be completed prior to initiation of any commuter rail service, although the work is contingent upon federal approval of a "4R-Act" track rehabilitation loan.[17] Should the 4R-Act loan not be approved, the project would have to be financed through other means—possibly by the proposed commuter rail project.

Between the junction at Grand Avenue and Canco Station, an adequate passenger train speed of 40 mph is not attainable. Between Milepost 88.2

[15] *Federal Railroad Administration track safety standards are a detailed set of engineering standards that prescribe minimum requirements for the safe operation of freight and passenger trains over railroad lines that are a part of the general railroad transportation system. There are a total of six classes that apply to specific track conditions existing in isolation. These minimum safety standards should not be confused with good engineering design and construction standards.*

[16] *These numeric designations refer to the weight per linear yard of the rail.*

[17] *The "4R-Act" stands for the Railroad Revitalization and Regulatory Reform Act of 1976, passed to aid railroads in averting the problems associated with the operation of bankrupt railroads in the United States. Certain sections of the Act provide for financial assistance directly to the railroads in the form of loan guarantees and government purchases of redeemable preference shares at subsidized rates.*

at Grand Avenue and Milepost 93.3 near North Milwaukee, very poor track and roadbed conditions have forced present maximum train speeds to be lowered to 10 mph. The designated timetable speed of 30 mph is attainable between Milepost 93.3 and Canco Station at Milepost 94.8. Both main tracks south of North Milwaukee are laid with 100-pound rail, installed at various times between 1922 and 1954. During the 1960's and early 1970's, short segments of track were relaid with used 131- and 132-pound rail. Rail on the single track between North Milwaukee and Canco Station varies from 90-pound laid in 1925 to 115-pound laid in 1966. Almost all of this rail is worn and should be replaced. During the 1981 working seasons, the Milwaukee Road contemplates a rehabilitation of this segment of line under the provisions of the federal 4R-Act. Included would be cross-tie replacement, installation of new crushed rock ballast, and relaying of the existing rail with 115-pound CWR. This work, including the grade-crossing protection renewal work projected to be necessary, would cost an estimated $3,676,000 (see Table 132).

The trackage and roadbed between Wiscona and Port Washington is in good condition and is maintained to Federal Railroad Administration Class 3 track safety standards. However, to ensure the Class 3 rating as well as to continuously operate passenger trains over this railway line segment at 60 mph, some track rehabilitation work would be necessary. This entire segment of railway line was laid with 112-pound rail from 1945 through 1948. Except for the need for some end-welding and cross-grinding at select joints, the rail is in good condition. The overall ballast condition is good, with crushed rock having been placed on the roadbed between Wiscona Junction and Milepost 18.0 from 1974 through 1976 and on the roadbed between Milepost 18.0 and Port Washington during 1961. The track surface and alignment is fair to good, there being a need for some spot ballasting. The necessary work would cost an estimated $1,502,000 (see Table 133).

The connection that once existed between the Milwaukee Road at Canco Station and the C&NW at Wiscona Junction—east switch, is no longer intact. Following the discontinuance of intercity passenger train operation through these junctions in April 1971, the trackwork and signal system was rearranged to more easily and economically serve freight train movements. Reinstatement of these facilities would require the replacement of about 2,700 feet of trackage and two turnouts. This work would cost an estimated $411,000, as shown in Table 134 and on Map 115.

Altogether, rehabilitation of the trackage between the passenger station at Milwaukee and Port Washington, including reconstruction of the connection at Wiscona Junction and installation of automatic gates at all public street and highway crossings, would cost an estimated $7,780,000, of which $5,205,000 in improvements is proposed to be accomplished by the Milwaukee Road in 1980 and 1981 if the rehabilitation project proposed by the railroad proceeds. As noted earlier in this chapter, failure of the Milwaukee Road to obtain the necessary funding for the track rehabilitation between Milwaukee and North Milwaukee may place the financial burden of such work on any proposed commuter rail project. The cost of track rehabilitation between Wiscona Junction and Port Washington, of reinstating the railway connection at

Table 131

TRACK REHABILITATION ESTIMATE: MILWAUKEE TO GRAND AVENUE

Item	Quantity	Cost of Material and Installation
Cross Ties	8,800	$ 310,552
Crushed Rock Ballast.	10,710 cubic yards	227,480
Continuous Welded Rail . . .	4.35 track miles	789,117
Grade Crossing Work	270 linear feet	2,160
Grade Crossing Protection . .	2 crossings	280,000
Signal Work	Item	37,600
Turnout Rehabilitation. . . .	8 turnouts	188;000
Supervision	5 percent	91,745
Subtotal	- -	$1,926,654
Contingencies	10 percent	$ 192,665
Less Salvage	- -	128,000
Total		$1,991,319

Source: SEWRPC.

Table 132

TRACK REHABILITATION ESTIMATE: GRAND AVENUE TO CANCO STATION

Item	Quantity	Cost of Material and Installation
Cross Ties	12,240	$ 428,400
Crushed Rock Ballast.	26,170 cubic yards	313,970
Continuous Welded Rail . . .	10.0 track miles	1,650,000
Grade Crossing Work	2 crossings	5,000
Grade Crossing Protection . .	2 crossings	120,000
Turnout Rehabilitation. . . .	36 turnouts	896,920
Supervision	5 percent	170,710
Subtotal	- -	$3,585,000
Contingencies	10 percent	$ 358,500
Less Salvage	- -	268,000
Total		$3,675,500

Source: SEWRPC.

Wiscona Junction, and of grade crossing protection renewal would have to be borne by the commuter rail project.

The trackage between Wiscona Junction and the City of Port Washington is currently used by two daily time freights in each direction and one local freight train that operates in each direction five days per week. Between North Milwaukee and Canco Station, one daily time freight operates in each direction and a way freight, or "patrol," operates on a tri-weekly basis in each direction. On a typical weekday, the trackage between Grand Avenue and North Milwaukee carries a minimum of three round-trip transfer trains per day and a daily time freight in each direction, as well as extensive switching activity in the segment between W. State Street and W. Capitol Drive. The route between the Milwaukee passenger station and Grand Avenue is shared with Chicago-Milwaukee-Twin Cities mainline traffic, as discussed in the section of this chapter on the Milwaukee to Oconomowoc route.

Delays to commuter trains could occur at two locations on this route. The first is the segment of trackage between Cut-Off Junction and Grand Avenue, which, as noted above, is extensively used by a large number of switching, local, transfer, and intercity freight and passenger trains. The second location is the segment of trackage directly south of North Milwaukee Station. The junction at North Milwaukee funnels freight traffic from the Saukville-Green Bay main line, the Chestnut Street line, and the Twelfth Subdivision branch line into Glendale Yard for classification and transfer to the freight yards in the Menomonee River Valley. There are also extensive switching operations performed over this segment.

In conclusion, it appears that the Milwaukee to Port Washington route over Milwaukee Road and C&NW trackage has good potential for commuter train operation insofar as the physical and engineering aspects of the trackage are concerned. This potential, however, is dependent on rehabilitation to varying degrees of the entire route, and on the reconstruction of the connecting track between the Milwaukee Road and the C&NW at Wiscona Junction. In addition, automatic crossing gates and/or flashing lights would need to be installed at certain public street and highway crossings. The schedules of any new commuter train service would have to be coordinated with the schedules of existing train movements.

Table 133

TRACK REHABILITATION ESTIMATE: WISCONA JUNCTION-EAST SWITCH TO PORT WASHINGTON

Item	Quantity	Cost of Material and Installation
Cross Ties	3,000	$ 105,870
Crushed Rock Ballast	5,000 cubic yards	66,600
Rail Joint Renewal	150 rail joints	2,250
Grade Crossing Work	365 linear feet	31,020
Grade Crossing Protection	18 crossings	1,080,000
Roadbed Widening	Item	15,000
Supervision	5 percent	65,040
Subtotal	- -	$1,365,780
Contingencies	10 percent	$ 136,580
Total		$1,502,360

Source: SEWRPC.

Table 134

TRACK REHABILITATION ESTIMATE: REINSTATEMENT OF CONNECTION BETWEEN MILWAUKEE ROAD AT CANCO STATION AND C&NW MAIN LINE TO PORT WASHINGTON AT WISCONA JUNCTION-EAST SWITCH

Item	Quantity	Cost of Material and Installation
Trackage Replacement	2,697 linear feet	$192,000
No. 15 Turnouts	2	66,000
Power Turnout Machinery	2 sets	60,000
Supervision	5 percent	15,900
Subtotal	- -	$333,900
Property Acquisition[a]	4 acres	$ 40,000
Contingencies	10 percent	$ 37,390
Total		$411,290

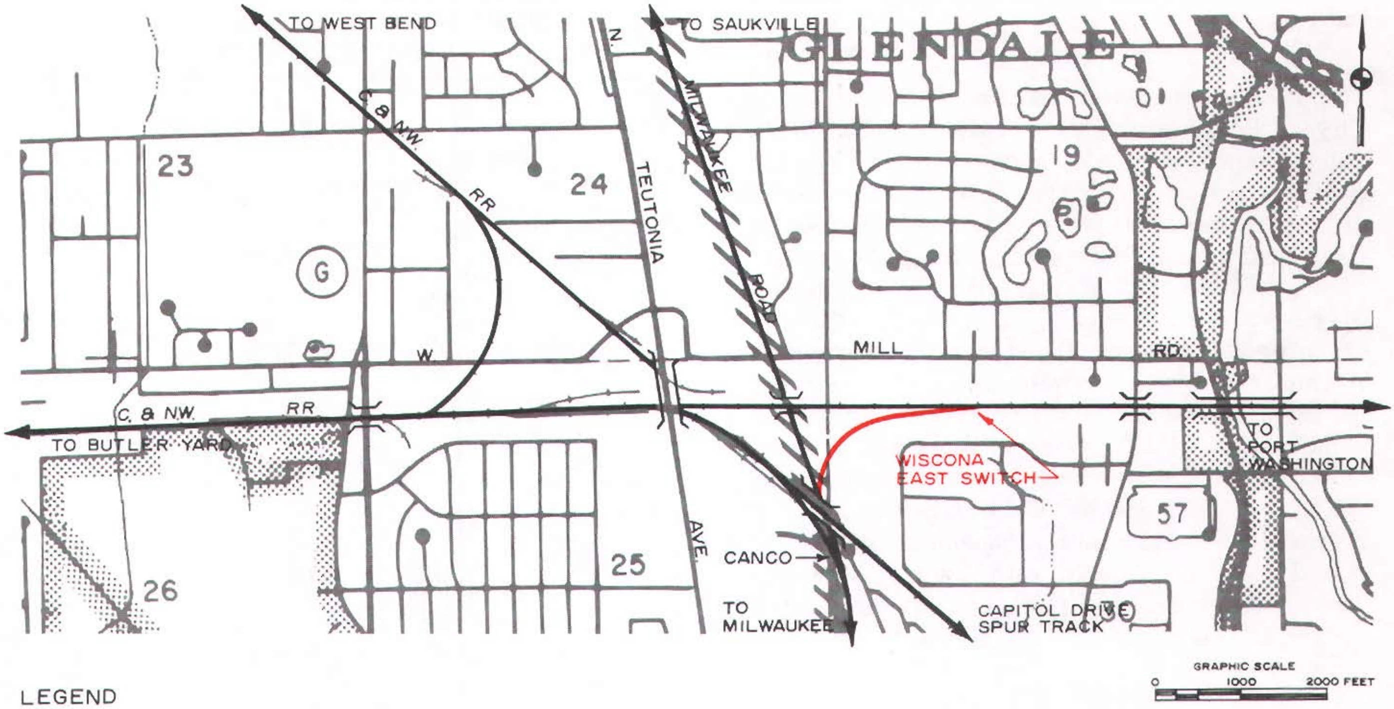
[a] *Following the removal of the track connection between the two railway lines, the right-of-way for the connection was sold in 1975 by the C&NW to the Wisconsin Electric Power Company, which constructed an electric power substation facility on the land. The alignment and grade for the connecting track are, however, still in existence and open for the reconstruction of the connection.*

Source: SEWRPC.

The total cost of rehabilitating the Milwaukee to Port Washington route for commuter train operations would be $7,780,000, not including the cost of purchasing rolling stock and of establishing and constructing passenger depot facilities. The renewal and installation of automatic grade crossing protection accounts for $1,702,000 of this total. If the Milwaukee Road completes all of its proposed track rehabilitation projects between the passenger station at Milwaukee and Canco Station, work that

Map 115

CONFIGURATION OF RAILWAY TRACK CONNECTION BETWEEN MILWAUKEE ROAD AT CANCO STATION AND C&NW AT WISCONA JUNCTION-EAST SWITCH



The connection which once existed between the Milwaukee Road at Canco Station and the C&NW at Wiscona Junction-east switch is no longer intact. Following the discontinuance of intercity passenger train operation through these junctions in April 1971, the trackwork and signal system were rearranged to more readily serve freight train movements. Reinstatement of these facilities would require the replacement of about 2,700 feet of trackage and the installation of two turnouts at a total cost of $411,000.

Source: SEWRPC.

is scheduled for the 1980 and 1981 seasons, the cost of track rehabilitation for a commuter rail project could be reduced by $5,205,000, resulting in a total cost of $2,575,000 for the route between Milwaukee and Port Washington.

Milwaukee to Saukville

A potential commuter rail route serving the Milwaukee urbanized area extends from the passenger station, located at the intersection of S. 5th Street and W. St. Paul Avenue in downtown Milwaukee, to the station at Saukville, located at the Dekora Street (STH 33) crossing in the Village of Saukville. This 27.6-mile-long route would utilize trackage of the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road) over its entire length. The route passes through the communities of Milwaukee, Glendale, Brown Deer, Mequon, Thiensville, Cedarburg, Grafton, and Saukville.

This route is operated as a double-track railway line between the passenger station at Milwaukee and the junction at North Milwaukee, a distance of 7.7 miles. Between North Milwaukee and Saukville, a distance of 19.9 miles, the railway line is single track. The entire route is part of the Milwaukee Road's main line between the Cities of Milwaukee and Green Bay and currently contains 11 stations, as listed by milepost in Table 135. The right-of-way is generally 66 feet wide between the passenger station at Milwaukee and the junction at Grand Avenue, 100 feet wide between Grand Avenue and North Milwaukee, and 66 feet wide between North Milwaukee Station and Saukville Station.

The horizontal alignment of the railway grade does not impose any significant limitations on passenger train operation. There are 19 horizontal curves along the entire route. Between the Milwaukee passenger station and Grand Avenue, there are three curves of 3°00' or greater, in addition to two reverse curves, one having curvatures of 6°00' and one having curvatures of 2°00', at the west end of the passenger station. Between Grand Avenue and Canco Station, there are three curves of 3°00' or greater, while all curves between Canco Station and Saukville are between 1°00' or 2°00' except for a 2°30' curve at North Milwaukee.

Table 135

EXISTING RAILWAY STATIONS ON THE MILWAUKEE TO SAUKVILLE COMMUTER RAIL ROUTE

Milepost	Station Name[a]	Distance (miles)
	The Milwaukee Road	
85.7	Milwaukee (passenger station)	0.0
87.1	Cut-Off	1.4
88.2	Grand Avenue	2.5
93.4	North Milwaukee	7.7
94.8	Canco	9.1
98.4	Brown Deer	12.7
100.5	Mequon	14.8
102.2	Thiensville	16.5
106.8	Cedarburg	21.1
108.9	Grafton	23.2
113.3	Saukville	27.6

[a]*Stations are specific locations designated by the operating timetable and do not necessarily denote the existence of depot buildings or other facilities.*

Source: The Chicago, Milwaukee, St. Paul & Pacific Railroad Company.

The vertical alignment also imposes no significant limitations on passenger train operation. Between the passenger station and Grand Avenue, the grade through the depot and to Cut-Off Junction is generally level or slightly ascending in a westerly direction at an average gradient of 0.26 percent. From Grand Avenue to the W. Center Street overpass, a distance of 2.6 miles, there is a westbound ascending grade that averages 0.42 percent, with the steepest segment being a 1.67 percent gradient for approximately 0.1 mile. From the W. Center Street bridge to the Village of Saukville, there are only two grades of consequence, the first—between Milepost 94.6 and Milepost 95.5—having about a 1.00 percent gradient, and the second—between Milepost 103.3 and Milepost 106.9—having an average gradient of 0.55 percent.

There are no vertical or horizontal clearance restrictions that would prohibit the use of conventional or new commuter train rolling stock over this route. In fact, bi-level gallery coaches have been operated between the station at Milwaukee and Canco Station.

Most of the route is well located on the natural grade of the surrounding topography. Between W. Highland Avenue and W. Meinecke Avenue, a distance of 1.5 miles, the trackage is located in a cut, while between W. Meinecke Avenue and W. Hampton Avenue, a distance of 3.0 miles, the trackage is raised on a fill. There are a total of 69 public street and highway crossings on this route, of which 38 are at-grade and 31 are grade-separated. Of the 38 at-grade crossings, 30 are protected by automatic grade-crossing signals, two of which have gates in addition to flashing lights. None of the street and highway grade crossings between North Milwaukee and Saukville are equipped with gates. Such protection would be required for 60 mile-per-hour train operation, and would cost an average of $60,000 per crossing.[18] There are a total of 30 private crossings, of which 27 are at-grade and three are grade-separated. There are two grade-separated crossings with the Chicago & North Western (C&NW) Railway, and both are located directly north of Canco Station. There are 10 bridges and trestles, none movable, over watercourses. Between the public at-grade crossing located underneath the 27th Street viaduct and the station at North Milwaukee, a total distance of 6.6 miles, the route is completely grade-separated.

The entire route is operated by timetable. and train order authority, with train spacing assisted by automatic block signals (ABS) between the stations at Milwaukee and Canco. Train movements between North Milwaukee and Canco Station are also controlled by centralized traffic control (CTC), controlled by an operator in the tower at North Milwaukee. The Milwaukee Road, however, is considering deactivation of this CTC installation. West of Canco Station, train operation is governed solely by timetable authority and written train orders. Depending on the number of commuter trains operated over this route, ABS may have to be installed in order for the line to safely carry the

[18] *The cost of installing automatic grade-crossing signals with gates ranges from $45,000 to $90,000 per single-track crossing and $130,000 to $180,000 per double-track crossing. The simplest installation would consist of two masts, each with flashing lights and a gate, an electric cabinet, and the necessary wiring and other signal work to create the track circuits for a simple single-track crossing of a two-lane street or highway. The cost of a crossing signal installation would depend on the site-specific needs of each location, such as the need for additional masts, gates, lights, a complex track configuration at the crossing, or coordination with highway traffic signals.*

increased traffic.[19] Turnouts at the east and west ends of the Milwaukee passenger station and at the junctions of Cut-Off Junction and Grand Avenue are controlled by the operators at the Menomonee River drawbridge and in the tower located at Cut-Off Junction. The turnouts for the C&NW connection track at Canco Station are controlled by the operator in the tower located at North Milwaukee.

The three passenger depots remaining along this route, are located at Milwaukee, North Milwaukee, and Cedarburg. The depot building in downtown Milwaukee is currently used by the railroad for office space and by Amtrak for passenger facilities. The depots at North Milwaukee and Saukville are currently used by maintenance-of-way forces, the building and platform at each being in poor condition. The Milwaukee Road owns all three depot buildings. Auxiliary trackage as well as facilities for the servicing and overnight storage of commuter train rolling stock would be required at the Saukville station. As discussed in the section of this chapter on a potential commuter rail route between Milwaukee and Port Washington, the total cost of such an installation would be about $200,000.

The following maximum permissible operating speeds are designated over this route: 10 miles per hour (mph) through the passenger station at Milwaukee; 40 mph between Milwaukee and Grand Avenue; 35 mph through the junction at Grand Avenue; 25 mph between Grand Avenue and North Milwaukee; and 30 mph between North Milwaukee and Saukville. The practical operation of commuter trains over this route would require greater maximum speeds on the segment between Grand Avenue and Saukville. For purposes of this inventory and assessment, such desirable speeds are assumed to be 40 mph between Grand Avenue and Canco Station and 60 mph between Canco Station and Saukville. These passenger train speeds require maintenance of the track to Federal Railroad Administration Class 1 track safety standards through the Milwaukee Passenger Station and Class 3 standards over the remainder of the route.

[19] *The cost of installing an ABS system averages $50,000 per track mile. Installing ABS on the railway segment between Canco Station and Saukville Station, therefore, would cost an estimated $925,000.*

The condition of the track and roadbed between the Milwaukee passenger station and the station at Canco would not permit the designated speeds to be achieved. As discussed in the section of this chapter on a potential commuter rail route between Milwaukee and Port Washington, the work necessary to correct these deficiencies would cost a total of $5,667,000. Subject to Federal Railroad Administration approval of a "4R-Act"[20] track rehabilitation loan, the Milwaukee Road is expected to complete track rehabilitation work on the Milwaukee-Grand Avenue segment during the 1980 work season, and on the Grand Avenue-Canco Station segment during the 1981 work season.

The trackage and roadbed between Canco Station and Saukville Station are also in poor condition, a result of deferred maintenance. At present, maximum speeds have been lowered from 30 mph to 10 mph between Mileposts 95.0 and 96.3, Mileposts 98.0 and 100.0, Mileposts 101.8 and 102.3, Mileposts 106.7 and 107.0, and Mileposts 110.0 and 112.5. This low speed has resulted in approximately 35 percent of the mileage between Canco Station and Saukville being placed under "slow orders" of 10 mph. With the exception of several very short stretches of 100-pound rail, the railway line between these two stations is laid with 90-pound rail installed in 1924, 1925, and 1926. During the 1981 work season, the Milwaukee Road contemplates a rehabilitation of this railway line segment under provisions of the federal 4R-Act. Included would be cross-tie replacement, installation of new crushed rock ballast, and relaying of the existing rail with 115-pound continuous welded rail. This work, including the grade-crossing protection renewal work projected to be necessary, would cost an estimated $7,490,000 (see Table 136).

Altogether, rehabilitation of the trackage between Milwaukee and Saukville, including the installation of automatic gates at all public street and highway crossings, would cost a total of $13,356,000, of

[20] *The "4R-Act" stands for the Railroad Revitalization and Regulatory Reform Act of 1976, passed to aid railroads in averting the problems associated with the operation of bankrupt railroads in the United States. Certain sections of the Act provide for financial assistance directly to the railroads in the form of loan guarantees and government purchases of redeemable preference shares at subsidized rates.*

Table 136

TRACK REHABILITATION ESTIMATE: CANCO STATION TO SAUKVILLE

Item	Quantity	Cost of Material and Installation
Cross Ties	19,550	$ 684,250
Crushed Rock Ballast.	41,810 cubic yards	501,600
Continuous Welded Rail . . .	20.1 track miles	3,316,500
Grade Crossing Work	32 crossings	80,000
Grade Crossing Protection . .	32 crossings	1,920,000
Turnout Rehabilitation. . . .	18 turnouts	448,460
Supervision	5 percent	347,540
Subtotal	- -	$7,298,350
Contingencies	10 percent	$ 729,040
Less Salvage	- -	538,000
Total		$7,490,190

Source: SEWRPC.

which $10,617,000 in improvements is proposed to be accomplished by the Milwaukee Road in 1980 and 1981 if the rehabilitation project proposed by the railroad proceeds. Although all of this work may be expected to be completed prior to initiation of any commuter rail service, the work is contingent upon approval by the Federal Railroad Administration of a 4R-Act track rehabilitation loan. Recognizing the current financial condition of the Milwaukee Road, such a loan may be delayed until the corporate reorganization plan is more certain. Should such a delay occur, or should the loan not be approved, track rehabilitation would have to be financed through other means—possibly by the proposed rail project. The cost of grade crossing protection renewal and construction of the servicing and storage facility at Saukville will have to be borne by the proposed commuter rail project.

This route between the Cities of Milwaukee and Saukville is currently used by one daily time freight in each direction and by a way freight or "patrol," which operates only between North Milwaukee, Saukville, and Plymouth on a tri-weekly basis in each direction. In 1980 and 1981, possible increases in freight traffic to and from the City of Green Bay might result in additional regular time freight movements. The trackage between Grand Avenue and North Milwaukee additionally carries a typical weekday minimum of three round-trip transfer trains per day between the freight yards in the Menomonee River Valley and North Milwaukee, plus extensive switching activity in the areas around W. State Street and W. Capitol Drive. The segment of this route between the Milwaukee passenger station and Grand Avenue is shared with Chicago-Milwaukee-Twin Cities intercity traffic, as discussed in the section of this chapter on the Milwaukee to Oconomowoc route.

Delays to commuter trains could occur at locations on this route. The first is the segment of trackage between the junctions at Cut-Off and Grand Avenue. As noted above, this segment is extensively used by a large number of switching, local, transfer, and intercity freight trains and passenger trains. The second location is the segment of trackage in the area directly south of North Milwaukee Station. The junction at North Milwaukee funnels freight traffic from the Saukville-Green Bay main line, the Chestnut Street line, and the Twelfth Subdivision branch line into Glendale Yard for classification and transfer to the freight yards in the Menomonee River Valley. There are also extensive switching operations performed over this segment.

In conclusion, it appears that the Milwaukee to Saukville route over Milwaukee Road trackage has good potential for commuter train operation insofar as the physical and engineering aspects of the trackage are concerned. This potential, however, is dependent on major rehabilitation of the entire route, and the coordination of any new commuter train service with the schedules of existing train movements. In addition, automatic grade-crossing gates would be required, and automatic block signals may be needed between North Milwaukee and Saukville, both of which would represent significant capital expenditures.

The total cost of rehabilitating the Milwaukee to Saukville route for commuter train operations would be $13,356,000, not including the cost of purchasing rolling stock and of establishing and constructing passenger depot facilities. The renewal of automatic grade-crossing protection accounts for $2,668,000 of this total. If the Milwaukee Road completes all of its proposed track rehabilitation projects between the passenger station at Milwaukee and Saukville Station, work that is scheduled for the 1980 and 1981 seasons, the cost of track rehabilitation for a proposed commuter rail project could be reduced by $10,617,000, resulting in a total cost of $2,739,000 for the route between Milwaukee and Saukville.

Milwaukee to West Bend

A potential commuter rail route serving the Milwaukee urbanized area extends from the passenger station, located at the intersection of S. 5th Street and W. St. Paul Avenue in downtown Milwaukee, to the station at West Bend, located at the E. Washington Street crossing near downtown West Bend. The 34.7-mile-long route would utilize trackage of the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road) between the stations at Milwaukee and Canco Station, a distance of 9.1 miles. Trackage of the Chicago & North Western Transportation Company (C&NW) would be utilized between the junction at Wiscona[21] and the station at West Bend, a distance of 25.6 miles. Within the Milwaukee urbanized area, the route passes through the communities of Milwaukee, Menomonee Falls, Germantown, and Rockfield. North of the Milwaukee urbanized area, the route passes through the communities of Jackson and West Bend.

This route is operated as a double-track railway line between the passenger station at Milwaukee and the junction of North Milwaukee, a distance of 7.7 miles. Between North Milwaukee Station and West Bend Station, a distance of 27.0 miles, the railway line is single track. The route consists of portions of the Milwaukee Road's main line and one of the C&NW's main lines between the Cities of Milwaukee and Green Bay. There are 10 stations on the route, as shown by milepost in Table 137. The right-of-way width is generally 66 feet between the Milwaukee passenger station and the junction at Grand Avenue and between the stations at North Milwaukee and Canco, and 100 feet between Grand Avenue and North Milwaukee and between Wiscona and West Bend.

The horizontal alignment of the railway grade does not impose any significant limitations on passenger train operation. There are 24 horizontal curves along the route. Between the Milwaukee passenger station and Grand Avenue, there are three curves of 3°00' or greater, in addition to two reverse curves, one having curvatures of 6°00' and one having curvatures of 2°00', at the west end of the passenger station. Between Grand Avenue and Canco Station, there are three curves of 3°00' or greater, while all curves between Canco Station and West Bend are generally 2°00' or less with the exception of one compound curve of 2°42' and 2°20' near Milepost 100.6. On the C&NW connection track at Canco Station and Wiscona Junction, there is a compound curve of 3°00' and 2°50' 12".

Table 137

EXISTING RAILWAY STATIONS ON THE MILWAUKEE TO WEST BEND COMMUTER RAIL ROUTE

Milepost	Station Name[a]	Distance (miles)
	The Milwaukee Road	
85.7	Milwaukee (passenger station)	0.0
87.1	Cut-Off	1.4
88.2	Grand Avenue	2.5
93.4	North Milwaukee	7.7
94.8	Canco	9.1
	The Chicago & North Western	
92.4	Wiscona (crossing)	9.5
98.2	Granville	15.3
105.3	Rockfield	22.4
110.4	Jackson	27.5
117.6	West Bend	34.7

[a] *Stations are specific locations designated by the operating timetable and do not necessarily denote the existence of depot buildings or other facilities.*

Source: *The Chicago, Milwaukee, St. Paul & Pacific Railroad Company and the Chicago & North Western Transportation Company.*

The vertical alignment also imposes no significant limitations on passenger train operation. Between the passenger station and Grand Avenue, the grade through the depot and to Cut-Off Junction is generally level or slightly ascending in a westerly direction at an average gradient of 0.26 percent. From Grand Avenue to the W. Center Street overpass, a distance of 2.6 miles, there is a westbound ascending grade that averages about 0.42 percent, with the steepest segment being a 1.67 percent gradient for approximately 0.1 mile. From the W. Center Street overpass to Wiscona Junction, the only significant grade is a westbound ascending gradient of 1.80 percent on the C&NW connection track. West of Wiscona Junction, the grades are somewhat more severe compared with those on the other potential commuter rail routes. There are nine 0.7 percent to 0.8 percent gradients for distances of up to 2.4 miles. The steepest

[21] *The stations of Wiscona on the C&NW and Canco on the Milwaukee Road are situated at the geographic location which represents the most logical and economical place to effect the necessary connection between the two railway lines.*

grade is 0.91 percent for 0.5 mile between Milepost 109.0 and Milepost 110.0, ascending in a westbound direction. The longest average grade ascending westbound is 0.50 percent for a distance of about 4.4 miles between Milepost 108.2 and Milepost 112.6. The most severe eastbound ascending grade is 0.67 percent, and occurs between Milepost 114.0 and Milepost 115.3—a distance of 1.3 miles.

There are no vertical or horizontal clearance restrictions that would prohibit the use of conventional or new commuter train rolling stock over this route. In fact, bi-level gallery coaches have been operated over this entire route in the past.

Most of the route is well located on the natural grade of the surrounding topography. Between W. Highland Avenue and W. Meinecke Avenue—a distance of 1.5 miles—the trackage is located in a cut, while between W. Meinecke Avenue and W. Hampton Avenue—a distance of 3.0 miles—the trackage is located on a fill. There are a total of 68 public street and highway crossings on this route, of which 34 are at-grade and 34 are grade-separated. Of the 34 at-grade crossings, 27 are protected by automatic grade crossing signals. Three of the 27 have gates in addition to flashing lights. Automatic crossing signals with gates would be required at all crossings for 60-mile-per-hour passenger train operation, and would cost an average of $60,000 per crossing.[22] There are a total of 34 private crossings on this route, of which 31 are at-grade and three are grade-separated. There is one at-grade crossing with another railway line on the route, that being the C&NW Shoreline Subdivision trackage between Butler Yard and the City of Green Bay via the City of Port Washington, located at Wiscona Junction. There are 20 bridges and trestles, none movable, over watercourses. Between the public at-grade crossing located under the 27th Street viaduct and North Milwaukee station, a distance of 6.6 miles, the route is completely grade-separated.

The entire route is operated by timetable and train order authority, with train spacing assisted by automatic block signals (ABS) over the entire route except on the C&NW connection track at Wiscona. Train movements between North Milwaukee and Canco Station are also controlled by Centralized Traffic Control (CTC), controlled by an operator in the tower at North Milwaukee. The Milwaukee Road, however, is considering deactivation of this CTC installation. Turnouts at the east and west ends of the Milwaukee passenger station and at the junctions at Cut-Off Junction and Grand Avenue are controlled by the operators at the Menomonee River drawbridge and in the tower located at Cut-Off Junction, respectively. The turnouts for the C&NW connection track at Canco Station are controlled by the operator in the tower located at North Milwaukee.

The three passenger depots remaining along this route are located at Milwaukee, North Milwaukee, and West Bend. The depot building in downtown Milwaukee is currently owned and used by the Milwaukee Road for office space and by Amtrak for passenger facilities. The depot at North Milwaukee is owned by the Milwaukee Road and is currently used by maintenance-of-way forces, the building and platform being in poor condition. The depot building at West Bend is owned by the C&NW and houses an agent as well as maintenance-of-way forces. The concrete platform of this facility is 265 feet long but is in poor condition. Auxiliary trackage as well as facilities for the servicing and overnight storage of commuter train rolling stock would be required at the West Bend station. As discussed in the section of this chapter on the potential commuter rail route between Milwaukee and Port Washington, the total cost of such an installation would be about $200,000.

The maximum permissible passenger train operating speeds over this route are designated as 10 miles per hour (mph) through the Milwaukee passenger station; 40 mph between Milwaukee and Grand Avenue; 35 mph through the junction at Grand Avenue; 25 mph between Grand Avenue and North Milwaukee; 30 mph from North Milwaukee through the junction at Wiscona; and 40 mph between Wiscona Junction and the station at West Bend. The practical operation of commuter trains over this route would require greater maxi-

[22] *The cost of installing automatic grade-crossing signals with gates ranges from $45,000 to $90,000 per single-track crossing and $130,000 to $180,000 per double-track crossing. The simplest installation would consist of two masts, each with flashing lights and a gate, an electric cabinet, and the necessary wiring and other signal work to create the track circuits for a simple single-track crossing of a two-lane street or highway. The cost of a crossing signal installation would depend on the site-specific needs of each location, such as the need for additional masts, gates, lights, a complex track configuration at the crossing, or coordination with highway traffic signals.*

mum speeds on the segment between Grand Avenue and West Bend. For purposes of this inventory and assessment, such desirable speeds are assumed to be 40 mph between Grand Avenue and Canco Station and 60 mph between Canco Station and West Bend, except through the C&NW connection track at Canco Station. These passenger train speeds require maintenance of the track to Federal Railroad Administration Class 1 track safety standards through the Milwaukee passenger station and Class 3 standards over the remainder of the route.

The existing condition of the track and roadbed between the Milwaukee passenger station and Canco Station would not permit the designated speeds to be achieved. As discussed in the section of this chapter on the potential commuter rail route between Milwaukee and Port Washington, the work necessary to correct these deficiencies would cost a total of $5,667,000. Completion of this work by the Milwaukee Road is anticipated during 1980 and 1981, but is subject to Federal Railroad Administration approval of a "4R-Act" track rehabilitation loan.[23]

The trackage and roadbed between Wiscona Junction and West Bend are in good condition and are maintained to Federal Railroad Administration Class 3 safety standards. However, to ensure the Class 3 rating as well as to continuously operate passenger trains over this segment at 60 mph, some track rehabilitation work will be necessary. With the exception of one segment of track, the route is laid with 115-pound-per-linear-yard rail, installed in the years of 1954 through 1958. Between Milepost 117.0 and Milepost 117.5, the roadbed is laid with 112-pound rail, installed in 1947. All of the rail is in fair to good condition, with about one-half of the 115-pound rail being double the normal length, or 78 feet long. About 200 joints have battered ends and require cross grinding as well as welding. Other required trackwork includes some tie renewal, ballast application together with aligning and surfacing, some highway crossing work, and some roadbed widening. As shown in Table 138, this work, including the grade crossing protection renewal work projected to be necessary, would cost an estimated $2,720,000.

Table 138

TRACK REHABILITATION ESTIMATE: WISCONA JUNCTION TO WEST BEND

Item	Quantity	Cost of Material and Installation
Cross Ties	11,250	$ 397,010
Crushed Rock Ballast	12,900 cubic yards	274,000
Rail Joint Renewal	200 rail joints	3,000
Grade Crossing Work	420 linear feet	46,200
Grade Crossing Protection	27 crossings	1,620,000
Roadbed Widening	Item	15,000
Supervision	5 percent	117,760
Subtotal	- -	$2,472,970
Contingencies	10 percent	$ 247,300
Total		$2,720,270

Source: SEWRPC.

In addition, the required connection between the Milwaukee Road and the C&NW at Wiscona Junction would have to be reconstructed. Following the discontinuance of intercity passenger train operation through these junctions in April 1971, the trackwork and signal system were rearranged to more readily and economically serve freight train movements. Reconstruction of these facilities would require the replacement of about 1,000 feet of trackage, two turnouts, and one at-grade railway crossing, and the reactivation of the signal protection at the crossing. This work would cost an estimated $332,000, as shown in Table 139 and on Map 116.

Altogether, rehabilitation of the trackage between the passenger station at Milwaukee and the station at West Bend, including reinstatement of the complete connection at Wiscona Junction as well as the installation of automatic gates at all public street and highway crossings, would cost an estimated $8,919,000, of which $5,205,000 in improvements is proposed to be accomplished by the Milwaukee Road in 1980 and 1981 if the rehabilitation project proposed by the railroad proceeds. As noted earlier in this chapter, failure of the Milwaukee Road to obtain the necessary funding for the track rehabilitation between Milwaukee and North Milwaukee may place the financial burden of such work on any proposed commuter rail

[23] *The "4R-Act" stands for the Railroad Revitalization and Regulatory Reform Act of 1976, passed to aid railroads in averting the problems associated with the operation of bankrupt railroads in the United States. Certain sections of the Act provide for financial assistance directly to the railroads in the form of loan guarantees and government purchases of redeemable preference shares at subsidized rates.*

project. The cost of track rehabilitation between Wiscona Junction and West Bend, of reinstating the railway crossing and connection at Wiscona Junction, and of grade-crossing protection renewal would have to be borne by any proposed commuter rail project.

The trackage between the junction at Wiscona and the City of West Bend is currently used by two daily time freights in each direction, and by one local freight train in each direction that operates five days per week. Between North Milwaukee and Canco Station, there is one daily time freight in each direction and a way freight, or "patrol," that operates on a tri-weekly basis in each direction. The trackage between Grand Avenue and North Milwaukee handles a typical minimum of three round-trip transfer trains per day and a daily time freight in each direction, as well as extensive switching activity in the segment between W. State Street and W. Capitol Drive. The route between the

Table 139

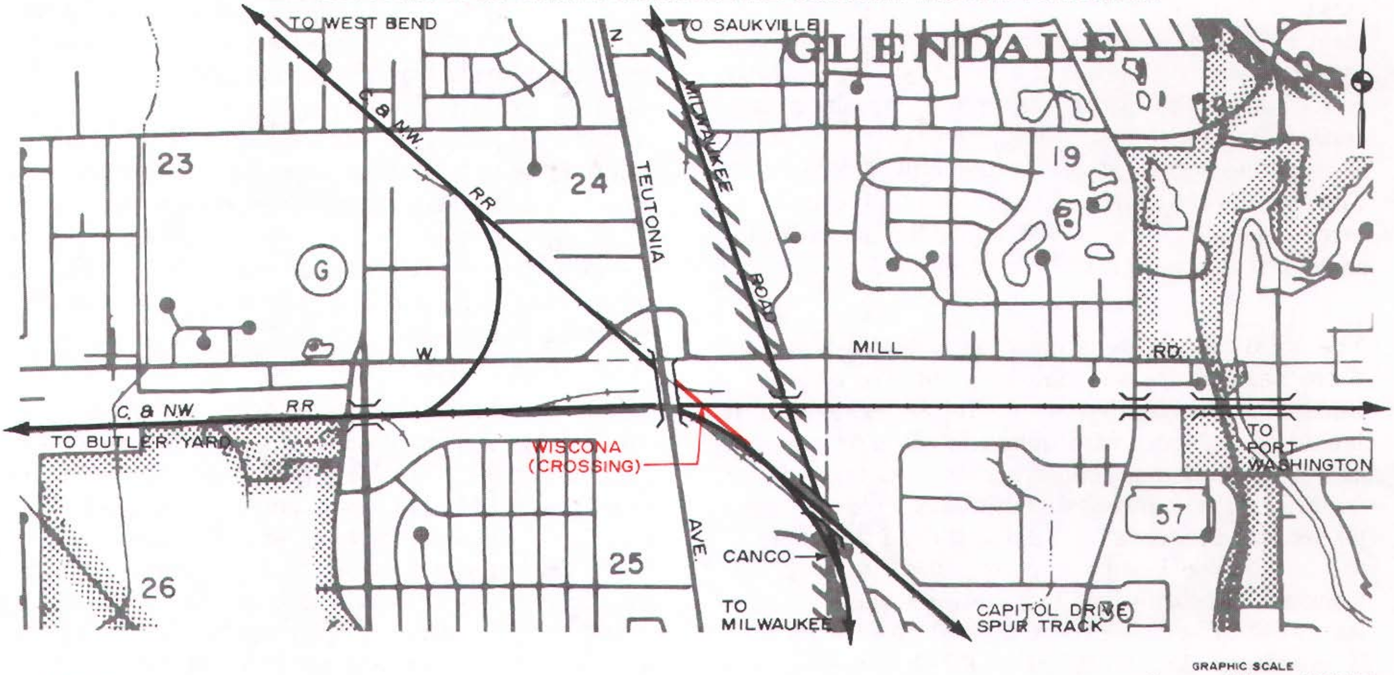
TRACK REHABILITATION ESTIMATE: REINSTATEMENT OF CONNECTION BETWEEN MILWAUKEE ROAD AND C&NW MAIN LINE TO WEST BEND AT WISCONA JUNCTION

Item	Quantity	Cost of Material and Installation
Trackage Replacement	1,040 linear feet	$ 67,600
Railway Crossing Diamond .	1 crossing diamond	35,000
No. 16 Turnouts	2 turnouts	50,000
Power Turnout Machinery . .	2 sets	60,000
Reactivation of Interlocking Signals at Crossing.	Item	75,000
Supervision	5 percent	14,380
Subtotal	- -	$301,980
Contingencies	10 percent	$ 30,200
Total		$332,180

Source: SEWRPC.

Map 116

CONFIGURATION OF RAILWAY TRACK CONNECTION BETWEEN MILWAUKEE ROAD AT CANCO STATION AND C&NW AT WISCONA JUNCTION



LEGEND

EXISTING RAILWAY TRACK — PROPOSED CONNECTION TRACK — OVERPASS — UNDERPASS

Following the discontinuance of intercity passenger train operation through the junctions at Canco and Wiscona in April 1971, the trackwork and signal system were rearranged to more readily serve freight train movements. Reconstruction of the connection between the Milwaukee Road at Canco Station and the C&NW at Wiscona Junction would require the replacement of about 1,000 feet of trackage, the installation of two turnouts, the construction of one at-grade railway crossing, and the reactivation of the signal protection at the railway crossing, at an estimated cost of $332,000.

Source: SEWRPC.

Milwaukee passenger station and Grand Avenue is shared with Chicago-Milwaukee-Twin Cities main line traffic, as discussed in the section of this chapter on the Milwaukee to Oconomowoc route.

Delays to commuter trains could occur at two locations on this route. The first is the segment of trackage between Cut-Off Junction and Grand Avenue which, as noted above, is extensively used by a large number of switching, local, transfer, and intercity freight trains and passenger trains. The second location is the segment of trackage directly south of North Milwaukee Station. The junction at North Milwaukee funnels freight traffic from the Saukville-Green Bay main line, the Chestnut Street line, and the Twelfth Subdivision branch line into Glendale Yard for classification and transfer to the freight yards in the Menomonee River Valley. There are also extensive switching operations performed over this segment.

In conclusion, it appears that the Milwaukee to West Bend route over Milwaukee Road and C&NW trackage has good potential for commuter train operation insofar as the physical and engineering aspects of the trackage are concerned. This potential, however, is dependent on rehabilitation to varying degrees of the entire route, and on the reconstruction of the connecting track between the Milwaukee Road and the C&NW at Wiscona Junction. In addition, automatic crossing gates and/or flashing lights would need to be installed at certain public street and highway crossings. Finally, the schedules of any new commuter train service would have to be coordinated with the schedules of existing train movements.

The total cost of rehabilitating the Milwaukee to West Bend route so that commuter train operations may be handled would be $8,919,000, not including the cost of purchasing rolling stock and of establishing and constructing passenger depot facilities. The renewal of automatic grade-crossing protection accounts for $2,323,000 of this total. If the Milwaukee Road completes all of its proposed track rehabilitation projects between the passenger station at Milwaukee and Canco Station, work that is scheduled for the 1980 and 1981 seasons, the cost of track rehabilitation for a proposed commuter rail project could be reduced by $5,205,000, resulting in a total cost of $3,714,000 for the route between Milwaukee and West Bend.

Milwaukee to Oconomowoc

A potential commuter rail route serving the Milwaukee urbanized area extends from the passenger station, located at the intersection of S. 5th Street and W. St. Paul Avenue in downtown Milwaukee, to the station at Oconomowoc, located at the S. Main Street crossing near downtown Oconomowoc. The 32.2-mile-long route would utilize trackage of the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road) over its entire length. Within the Milwaukee urbanized area, the route passes through the communities of Milwaukee, Wauwatosa, Elm Grove, and Brookfield. West of the Milwaukee urbanized area, the route passes through the Cities of Delafield and Oconomowoc, the Villages of Pewaukee, Hartland, Chenequa, Nashotah, and Oconomowoc Lake, the unincorporated community of Duplainville, and the Towns of Pewaukee and Summit.

This entire route is operated as a double-track railway line except at Grand Avenue Junction, where there is only a single track for approximately 0.1 mile. The route is part of the Milwaukee Road's main line between Chicago and St. Paul and currently contains 10 stations, as listed by milepost in Table 140. Between Elm Grove Station and Brookfield Station the westbound and eastbound tracks are located over separate rights-of-way. The right-of-way is generally 66 feet wide between the passenger station at Milwaukee and Elm Grove Station, and between Elm Grove Station and Brookfield Station on the westbound main line. The right-of-way of the eastbound main line between these two stations is generally 100 feet wide. West of Brookfield, the right-of-way is generally 82.5 feet wide.

The horizontal alignment of the railway grade does not impose any significant limitations on passenger train operation. There are 32 horizontal curves on both the westbound main line and the eastbound main line. Between Milwaukee and Grand Avenue, there are three curves of $3^{\circ}00'$ or greater in addition to two reverse curves, one having curvatures of $6^{\circ}00'$ and one having curvatures of $2^{\circ}00'$, at the west end of the passenger station. Between Grand Avenue and Brookfield, there are two curves of $3^{\circ}00'$ or greater, while all curves between Brookfield and Oconomowoc are $1^{\circ}00'$ or less except for a short $2^{\circ}00'$ curve and a short $1^{\circ}30'$ curve.

Table 140

EXISTING RAILWAY STATIONS ON THE MILWAUKEE TO OCONOMOWOC COMMUTER RAIL ROUTE

Milepost	Station Name[a]	Distance (miles)
	The Milwaukee Road	
85.7	Milwaukee (passenger station) . .	0.0
87.1	Cut-Off	1.4
88.2	Grand Avenue	2.5
90.6	Wauwatosa	4.9
95.1	Elm Grove	9.4
99.4	Brookfield	13.7
102.2	Duplainville.	16.5
105.6	Pewaukee	19.9
110.1	Hartland.	24.4
117.9	Oconomowoc.	32.2

[a]*Stations are specific locations designated by the operating timetable and do not necessarily denote the existence of depot buildings or other facilities.*

Source: The Chicago, Milwaukee, St. Paul & Pacific Railroad Company.

The vertical alignment is of little consequence insofar as passenger train operation is concerned. Between the passenger station and Grand Avenue, the grade through the depot and to Cut-Off Junction is generally level or slightly ascending in a westerly direction at an average gradient of 0.26 percent. West of Grand Avenue, to Milepost 98.5, located between Elm Grove and Brookfield, the westbound ruling grade gradually ascends at an average gradient of about 0.4 percent. The steepest grade in this segment is a one-mile grade of 0.67 percent between Milepost 96.0 and Milepost 97.0. West of Brookfield, the grade is very slight to about Milepost 111.0, where the grade descends into Oconomowoc at an average gradient of 0.17 percent.

There are no vertical or horizontal clearance restrictions that would prohibit the use of conventional or new commuter train rolling stock over this route. In fact, bi-level gallery coaches have been operated on this entire segment of trackage in the past.

The entire route is well located on the natural grade of the surrounding topography. There are a total of 59 public street and highway crossings on this route, of which 37 are at-grade and 22 are grade-separated. All of the at-grade public crossings are protected by automatic grade-crossing signals, 25 of which have gates in addition to flashing lights. There are a total of 14 private crossings, of which 11 are at-grade and three are grade-separated. There are two crossings with other railway lines, those being the grade-separated crossing of the Chicago & North Western near Milepost 93.5 and the at-grade crossing of the Soo Line at Duplainville. There are 13 bridges, none movable, over various watercourses.

The entire route is operated by timetable and train order authority, with train spacing assisted by automatic block signals (ABS). The "normal direction of traffic" utilizes the right-hand track. Turnouts at the east and west ends of the passenger station at Milwaukee are controlled by the operator at the Menomonee River drawbridge. Turnouts for the junctions at Cut-off Junction and Grand Avenue are controlled by the operator in the tower at Cut-Off Junction. At Duplainville, the at-grade crossing with the Soo Line Railroad is controlled by the operator at the Duplainville tower. This facility may be replaced in the near future with an automatic interlocking plant, which would not require an operator.

The four passenger depots remaining along this route are located at Milwaukee, Brookfield, Nashotah, and Oconomowoc. The depot building in downtown Milwaukee is owned by the Milwaukee Road and is currently used by the railroad for office space and by Amtrak for passenger facilities. The Brookfield depot building is owned by the Milwaukee Road and is currently used as a freight agent's office and as a base for maintenance-of-way forces. The platforms at the Brookfield depot are in a fair state of repair. The depot buildings located at Nashotah and Oconomowoc have been sold by the railroad to private parties; the 300-foot-long platforms at the Oconomowoc location are still intact. Should this route be utilized for commuter rail service, auxiliary trackage as well as facilities for the servicing and overnight storage of commuter train rolling stock would be required at the Oconomowoc station. As discussed in the section of this chapter on the potential commuter rail route between Milwaukee and Port Washington, such an installation would cost an estimated $200,000. Finally, there are two crossovers between the two main tracks at Oconomowoc for changing the direction of train movements.

The following maximum permissible passenger train speeds are designated over this route: 10 miles per hour (mph) through the passenger station at Milwaukee; 40 mph between Milwaukee and Grand Avenue; 35 mph through the junction at Grand Avenue and between Grand Avenue Junction and W. Harwood Avenue in Wauwatosa; and 70 mph between Wauwatosa and Oconomowoc. These passenger train speeds require maintenance of the track to Federal Railroad Administration Class 1, Class 2, Class 3, and Class 4 track safety standards, respectively.[24]

The existing condition of the track and roadbed east of Grand Avenue Junction does not permit the designated speeds to be achieved. Because of deferred track maintenance, present speeds have temporarily been lowered to 10 mph between Milepost 86.05, located at the passenger station at Milwaukee, and Milepost 86.2; 35 mph between Mileposts 86.2 and 87.1; 25 mph between Mileposts 87.1 and 87.2; and 35 mph between Mileposts 87.2 and 88.2—located at Grand Avenue Junction. Both main tracks between Milwaukee and Grand Avenue Junction are laid with 130-pound, 131-pound, and 132-pound sections of rail,[25] installed between 1930 and 1966. During the 1980 work season, this trackage is scheduled for complete rehabilitation, including cross-tie replacement, installation of new crushed rock ballast, and relaying of the existing rail with 132-pound continuous welded rail (CWR). This work will cost an estimated $1,991,000 (see Table 141) and may be expected to be completed prior to initiation of any commuter rail service, although the work is contingent upon federal approval of a "4R-Act" track rehabilitation loan.[26] Should the 4R-Act loan not be approved, the project would have to be financed through other means—possibly by the proposed commuter rail project.

The existing condition of the track and roadbed between Grand Avenue and Oconomowoc is good to very good, both main tracks being maintained to Federal Railroad Administration Class 4 track safety standards. The westbound main track consists of 131-pound rail laid in 1947, with the exception of three track miles of 131-pound rail laid in 1935 and one track mile of 132-pound rail laid in 1966. With some routine surface and alignment work in the near future, the westbound main track should continue to be capable of 70-mph passenger train speeds. The eastbound track consists of 23 track miles of 132-pound CWR laid in 1979 between Mileposts 93.0 and 116.0. The remaining segments of rail are of 131-pound sections laid in 1947. Cross-tie and ballast renewal have been extensive along the eastbound track, making 70-mph passenger train speeds attainable.

There are 10 at-grade public street and highway crossings between Grand Avenue and Oconomowoc that are not protected by automatic gates. The

Table 141

TRACK REHABILITATION ESTIMATE: MILWAUKEE TO GRAND AVENUE

Item	Quantity	Cost of Material and Installation
Cross Ties	8,800	$ 310,552
Crushed Rock Ballast	10,710 cubic yards	227,480
Continuous Welded Rail	4.35 track miles	789,117
Grade Crossing Work	270 linear feet	2,160
Grade Crossing Protection	2 crossings	280,000
Signal Work	Item	37,600
Turnout Rehabilitation	8 turnouts	188,000
Supervision	5 percent	91,745
Subtotal	--	$1,926,654
Contingencies	10 percent	$ 192,665
Less Salvage	--	128,000
Total		$1,991,319

Source: SEWRPC.

[24] *Federal Railroad Administration track safety standards are a detailed set of engineering standards that prescribe minimum requirements for the safe operation of freight and passenger trains over railroad lines that are a part of the general railroad transportation system. There are a total of six classes that apply to specific track conditions existing in isolation. These minimum safety standards should not be confused with good engineering design and construction standards.*

[25] *These numeric designations refer to the weight per linear yard of the rail.*

[26] *The "4R-Act" stands for the Railroad Revitalization and Regulatory Reform Act of 1976, passed to aid railroads in averting the problems associated with the operation of bankrupt railroads in the United States. Certain sections of the Act provide for financial assistance directly to the railroads in the form of loan guarantees and government purchases of redeemable preference shares at subsidized rates.*

cost of automatic grade-crossing signals with gates generally ranges from $130,000 to $150,000 per double-track crossing, depending upon the needs of the individual site. Such protection should be provided at all crossings, and would cost an average of $140,000 per crossing, or a total of $1,610,000 including supervision and contingencies for all public grade crossings without gates between Grand Avenue and Oconomowoc.

Altogether, rehabilitation of the trackage between the passenger station at Milwaukee and Oconomowoc, including the installation of the automatic crossing gates and the storage and service facility at Oconomowoc, would cost an estimated $3,801,000, of which $1,668,000 in improvements is projected to be accomplished by the Milwaukee Road in 1980 if the rehabilitation project proposed by the railroad proceeds. The cost of grade-crossing gate installation and storage facilities would have to be borne by the commuter rail project.

The trackage between the cities of Milwaukee and Oconomowoc is used by a daily average of one or two Amtrak intercity passenger trains in each direction and eight Milwaukee Road freight movements in each direction. The total freight movements are divided between a daily way freight or "patrol" and a varying number of time freights, unit coal trains, and trailer-on-flatcar trains. Trackage between Cut-Off Junction and Grand Avenue Junction is also used by numerous additional freight train movements operating between the freight classification yards in the Menomonee River Valley and the railway line to North Milwaukee Station. This segment of railway line is one of three potential locations on the overall line where significant delays to commuter trains could occur, the other two being the segments at Duplainville Station and Grand Avenue Junction.

An at-grade crossing with the Soo Line Railroad's Class A main line between Chicago and Minneapolis is located at Duplainville. If the tower at Duplainville is replaced by an automatic interlocking plant, Soo Line train movements that approach the facility first could delay Milwaukee Road and commuter train movements. The junction at Grand Avenue represents a potential point of congestion because of the short segment of single track, in addition to freight and switching movements to and from the North Milwaukee railway line as well as to and from Blue Mound Yard. This track arrangement has caused delays to trains on the main line in the past and could present a problem in the future with the addition of commuter train traffic to Oconomowoc and to the North Milwaukee railway line destined for Port Washington, Saukville, or West Bend. Alleviating this condition by constructing a second main track through the interlocking plant would entail a capital investment of about $300,000 for track and signal work.

In conclusion, it appears that the Milwaukee to Oconomowoc route over Milwaukee Road trackage has excellent potential for commuter train operation insofar as the physical and engineering aspects of the trackage are concerned. If the schedules for a proposed commuter train service can be coordinated with existing train movements and if the trackage between the Milwaukee passenger station and Grand Avenue is rehabilitated, this route would be capable of providing a high-speed, direct alignment for commuter trains between the City of Milwaukee and Waukesha County communities.

The total cost of rehabilitating the Milwaukee to Oconomowoc route for commuter train operations would be $3,801,000, not including the cost of purchasing rolling stock and of establishing and constructing passenger depot facilities. The renewal of automatic grade-crossing protection accounts for $1,932,000 of this total. If the Milwaukee Road completes all of its proposed track rehabilitation between the passenger station at Milwaukee and the junction at Grand Avenue, work that is scheduled for the 1980 season, the cost of rehabilitation for a proposed commuter rail project could be reduced by $1,668,000, resulting in a total cost of $2,133,000 for the route between Milwaukee and Oconomowoc.

Milwaukee to Kenosha

A potential commuter rail route serving the Milwaukee urbanized area extends from the passenger station, located at the intersection of S. 5th Street and W. St. Paul Avenue in downtown Milwaukee, to the station in Kenosha, located at 54th Street near downtown Kenosha. The 33.1-mile-long route would utilize trackage of the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road) between the Milwaukee passenger station and the connection at Washington Street, a distance of 1.6 miles. Trackage of the Chicago & North Western Transportation Company (C&NW) would be utilized between Washington Street and Kenosha, a distance of 31.5 miles. Within the Milwaukee urbanized area, the route passes through the communities of Milwaukee, St. Francis, Cudahy, South Milwaukee, and Oak Creek. South of the Milwaukee urbanized area, the route passes through the Cities of Racine and Kenosha, the unincorporated community of Tabor in the Town of Caledonia, and the Towns of Mt. Pleasant and Somers. This route would also serve the Racine and Kenosha urbanized areas and would connect with an existing commuter rail route to the City of Chicago.

This route is operated as two bi-directional main tracks between the passenger station at Milwaukee and Washington Street, and as a double-track railway line between the junction at St. Francis and Kenosha, a combined distance of 29.9 miles. Between Washington Street and St. Francis, a distance of 3.2 miles, the railway line is operated as a single-track switching line. The route consists of a portion of the Milwaukee Road main line between the Cities of Milwaukee and Chicago, a portion of the C&NW National Avenue spur track, and a portion of one of two C&NW main lines between the Cities of Milwaukee and Chicago. The route currently contains 10 stations, as listed by milepost in Table 142. The right-of-way width varies between 60 feet and 140 feet between the Milwaukee passenger station and Washington Street. Between Washington Street and Kenosha, the right-of-way width varies between 80 and 100 feet.

The horizontal alignment of the railway grade does not impose any significant limitation on passenger train operation. There are 30 horizontal curves along the entire route. Between Milwaukee and Washington Street, there is a curve of 3°45' in addition to a compound curve of 14°00' and 12°30' at the east end of the passenger station and a reverse curve of 10°00' and 9°30' on the bridges over S. 1st and E. Floria Streets. Between Washington Street and Kenosha, there are 26 horizontal curves on the eastbound track and 27 horizontal curves on the westbound track. All but nine curves on this segment are of 1°00' or less, while only two curves are greater than 2°00', these being a 3°48' curve and a compound curve of 1°30' and 2°34', both at the St. Francis junction. On the connection track between the two railways located at Washington Street there is a reverse curve of 2°22' and 5°30'.

The vertical alignment also imposes no significant limitation on passenger train operation. Between the passenger station at Milwaukee and Washington Street, the grade ascends in an easterly direction immediately east of the depot at an average grade of 0.70 percent for a distance of 0.6 mile before becoming generally level to Washington Street. South of Washington Street, the grade descends in an easterly direction for about 0.9 mile, the steepest part of the segment being a gradient of 0.75 between Washington Street and Milepost 82.6, and then ascends in an easterly direction to Cudahy, the steepest parts of this segment being a 0.70 percent gradient between Mileposts 81.2 and 79.8 and a 0.78 percent gradient between Mileposts 79.4 and 77.9. The railway grade then descends in an easterly direction on a 0.75 percent gradient for a distance of 1.4 miles into South Milwaukee before again ascending to a crest at Milepost 70.3 at an average gradient of about 0.23 percent for a distance of 5.0 miles. Between Mileposts 70.3 and 61.5 in the City of Racine, the grade descends in an easterly direction at an average gradient of 0.2 percent. Grades between Racine and Kenosha are moderate, with two short 0.57 percent grades ascending in an eastbound direction at Milepost 55.0 and Milepost 53.0. There are also two short easterly descending grades, one of 0.50 percent at Milepost 55.6 and one of 0.25 percent at Milepost 54.0.

Table 142

EXISTING RAILWAY STATIONS ON THE MILWAUKEE TO KENOSHA COMMUTER LINE

Milepost	Station Name[a]	Distance (miles)
	The Milwaukee Road	
85.7	Milwaukee (passenger station)	0.0
84.1	Washington Street	1.6
	The Chicago & North Western	
82.5	Kinnickinnic River Bridge	2.2
79.9	St. Francis	4.8
78.2	Cudahy	6.5
74.7	South Milwaukee	10.0
72.6	Oak Creek	12.1
60.5	Racine	24.2
51.6	Kenosha	33.1

[a] *Stations are specific locations designated by the operating timetable and do not necessarily denote the existence of depot buildings or other facilities.*

Source: The Chicago, Milwaukee, St. Paul & Pacific Railroad Company and the Chicago & North Western Transportation Company.

There are no vertical or horizontal clearance restrictions that would prohibit the use of conventional or new commuter train rolling stock over this route. In fact, bi-level gallery coaches have been operated over this entire route in the past.

Most of the route is well located on the natural grade of the surrounding topography. Between the Menomonee River drawbridge and Washington Street—a distance of 1.2 miles—and between 36th Street and the passenger depot in the City of Kenosha—a distance of 1.3 miles—the trackage is located on a fill. There are a total of 73 public street and highway crossings on this route, of which 51 are at-grade and 22 are grade-separated. Of the 51 at-grade crossings, 49 are protected by automatic grade-crossing signals, 42 of which have gates in addition to flashing lights. Automatic crossing signals with gates would be required at all crossings for 60-mile-per-hour passenger train operation and would cost an average of $140,000 per crossing.[27] There are a total of five at-grade private crossings on this route and three pedestrian crossings, two of which are grade-separated. In addition, there are two crossings with other railway lines, one with the Milwaukee Road's Bay View spur at Tower BA, and the other with the Milwaukee Road's Thirty-First Subdivision—Wisconsin Division—branch line at the present station at Racine, formerly referred to as Racine Junction. Finally, there are six bridges, two of which are movable drawbridges, over watercourses—one over the Menomonee River at the east end of the passenger station at Milwaukee and the other over the Kinnickinnic River at Milepost 82.5.

The entire route is operated by timetable and train order authority, with train spacing assisted by automatic block signals (ABS) over the entire route, and automatic train stop (ATS) between St. Francis and Kenosha. Any locomotives or self-propelled coaches that would operate over this route would have to be equipped for ATS. The "normal direction of traffic" utilizes the right-hand track while on Milwaukee Road trackage and the left-hand track while on C&NW trackage. Train movements between the Menomonee River drawbridge—located just east of the passenger station at Milwaukee—and Washington Street are governed by centralized traffic control (CTC), controlled by the dispatcher at Milwaukee. Turnouts at the east and west ends of the Milwaukee passenger station are controlled by the operator at the Menomonee River drawbridge. The at-grade railway crossings with the Milwaukee Road at Tower BA and Racine are both automatic interlocking plants, which do not require an operator.

The seven passenger depots remaining along this route are located at Milwaukee, E. National Avenue in Milwaukee, Cudahy, South Milwaukee, Oak Creek, Racine, and Kenosha. The depot building in downtown Milwaukee is currently owned and used by the Milwaukee Road for office space and by Amtrak for passenger facilities. The depot building at E. National Avenue—formerly referred to as the Allis Station—is leased to a private organization. The Cudahy depot building has been sold by the C&NW to the Cudahy Historical Society for use as a historical museum. The South Milwaukee and Oak Creek depot buildings are still owned and used by the railway for storage and maintenance purposes. Except for the Milwaukee passenger station, the platforms of these stations are no longer intact; only short segments remain and they are in poor condition.

The Racine passenger depot—located at the W. State Street crossing, 1.4 miles north of the present station at Racine—is a brick building with brick platforms that are 600 feet long. Both the building and the platforms are in poor condition. The City of Racine has proposed renovation of this depot in connection with a proposal to extend to Racine the Chicago area Regional Transportation Authority (RTA) commuter train service that now operates between Chicago and Kenosha.

The passenger depot at the Kenosha station consists of a building and a 750-foot-long blacktop and asphalt center island platform between the two main tracks. The City of Kenosha has proposed renovation of the depot, which is in fair to good the condition, in connection with the development of nearby transit mall and public safety building. The depot is currently utilized by the C&NW and the RTA, which operate commuter train service to Chicago. Although the C&NW has some storage and servicing facilities for the existing commuter train service near the Kenosha station, a commuter train operation between Milwaukee and Kenosha would require additional storage track space plus either the addition to, or improvement of, the existing servicing facilities. The total cost of such

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[27] *The cost of installing automatic grade crossing signals with gates generally ranges between $130,000 and $150,000, and in some cases can be as high as $180,000 per double-track crossing depending upon the complexity of the individual installation.*

improvements would be $200,000. There are three crossovers between the two main tracks for changing the direction of train movements at Kenosha.

The following maximum permissible passenger speeds are designated over this route: 10 miles per hour (mph) through the Milwaukee passenger station and in an easterly direction as far as the Menomonee River drawbridge; 30 mph between the Menomonee River drawbridge and Washington Street; 10 mph between Washington Street and St. Francis; and 25 mph through the junction at St. Francis. Between St. Francis and Kenosha, the designated timetable speed limit for all train movements is 60 mph, with speed restrictions of 40 mph through St. Francis, Cudahy, Racine, and Kenosha. Temporary speed restrictions, however, do not permit these speeds to be achieved, and actual operating speeds between St. Francis and Kenosha are rarely greater than 30 mph, implying the existence of track conditions that meet Class 2 Federal Railroad Administration track safety standards.

The practical operation of commuter trains over this route would require greater maximum speeds on the segment between Washington Street and Kenosha. For purposes of this inventory and assessment, such desirable speeds are assumed to be 40 mph between Washington Street and Milepost 79.9—south of the Cudahy station—between Milepost 63.2 and Milepost 58.8—both within the City of Racine—and between Milepost 54.2 and Milepost 51.6—both in the vicinity of the Kenosha station. Elsewhere, the maximum desirable speed for commuter trains is 60 mph. These passenger train speeds require maintenance of the track to Federal Railroad Administration Class 1 track safety standards between the passenger station at Milwaukee and the Menomonee River drawbridge, Class 2 track safety standards between the Menomonee River drawbridge and Washington Street, and Class 3 track safety standards over the remainder of the route.

The trackage and roadbed between the passenger station at Milwaukee and the junction at Washington Street is in fair to good condition and currently meets Class 2 track safety standards. However, to ensure this rating as well as to continuously operate passenger trains over this railway line at 30 mph, some track rehabilitation work is necessary. Both main tracks are laid with either 130-pound, 131-pound, or 132-pound rail installed between 1940 and 1963. This track is now worn and contains defects. During the 1980 working season this trackage is scheduled for rehabilition, including cross-tie replacement, installation of new crushed rock ballast, and relaying of the existing rail with 132-pound continuous welded rail (CWR). This work will cost an estimated $921,000 (see Table 143), and may be expected to be completed prior to installation of any commuter rail service. The work, however, is contingent upon federal approval of a "4R-Act" track rehabilitation loan.[28] Should the 4R-Act loan not be approved, the project would have to be financed through other means—possibly by the proposed commuter rail project.

The existing condition of the track and roadbed between Washington Street and Kenosha can be classified as fair, a result of deferred maintenance since intercity passenger train service was discontinued in 1971. Both main tracks are laid with a combination of 110-pound, 112-pound, and 115-pound bolted rail installed between 1929 and 1963, with most of the rail having been installed during the 1930's and 1950's. Between Milepost 70.0 and Milepost 74.0, the westbound track is laid with 115-pound CWR installed during 1964 and 1966. To enable 60-mph commuter train operation, a significant amount of track rehabilitation, such as cross-tie renewal, track alignment, and track surfacing, would be required. In addition, there are two segments of single track, together totaling 4,000 feet in length, that would have to be replaced between Washington Street and St. Francis. These two segments of trackage were converted from double track to single track foll lowing the discontinance of all intercity passenger train operation by the C&NW in 1971. As shown in Table 144, this work, including the grade-crossing protection renewal work projected to be necessary, would cost an estimated $7,393,000.

Altogether, rehabilitation of the trackage between the passenger station at Milwaukee and Kenosha, including the replacement of portions of the double-track railway line between Washington

[28] *The "4R-Act" stands for the Railroad Revitalization and Regulatory Reform Act of 1976, passed to aid railroads in averting the problems associated with the operation of bankrupt railroads in the United States. Certain sections of the Act provide for financial assistance directly to the railroads in the form of loan guarantees and government purchases of redeemable preference shares at subsidized rates.*

Table 143

TRACK REHABILITATION ESTIMATE: MILWAUKEE TO WASHINGTON STREET

Item	Quantity	Cost of Material and Installation
Cross Ties	2,035	$ 71,815
Crushed Rock Ballast	5,520 cubic yards	73,526
Continuous Welded Rail	2.4 track miles	435,410
Turnout Rehabilitation	10 turnouts	277,544
Supervision	5 percent	42,915
Subtotal	- -	$901,210
Contingencies	10 percent	$ 90,121
Less Salvage	- -	70,626
Total		$920,705

Source: SEWRPC.

Table 144

TRACK REHABILITATION ESTIMATE: WASHINGTON STREET TO KENOSHA

Item	Quantity	Cost of Material and Installation
Cross Ties	44,800	$1,580,992
Track Alignment and Surfacing	56.6 miles	1,195,392
115-Pound Rail	6.0 track miles	1,108,800
Rail Joint Renewal	3,500 feet	52,500
Grade Crossing Work	764 feet	84,040
Grade Crossing Protection	9 crossings	1,260,000
Turnout Rehabilitation	12 turnouts	708,000
Roadbed Widening	Item	8,000
New Track Installation	4,000 feet	292,000
New No. 16 Turnout Installation	4 turnouts	132,000
Railway Crossing Diamond	1 diamond	35,000
Signal Work	Item	100,000
Supervision	5 percent	327,836
Subtotal	- -	$6,884,560
Contingencies	10 percent	$ 688,456
Less Salvage	- -	180,000
Total		$7,393,016

Source: SEWRPC.

Street and St. Francis as well as the installation of automatic crossing gates at all public street and highway crossings that do not now have such gates, would cost an estimated $8,514,000, of which $921,000 in improvements is proposed to be accomplished by the Milwaukee Road in 1980 if the rehabilitation project proposed by the railroad proceeds. Failure of the Milwaukee Road to obtain the necessary funding for the track rehabilitation between Milwaukee and Washington Street may place the financial burden of such work on other sources, including any new proposed commuter rail project. The cost of track rehabilitation between Washington Street and Kenosha, as well as the cost of replacing the short segments of double track and of grade-crossing protection renewal, would have to be borne by any proposed commuter rail project.

The trackage between the passenger station at Milwaukee and Washington Street is shared with Chicago-Twin Cities mainline traffic of both the Milwaukee Road and Amtrak, and also with Chicago-Milwaukee Amtrak trains. There are currently six daily intercity passenger trains in each direction—five in each direction on Sundays—plus 12 daily freight trains in each direction between Milwaukee and Chicago. About half of these freight train movements can be expected to use the "passenger main line" between the passenger station and Washington Street, while the remaining freight train movements operate to and from Muskego Yard, necessitating use of the "freight main line" adjacent to the passenger main line between Washington Street and E. Florida Street. Generally, the long-distance intercity time freight and trailer-on-flatcar trains will use the trackage through the passenger station. In addition, there is some switching activity over this segment on weekdays.

The trackage between Washington Street and St. Francis carries one daily time freight in each direction between National Avenue and Chicago plus two local switch runs on weekdays, one that operates in the 3rd Ward near E. National Avenue and the other that operates between Mitchell Yard and the Jones Island area.

South of St. Francis, any proposed commuter train service would share trackage with C&NW Chicago-Milwaukee-Twin Cities mainline freight traffic. The C&NW operates between 17 and 20 freight train movements between Milwaukee and Chicago over the Kenosha Subdivision through the Cities of Racine and Kenosha, and over the New Line Subdivision, which roughly parallels the Kenosha Subdivision but west of Racine and Kenosha. The number of train movements that are dispatched over each of the two routes varies according to daily traffic conditions. However, at least half of the trains may be expected to be routed over the Kenosha Subdivision trackage. Local switching activity also occurs, switching crews being based at Cudahy, Racine, and Kenosha.

Delays to commuter trains could occur at two locations on this route. The first is Washington Street, where commuter trains would have to enter and leave the Milwaukee Road main line. This station is extensively used by a large number of local, transfer, intercity freight, and intercity passenger trains. In addition, immediately north of Washington Street there is the possibility of freight trains switching to and from the "freight main line" to enter or leave Muskego Yard. The second location is the junction at St. Francis, which is a wye-track arrangement providing a connection between four C&NW railway lines. The wye track plus the four approaches are single track, a condition which could create congestion and train movement backups. Installation of a second track through one leg of the junction would help to alleviate the potential congestion problem.

In conclusion, it appears that the Milwaukee to Kenosha route over Milwaukee Road and C&NW trackage has good potential for commuter train operation insofar as the physical and engineering aspects of the trackage are concerned. This potential, however, is dependent on the rehabilitation of the track along the entire route, and on the reconstruction of two small lengths of double track. In addition, automatic crossing gates and flashing lights would need to be installed at certain public street and highway crossings. Finally, the schedules of any new commuter train service would have to be coordinated with the schedules of existing train movements.

The total cost of rehabilitating the Milwaukee to Kenosha route for commuter train operation would be $8,514,000, not including the cost of purchasing rolling stock and of establishing and constructing or reconstructing passenger depot facilities. The renewal and installation of automatic grade-crossing protection accounts for $1,449,000 of this total. If the Milwaukee Road completes the proposed track rehabilitation project between the passenger station at Milwaukee and the connection to the C&NW at Washington Street, work that is scheduled for the 1980 season, the cost of track rehabilitation for a proposed commuter rail project could be reduced by $921,000, resulting in a total cost of $7,593,000 for the route between Milwaukee and Kenosha.

Milwaukee to Waukesha

A potential commuter rail route serving the Milwaukee urbanized area extends from the passenger station, located at the intersection of S. 5th Street and W. St. Paul Avenue in downtown Milwaukee, to the station at Waukesha, located at the N. Barstow Street crossing in the City of Waukesha. This 19.7-mile-long route would utilize trackage of the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road) between the Milwaukee passenger station and a proposed connection at E. Lincoln Avenue, a distance of 2.9 miles. Trackage of the Chicago & North Western Transportion Company (C&NW) would be utilized between Lincoln Avenue and Waukesha, a distance of 16.8 miles. The entire route is within the Milwaukee urbanized area, passing through the communities of Milwaukee, West Milwaukee, West Allis, New Berlin, and Waukesha.

This route is operated as two bi-directional main tracks between the Milwaukee passenger station and E. Lincoln Avenue, and as a double-track railway line between the junctions at Chase and at Belton, a combined distance of 8.6 miles. Between the junctions at E. Lincoln Avenue and Chase, and between the stations at Belton and Waukesha, a combined distance of 11.1 miles, the railway line is operated as a single-track line. The route consists of a portion of the Milwaukee Road's Chicago to Milwaukee main line, a portion of the C&NW Chase spur track, a portion of the C&NW Chicago to Twin Cities main line, and a portion of the C&NW branch line between the Cities of Milwaukee and Madison. There are currently 11 stations along this route, as listed by milepost in Table 145. The right-of-way width varies from 40 feet to 100 feet between the passenger station at Milwaukee and the proposed connection track at E. Lincoln Avenue and between 75 feet and 100 feet between Chase Junction and the West Allis station, is generally 160 feet between West Allis and the junction at Belton, and is generally 100 feet between Belton and Waukesha Station.

The horizontal alignment of the railway grade does not impose any significant limitations on passenger train operation. Between Milwaukee and Washington Street, there is a curve of $3^{o}45'$ in addition to a compound curve of $14^{o}00'$ and $12^{o}30'$ at the east end of the passenger station and a reverse curve of $10^{o}00'$ and $9^{o}30'$ on the bridges over S. 1st and E. Florida Streets. Between Washington Street and the proposed connection track at E. Lincoln Avenue, there is only one short curve of $2^{o}00'$. On the Chase spur track there is also only one curve, that being a compound curve of $2^{o}58'$ and $2^{o}59'52''$. Between the junctions at Chase and Belton, there are four curves, all of $2^{o}29'$ or less.

Table 145

EXISTING RAILWAY STATIONS ON THE MILWAUKEE TO WAUKESHA COMMUTER RAIL ROUTE

Milepost	Station Name[a]	Distance (miles)
	The Milwaukee Road	
85.7	Milwaukee (passenger station) . .	0.0
84.1	Washington Street	1.6
83.4	Kinnickinnic Bridge	2.3
82.8	Lincoln Avenue[b].	2.9
	The Chicago & North Western	
3.6	Chase	3.8
5.5	Mitchell Yard.	5.7
8.5	West Allis	8.7
9.3	Belton	9.5
14.2	New Berlin	14.4
17.7	Halls Siding	17.9
19.5	Waukesha	19.7

[a] *Stations are specific locations designated by the operating timetable and do not necessarily denote the existence of depot buildings or other facilities.*

[b] *This station is proposed as a connection between the two railroads.*

Source: The Chicago, Milwaukee, St. Paul & Pacific Railroad Company and the Chicago & North Western Transportation Company.

At Belton-west wye, there is a reverse curve consisting of a pair of 1°00' curves. From Belton-west wye to Waukesha, the track is tangent for 8.0 miles. At the station in Waukesha, there are three small curves, all being no greater than 2°30'. On the proposed connection track located at W. Lincoln Avenue, there are two curves of 6°00'.

The vertical alignment also imposes no significant limitations on passenger train operation. Between the passenger station at Milwaukee and W. Lincoln Avenue, the grade ascends in an easterly direction immediately east of the depot at an average grade of about 0.70 percent for a distance of 0.6 mile before becoming generally level to W. Lincoln Avenue. On the C&NW trackage, the gradient is level on the Chase spur track but is generally on a westerly ascending grade with an average gradient of 0.50 percent between Chase Junction and Belton Junction. The steepest grade on this segment is 1.03 percent and occurs between Milepost 7.0 and Milepost 7.5. Between the junction at Belton and Waukesha the grade is undulating, with the steepest grades being a westerly ascending average gradient of 0.86 for a distance of 2.6 miles from Milepost 10.6 to Milepost 13.2 and a westerly descending gradient of 0.79 from Milepost 18.6 to Milepost 19.4.

There are no vertical or horizontal clearance restrictions that would prohibit the use of conventional or new commuter train rolling stock over this route. In fact, bi-level gallery coaches have been operated over the Milwaukee Road portion of this route in the past.

The route is located on a fill between the Menomonee River drawbridge and the C&NW overpass at W. Chase Avenue—a distance of about 1.8 miles—and in a cut between the junction at Chase and Mitchell Yard—a distance of 1.9 miles. The proposed connection track between the C&NW and the Milwaukee Road at E. Lincoln Avenue would also be located on a fill. The remaining trackage between Mitchell Yard and the City of Waukesha is well located on the natural grade of the surrounding topography except between West Allis and Belton Junction, where there are some short cuts and fills. There are a total of 55 public street and highway crossings on this route, of which 26 are at-grade and 29 are grade-separated. All of the 26 at-grade crossings are protected by automatic grade crossing signals, 12 of which have gates in addition to flashing lights. If this route were utilized as a primary transit facility, automatic crossing signals with gates would be required at all crossings for 60-mile-per-hour passenger train operation, and would cost an average of $60,000 per single-track crossing and $140,000 per double-track crossing.[29] There are a total of three private crossings on this route, of which two are at-grade and one is grade-separated, as well as one at-grade pedestrian crossing and one grade-separated pedestrian crossing. There is one grade-separated crossing with

[29] *The cost of installing automatic grade-crossing signals with gates ranges from $45,000 to $90,000 per single-track crossing and $130,000 to $180,000 per double-track crossing. The simplest installation would consist of two masts, each with flashing lights and a gate, an electric cabinet, and the necessary wiring and other signal work to create the track circuits for a simple single-track crossing of a two-lane street or highway. The cost of a crossing signal installation would depend on the site-specific needs of each location, such as the need for additional masts, gates, lights, a complex track configuration at the crossing, or coordination with highway traffic signals.*

a railway spur track at E. Lincoln Avenue. There are seven bridges, two of which are movable drawbridges over watercourses one over the Menomonee River at the east end of the passenger station at Milwaukee and the other over the Kinnickinnic River at Milepost 83.4.

The entire route is operated by timetable and train order authority, with train spacing assisted by automatic block signals (ABS) between the Milwaukee passenger station and the proposed track connection with the C&NW at E. Lincoln Avenue and between the junctions at Chase and at Belton. At present, the segment of this route on the Chase spur track between the proposed connection track with the Milwaukee Road and Chase Junction is operated as an industrial switching track. The segment of this route between Belton Junction and Waukesha is governed solely by timetable and written train order authority. The south leg of the wye track at Belton—which would be a necessary segment of this route—is frequently utilized by the C&NW as a freight car storage track. The "normal direction of traffic" utilizes the right-hand track while on Milwaukee Road trackage and the left-hand track while on C&NW trackage. Train movements between the Menomonee River drawbridge—located just east of the passenger station at Milwaukee—and the proposed connection between the Milwaukee Road and the C&NW railway line at E. Lincoln Avenue are governed by centralized traffic control (CTC), controlled by the dispatcher at Milwaukee. Turnouts at the east and west ends of the Milwaukee passenger station are controlled by the operator at the Menomonee River drawbridge. Turnouts that must be thrown for the Milwaukee-Waukesha route at Chase and Belton Junctions are manually controlled.

The four passenger depots remaining along this route are located at Milwaukee, E. National Avenue in Milwaukee, West Allis, and Waukesha. The depot building in downtown Milwaukee is currently owned and used by the Milwaukee Road for office space and by Amtrak for passenger facilities. The depot building at E. National Avenue—formerly referred to as the Allis Station—is leased to a private organization. The depot building at West Allis is currently owned and used by the C&NW for storage. This building is in poor condition, the platforms having been removed. The Waukesha passenger depot has been sold by the C&NW to a private concern, which remodeled the building and platforms into a restaurant. The C&NW maintains a small office building for the local agent west of the N. Barstow Street grade crossing. There are, however, no platforms at this location. Auxiliary trackage as well as facilities for the servicing and overnight storage of commuter train rolling stock would be required at Waukesha Station. The total cost of such an installation would be $200,000.

The following maximum permissible passenger train speeds are designated over this route: 10 miles per hour (mph) through the Milwaukee passenger station and in an easterly direction as far as the Menomonee River drawbridge; 30 mph between the Menomonee River drawbridge and Washington Street; 40 mph between Washington Street and E. Lincoln Avenue; 10 mph between E. Lincoln Avenue and Chase Junction; 40 mph between Chase Junction and Belton Junction; 10 mph between Belton Junction and Belton-west wye; and 30 mph between Belton-west wye and Waukesha. The practical operation of commuter trains over this route would require greater maximum speeds on the segment between the proposed junction at E. Lincoln Avenue and Waukesha. For purposes of this inventory and assessment, such desirable speeds are assumed to be 40 mph between E. Lincoln Avenue and Belton-west wye, 60 mph between Belton-west wye and Halls Siding, and 30 mph between Halls Siding and Waukesha. These passenger train speeds require maintenance of the track to Federal Railroad Administration Class 1 track safety standards between the passenger station at Milwaukee and the Menomonee River drawbridge, Class 2 track safety standards between the Menomonee River drawbridge and Washington Street, Class 3 track safety standards between Washington Street and Halls Siding, and Class 2 track safety standards between Halls Siding and Waukesha.

The trackage and roadbed between the passenger station at Milwaukee and E. Lincoln Avenue are in fair to good condition and currently meet Class 2 track safety standards on the No. 1 main track and on the No. 2 main track west of Washington Street.[30] East of Washington Street, the No. 2 main

[30] *This segment of Milwaukee Road trackage is operated with CTC as two bi-directional main tracks, both tracks equipped with signals aimed in both directions. This allows greater dispatching efficiencies than available on an ordinary double-track railway line since trains may be operated over either track at full speeds with full protection. On this segment of trackage, the No. 1 main track is considered to be the westbound main while the No. 2 main track is considered to be the eastbound main.*

track meets Class 3 track safety standards. However, In order to ensure this rating as well as to continuously operate passenger trains over this segment at 30 mph and 40 mph, some track rehabilitation work will be necessary. Both main tracks are laid with either 130-pound, 131-pound, or 132-pound rail, generally installed between 1940 and 1963. This trackage is now worn and contains defects. During the 1980 work season, this trackage is scheduled for rehabilitation, including cross-tie replacement, installation of new crushed rock ballast, and relaying of the existing rail with 132-pound continuous welded rail (CWR). This work will cost an estimated $1,786,000 (see Table 146), and may be expected to be completed prior to initiation of any commuter rail service. The work, however, is contingent upon federal approval of a "4R-Act" track rehabilitation loan.[31] Should the 4R-Act loan not be approved, the project would have to be financed through other means, including—possibly by the proposed commuter rail project.

The condition of the track and roadbed between Chase and Belton Junctions can be classified as fair to good. Most of the rail on both main tracks is 112-pound rail laid during the 1930's and 1940's. There is one short segment of 112-pound rail laid in 1962 and three short segments of 112-pound CWR laid in 1976 and 1977. To enable this track to be maintained at Class 3 track safety standards and to be satisfactory for commuter train operation, some track rehabilitation work will be necessary, including cross-tie and switch-tie renewal, track alignment, and track surfacing. As shown in Table 147, this work, including the grade-crossing protection renewal work projected to be necessary, would cost an estimated $762,000.

The existing condition of the track between Belton Junction and Waukesha Station is fair. All of the rail is second-hand 100-pound rail laid in the 1920's and 1930's. Rolled in 1911 and 1912, this rail is old and badly surface worn, with some end batter. To enable 60-mile-per-hour commuter train operation, a major track rehabilitation effort would be necessary on this segment, including cross-tie replacement and relaying of the existing rail with 115-pound CWR. This work would cost an estimated $4,084,000, as shown in Table 148.

In addition, a connection track must be constructed between the Milwaukee Road main line and the C&NW Chase spur track. It is proposed that such a connection be effected south of the E. Lincoln Avenue overpass. Unlike the connection tracks necessary for some of the other potential commuter rail routes inventoried within this

[31] *The "4R-Act" stands for the Railroad Revitalization and Regulatory Reform Act of 1976, passed to aid railroads in averting the problems associated with the operation of bankrupt railroads in the United States. Certain sections of the Act provide for financial assistance directly to the railroads in the form of loan guarantees and government purchases of redeemable preference shares at subsidized rates.*

Table 146

TRACK REHABILITATION ESTIMATE: MILWAUKEE TO PROPOSED CONNECTION WITH C&NW AT E. LINCOLN AVENUE

Item	Quantity	Cost of Material and Installation
Cross Ties	7,400	$ 261,146
Crushed Rock Ballast.	10,840 cubic yards	144,389
Continuous Welded Rail . . .	5.2 track miles	943,390
Turnout Rehabilitation. . . .	10 turnouts	327,352
Supervision	5 percent	83,814
Subtotal	- -	$1,760,091
Contingencies	10 percent	$ 176,009
Less Salvage	- -	150,000
Total		$1,786,100

Source: SEWRPC.

Table 147

TRACK REHABILITATION ESTIMATE: CHASE JUNCTION TO BELTON JUNCTION

Item	Quantity	Cost of Material and Installation
Cross Ties	4,430	$156,335
Track Alignment and Surfacing	11.1 track miles	234,432
Rail Joint Renewal	370 rail joints	5,500
Grade Crossing Work	175 linear feet	7,875
Grade Crossing Protection . .	1 crossing	140,000
Turnout Rehabilitation. . . .	575 switch ties	100,625
Signal Work	Item	15,000
Supervision	5 percent	32,988
Subtotal	- -	$692,755
Contingencies	10 percent	$ 69,276
Total		$762,031

Source: SEWRPC.

Table 148

TRACK REHABILITATION ESTIMATE: BELTON JUNCTION TO WAUKESHA

Item	Quantity	Cost of Material and Installation
Cross Ties	8,625	$ 394,376
Crushed Rock Ballast	5,125 cubic yards	46,125
Track Alignment and Surfacing	10.26 track miles	216,690
Continuous Welded Rail	10.26 track miles	1,861,370
Grade Crossing Work	300 linear feet	13,500
Grade Crossing Protection	13 crossings	780,000
Signal Work	Item	110,000
Turnout Rehabilitation	16 turnouts	376,000
Supervision	5 percent	185,403
Subtotal	--	$3,983,464
Contingencies	10 percent	$ 398,346
Less Salvage	--	297,819
Total		$4,083,991

Source: SEWRPC.

Table 149

TRACK REHABILITATION ESTIMATE: CONSTRUCTION OF CONNECTION BETWEEN MILWAUKEE MAIN LINE AT E. LINCOLN AVENUE AND C&NW MAIN LINE AT CHASE JUNCTION

Item	Quantity	Cost of Material and Installation
Embankment Construction	14,000 cubic yards	$ 70,000
New Track Installation	1,000 track feet	73,000
No. 16 Turnout	1 turnout	33,000
No. 10 Turnout	1 turnout	19,700
Corrugated Iron Pipe	58 linear feet	2,030
Cross Ties	1,230	43,407
Crushed Rock Ballast	2,020 cubic yards	26,906
Roadbed Widening	Item	5,000
Continuous Welded Rail	4,000 track feet	137,400
Signal Work	Item	250,000
Supervision	5 percent	33,022
Subtotal	--	$693,465
Property Acquisition[a]	1.35 acres	$ 35,000
Contingencies	10 percent	$ 72,846
Less Salvage	--	22,000
Total		$779,311

Source: SEWRPC.

chapter, this connection would involve the construction of a completely new segment of track, including property acquisition, earthwork, and rehabilitation of a portion of the Chase spur track. This work would cost an estimated $779,000, as shown in Table 149.

Altogether, rehabilitation of the trackage between the passenger station at Milwaukee and Waukesha, including construction of the required connection at E. Lincoln Avenue and the installation of automatic crossing gates at all public street and highway crossings that do not now have such gates, would cost $7,611,000, of which $1,786,000 in improvements is proposed to be accomplished by the Milwaukee Road in 1980 if the rehabilitation project proposed by the railroad proceeds. Failure of the Milwaukee Road to obtain the necessary funding for the track rehabilitation between Milwaukee and E. Lincoln Avenue may place the financial burden of such work on other funding sources—including possibly the proposed commuter rail project. The cost of track rehabilitation between Chase Junction and Waukesha, of constructing the track connection between the Milwaukee Road and C&NW railway lines, and of grade-crossing protection renewal would have to be borne by any proposed commuter rail project.

The trackage between the passenger station at Milwaukee and the proposed junction at E. Lincoln Avenue is shared with Chicago-Twin Cities and Chicago-Milwaukee mainline traffic of both the Milwaukee Road and Amtrak. There are currently six daily intercity passenger trains in each direction—five in each direction on Sundays—plus 12 daily freight trains in each direction between Milwaukee and Chicago. About half of these freight train movements can be expected to use the "passenger main line" between the passenger station and the Kinnickinnic River drawbridge, while the remaining freight movements operate to and from Muskego Yard, necessitating use of the "freight main line" adjacent to the passenger main line between the Kinnickinnic River drawbridge and E. Florida Street. Generally, the long-distance intercity time freight and trailer-on-flatcar trains will use the trackage through the passenger station. In addition, there is some switching activity over this segment on weekdays.

There is one weekday local switch run over the Chase spur track. West of Chase Junction, the C&NW operates between 15 and 18 freight train movements on the main line in each direction between Chase and Belton Junctions. Some of these trains stop at Mitchell Yard, located at the S. 35th Street overpass, to set out or pick up freight cars. The configuration of trackage in this area dictates that such switching be performed while the train is stopped on the main line, thus blocking other train movement. Local switching activity also occurs along the segment between Chase and Belton Junctions, with switching crews based at Mitchell Yard.

Between Belton-west wye and Waukesha, one daily time freight operates in each direction between Butler Yard and Madison, and one local weekday switch run operates from Butler to Waukesha and return. The local switch run operates in the vicinity of the New Berlin and Waukesha Stations.

Delays to commuter trains could occur at two locations on this route. The first is the Kinnickinnic River drawbridge, where the passenger main line from the Milwaukee passenger station and the freight main line from Muskego Yard converge to form the Milwaukee Road's main line to Chicago. Trackage at this location is used by a large number of local, transfer, intercity freight, and intercity passenger trains. Thus, congestion could occur at this location with the addition of commuter trains, which would have to be switched onto the C&NW connection track immediately south of the drawbridge. The second location is Mitchell Yard where, as noted above, freight trains must occupy the main line in order to set out and pick up freight cars.

In conclusion, it appears that the Milwaukee to Waukesha route over Milwaukee Road and C&NW trackage has good potential for commuter train operation insofar as the physical and engineering aspects of the trackage are concerned. This potential, however, is dependent upon the rehabilitation of trackage along the entire route to varying degrees, and the construction of the required connection between the Milwaukee Road and C&NW at E. Lincoln Avenue. In addition, automatic crossing gates and flashing lights would need to be installed at certain public street and highway crossings. Finally, the schedules of any new commuter train service would have to be coordinated with the schedules of existing train movements.

The total cost of rehabilitating the Milwaukee to Waukesha route for commuter train operations would be $7,611,000, not including the cost of purchasing rolling stock and of establishing and constructing or reconstructing passenger depot facilities. The renewal and installation of automatic grade-crossing protection accounts for $1,058,000 of this total. If the Milwaukee Road completes the proposed track rehabilitation project between the passenger station at Milwaukee and the proposed connection with the C&NW at E. Lincoln Avenue, work that is scheduled for the 1980 work season, the cost of track rehabilitation for a proposed commuter rail project could be reduced by $1,786,000, resulting in a total cost of $5,825,000 for the route between Milwaukee and Waukesha.

SUMMARY

The ready availability of alignments for exclusive primary transit guideways in an area must be assessed in any primary transit alternatives analysis. Such availability can significantly affect the cost and practicality of alternative system configurations and of alternative transit modes. This chapter has presented the findings of an inventory of the extent, location, and physical characteristics of such potential fixed guideway alignments in the greater Milwaukee area. The inventory was conducted to determine the potential location of exclusive light rail, heavy rail, or bus guideway alignments. It included an analysis of abandoned electric interurban railway rights-of-way, electric power transmission line rights-of-way, freeway rights-of-way, and active and abandoned railway rights-of-way and, for potential commuter rail routes, an analysis of existing railway lines.

In any consideration of the findings of this inventory, it must be recognized that the desirability of any particular transit alignment will be determined not only by the cost and disruption attendant to its development, but also by the land uses and potential travel demand which the alignment might serve. An existing, readily available right-of-way that is not properly located with respect to major potential transit trip generators and major travel desire lines may have little utility for primary transit development. Also, it should be recognized that some types of primary transit technology, if accorded adequate preferential treatment at street intersections, can provide an adequate level of primary transit service even if not developed on a totally exclusive right-of-way, as these technologies can utilize surface arterial street boulevard medians or reserved lanes. Thus, the findings of this inventory must be regarded as only one consideration in the design and evaluation of alternative primary transit facility alignments and system configurations.

Abandoned Electric Interurban and Street Railway Rights-of-Way

It is especially important in this assessment of potentially available rights-of-way to consider the current status of the former electric interurban and street railway rights-of-way in the Milwaukee area, since such rights-of-way were once used for light rail guideway locations. Two electric interurban railway systems served the Milwaukee urbanized area from 1895 to 1963. The largest of these two systems was owned and operated by The Milwaukee Electric Railway & Light Company (the Milwaukee Electric Lines). This company and its predecessor and successor companies developed and operated an extensive electric interurban railway system offering both intercity and suburban service over combinations of private rights-of-way and public street rights-of-way. The system consisted of 200 miles of lines radiating from the Public Service Building at N. 3rd Street and W. Michigan Avenue in downtown Milwaukee north to Port Washington and Sheboygan, west to Oconomowoc and Watertown, southwest to East Troy and Burlington, and south to Racine and Kenosha.

Beginning in 1939, segments of this extensive system were successively abandoned, and service on the last major segment between the Public Service Building and the City of Waukesha was discontinued in 1951. Small segments were retained for freight service, but, with the exception of a 7.5-mile segment operated by the Village of East Troy between East Troy and Mukwonago, have also since been abandoned. The private rights-of-way used for the system in the Milwaukee urbanized area, however, are still, to a limited extent, intact today, some owned by the Wisconsin Electric Power Company and used for electric power transmission line rights-of-way.

Summarized in Table 150 are the findings of an analysis of the potential of the former private electric interurban and street railway rights-of-way to be utilized for primary transit in the Milwaukee area. The rights-of-way have been divided into seven segments, according to the original railway line or operating division for which they were used. These segments include: 1) the Milwaukee Northern Division between the Public Service Building and Grafton; 2) the Local Rapid Transit Line between the Public Service Building and West Junction; 3) the Watertown Division between West Junction and the City of Waukesha; 4) the Muskego Lakes Division between West Junction and Big Bend, including the Burlington line between St. Martin's and Durham Hill station; 5) the Lakeside Belt Line between the Lakeside Power Plant and Greenwood Junction; and 6) the Milwaukee-Racine-Kenosha Division between the Public Service Building and the Racine County line. The seventh segment consists of the 10 private rights-of-way once provided as a part of the Milwaukee street railway system. The seven segments represent only those portions of the lines that are within the Milwaukee urbanized area and that used private, not public, rights-of-way.

As shown in Table 150, nearly all of the former rights-of-way have portions with good potential for primary transit development. The right-of-way of these portions is largely intact and is owned by the Wisconsin Electric Power Company and used for electric power transmission line location. Some portions with potential, however, would require some relocation of electric power transmission line support structures. In addition, in the dismantling of the electric interurban railway lines, virtually all bridges, trestles, abutments, support piers, and retaining walls have been removed. In addition, many cuts have been filled in and many embankments have been leveled to conform to the surrounding land forms or in preparation for other uses. Therefore, although certain segments of right-of-way remain, major earthwork would be required and structures for the many public street, railway, and watercourse crossings along these intact rights-of-way would have to be replaced in order for fixed guideway facilities to be developed.

The second electric interurban railway system serving the Milwaukee urbanized area was the Chicago, North Shore & Milwaukee Railway Company (North Shore Line). This operation, abandoned in 1963, consisted of a single route from downtown Milwaukee to Chicago via the Cities of Racine and Kenosha. The portion of the railway right-of-way that did not use public streets is largely intact within the Milwaukee urbanized area, being primarily owned by Milwaukee County (see Table 150). The Wisconsin Department of Transportation purchased two small portions of the right-of-way for construction of the North-South Freeway (IH 94) and the Airport Spur Freeway (STH 119). In addition, the Milwaukee Area Technical College purchased approximately 0.5 mile of the right-of-way directly south of W. College Avenue for construction of its South Campus. Milwaukee County has leased other portions for parking lots, a truck terminal, and airport facilities. Like remaining rights-of-way of the Milwaukee Electric Lines, the railway grade of the North Shore Line is only partially intact. Many fills have been leveled or severely altered and many cuts have been filled in. Nearly all bridges at former grade separations with highways or other railways have been removed. Consequently, crossings with public streets, freeways, and trunkline railways appear to constitute the most serious limitation to the use of the remaining portion of this right-of-way, as substantial earthwork, in addition to the replacement of structures, would be necessary.

Small segments of the Milwaukee Electric Lines street railway system in and around the City of Milwaukee also included private rights-of-way. This street railway system in its entirety consisted of 15 to 20 lines and about 130 route miles of trackage. As shown in Table 150, most segments of former street railway routes which operated over private rights-of-way, a total of 10 segments totaling 10.1 miles in and around the City of Milwaukee, have poor potential for use in the development of a fixed guideway primary transit system. Only one of the 10 segments, representing only 0.4 mile of right-of-way from N. 35th Street and W. St. Paul Avenue to the connection with the Local Rapid Transit Line at N. 41st Street, has good potential for primary transit use since its alignment is still clear. Two segments—representing 2.5 miles of right-of-way from N. 52nd Street and W. Wells Street to S. 70th Street and W. Greenfield Avenue, and 1.0 mile from S. 87th Street and W. Lapham Street to West Junction—have fair potential since discontinuous portions are still clear. The remaining segments all have poor potential since they have been converted to other uses.

Electric Power Transmission Line Rights-of-Way

Electric power transmission trunkline rights-of-way have been suggested as having potential for use in the development of primary transit fixed guideways. The Wisconsin Electric Power Company owns and operates all electric power transmission trunk lines within the Milwaukee urbanized area, a total of 1,987 miles in 1978. These 1,987 miles of trunk line are located on approximately 56.8 route miles of right-of-way and approximately 173.5 route miles of easements. Such transmission lines are physically situated either on continuous rights-of-way which are owned in fee simple by the power company or on easements obtained for power transmission purposes from other property owners. The continuous rights-of-way in the Milwaukee urbanized owned in fee simple by the Wisconsin Electric Power Company are specifically those that were formerly utilized for electric interurban railway alignments by The Milwaukee Electric Railway & Light Company. These have been examined in this inventory for their potential based on that previous use. All electric power transmission trunk lines in the Milwaukee urbanized area which are not located on former electric interurban railway rights-of-way are located on property easements held by the Wisconsin Electric Power Company. These easements, along with the aerial rights for the transmission lines between the towers or poles constructed on the easements, are leased by the power company.

For the following reasons, it does not appear that electric power transmission line easements could be developed into primary transit fixed guideways at a minimum of cost or disruption. First, the easements consist only of small areas of land connected by corridors over which only aerial rights are held by the power company. The land between the power line support structures is usually utilized in conjunction with surrounding land uses. Second, the easements provide the Wisconsin Electric Power Company with only limited rights, and use of them for other than the transmission of electric power could be expected to present problems similar to those inherent in the acquisition of an entirely new right-of-way. Third, there is no "head-start" toward the preparation of the grade for the development of a guideway, as is the case, at least in part, on the former interurban railway rights-of-way owned by the Wisconsin Electric Power Company.

Freeway Rights-of-Way

The Milwaukee area freeway system has significant potential for use in the provision of primary transit guideway alignments. For example, primary transit service could be provided on freeway lanes reserved for the exclusive use of motor buses, either in a normal flow direction or in a contraflow direction. Alternatively, the parts of the freeway right-of-way other than the traffic-carrying lanes could be used for the location of primary transit fixed guideway alignments, including busways, light rail guideways, and heavy rail guideways. The parts of the freeway right-of-way that could be used include the inside shoulder or median of the freeway, the outside shoulders of the freeway, and the nonroadway portions of the freeway right-of-way adjacent to the freeway outside shoulders.

There are two major obstacles to the provision of a system of reserved bus lanes on the Milwaukee area freeway system. One is the configuration of the system and the design of its interchanges, which results in freeway entrance and exit ramps connecting to the right- and left-hand lanes of the

Table 150

POTENTIAL FOR PRIMARY TRANSIT USE OF FORMER ELECTRIC INTERURBAN AND STREET RAILWAY PRIVATE RIGHTS-OF-WAY IN THE MILWAUKEE URBANIZED AREA

Right-of-Way					
Name and Owner	Limits	Width (feet)	Past Use	Present Use	Potential for Primary Transit Use
Milwaukee Electric Lines—Milwaukee Northern Division	N. 19th Street and W. Fiebrantz Avenue in the City of Milwaukee to northern limits of the Village of Grafton—17.5 miles, of which 0.6 mile in Village of Grafton is over public streets	66	Double-track interurban railway from W. Fiebrantz Avenue to W. Silver Spring Drive and single track for remainder (part of route from Public Service Building to City of Sheboygan)	Owned by the Wisconsin Electric Power Company and used for electric power transmission	Good—Right-of-way is largely intact to Village of Grafton. Three electric power substations constructed in right-of-way. Some relocation of wooden power line poles and steel latticed transmission towers may be necessary. Crosses 39 public streets, five railway main lines, and two railway spur tracks
Milwaukee Electric Lines—Local Rapid Transit Line	N. 8th Street and W. Clybourn in the City of Milwaukee to West Junction in the City of West Allis (Zoo Freeway and C&NW Belton Junction)—6.6 miles	100	Double-track interurban railway fully grade-separated (part of route from Public Service Building to West Junction, connecting with routes to City of Watertown, Village of East Troy, and City of Burlington)	East-West Freeway from N. 8th Street to Mitchell Boulevard. Owned by the Wisconsin Electric Power Company and used for electric power transmission from Mitchell Boulevard to West Junction, except for three freeway interchanges located over that distance (2.8 miles in freeway use)	Fair—Right-of-way is not intact. Between N. 8th Street and N. 29th Street does not exist; between N. 29th Street and N. 60th Street only short broken segments exist; between N. 60th Street and West Junction, crosses two freeway interchanges and one electric power substation. Crosses 23 public streets and two railway main lines
Milwaukee Electric Lines—Watertown Division	West Junction in the City of West Allis to the Silvernale station at western limits of the City of Waukesha—western limits of the Milwaukee urbanized area (East-West Freeway and CTH TJ)—13.4 miles, of which 2.9 miles in City of Waukesha are over public streets	66	Double-track interurban railway (part of route from West Junction to City of Watertown)	Between West Junction and S. 108th Street used for Zoo Freeway, mainline railway, and urban development. Between S. 108th Street and Silvernale station owned by the Wisconsin Electric Power Company and used for electric power transmission except through City of Waukesha, where right-of-way is public street	Good in Part—From 108th Street to the City of Waukesha eastern limits, the right-of-way is generally intact. One electric power distribution facility is constructed in the right-of-way of this segment. Crosses eight public streets and one railway spur track
Milwaukee Electric Lines—Muskego Lakes Division	West Junction in the City of West Allis to St. Martin's Junction—7.6 miles—and branches to Village of Big Bend—8.3 miles—and Durham Hill station at North Cape Road—3.0 miles—located at the western and southern limits of the Milwaukee urbanized area, respectively	66, except 100 to 120 between West Junction and W. Layton Avenue	Single-track interurban railway with passing sidings (part of routes from West Junction to the Village of East Troy and City of Burlington)	Between West Junction and Layton Avenue four freeway interchanges are constructed along the right-of-way. Between Layton Avenue and St. Martin's Junction, is used for streets and commercial and residential development. Owned by the Wisconsin Electric Power Company between West Junction and W. Layton Avenue and between St. Martin's Junction and Village of Big Bend and the Durham Hill station	Fair to Good in Part—Right-of-way is only fair between West Junction and W. Layton Avenue because of construction of freeway interchanges, but good south and west of St. Martin's Junction. Relocation of wooden power line poles may be necessary. Crosses one freeway, 36 public streets, and one railway main line

Table 150 (continued)

Right-of-Way					
Name and Owner	Limits	Width (feet)	Past Use	Present Use	Potential for Primary Transit Use
Milwaukee Electric Lines—Lakeside Belt Line	Lakeside Power Plant in City of St. Francis to Greenwood Junction in City of Greenfield (IH 894 and W. Howard Avenue)—9.5 miles	150 to 180	Single-track freight railway, fully grade-separated with passing sidings (connected with Muskego Lakes Division of the Milwaukee Electric Lines)	Owned by the Wisconsin Electric Power Company and used for electric power transmission	Good—Right-of-way is intact. Some relocation of wooden power lines may be necessary. Crosses one freeway, 28 public streets, and three railway main lines
Milwaukee Electric Lines—Milwaukee-Racine-Kenosha Division	S. Howell Avenue and E. Burdick Avenue in the City of Milwaukee to the Racine County line at southern limit of the Milwaukee urbanized area—13.6 miles	100	Double-track interurban railway north of Lakeside Belt Line, and remainder is single track with sidings (part of route from Public Service Building to the City of Kenosha)	Owned by the Wisconsin Electric Power Company and used for electric power transmission	Good in Part—Right-of-way is largely intact between E. Layton Avenue and E. Elm Road in the City of Oak Creek. Northern portion of right-of-way now in residential development and southern portion used for Oak Creek Power Plant. Crosses 26 public streets, three railway main lines, and one railway spur track
North Shore Line	S. 5th Street and W. Harrison Avenue to Racine County line at southern limit of the Milwaukee urbanized area	100 to 140	Double-track interurban railway (route from City of Milwaukee to City of Chicago)	Owned by Milwaukee County except for parcels of the North-South and Airport Spur Freeways, and of the MATC South Campus. Other portions leased for parking lots and truck terminals	Good in Part—Right-of-way is intact south of E. College Avenue to Racine County line. Crosses 11 public streets and one railway main line
Milwaukee Electric Lines—Street Railway System (private right-of-way segments of 10.1 miles)	See Table 108	- -	Single- and double-track street railway of 15 to 20 lines and about 130 miles of trackage, mostly located on public streets (10.1 miles of private rights-of-way) in the City of Milwaukee	Mostly public streets and urban development	Fair to Poor—Right-of-way is generally fair to poor as a result of conversion to urban use except one 0.4-mile portion between N. 35th Street and W. St. Paul Avenue to connection with Local Rapid Transit Line at N. 41st Street, and other shorter discontinuous segments between N. 52nd Street and W. Wells Street and S. 70th Street and Greenfield Avenue, and between S. 87th and W. Lapham Streets and West Junction

Source: SEWRPC.

freeway where reserved lanes for buses would be provided. Because of the number of such ramps connecting to the right-hand side of the freeway, it may be concluded that, in general, only median lanes should be considered for use as either normal flow or contraflow reserved bus freeway lanes in the Milwaukee area. A total of about 90 miles, or 88 percent of the Milwaukee freeway system leading to the Milwaukee central business district, could physically accommodate normal flow reserved median lanes, the remaining freeway distance being required for use by mixed traffic merging into and diverging from the freeway at right-hand ramps to the freeway. On about 80 miles, or 78 percent, of the system, median lanes could be used for contraflow reserved bus lanes. Again, the remaining freeway distance would be required for use by freeway traffic merging into or diverging from the freeway at left-hand ramps. In addition, the remaining distance includes those reaches where the contraflow lanes must be terminated sooner than otherwise since the median widths do not permit construction of a transition lane through the median and into the freeway traffic lanes operating in the same direction as the motorbus operation. Unfortunately, because of the left-hand ramps and limited median width, the portion of the East-West Freeway (IH 94 and IH 794) in Milwaukee County and the inner portions of the North-South Freeway (IH 94 and IH 43) approaching the central business district of Milwaukee do not lend themselves to development for reserved contraflow bus lanes. Normal flow reserved lanes, however, could be provided over parts of the East-West Freeway in Milwaukee County, and over a large portion of the North-South Freeway leading to the Milwaukee central business district.

The other major obstacle to implementing reserved freeway lanes on the Milwaukee area freeway system is the traffic congestion that may be caused by reserving an existing lane for exclusive bus use. In contrast to the problems that would be caused by the physical configuration and design of the freeway system, the problems that could result from traffic congestion would be more severe on normal flow bus lanes than on contraflow bus lanes. Most of the Milwaukee area freeway system—about 65 miles, or 58 percent—carries peak travel-hour traffic volumes which would exceed the design capacity of the freeway facilities concerned if reserved bus lanes in the peak flow direction were implemented. Operating conditions on the freeways exceeding design capacity would approach unstable flow, or intermittent stop-and-go driving, and operating speeds would be at or below 40 miles per hour. Even more importantly, the central portions of the Milwaukee area freeway system—totaling 40 miles, or 39 percent of the system—would not have sufficient capacity with a reduced number of lanes to accommodate the existing freeway traffic volumes. Diversion of between 1,000 and 1,900 vehicles would be required during the morning and evening peak hours on parts of the East-West Freeway (IH 94), the North-South Freeway (IH 43 and IH 94), the Zoo Freeway (USH 45), and the Airport Freeway (IH 894) to accommodate reservation of a normal flow bus lane.

The traffic congestion problem caused by reserving an existing freeway lane for buses is less severe for contraflow reserved bus lanes. Only about six miles of the East-West Freeway (IH 94) and the Zoo Freeway (USH 45) would have insufficient capacity with reduced lanes in the nonpeak direction to accommodate existing peak-hour traffic volumes. An additional 12 miles of the Milwaukee area freeway system, primarily segments of the East-West Freeway and Zoo Freeway and small segments of the North-South Freeway (IH 43) and Airport Freeway (IH 894), would operate over design capacity with existing traffic volumes if a traffic lane were reserved for a contraflow bus lane.

Thus, based upon the configuration and design of the Milwaukee area freeway system and the existing traffic volumes carried on that system, reserved bus lanes could be developed in a contraflow direction only over parts of the system, including nearly all freeway segments outside Milwaukee County and, within Milwaukee County, on segments of the North-South Freeway (IH 43 and IH 94), Airport Freeway (IH 894), Zoo Freeway (USH 45), and Fond du Lac Freeway (USH 41 and USH 45) between freeway-to-freeway interchanges. Normal flow, reserved bus lanes could only be readily developed on segments of the Lake Freeway (IH 794), the Fond du Lac Freeway (USH 41 and USH 45), and the Rock Freeway (USH 15). Consequently, these segments of freeway could be considered as alternative motor bus guideway alignments if primary transit corridors are proposed in their vicinity.

As another alternative, the medians, outside shoulders, and nonroadway portions of the existing Milwaukee area freeway system could be considered for the location of primary transit guideways. However, an assessment of the inventory data indicates that the freeway medians, outside shoulders, and nonroadway portions of the Milwaukee area freeway system cannot readily be used as a location for fixed guideways for motor buses, light rail vehicles, or heavy rail vehicles. A major obstacle to such use is the width available for guideway development, particularly in the median but also in the freeway shoulders and nonroadway portions of the rights-of-way, as shown in Table 128. This problem is most severe on those parts of the freeway system located in the central portions of Milwaukee County. Another major obstacle is the frequency with which freeway-to-freeway ramps and freeway entrance and exit ramps would cross the primary transit guideway alignments in the freeway right-of-way. This problem would be particularly severe for use of the freeway shoulders and nonroadway portions of the right-of-way, as there would be a need to grade-separate the guideways from the many right-hand freeway ramps which would cross the potential guideway alignments. The construction of elevated guideways in the freeway right-of-way to alleviate the problem of limited horizontal clearance or to provide grade separation at freeway ramps may be expected to be particularly difficult and costly since the elevated guideway would need to be constructed through, over, or around freeway-to-freeway interchanges, and over other overpasses to the freeway. Consequently, only the outer reaches of the Milwaukee area freeway system where freeway ramps—particularly those on the right-hand side—are relatively infrequent and where freeway medians, shoulders, and nonroadway portions are of sufficient width to support an at-grade dual guideway will be considered in this alternatives analysis for use as primary transit corridors.

There are two freeway corridors in the Milwaukee urbanized area with excellent potential for fixed guideway primary transit development; both of these corridors have been cleared in anticipation of freeway construction and are in the "upper tier" of the adopted regional transportation system plan. These two freeways are the Park Freeway-East and the Stadium Freeway-South. The segment of cleared right-of-way for the Stadium Freeway-South is, in fact, considered part of the stub end of that freeway, and is recommended for construction under the "lower tier" of the regional transportation plan. The Stadium Freeway-South cleared corridor is about 0.8 mile long. Its cleared right-of-way, which is approximately 260 feet wide, should be able to accommodate a primary transit fixed guideway of any mode as well as the six-lane freeway recommended to be constructed within the corridor. The Park Freeway-East corridor is cleared for a distance of about 0.8 mile, and is 260 to 400 feet wide—sufficiently wide to accommodate a primary transit guideway as well as the recommended four-lane freeway facility. There is one more cleared freeway corridor in the Milwaukee area, that of the no longer recommended Park West Freeway. This corridor is approximately 2.2 miles in length and 320 to 420 feet wide, and could accommodate primary transit fixed guideways.

Active and Abandoned Railway Rights-of-way

For the purpose of this inventory and assessment, the railway system within the study area was divided into 23 right-of-way segments within which fixed guideway primary transit facilities could be located. These railway rights-of-way consist of 20 active and three abandoned mainline and branchline railway facilities currently, or historically, owned and operated for freight and passenger service by the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road), the Chicago & North Western Transportation Company (C&NW), and the Soo Line Railroad Company. Table 151 and Table 152 summarize the physical characteristics and potential for primary transit use of each active and abandoned railway right-of-way in the study area.

As indicated in Table 151, 14 of the 20 active railway lines that have been inventoried have, overall, either good or fair potential for the location of light rail transit, heavy rail rapid transit, or exclusive busway fixed guideway facilities. In addition, of the three active railway lines which were assessed as having either poor or no potential for the development of fixed guideway facilities, all had portions suitable for the location of at-grade fixed guideway facilities. Those railway rights-of-way determined not to be suitable for the location of at-grade, fixed guideway, primary transit facility development generally had a large concentration of industrial sidings and lead tracks on both sides of the right-of-way; additional railway trackage for passing, storage, and station facilities within the right-of-way; and intensive industrial development located immediately adjacent to the right-of-way.

Crossings with public streets and highways, industrial trackage, and watercourses pose a serious limitation to the use of all the rights-of-way for the location of fixed guideway facilities. This limitation is more serious for heavy rail rapid

Table 151

POTENTIAL FOR PRIMARY TRANSIT FIXED GUIDEWAY LOCATION ON ACTIVE RAILWAY RIGHTS-OF-WAY IN THE MILWAUKEE URBANIZED AREA

Right-of-Way			
Name and Owner	Limits	Physical Characteristics	Potential for Primary Transit Use
Milwaukee Road—First Subdivision	Milwaukee passenger station and N. Springdale Road in the Town of Pewaukee—15.7 miles	Double-track railway line with passing and industrial sidings along both sides of the track. Right-of-way width ranges from 66 feet to 250 feet; outside clearances along the eastbound main line range from 10 feet to 45 feet and along the westbound main line from 10 feet to 35 feet. Most horizontal curves have curvature generally less than 2°00′. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 49 street, railroad, and watercourse crossings and industrial sidings concentrated east of the Stadium Freeway and between the Stadium Freeway Interchange and W. Harwood Avenue	Poor or No Potential—Insufficient horizontal clearance, industrial sidings and trackage requiring complete grade separation and the need to acquire additional right-of-way generally precludes ready development of primary transit fixed guideway on this right-of-way. Grade separations of at-grade crossings constitute a serious limitation and large capital cost consideration
Milwaukee Road—Fifth Subdivision	North Milwaukee Station located at N. 33rd Street and W. Cameron Avenue to Cedar Creek Road in the Village of Grafton—16.5 miles	Single-track railway line with passing and industrial sidings along both sides of the right-of-way. Right-of-way width ranges from 66 feet to 100 feet; outside clearances range from 15 feet to 47 feet on each side of the right-of-way. Horizontal alignment is marked by long stretches of tangent between large radius curves with curvatures less than 2°30′. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 51 street, railroad, and watercourse crossings and 25 industrial sidings concentrated between Good Hope Road and Cedar Creek Road in the Town of Grafton	Fair Potential—In general, the portion of this right-of-way west of Canco Station in the City of Milwaukee has good potential for the location of at-grade primary transit facilities. However, the section between North Milwaukee Station and Canco Station is not suitable for at-grade primary transit fixed guideway development because of the presence of industrial and railroad trackage, and of industrial development immediately adjacent to the right-of-way. Grade separation of at-grade crossings constitute a serious limitation and large capital cost consideration
Milwaukee Road—Twelfth Subdivision	North Milwaukee Station at N. 33rd and W. Cameron Avenue to USH 41/45 in the Village of Germantown—15.8 miles	Single-track railway line with passing and industrial sidings along both sides of the right-of-way. Right-of-way width is 99 feet along its entire length; outside clearances are 47 feet, except at North Milwaukee, Granville, and Germantown Stations, where they range between 10 feet and 20 feet. Horizontal alignment is marked by 12 curves, most of which have a curvature of less than 2°30′. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 39 street, railway, and watercourse crossings and 26 industrial sidings concentrated between W. Hampton Avenue and N. 43rd Street	Good Potential—The physical characteristics of the right-of-way, including horizontal and vertical alignment and right-of-way width, all allow for at-grade primary transit development. The portion of the right-of-way between N.43rd Street and W. Hampton Avenue is not well suited because of the presence of additional railroad and industrial trackage within the right-of-way, requiring grade separation along this section of right-of-way
Milwaukee Road—Seventeenth Subdivision	Granville Station located at the intersection of N. 107th Street and N. Granville Road to the Menomonee Falls station located at E. Water Street in the Village of Menomonee Falls—3.8 miles	Single-track railway line with passing and industrial sidings. Right-of-way width is 100 feet between Granville Station and Milepost 101.0, where it narrows to 60 feet in width and remains this width to the Village of Menomonee Falls; outside clearances along both sides of the track are generally 27 feet. Horizontal alignment is marked by curves, most of which have a curvature of less than 2°30′. Vertical alignment is characterized by flat gradients, less than 2.0 percent. There are eight street, railway, and watercourse crossings along this line, and five industrial sidings which are concentrated between CTH YY and E. Water Street in the Village of Menomonee Falls	Good Potential—The physical characteristics of the right-of-way do not place severe constraints on the location of at-grade primary transit facilities. Crossings with public streets and industrial trackage pose a serious limita- to the use of the right-of-way for the location of fixed guideway facilities, placing a particularly serious constraint on heavy rail rapid transit development
Milwaukee Road—Twenty-Sixth Subdivision	Brookfield Station in the City of Brookfield to the Chicago & North Western railway crossing in the City of Waukesha—7.4 miles	Single-track railway line with passing and industrial sidings. The right-of-way is 66 feet wide except between W. Broadway Street and Mary Street in the City of Waukesha, where it is 80 feet wide, and between the junction with the First Subdivision and N. Brookfield Road, where it is 250 feet wide; outside clearances range between 10 feet and 31 feet. Most horizontal curves have a curvature of less than 2°00′. Vertical alignment is marked by flat gradient, generally less than 0.2 percent. There are 27 street, railway, and watercourse crossings along this line, and there are 12 industrial sidings concentrated between the C&NW railway crossing and the Soo Line crossing in the City of Waukesha	Fair Potential—The physical characteristics of the right-of-way would allow for at-grade primary transit development except between the C&NW Railway crossing and the Soo Line Railroad crossing, which is not well suited for primary transit fixed guideway development because of the presence of additional railroad trackage in the right-of-way and because of the industrial development located immediately adjacent to the right-of-way. Grade separations constitute a serious limitation and large capital cost consideration

Table 151 (continued)

Right-of-Way		Physical Characteristics	Potential for Primary Transit Use
Name and Owner	Limits		
Milwaukee Road—Thirtieth Subdivision	Milwaukee passenger station and the Milwaukee-Racine County line located in the City of Oak Creek—14.8 miles	Double-track railway line with passing and industrial sidings. Right-of-way is generally 100 feet wide except at Lake and Oakwood Stations, where it is 200 feet and 150 feet wide, respectively; outside clearances are generally 38 feet along each side of the track, but at some locations are reduced to 15 feet. There are 10 horizontal curves, most of which have a curvature of $2^o00'$. Vertical alignment is marked by flat gradients, generally less than 0.5 percent. There are 41 street, railway, and watercourse crossings along this line, and there are 31 industrial sidings concentrated between the Milwaukee passenger station and W. Drexel Avenue	Fair Potential—The right-of-way south of W. Drexel Avenue has good potential for the location of at-grade fixed guideway facilities; the portion north of W. Drexel Avenue has little or no potential because of the concentration of industrial sidings and the railway trackage for passing, storage, and station facilities within the right-of-way
Milwaukee Road—Trackage Between Grand Avenue Junction and North Milwaukee Station	Between the intersection of W. Wisconsin Avenue and N. 44th Street and North Milwaukee Station located at the intersection of W. Cameron Avenue and N. 33rd Street—5.2 miles	Double-track railway line located in a cut section between Grand Avenue Junction and W. Meinecke Avenue, and in a fill section from W. Meinecke to North Milwaukee Station. The right-of-way is generally 100 feet wide; outside clearances range between 10 feet and 38 feet. There are six horizontal curves, all of which have a curvature of less than $4^o00'$. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 22 street, railway, and railroad crossings along this line, and there are 52 industrial sidings concentrated between W. Meinecke Avenue and North Milwaukee Station	Poor Potential—The portion of the right-of-way north of W. Meinecke Avenue has poor potential because of the large number of industrial sidings, the presence of other railroad trackage in the right-of-way, and the intensive industrial development located immediately adjacent to the right-of-way Good Potential—The portion of the right-of-way south of W. Meinecke Avenue has good potential for the location of fixed guideway facilities. However, crossings with industrial lead tracks pose a serious limitation to the use of this portion of right-of-way, placing a particularly serious constraint on heavy rail rapid transit development
Milwaukee Road—*Chestnut Street Line*	North Milwaukee Station at W. Cameron Avenue and N. 33rd Street to S. Juneau Avenue in the City of Milwaukee—6.3 miles	Single-track railway line with passing and industrial sidings. Right-of-way width is generally 50 feet except between E. North Avenue and W. Juneau Avenue, where it is 400 feet; outside clearances are generally less than 20 feet on each side of the right-of-way. There are 10 horizontal curves most of which have a curvature of less than $4^o00'$. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 33 street, railway, and watercourse crossings along this line, and there are 65 industrial sidings distributed uniformly along the segment	Poor Potential—Because of the large number of industrial sidings, the presence of other railroad trackage for yards or stations in the right-of-way, and the intensive industrial development located immediately adjacent to the right-of-way, this railway line is not suitable for at-grade primary transit fixed guideway development. In addition, grade separations at crossings constitute a serious constraint and large capital cost consideration
Milwaukee Road—Elm Grove Line	Elm Grove Station in the City of Elm Grove to the west end of Air Line Yard in the Menomonee River Valley—6.0 miles	Single-track railway line with passing and industrial sidings. The right-of-way width is generally 100 feet; outside clearances are generally 47 feet on each side of the track. There are eight horizontal curves, most of which have a curvature of less than $2^o00'$. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 21 street, highway, and railroad crossings along this line, and there are 25 industrial sidings, most of which are concentrated along the south side of the right-of-way between Elm Grove Station and S. Hawley Road	Good Potential—The physical characteristics of this railway right-of-way would allow for primary transit development along the entire length of this segment. The north side of the right-of-way lends itself more readily to fixed guideway development
Milwaukee Road—Menomonee Valley Railway Trackage	Extends three miles westerly from the Milwaukee River to S. 44th Street and the Stadium Freeway (USH 41). Bounded along the north by the East-West Freeway (IH 94) and the south by a bluff located immediately north of Mitchell Park and W. Pierce Street	The Canal Street switching spur is a double-track railway line. Between N. 30th Street and S. 20th Street the right-of-way is 65 feet wide; between S. 20th Street and the South Menomonee Canal right-of-way is located within a 35-foot easement in the center of Canal Street. Outside clearances range between 10 feet and 20 feet except east of S. 20th Street, where there is no right-of-way available. There are 29 industrial sidings uniformly distributed along the entire length of the segment. The Plankinton spur track is a double-track railway. The right-of-way width west of the 16th Street viaduct is 50 feet; the portion of the railway segment east of the viaduct was sold to a private concern. The outside clearance along each side of the right-of-way is generally 16 feet	Poor Potential—The concentration of sidings along the outside of the right-of-way and inadequate outside clearances make the location of fixed guideway transit facilities on Menomonee Valley railway trackage impractical
Chicago & North Western—Shoreline Subdivision	Wiscona Junction and Pioneer Road in the City of Mequon—12.9 miles	Single-track railway line with passing sidings. The right-of-way width ranges between 99 feet and 200 feet, outside clearances range between 29 feet and 96 feet on each side of the track. There are five horizontal curves, all of which have a curvature of less than $2^o00'$. Vertical alignment is marked by flat gradients, less than 0.5 percent. There are 23 street, railway, and watercourse crossings along this line, and there are no industrial sidings or lead tracks along this segment	Good Potential—The physical characteristics would allow for at-grade primary transit development along this railway segment except west of N. Port Washington Road, where substantial earthwork would be required to obtain an adequate cross-sectional area for the location of at-grade primary transit fixed guideway facilities. Crossings with public streets pose a serious limitation to the use of the right-of-way, placing a particularly serious constraint on heavy rail rapid transit development

Table 151 (continued)

Right-of-Way: Name and Owner	Right-of-Way: Limits	Physical Characteristics	Potential for Primary Transit Use
Chicago & North Western—Air Line Subdivision	Butler Junction in the City of Milwaukee to Cedar Lane in the unincorporated village of Rockfield—19.5 miles	Single-track railway line except between Butler Junction and the west switch of Wiscona Junction, where the line is a double-track railway. The right-of-way width is generally 100 feet; outside clearances range between 10 feet and 47 feet on each side of the track. There are 10 horizontal curves, most of which have a curvature of less than 3°00′. Vertical alignment is marked by flat gradients, generally less than 0.5 percent. There are 53 street, railroad, and watercourse crossings along this line, and there are 24 industrial sidings concentrated on the portion of the right-of-way between the junctions at Butler and Wiscona	Good Potential—The physical characteristics of the right-of-way would allow for at-grade primary transit development except between USH 45 and Wiscona Junction, where the presence of additional railroad and industrial trackage in the right-of-way precludes the location of at-grade primary transit development
Chicago & North Western—Adams Subdivision	Butler Yard and CTH J located northwest of the Village of Sussex—9.3 miles	Double-track railway line between Butler Yard and Milepost 18.0 and single-track line between Milepost 18.0 and CTH J. The right-of-way ranges in width between 100 feet and 725 feet; the outside clearances range from 10 feet to 97 feet along the north or east side of the right-of-way, and 33 feet to 170 feet along the south or west side of the right-of-way. There are three horizontal curves, all of which have curvatures of 3°00′ or less. Vertical alignment is marked by flat gradients, generally less than 0.6 percent. There are 22 street, highway, railroad, and watercourse crossings along this line, and there are nine industrial crossings concentrated at Butler Yard and between Butler Junction and Lily Road	Good Potential—The physical characteristics of the right-of-way would allow for at-grade primary transit development along this railway section. Crossings with public streets and watercourses pose the most serious limitation to the use of the right-of-way, placing a particularly serious constraint on heavy rail rapid transit development
Chicago & North Western—New Line Subdivision	Butler Yard and the Milwaukee-Racine County line—25.1 miles	Double-track railway line with passing and industrial sidings. The right-of-way width is generally 100 feet, but increases to 400 feet at Mitchell Yard; outside clearances range between 10 feet and 95 feet. There are 14 horizontal curves, most of which have a curvature of less than 3°00′. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 85 street, railway, and watercourse crossings along this line, and there are 49 industrial lead tracks or sidings, most of which are concentrated between Belton Junction and Chase Junction	Poor Potential—In general, the portions of the right-of-way between Butler Yard and Chase are not suitable for at-grade primary transit fixed guideway development because of the concentration of industrial sidings and lead tracks, the presence of other railroad trackage, and industrial development located immediately adjacent to the right-of-way Good Potential—The portion of the right-of-way between Chase and the Milwaukee-Racine County line has good potential. Crossings with public streets and industrial trackage pose a serious limitation on the use of the right-of-way, presenting a more serious constraint on heavy rail rapid transit development
Chicago & North Western—Waukesha Subdivision	Belton Junction and STH 59 in the City of Waukesha—11.0 miles	Single-track railway line with passing and industrial sidings. The right-of-way width is generally 100 feet except between E. Broadway Street and West Avenue in the City of Waukesha, where it ranges between 50 and 200 feet; outside clearances are generally 47 feet but are reduced to between 10 feet and 20 feet where passing track is located. There are eight horizontal curves, most of which have a curvature of less than 3°00′. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 30 street, railroad, and watercourse crossings along this line, and there are 14 industrial crossings concentrated between Hall's Siding and the Milwaukee Road railway crossing in the City of Waukesha	Fair Potential—While the physical characteristics of the right-of-way allow for at-grade primary transit development along this segment, the presence of industrial lead tracks and other railraod trackage in the right-of-way precludes the at-grade location of primary transit fixed guideway facilities between S. East Avenue and the Milwaukee Road railway crossing in the City of Waukesha
Chicago & North Western—Kenosha Subdivision	St. Francis Station and the Milwaukee-Racine County line in the City of Oak Creek—10.0 miles	Double-track railway line with passing and industrial sidings. The right-of-way width ranges between 100 feet and 200 feet; outside clearances range between 10 feet and 40 feet on both sides of the track. There are 10 horizontal curves, most of which have a curvature of less than 1°00′. Vertical alignment is marked by flat gradients, generally less than 0.75 percent. There are 23 street and watercourse crossings along this line, and there are 25 industrial crossings concentrated on that portion at Cudahy Station, South Milwaukee Station, and Oak Creek Station	Good Potential—The physical characteristics of the right-of-way generally allow the location of primary transit fixed guideway facilities along this railway segment. Crossings with public streets and industrial trackage pose the most serious limitation on the use of the right-of-way, presenting a more serious constraint on heavy rail rapid transit development

Table 151 (continued)

Right-of-Way: Name and Owner	Right-of-Way: Limits	Physical Characteristics	Potential for Primary Transit Use
Chicago & North Western—Capitol Drive Spur Track	Wiscona Junction and E. Bradford Avenue in the City of Milwaukee—5.7 miles	Single-track railway line. Right-of-way width is generally 100 feet except between Wiscona Junction and N. Green Bay Avenue, where it is 160 feet; outside clearance between Wiscona Junction and N. Green Bay Avenue is 77 feet on each side of the track, and between N. Green Bay Avenue and E. Hampton Road is generally 47 feet. There are five horizontal curves, most of which have a curvature of less than $3^{o}00'$. Vertical alignment is marked by flat gradients, generally less than 1.0 percent. There are 22 street, railway, and watercourse crossings along this line, and there are seven industrial sidings along the west side of the railway right-of-way	Good Potential—Between Wiscona Junction and E. Hampton Avenue the location of at-grade primary transit fixed guideway facilities would not require changes to existing track configuration, nor would it necessitate the purchase of additional right-of-way or facility grade separation to provide adequate outside clearances. The remaining portion of this right-of-way—that between E. North Avenue and E. Hampton Avenue—has fair to good potential for the location of at-grade primary transit facilities. The outside clearances along both sides of the right-of-way would be adequate to permit at-grade transit fixed guideway development if the existing bicycle trail in the right-of-way were removed. The industrial sidings in the railroad right-of-way in the vicinity of E. Bradford Avenue will also present a problem to at-grade guideway development
Chicago & North Western—Chase Spur Track	Chase Junction to E. Washington Street in the City of Milwaukee—2.1 miles	Single-track railway line with passing and industrial trackage. The right-of-way width ranges between 30 feet and 100 feet; outside clearances range between 15 feet and 60 feet on both sides of the track. There are four horizontal curves, all of which have a curvature of less than $4^{o}00'$. Vertical alignment is marked by level gradients. There are eight street and watercourse crossings along this line, and there are nine industrial sidings concentrated between E. Lincoln Avenue and E. Washington Street	Poor Potential—Although the physical characteristics of the right-of-way would allow for primary transit development along the section of right-of-way north of E. Lincoln Avenue, the concentration of sidings and the presence of other railraod trackage for passing and storage in the right-of-way, along with a major watercourse crossing, make the location of fixed guideway facilities impractical Good Potential—The portion of the right-of-way south of E. Lincoln Avenue has good potential for an at-grade primary transit facility
Chicago & North Western—National Avenue Spur Track	St. Francis Tower to E. Erie Street in the City of Milwaukee—3.5 miles	Four-track railway line between St. Francis tower and E. Linus Street, and double-track line between E. Linus Street and E. Erie Street. The right-of-way width ranges between 100 feet and 475 feet; outside clearances range between 10 feet and 60 feet along both sides of the right-of-way. There are four horizontal curves, all of which have a curvature of less than $3^{o}31'$. Vertical alignment is marked by flat gradients, generally less than 0.75 percent. There are 13 street and watercourse crossings along this line, and there are 12 industrial sidings concentrated between E. Lincoln Avenue and E. Erie Street	Good Potential—The portion of the right-of-way south of E. Linus Street has good potential for the location of an at-grade primary transit facility. The concentrations of industrial sidings and other railroad trackage north of E. Linus Street, however, make the location of fixed guideway facilities impractical
Soo Line—First Subdivision	City limits of Waukesha—4.2 miles; village limits of Sussex—1.1 miles	Single-track railway line along both sections of the right-of-way. The right-of-way within the city limits of Waukesha between CTH A and W. College Avenue is generally 100 feet wide, and between W. College Avenue and the Waukesha city limits is 66 feet wide. The right-of-way width within the Village of Sussex is generally 66 feet; outside clearance within the City of Waukesha is generally 47 feet on each side of the right-of-way between CTH A and W. College Avenue. From W. College Avenue to the Waukesha city limits, the outside clearances are generally 30 feet on each side of the right-of-way except between E. Broadway and E. Arcadian Avenue and between E. Main Street and Whiterock Avenue, when no outside clearances are provided. The outside clearance along the portion of right-of-way located in the Village of Sussex is about 30 feet on each side of the right-of-way. There are five horizontal curves, all of which have a curvature of less than $4^{o}00'$. Vertical alignment is characterized by flat gradients. There are 23 street and railway crossings along this line, most of which are located in the City of Waukesha, and there are six industrial crossings concentrated in the City of Waukesha between E. Broadway and Whiterock Avenue	Fair Potential—The right-of-way in the City of Waukesha could accommodate at-grade primary transit facilities except between E. Broadway and White Rock Avenue, where the presence of industrial crossings and other railroad trackage within the right-of-way precludes the development of at-grade primary transit facilities Good Potential—The physical characteristics of the right-of-way would allow for at-grade primary transit development along the portion of the right-of-way located in the Village of Sussex

Source: SEWRPC.

transit development than for light rail transit or exclusive busway development. While heavy rail rapid transit requires grade-separated facilities at all crossings, both light rail transit and exclusive busway systems can usually tolerate the grade crossings along these railway segments without severe operating impediments to either primary transit service or existing railroad operations.

With respect to the three abandoned railway rights-of-way in the study area, Table 152 indicates that there is potential to locate primary transit fixed guideway facilities only within the right-of-way of the former Chicago & North Western Railway Company lakefront main line. The rights-of-way of the former Milwaukee Road North Lake branch line and the Chicago & North Western Railway Whitefish Bay main line have poor or no potential for use in the development of a primary transit fixed guideway principally because portions of these rights-of-way have been converted to other uses, including public street rights-of-way and commercial and residential development.

It may be concluded from this inventory and assessment that fixed guideway primary transit facilities may be able to be constructed with less difficulty, cost, and urban and environmental disruption on those railway rights-of-way that have been identified as having good or fair potential for the location of such facilities than on land which is currently used for other purposes.

Potential Commuter Rail Routes

A total of six railway routes within the seven-county Southeastern Wisconsin Region have been identified in this inventory and assessment as having the potential to be utilized for the operation of commuter rail service. In the identification of these commuter rail routes, the following char-

Table 152

POTENTIAL FOR PRIMARY TRANSIT FIXED GUIDE LOCATION ON ABANDONED RAILWAY RIGHTS-OF-WAY IN THE MILWAUKEE URBANIZED AREA

Right-of-Way				
Name and Owner	Limits	Past Use	Present Use	Potential for Primary Transit Use
Former Chicago & North Western Railway Company—Lakefront Main Line	E. Bradford Avenue to E. Erie Street—2.7 miles	Used primarily for intercity passenger service and local freight and switching movements. Double-track railway with additional yard and terminal trackage to serve as an intercity passenger depot, passenger coach yard, industrial trackage, and locomotive servicing facilities. Right-of-way width is generally 100 feet north of E. Kane Place and 66 feet between E. Kane Place and E. Mequon Street	Right-of-way is intact north of E. Mason Street. North of E. Kane Place the grade is depressed below street level and the right-of-way width is about 60 feet. This section is owned by Milwaukee County and is used as a bicycle trail. South of E. Mason Street the right-of-way is not intact, is owned by the City and County of Milwaukee, and is either vacant or used for automobile parking lots. This section of the right-of-way is in the process of being developed for parkland and warehousing. There are 12 public street, highway, and pedestrian crossings on this line	Very Good Potential—North of E. Mason Street there is very good potential for the development of a primary transit system fixed guideway Poor Potential—The right-of-way south of E. Mason Street has poor potential for the ready location of primary transit since the land is being converted to other use
Former Milwaukee Road—North Lake Branch Line	E. Water Street in the Village of Menomonee Falls to the western limits of the Village of Sussex—8.7 miles	Operated as a single-track railway line. The right-of-way is generally 60 feet wide	The right-of-way is generally intact. The right-of-way between E. Water Street and W. Appleton Avenue has been purchased by Bend Industries, Inc. The right-of-way between W. Appleton Avenue and the easterly limits of the Village of Sussex has been purchased by Waukesha County, part of which is being used as an alignment for a sanitary trunk sewer, and part of which is to be used as a recreational trail	Poor Potential—Purchase of the right-of-way for a recreational trail by Waukesha County and the purchase of a portion of the right-of-way in the Village of Menomonee Falls suggests its long-term use for freight shipments by railway, creating a break in the continuity of the right-of-way
Former Chicago & North Western Railway—Whitefish Bay Main Line	Capitol Drive spur track near E. Capitol Drive to a connection with the Shoreline Subdivision, approximately 0.2 mile south of E. Green Tree Road—4.3 miles	Operated as a single-track railway line. The right-of-way is generally 66 feet wide. This route segment was utilized by all passenger and freight trains between Milwaukee and Green Bay	The railway grade has been leveled and converted to other uses, including public street rights-of-way and commercial and residential development	Poor Potential—Since the right-of-way no longer exists, there is no potential for its use in the development of primary transit fixed guideway facilities

Source: SEWRPC.

acteristics of the routes were considered: construction to railway mainline engineering standards; access to the Milwaukee central business district and other major trip generators with concentrations of residential development; and the existence of double track. The six potential commuter rail routes radiate from downtown Milwaukee to Port Washington, Saukville, West Bend, Oconomowoc, Kenosha, and Waukesha.

The first potential commuter rail route extends a distance of 29.5 miles between the Cities of Milwaukee and Port Washington. The route would utilize trackage of the Chicago, Milwaukee, St. Paul & Pacific Railroad Company (the Milwaukee Road) and the Chicago & North Western Transportation Company (C&NW), and would serve the communities of Milwaukee, Glendale, Whitefish Bay, Fox Point, Bayside, Mequon, and Port Washington. The existing condition of the track and roadbed limits maximum operating speeds to either 25 or 35 miles per hour (mph) over certain segments of trackage between Milwaukee and Grand Avenue, to 10 mph between Grand Avenue and North Milwaukee, to 30 mph between North Milwaukee and Canco Station, and to 40 mph between Wiscona Junction and Port Washington. Trackage between Milwaukee and Canco Station is in need of extensive rehabilitation, while the trackage between Wiscona Junction and Port Washington requires a relatively small rehabilitation effort. To enable commuter train operation over this route, trackage over the entire 29.5-mile distance would have to be rehabilitated to varying degrees, a connection between the tracks of the two railway companies concerned would have to be reconstructed, commuter train storage and servicing facilities would need to be constructed at Port Washington, and automatic grade-crossing protection with gates would need to be provided at all public at-grade street and highway crossings. The total cost of this work would be an estimated $7,780,000, not including the cost of purchasing rolling stock and constructing passenger depot facilities. If the Milwaukee Road completes all of the track rehabilitation work scheduled by that company for the 1980 and 1981 construction seasons, then the cost of the necessary work for a proposed commuter rail project could be reduced by $5,205,000, from a total cost of $7,780,000 to a cost of $2,575,000 for the Milwaukee-Port Washington route.

The second potential commuter rail route exends a total distance of 27.6 miles between the Cities of Milwaukee and Saukville. The route would utilize Milwaukee Road trackage over the entire route, serving the communities of Milwaukee, Glendale, Brown Deer, Mequon, Thiensville, Cedarburg, Grafton, and Saukville. The existing condition of the track and roadbed limits the maximum operating speeds to either 25 or 35 mph over certain segments of trackage between Milwaukee and Grand Avenue, to 10 mph between Grand Avenue and North Milwaukee, and to either 10 or 30 mph over certain segments of trackage between North Milwaukee and Saukville. To enable commuter train operation over this route, trackage over the entire 27.6-mile distance would have to be extensively rehabilitated, commuter train storage and servicing facilities would have to be constructed at Saukville, and automatic grade-crossing protection with gates would need to be provided at all public at-grade street and highway crossings. The total cost of this work would be an estimated $13,356,000, not including the cost of purchasing rolling stock and constructing passenger depot facilities. If the Milwaukee Road completes all of the track rehabilitation work scheduled by that company for the 1980 and 1981 construction seasons, then the cost to a proposed commuter rail project could be reduced by $10,617,000, from total cost of $13,356,000 to a cost of $2,739,000 for the Milwaukee-Saukville route.

The third potential commuter rail route extends a total distance of 34.7 miles between the Cities of Milwaukee and West Bend. The route would utilize trackage of the Milwaukee Road and the C&NW, serving the communities of Milwaukee, Menomonee Falls, Germantown, Jackson, and West Bend. The existing condition of the track and roadbed limits the maximum operating speeds to either 25 or 35 mph on certain segments of trackage between Milwaukee and Grand Avenue, to 10 mph between Grand Avenue and North Milwaukee, to 30 mph between North Milwaukee and Canco Station, and to 40 mph between Wiscona Junction and West Bend. Trackage between Milwaukee and Canco Station is in need of extensive rehabilitation, while the trackage between Wiscona Junction and West Bend requires a relatively small rehabilitation effort. To enable commuter train operation over this route, trackage over the entire 34.7-mile distance would have to be rehabilitated to varying degrees, a connection between the tracks of the two railway companies would have to be reconstructed, commuter train storage and servicing facilities would have to be constructed at West Bend, and automatic grade-crossing protection with gates would need to be provided at all public at-grade street and highway crossings. The total cost of this work would be an estimated $8,919,000, not including the cost of purchasing rolling stock and constructing passenger depot facilities. If the Milwaukee Road completes all of the track rehabilitation work scheduled by that company for the 1980 and 1981 construction seasons, then the cost to a proposed commuter rail project could be reduced by $5,205,000, from a total cost of $8,919,000 to cost of $3,714,000 for the Milwaukee-West Bend route.

The fourth potential commuter rail route extends a total distance of 32.2 miles between the Cities of Milwaukee and Oconomowoc. The route would utilize Milwaukee Road trackage over the entire route, serving the communities of Milwaukee, Wauwatosa, Elm Grove, Brookfield, Pewaukee, Hartland, Delafield, Chenequa, Nashotah, and Oconomowoc. The existing condition of the track and roadbed limits the maximum operating speeds to either 25 or 35 mph over certain segments of trackage between Milwaukee and Grand Avenue, but permits maximum operating speeds of up to 70 mph to be achieved between Grand Avenue and Oconomowoc. Trackage between Milwaukee and Grand Avenue is in need of extensive rehabilitation, while no rehabilitation of the trackage between Grand Avenue and Oconomowoc is necessary. To enable commuter train operation over this route, some trackage would have to be rehabilitated, commuter train storage and servicing facilities would have to be constructed at Oconomowoc, and automatic grade-crossing protection with gates would need to be provided at all public at-grade street and highway crossings. The total cost of this work would be $3,801,000, not including the cost of purchasing rolling stock and of constructing passenger depot facilities. If the Milwaukee Road completes all of its anticipated track rehabilitation work scheduled for the 1980 construction season, then the cost to a proposed commuter rail project could be reduced by $1,668,000, from a total cost of $3,801,000 to a cost of $2,133,000 for the Milwaukee-Oconomowoc route.

A fifth potential commuter rail route extends a total distance of 33.1 miles between the Cities of Milwaukee and Kenosha. The route would utilize trackage of the Milwaukee Road and the C&NW, serving the communities of St. Francis, Cudahy, South Milwaukee, Oak Creek, and Racine. At Kenosha, this proposed route would connect with or be operated as a part of an existing commuter rail route into Chicago operated by the Chicago area Regional Transportation Authority. The existing condition of the track and roadbed limits the maximum operating speeds to 30 mph between Milwaukee and Washington Street, to 10 mph between Washington Street and St. Francis, and generally to 30 mph between St. Francis and Kenosha. To enable commuter train operation over this route, trackage over the entire 33.1-mile distance would have to be rehabilitated to varying degrees, commuter train storage and servicing facilities at Kenosha would have to be enlarged, and automatic grade-crossing protection with gates would need to be provided at all public at-grade street and highway crossings. The total cost of this work would be an estimated $8,514,000, not including the cost of purchasing rolling stock and constructing passenger depot facilities. If the Milwaukee Road completes all of its track rehabilitation work scheduled for the 1980 construction season, then the cost to a proposed commuter rail project could be reduced by $921,000, from a total cost of $8,514,000 to a cost of $7,593,000 for the Milwaukee-Kenosha route.

The sixth and last potential commuter rail route extends a total distance of 19.7 miles between the Cities of Milwaukee and Waukesha. The route would utilize trackage of the Milwaukee Road and the C&NW, serving the communities of Milwaukee, West Milwaukee, West Allis, New Berlin, and Waukesha. The existing condition of the track and roadbed limits the maximum operating speeds to 30 mph between Milwaukee and Washington Street, to 40 mph between Washington Street and E. Lincoln Avenue, to 10 mph between E. Lincoln Avenue and Chase Junction, to 40 mph between Chase Junction and Belton Junction, and to 30 mph between Belton Junction and Waukesha except through the junction at Belton, where the speed is 10 mph. To enable commuter train operation over this route, trackage over the entire 19.7-mile distance would have to be rehabilitated to varying degrees, a connection between the tracks of the two railway companies would have to be constructed, commuter train storage and servicing facilities would have to be constructed at Waukesha, and automatic grade-crossing protection with gates would need to be provided at all public at-grade street and highway crossings. The total cost of this work would be $7,611,000, not including the cost of purchasing rolling stock and constructing passenger depot facilities. If the Milwaukee Road completes all of its track rehabilitation work scheduled for the 1980 construction season, then the cost to a proposed commuter rail project could be reduced by $1,786,000, from a total cost of $7,611,000 to a cost of $5,825,000 for the Milwaukee-Waukesha route.

Five of these six potential commuter rail routes appear to have good potential for commuter rail operation insofar as the engineering standards and physical condition of the trackage are concerned. This potential, however, is dependent upon a significant amount of track rehabilitation being accomplished for each route, the construction of storage and servicing facilities for the trains at the outermost station on each route, the installation of automatic crossing gates at all public at-grade street and highway crossings, and—on three of the routes—the construction of a connecting track between the trackage of the Milwaukee Road and C&NW railway lines. The route between Milwaukee and Oconomowoc appears to have excellent potential for commuter rail operation since most of the trackage that would be utilized is presently in very good condition and allows commuter train operational speeds of 60 mph. Table 153 summarizes the work required and the cost thereof to operate commuter trains over each route.

There are two important considerations that must be recognized when considering this inventory and assessment of potential commuter rail lines. First, the Milwaukee Road is anticipating the completion of major track rehabilitation work during the 1980 and 1981 construction seasons on some of the railway line segments herein considered for potential use by commuter trains. Should this occur, the initial investment required for track rehabilitation for some proposed commuter rail projects would be significantly reduced. The differences in total costs of track rehabilitation are summarized for each of the six commuter rail routes in Table 154.

Second, there are some segments of the six commuter rail routes considered which utilize common trackage to gain access to the passenger station at Milwaukee. If a commuter rail system were implemented that used such a combination of routes, certain segments of rehabilitated railway track could be used by trains of more than one route. Accordingly, the total cost of track rehabilitation for a commuter rail system could be reduced. The total capital cost of track rehabilitation and construction, grade-crossing protection improvement and storage facility construction for a system of six lines would be $35,738,000 which could be reduced to $23,464,000 if the Milwaukee Road track rehabilitation work anticipated to be carried out in 1980 and 1981 is completed.

Table 153

COMPARISON OF COST PER ITEM FOR COMMUTER TRAIN OPERATION ON EXISTING RAILWAY LINES IN SOUTHEASTERN WISCONSIN

Item	Route					
	Milwaukee-Port Washington	Milwaukee-Saukville	Milwaukee-West Bend	Milwaukee-Oconomowoc	Milwaukee-Kenosha	Milwaukee-Waukesha
Cross Tie Replacement	$ 844,822	$ 1,423,202	$1,135,962	$ 310,552	$1,652,807	$ 855,264
Ballast Work	608,050	1,043,050	815,450	227,480	1,268,918	668,542
Continuous Welded Rail Installation	2,439,117	5,755,617	2,439,117	789,117	1,544,210	2,942,160
Rail Joints Renewal	2,250	--	3,000	--	52,500	5,500
Grade Crossing Renewal	38,180	87,160	53,360	2,160	84,040	21,375
Grade Crossing Protection	1,480,000	2,320,000	2,020,000	1,680,000	1,260,000	920,000
Turnout Rehabilitation	1,084,920	1,533,380	1,084,920	188,000	985,544	803,977
Roadbed Widening and Construction	15,000	--	15,000	--	8,000	77,030
New Track Installation	258,000	--	117,600	--	424,000	125,700
Railway Crossings	--	--	35,000	--	35,000	--
Signalization and Traffic Control	97,600	37,600	172,600	37,600	100,000	375,000
Property Acquisition	40,000	--	--	--	--	35,000
Supervision	343,395	609,995	394,595	161,745	370,751	335,227
Contingencies	725,135	1,280,205	828,665	332,665	778,577	716,477
Less Salvage[a]	396,000	934,000	396,000	128,000	250,626	469,819
Storage and Servicing Facilities	200,000	200,000	200,000	200,000	200,000	200,000
Total	$7,780,469	$13,356,209	$8,919,269	$3,801,319	$8,513,721	$7,611,433
Total Per Mile	$ 263,745	$ 483,521	$ 257,039	$ 118,053	$ 257,212	$ 386,367

[a] *Salvage represents the value of steel rails sold for scrap as a result of replacement with continuous welded rail.*

Source: SEWRPC.

Table 154

TOTAL COST OF TRACK REHABILITATION FOR POTENTIAL COMMUTER RAIL ROUTES IN SOUTHEASTERN WISCONSIN WITH AND WITHOUT COMPLETION OF ANTICIPATED MILWAUKEE ROAD TRACK REHABILITATION[a]

Item	Route					
	Milwaukee-Port Washington	Milwaukee-Saukville	Milwaukee-West Bend	Milwaukee-Oconomowoc	Milwaukee-Kenosha	Milwaukee-Waukesha
Total Cost of Rehabilitation.	$7,780,000	$13,356,000	$8,919,000	$3,801,000	$8,514,000	$7,611,000
Cost of Milwaukee Road Portion	$5,205,000	$10,617,000	$5,205,000	$1,668,000	$ 921,000	$1,786,000
Total Cost With Milwaukee Road Participation.	$2,575,000	$2,739,000	$3,714,000	$2,133,000	$7,593,000	$5,825,000
Percent of Total Cost Attributable to Potential Commuter Rail Project With Milwaukee Road Participation	33.1	21.5	41.6	56.1	89.2	76.5

[a] *Estimates of the costs of statewide rail passenger route track rehabilitation prepared by the Wisconsin Department of Transportation in late 1980, as a part of a study of interregional rail passenger service in the State of Wisconsin, have confirmed the validity of these southeastern Wisconsin potential commuter rail route track rehabilitation estimates.*

Source: SEWRPC.

Chapter VIII

SUMMARY AND CONCLUSIONS

INTRODUCTION

Reliable basic planning and engineering data collected on a uniform, areawide basis are essential to the formulation of practical public facility and services plans. Inventory is therefore not only the first operational step in any planning process, but also one of the most important functions of such a process. Accordingly, the first step in the development of the Milwaukee area primary transit system alternatives analysis was the collation of factual data on historic and existing population and economic activity levels and land use patterns; travel habits and characteristics; and the existing and planned supply of transportation system facilities and services; as well as the inventory of the availability of rights-of-way for exclusive primary transit guideways. These data with the exception of the right-of-way inventory, which was new, were summarized from inventories recently completed under the Commission's major regional land use and transportation plan reevaluation effort and the Commission's continuing planning programs, updated as necessary and possible for this specific planning effort. When considered together with additional data concerning the state-of-the-art of transit technologies, set forth in a companion technical report, these data are considered sufficient to support the forecasts and analyses essential to formulation and evaluation of alternative primary transit systems for the Milwaukee area. In the primary transit system planning effort, these data are used principally to provide a qualitative understanding of the Region and to identify potential transit corridors, essential to the sound selection of the best primary transit system plan from among the alternatives to be considered. Additionally, the inventory data will be applied in the calibration and refinement of the travel simulation models and used in the identification of primary transit corridors and in the design and quantitative evaluation of alternative primary transit system plans.

DEMOGRAPHIC ACTIVITY

The population of the Southeastern Wisconsin Region has increased every decade since 1850, when the first federal census of population was taken in Wisconsin. By 1970, the resident population of the Region totaled approximately 1,756,100 people, or about 1 percent of the total population of the nation and about 40 percent of the total population of the State. Population growth within the Region was especially pronounced between 1940 and 1970. From 1940 to 1950, the population grew by about 173,000 people. From 1950 to 1960, the population grew by about 333,000 people, an historic peak; and from 1960 to 1970, the population grew by about 182,000 people. These large increases in the population were primarily the result of natural increase—that is, the excess of births over deaths—and not of in-migration which, while a factor, was not the predominant one.

Since 1970, however, population growth within the Region has virtually halted. By 1978, the resident population of the Region was estimated at 1,770,500 people—only 14,400 people, or about 1 percent, greater than that in 1970. Declines in fertility partially account for this greatly reduced rate of population growth. Since 1970, however, and particularly since 1975, net out-migration has become a significant component of population change in the Region. Between 1970 and 1978, net out-migration offset approximately 75 percent of the population change attributable to natural increase.

From 1900 to 1930, the highest rates of population increase occurred in the three urban counties of Milwaukee, Kenosha, and Racine. Since 1930, however, the outlying counties, notably Ozaukee, Washington, and Waukesha, have experienced the highest rates of population increase. From 1960 to 1970, the proportion of the regional population in three urban counties, Kenosha, Milwaukee, and Racine, decreased—from 81 percent in 1960 to 76 percent in 1970. Between 1970 and 1978, the resident population of Milwaukee County actually decreased by about 100,000 persons, while the proportion of the regional population in Milwaukee County decreased from about 60 percent in 1970 to about 54 percent in 1978.

The age structure of the population has been changing since 1960 toward that of an older, more mature population. The racial composition of the population has also been changing, with a greater proportion of the population being comprised of nonwhites, although whites still comprise approximately 90 percent of the total regional population.

In Milwaukee County, still the most populous county in the Region, whites comprised approximately 85 percent of the estimated resident population of 954,000 in 1978.

The number of households in the Region continues to grow at a greater rate than the resident population, reflecting an overall decrease in the number of persons per household. From 1950 to 1960, the number of households in the Region increased by 111,400, or 31 percent. Between 1960 and 1970, the number of households increased by 70,600, or 15 percent. The average number of persons per household within the Region decreased from 3.36 in 1950 to 3.30 in 1960 to 3.20 in 1970. The results of special censuses taken in some civil divisions in the Region since 1970 indicate that the trend toward decreasing household size is continuing. In Milwaukee County, the average household size decreased from 3.34 in 1950 to 3.21 in 1960 to 3.04 in 1970.

Total regional personal income increased nearly 17 percent betweem 1960 and 1970, measured in constant 1967 dollars. This increase, however, was less than the national and state rates of increase over this period. The increase was also less than the 93.5 percent rate of increase experienced in the Region from 1950 to 1960 measured in constant 1967 dollars, or the 35.2 percent rate of increase on a per capita basis, a rate which exceeded both the state and national rates.

ECONOMIC ACTIVITY

Between 1950 and 1970, the Region's labor force increased from about 540,100 people to about 744,500 people—an overall increase of 204,400 people, or about 38 percent. Between 1970 and 1978, the labor force increased to 891,700 people—an increase of about 147,200 people, or 20 percent. The labor force participation rate has been increasing since 1950. The labor force participation rate in 1950 was about 57 percent and by 1970 had reached 59 percent. Over this same period of time, the female labor force participation increased from 32 percent to 43 percent, while male participation decreased from 82 percent to 76 percent.

Between 1950 and 1970, the number of jobs in the Region increased by 188,900, or by 34 percent, over the 1950 level of 552,700 jobs. Between 1970 and 1978, the number of jobs increased by 110,200 jobs, or by 15 percent, over the 1970 level of 741,600 jobs, despite the fact that the resident population increased by only 14,400 persons, or about 1 percent, over this same period. The increase in jobs has been accommodated by an increase in the female labor force participation rate, by the changing age structure of the Region's population—wherein a larger proportion of the total population is presently in the working age groups, and by the increasing tendency of workers to hold multiple jobs.

Like population, jobs have shown a trend toward decentralization. In 1960, 75 percent of the economic activity of the Region, as measured by jobs, was located in Milwaukee County. By 1970, the proportion of the economic activity of the Region located in Milwaukee County had declined to 69 percent, and by 1978 to 66 percent. Waukesha County experienced the largest proportional increase in regional jobs—from 5 percent in 1960 to 9 percent in 1970 to about 11 percent in 1978.

The structure of the regional economy has been heavily concentrated in manufacturing, although this concentration is diminishing over time. In 1960, about 276,600, or about 43 percent, of the total jobs in the Region were in manufacturing. By 1970, the number of manufacturing jobs had decreased slightly to approximately 251,000 jobs, or to about 34 percent of the total—a decline of about 9 percentage points since 1960. By 1978 the number of manufacturing jobs had increased slightly to 257,800 jobs, but the proportion of total manufacturing jobs had declined to about 30 percent.

While the relative importance of manufacturing as a regional employer has declined, wholesale trade, retail trade, private services, government services, and education have grown in relative importance since 1960. The private services group in particular has experienced a rapid growth in jobs, and by 1978 represented approximately 26 percent of total regional employment as compared to 18 percent in 1960. These changes being experienced in the economic structure of the Region are similar to the changes being experienced in the national economy. Both nationally and regionally, the economy has become less manufacturing-oriented and more service-oriented.

FINANCIAL RESOURCES

Total revenues of all local governments in the Region have increased steadily from about \$0.93 billion in 1960 to about \$1.91 billion in 1976—an increase of 107 percent, measured in constant

1976 dollars. Since 1960, the property tax levy has consistently been the major source of revenue for local governments in the Region. It should be noted, however, that the per capita property tax rate has declined since 1972, when the per capita rate peaked at about $443 per capita, reaching $416 per capita in 1976. The full or equalized value of all taxable real and personal property has increased from $16.15 billion in 1960 to $25.75 billion in 1976—an overall increase of about 59 percent, measured in constant 1976 dollars.

Total revenues of all municipal units of governments within Milwaukee County increased by about 60 percent between 1960 and 1976—from $484 million to $774 million. During this same period, property tax revenues collected by municipal units of government in Milwaukee County declined in relative importance—from providing over 49 percent of total revenues in 1960 to just over 40 percent of total revenues in 1976. Receipts from borrowing also declined within Milwaukee County, from a 1960 level of over $66 million to just under $60 million in 1976—a decrease of about 11 percent.

A growing portion of local government revenue is comprised of state-collected taxes and fees which are returned to local units of government and school districts. While state-returned monies to local units of government in the Region have grown over time, from $301 million, or 25 percent of total local revenues, in 1964 to $737 million, or over 38 percent of total local revenues, measured in constant 1976 dollars, not all forms of these returned revenues have increased uniformly. Money returned to local governments in the form of transportation aids have declined from their peak of over $22 million in 1968 to about $15 million in 1976—a decrease of $7 million, or about 32 percent. The percentage of monies collected by the State and returned to local units of government in the Region has also increased—from about 52 percent in 1964 to about 68 percent in 1976. However, the percentage of state-collected monies returned to the Region has consistently been lower than the statewide average, with Milwaukee County alone of the seven counties in the Region receiving a higher percentage, 24 percent, of state payments than the statewide average for such payments of about 11 percent.

Since 1960, the combined expenditures of all local governments within the Region have increased by about 103 percent—from the $924 million level in 1960 to $1.88 billion in 1976, measured in constant 1976 dollars. The three largest categories of expenditure by governments in the Region in 1976 were education; health, sanitation, and welfare; and the protection of persons and property. In 1976, these three categories accounted for 70 percent of all governmental expenditures. Expenditures by all general-purpose units of governments in the Region for the construction, operation, and maintenance of highways, streets, and bridges totaled about $160 million in 1960, or about 17 percent of total local expenditures, and $190 million in 1970, or about 10 percent of total local expenditures, measured in constant 1976 dollars.

The public financial expenditure pattern for the municipal units of government in Milwaukee County shows an overall increase in total expenditures—from about $469 million in 1960 to $787 million in 1976, an increase of about 68 percent. Expenditures for highway construction, operation, and maintenance by Milwaukee County municipal units of government also increased by about 68 percent—from over $80 million in 1960 to over $135 million in 1976—thus keeping pace with the increase in total expenditures. Expenditures for capital construction of highways, streets, and bridges by the municipal units of government in Milwaukee County, however, showed a much smaller increase—from over $52 million in 1960 to over $67 million in 1976, an increase of only about 29 percent. Thus, most of the increase in highway-related expenditures within Milwaukee County was for operation and maintenance and not for capital construction. The highway construction expenditure patterns proposed for future years indicate that even for construction, the trend is increasing toward funding only the preservation of the existing system. For example, in the annual element of the 1979-1983 transportation improvement program for the Milwaukee urbanized area, highway system preservation expenditures, which are categorized as those required merely to maintain existing highway system facility capacity, account for 53 percent of total proposed highway construction expenditures. Highway system improvement expenditures, those used to provide existing facilities with additional capacity, account for an additional 41 percent of total highway construction expenditures, leaving only 6 percent for highway system expansion or the construction of new facilities.

The regional public transit systems major source of financial support is federal and state revenue in the form of capital and operating assistance. Through grants from the U. S. Department of Transportation, Urban Mass Transportation Administration and the State of Wisconsin, Department of Transportation, the bulk of public transit's capital and operating financial needs are being met. However, the local share of public transit operating and capital expenditures represents an increasingly heavy burden on local taxpayers, and probably acts as a limiting factor on transit service improvement and expansion and fleet replacement. Within the Milwaukee area, total public operating assistance has substantially increased each year since 1975, when public funds were first used to subsidize public transit service in Milwaukee County—from \$7.0 million in 1976 to \$9.6 million in 1977 to \$13.5 million in 1978. Of these amounts, \$1.5 million, \$1.9 million, and \$2.0 million were provided by local tax levies in 1976, 1977, and 1978, respectively. On a per capita basis, public subsidies have increased from \$0.15 per ride in 1976 to \$0.20 in 1977, to \$0.30 in 1978. Like highways expenditure patterns, transit expenditure patterns are increasingly directed toward system preservation rather than capital acquisition.

Federal and state funds are used in the acquisition, operation, and maintenance of the transit fleet. Such funds are also used in the purchase of specialized vehicles for use by nonprofit organizations in the provision of service for people whose mobility is severely limited. However, the extent to which federal and state monies can be relied upon to fund future transit development projects depends upon the Region's ability to develop local matching funds.

NATURAL RESOURCE BASE

The natural resources of the Region are vital to its economic development and its ability to provide a pleasant and habitable environment for human life. However, the natural resource base of the Region is limited, and all forms of both urban and rural development, including transportation system development, must be properly adjusted to the natural resource base if serious developmental and environmental problems are to be avoided. The principal elements of the natural resource base of the Region are its climate, air, soils, surface water resources and associated shorelands and floodlands, groundwater resources and associated recharge areas, woodlands, wetlands, and fish and wildlife habitat areas.

The Region's mid-continent location, far removed from the moderating effect of the oceans, gives it a typical continental-type climate characterized primarily by a continuous progression of markedly different seasons and a large range in temperature over the year. Low temperatures during the winters are accentuated by prevailing cold northwesterly winds, while high temperatures during the summers are reinforced by the warm southwesterly winds common during that season. Total precipitation in the Region averages 2.5 inches per month, ranging from a low of 1.3 inches in February to a high of 3.9 inches in June. The greatest amount of snow and sleet—an average of 11.9 inches—is received during the month of January. From December through March, an average of eight inches of snow and sleet is received per month. Snow cover in the Milwaukee area is most likely during the months of December, January, and February. The climate, and particularly its severe winter aspects, has important implications for the design, operation, maintenance, and use of transit facilities.

Air pollution problems exist in the highly developed portions of the Region, particularly in the central areas of the three largest cities: Kenosha, Milwaukee, and Racine. Atmospheric levels of carbon monoxide, particulate matter, sulphur dioxide, and hydrocarbons and ozone approach, and at times exceed, the national ambient air quality standards established by the U. S. Environmental Protection Agency. This air pollution is the result of commercial and industrial activities, transportation movements, waste burning, power generation, and space heating. The recently completed regional air quality attainment and maintenance plan recommends short- and long-term improvements in regional public transit service to help achieve the ambient air quality standards for carbon monoxide and hydrocarbon/ozone.

The highly complex soil pattern of the Region indicates a continuing need to carefully consider soil limitations in any development proposals. About one-fourth of the total area of the Region is covered by soils poorly suited for urban development, even with public sanitary sewer service, while about 60 percent of the Region is covered by soils poorly suited for residential development utilizing conventional onsite sewage disposal systems. Transportation system planning should seek to encourage intensive urban development only in areas covered by soils suitable for such use, and should seek to discourage nonagricultural uses of prime agricultural soils.

Stream water quality has been markedly deteriorated by human activities within the Region, and evidence of persistently severe stream and inland lake pollution is found in all of the 11 watersheds of the Region. Deteriorated surface water quality in turn impairs or negates the aesthetic and recreational water uses sought by an expanding segment of the Region's population. Based upon an examination of stream sampling data collected since 1963, it is apparent that stream water quality conditions have neither markedly improved nor deteriorated since that time, despite significant urban growth and development. It would appear, therefore, that efforts over the past decade to improve stream water quality have had a positive effect, since it is logical to assume that without such efforts stream water quality would have continued to deteriorate. Failure to adjust land use and transportation system development patterns to reflect the point and nonpoint source water pollution abatement needs of the Region can, however, be expected to lead to a further deterioration of surface water and groundwater quality conditions.

When combined, the most important elements of the underlying and sustaining regional natural resource base, including the best remaining woodlands; wetlands; surface water and associated undeveloped shorelands and floodlands; wet or poorly drained soils; wildlife habitat; significant topography and geologic formations; groundwater recharge areas; and historic, scenic, and scientific sites, are found to occur in essentially linear patterns. These patterns have been termed by the Commission "environmental corridors." Such corridors occupy a total area of about 534 square miles, or about 20 percent of the total area of the Region. The preservation and protection of these corridors will do much not only to maintain a good environment for life within the Region, but also to preserve the unique cultural and natural heritage and natural beauty of the Region. Failure to properly adjust land use development to these environmental corridors and to prevent the intrusion of intensive urban development into the corridors will inevitably result in the loss of the best remaining potential park and related open space sites, the deterioration or destruction of the best remaining wildlife habitat, the destruction of significant physiographic and geologic formations, the loss of water impoundment areas and reduction of groundwater recharge, the loss of the best remaining woodlands, the continued deterioration of surface water and groundwater quality within the Region, and increasing flood damages.

From 1963 to 1970, about 4,000 acres of primary environmental corridor land, or about 1 percent of the total corridor area, were lost to urban development—particularly residential development, which increased by about 3,000 acres in the corridors. Significant steps have been taken, however, by the state and local units of government toward permanent preservation of the primary environmental corridor lands as recommended in the adopted regional land use plan. By 1970, about 202 square miles, or about 38 percent of the total corridor area, were considered to be permanently preserved by virtue of either public ownership for park use or protective floodland zoning. An additional 73 square miles of corridor, representing nearly an additional 14 percent of the total corridor area, were considered to be temporarily preserved through private park development or through such tools as conservancy and park zoning, exclusive agricultural zoning, and country estate zoning.

LAND USE

One of the central concepts underlying areawide land use-transportation planning is that land use and transportation are closely interrelated. The type, intensity, and spatial distribution of land uses determine the number and variety of trips generated by each subarea of the Region. A complete inventory of existing land use is, therefore, essential to any areawide transportation planning effort. Through such an inventory, the quantitative relationships existing between land use and travel can be established and used to test and evaluate alternative transportation system plans.

By 1850 there were more than 113,000 people in the Region residing in many scattered developments. In addition to being evident in the larger urban centers of Burlington, Kenosha, Milwaukee, Racine, Waukesha, and West Bend, traces of this early development are evident in many of the smaller communities that exist in the Region today. Urban development within the Region after 1850 occurred in a fairly compact pattern until about 1950, forming concentric rings of relatively high-density urban development contiguous to, and outward from, the existing urban areas. Urban development dramatically increased in the 20-year period from 1950 to 1970 and occurred in a highly diffused pattern of low-density development. Between 1963 and 1970, the amount of land devoted to urban use within the Region increased by 17 percent, significantly exceeding the 6 percent increase in urban population over the same period. This increased urban development was accompanied by a marked reduction in the population density of the older developed areas of the Region. This trend was strongest between 1950 and 1963, when the population density of the developed urban areas of the Region declined from 8,544 persons per square mile to 4,807 persons per square mile. The annual decline in urban population density over this period approximated 3 percent, or about 288 persons, per square mile. Since 1963 the rate of decline has abated to an annual reduction of about 1 percent, or about 65 persons, per square mile. The population density of the developed urban areas of the Region had declined to 4,355 persons per square mile by 1970.

In 1970 the urban land use occupying the greatest area in the Region was residential, which accounted for approximately 156,266 acres, or 9 percent of the total area of the Region, and 48 percent of the developed urban area of the Region. This land accommodated a total of about 557,000 year-round housing units in 1970. Land uses for transportation, communications, and utilities accounted for 109,407 acres, or 6 percent of the total area of the Region, and 33 percent of the developed urban area. Total land area devoted to commercial and industrial uses amounted to only 16,566 acres, or 1 percent of the total area of the Region and 5 percent of the developed urban area, yet supported over 80 percent of the jobs in the Region. Governmental land uses accounted for 16,618 acres, or 5 percent of the total urban area of the Region. Recreational land uses accounted for 28,996 acres, or 2 percent of the total area of the Region. Approximately 1.4 million acres, or the remaining 81 percent of the total area of the Region, were devoted to nonurban land uses in 1970, including 1.0 million acres in agricultural use.

Between 1970 and 1978, a total of 29,500 acres of land in the Region, or about 46 square miles, were platted for future residential use. This development activity created 35,745 lots, of which 25,002 or 70 percent, were proposed to be provided with centralized sanitary sewer service. In Milwaukee County, almost 3,000 acres of land were platted for future residential use. Virtually all of these lands were proposed to be sewered, and most of the proposed subdivisions were located in the extreme northern and southern portions of the County. Subdivisions platted in Milwaukee County were typically small in area, reflecting the fact that many subdivisions are of an "in-fill" nature, providing for the development of remaining parcels of vacant land within the highly developed urban area.

Since 1970, actual urban development has occurred both in locations adjacent to existing urban development and in outlying rural areas, considerably removed from existing urban centers. Scattered low-density residential development was especially evident between 1970 and 1975 in Waukesha County. The overall regional trend established in the 1950's of declining urban population density appears to have abated somewhat between 1970 and 1975. The slight decline estimated in the average urban density within the Region may be attributed to Milwaukee County, which continues to experience both a decline in population and an increase in available urban land. Urban population densities within the other six counties of the Region remained basically unchanged or actually increased slightly between 1970 and 1975.

TRAVEL HABITS AND PATTERNS

Personal travel is an orderly, regular, and measurable occurrence, evidenced by recognizable travel patterns. Recognition of those patterns and travel aspects which demonstrate a high degree of repetitiveness is a prerequisite to an understanding of probable future personal travel behavior and, consequently, to sound transportation planning. The inventory of travel describes in detail each of the component parts of total travel. Understanding of each of these parts is essential to a complete understanding of total travel demand within the Region.

Presented in summary form are the basic findings of the 1972 regional inventory of travel, which have been updated to the current year 1978 wherever possible. To measure the changes occurring in travel habits and patterns within the Region, comparisons have been made between the findings of the 1963 and 1972 travel inventories. It should be noted that through the use of the Commission's mathematical travel simulation models, current year 1978, as well as any future year, travel habits and patterns can be estimated, given estimates or forecasts, as appropriate, of demographic, economic and land use activity within the Region. Certain travel habits and patterns bear special significance for primary transit planning, including the quantity, purpose, mode, and time of day in which travel occurs. A basic understanding of these characteristics of travel behavior is essential to the consideration of future alternative primary transit system plans in this study. Existing and historical trends in travel habits and patterns help to identify the trips which primary transit in the Milwaukee area may be expected to serve, and provide an indication of the degree of change in modal choice that development of a primary transit system can be expected to bring about.

On an average weekday in 1972, nearly 4.5 million person trips and 3.4 million vehicle trips were made within southeastern Wisconsin by residents of the Region, an increase of 25 percent over the 3.6 million person trips made within the Region on an average weekday in 1963. The number of person trips made on an average weekday increased from 2.2 trips per capita in 1963 to 2.5 trips per capita in 1972, and from 7.3 to 7.9 trips per household. The amount of tripmaking by people in a household is strongly correlated to the number of automobiles available to the household, the income level of the household, and the number of people in the household. Internal trips within the Region are made principally by private automobiles. Auto driver trips alone accounted for 64 percent of total internal travel in 1972, as compared with 60 percent in 1963; while auto passenger trips accounted for an additional 27 percent of the total in 1972, the same as in 1963. Of the remaining modes, public transit trips accounted for 4 percent of total travel in 1972 as compared with 13 percent in 1963; school bus trips for 4 percent in 1972 as compared with 3 percent in 1963; and all other modes together (taxi and truck passenger trips and motorcycle trips) for less than 0.5 percent in 1972 as compared with 1 percent in 1963. Transit usage was found to be highest in trips made to the Milwaukee central business district in 1972, where 22 percent of all trips entering, leaving, or made within the area were made on public transit. This compares with 37 percent in 1963.

While the substantial overall increases in tripmaking between 1963 and 1972 were found to be accompanied by sharp declines in public transit use, there are indications that this decline has stabilized or reversed. In the Milwaukee urbanized area, transit ridership declined from over 215 million revenue passengers in 1950 to 90 million in 1963, or from about 242 to about 84 rides per capita, respectively. Between 1963 and 1972 the trend of declining transit utilization continued, with transit ridership decreasing to only 52 million revenue passengers, or about 50 rides per capita, in 1972. However, only slight declines were recorded in 1977, when 48.5 million revenue passengers were served, equivalent to 50.8 rides per capita. Total transit ridership in the Milwaukee area increased between 1977 and 1978 to 52.6 million trips per year, if the 1978 ridership is adjusted to discount the effects of a two-month transit strike. In the Racine and Kenosha urbanized areas, the pattern of sharp decline in transit ridership also appears to have been reversed.

Trips either originating at or destined for home constituted over 80 percent of total internal travel in 1972 and 59 percent in 1963, highlighting the interdependence of residential development and transportation facilities and services. Next in importance were trips to work, which accounted for 16 percent of total internal travel in 1972 and 18 percent in 1963. The remaining trip purposes, including personal business, shopping, social-recreational and trips to attend school, accounted for 43 percent of total internal travel in 1972 and 41 percent in 1963. It is apparent that future travel facility and service requirements within the Region will be determined largely by the amount and location of future residential development. Also important are the principal areas to which these trips are attracted for work, shopping, and other purposes. These trips are largely concentrated in the Milwaukee central business district, in the major industrial and commercial centers located throughout the Milwaukee area, and, to a much lesser extent, in the central business districts and industrial and commercial centers of other large cities of the Region.

Significant increases in tripmaking between 1963 and 1972 were found in trips to residential land uses (22 percent), commercial land uses (37 percent), and governmental and institutional land uses (35 percent). Decreases in tripmaking over the same period were found in trips to both industrial land uses (2 percent) and transportation, commercial, and utility land uses (5 percent).

The hourly distributional patterns of internal travel indicate that the timing of travel during the day remained quite similar between 1963 and 1972, both in the proportion of trips by trip purpose during given time periods and in the proportion and times of peak periods. Of the peak-hour movements, trips to and from work comprised 44 percent of the total in 1972 and 47 percent in 1963, thus indicating that one of the primary transportation problems within the Region continues to be meeting the demand during the peak hours for trips to and from work.

EXISTING TRANSPORTATION FACILITIES AND SERVICES

Any transportation system planning effort must include an examination of the supply of as well as the demand for transportation facilities and services. The examination of demand is achieved through travel inventories and travel simulation model studies, while the examination of supply is achieved through an inventory of the location, capacity, and use of the existing transportation system. Location, capacity, and utilization inventories are necessary to establish the characteristics of the existing transportation system so that its existing and future deficiencies can be determined and used to guide primary transit system plan preparation, testing, and evaluation.

In 1978 the entire street and highway system of the Region was composed of 10,440 miles of facilities, of which 3,290 miles, or 32 percent, were classified by primary function as arterials, and 7,140 miles, or 68 percent, were classified as collector and land access streets. Thus, total arterial street and highway mileage within the Region increased by 1,492 miles, or 17 percent, between 1963 and 1978. Arterial street mileage increased by roughly 12 percent, or 347 miles, over this same period. Between 1972 and 1978, freeway mileage within the Region increased 47 percent—from 162 to 238 miles—with the completion of the North-South Freeway, the Rock Freeway, the East-West Freeway, and the Airport Spur Freeway, as well as with completion of portions of USH 16, USH 41, the Lake Freeway, and the West Bend Freeway.

Freeways and expressways, while comprising less than 7 percent of the arterial street and highway mileage when last comprehensively determined in 1972, carried approximately 31 percent of the total arterial travel. As measured by the continuing traffic counting programs conducted by the Wisconsin Department of Transportation and the City of Milwaukee, freeway utilization in Milwaukee County increased, in some cases substantially, between 1972 and 1978. Substantial increases in standard arterial street and highway traffic volumes between 1972 and 1978 primarily occurred on facilities in the outlying areas of Milwaukee County. Minor decreases in traffic volumes have been observed recently on some freeway facilities, and on some arterial streets in central parts of Milwaukee County. A comparison of 1979 traffic volume count data with comparable data from 1978 indicates freeway traffic volume declines of about 2 percent along the North-South Freeway (IH 43 and IH 94) and of about 5 percent along the East-West Freeway (IH 794). Increases in freeway traffic volumes of about 2 to 3 percent were found along the East-West Freeway (IH 94) between North 92nd Street and North 26th Street, and of about 2 to 6 percent were found along the Zoo Freeway (USH 45). Over one-half of the 38 standard arterial street locations in Milwaukee County used in the comparison showed increases in traffic volumes, with the increases in traffic volumes observed ranging from less than 1 percent to greater than 20 percent.

About 87 percent of the arterial system milage operating at or over design capacity in 1972 was located in the intensely developed urbanized areas of the Region. Over 16 percent of Milwaukee County's arterial mileage was operating at or over design capacity in 1972, compared with the regional percentage of about 10 percent. Between 1963 and 1972, the number of miles of arterial streets and highways operating over design capacity in the Region was reduced from about 192 to 166, or by 14 percent. This reduction was even more marked in Milwaukee County, where the number of miles of streets operating over design capacity was reduced by nearly one-half—from 116 miles to 61 miles. The number of miles of arterials operating at design capacity in the Region, however, increased from 140 in 1963 to 152 in 1972, or by 9 percent. In Milwaukee County, the number of miles of arterial streets operating at design capacity decreased between 1963 and 1972 by nearly 16 percent—from 85 miles to 72 miles. Thus, the effect of changes in arterial supply and use from 1963 to 1972 was a net reduction of 14 miles, or 4 percent—from 332 to 318 miles—in facilities operating at or over design capacity in the Region, and a net reduction of 69 miles or almost 35 percent—from 202 to 133 miles—in Milwaukee County.

Public transit service in the Milwaukee area is limited largely to Milwaukee County and is currently provided by fixed-route common carrier service, fixed-route special carrier service, and nonfixed route special carrier service. Primary fixed-route common carrier service is currently provided by modified rapid transit "Freeway Flyer" motor bus service operated by the Milwaukee County Transit System and by Wisconsin Coach Lines, Inc. Primary service, provided primarily during peak travel hours, is offered by 10 freeway bus routes from 13 outlying park-ride lots to the Milwaukee central business district. This service was used by approximately 4,700 average daily revenue passengers in 1978. Total Freeway Flyer ridership has increased from about 81,000 annual revenue passengers in 1964 to nearly one million annual revenue passengers in 1978.

Secondary public transportation service in the Milwaukee area is currently composed of five express bus routes operating over arterial streets. An average of 350 weekday vehicle trips were made on these express bus routes in 1979. Tertiary transit service was provided in Milwaukee County on 44 local routes making approximately 5,107 weekday vehicle trips in 1978. Secondary and tertiary transit service in the Milwaukee area was used by an estimated 43,616,900 revenue passengers in 1978, or about 171,500 per average weekday.

PLANNED TRANSPORTATION FACILITIES AND SERVICES

In the development of the regional transportation system plan, it was recognized that the growth and change anticipated to occur within southeastern Wisconsin would generate demands for additional travel and for improved transportation facilities and services. During the preparation of the plan, the Regional Planning Commission had to grapple with a serious division of public opinion as to whether or not any additional freeways should be constructed in Milwaukee County. This division of opinion reflected many considerations. Some elected officials and interested citizens expressed concern over the escalating cost of freeway construction, the displacement of homes and businesses, uncertainties in future population and employment levels and motor fuel availability, and a belief that additional freeway construction would contribute to further population loss in the City of Milwaukee. Other elected officials and the business and labor community stressed the vital nature of an integrated freeway system to the social and economic well being of not only the Region but of the central city as well.

A two-tier plan approach was adopted by the Commission in order to deal with the divided public opinion and with the uncertainties related to population and employment growth and attendant travel demand, energy cost and availability, and legislative and fiscal constraints. Only the adopted plan's freeway recommendations were divided into two tiers, an "upper tier" and a "lower tier." All other recommendations of the plan—those regarding standard arterial streets, public transit, and, importantly, transportation systems management—were included in the lower tier of the plan. The concept of the two-tier plan was that, the facilities placed in the upper tier—about 37 miles of freeway in the Region and 13 miles in Milwaukee County—would remain on the long-range plan, but no further work would be undertaken toward the construction of these facilities for at least a decade. During that decade, a combination of transportation systems management measures intended to reduce the anticipated peak-hour travel demand in Milwaukee County while obtaining the highest possible efficiency from existing transportation facilities and services was proposed for implementation. The proposed transportation systems management actions included an extensive freeway operational control system, increased promotion of carpooling and vanpooling, and significantly improved mass transit service. The two-tier plan envisioned that if at some future time it was determined that these actions to modify travel demand and achieve maximum facility and service efficiency had been effective and that surface arterials and transit services were adequately accommodating travel demand, then steps could be taken at that time to formally remove the upper-tier freeway proposals from the long-range plan. On the other hand, if the consensus at such future time was that travel demand modification and improved transportation efficiency efforts had not worked well and that arterial street and transit improvements had not adequately provided the needed transportation service, work could again proceed toward the construction of the upper-tier freeways. In the meantime, the plan recommended that all right-of-way currently cleared for the remaining freeway segments be held in a transportation land bank, with appropriate consideration given to the use of the land for park and open space purposes. The plan also recommended that any currently undeveloped lands needed to accommodate the construction of freeways in the upper tier of the plan continue to be held in open use.

The Commission at the same time prepared and adopted a transportation systems management plan which expanded upon the long-range plan's recommendations to maximize the efficiency of the transportation system within southeastern Wisconsin. This plan proposed a coordinated areawide program of 24 actions to ensure full and efficient use of existing arterial street and highway facilities, to reduce vehicle use in congested areas, to improve transit service, and to increase internal transit management efficiency. Among the actions proposed were studies for treatments at the "stub ends" of freeways, a study of arterial corridors, a taxi fare and regulation study, a study of work time rescheduling, a study of downtown parking rate structures, and continued implementation and improvement of transit service and carpool and vanpool promotion programs. Thus, the recommended regional transportation system plan for the year 2000 was composed of four elements staged in two tiers: freeways, standard arterial streets and highways, public transit facilities and services, and transportation systems management. The regional freeway system proposed to serve the Region in the year 2000 includes the nearly 232 miles of freeways in the area open to traffic; 7 miles of freeways committed for construction; an additional 60 miles of proposed freeways in the lower tier of the plan recommended for immediate implementation; an additional 12 miles of existing freeways in the lower tier of the plan recommended for significant immediate improvement; and a total of 37 miles of proposed freeways in the upper tier of the plan whose implementation is recommended to be deferred. The standard arterial street and highway system would be increased from the 2,850 miles existing in 1972 to about 3,190 miles in the year 2000. The additional mileage reflects primarily the addition of existing nonarterial facilities to the arterial system. Only about 150 miles of new arterial facilities would be constructed under the current plan. As provided for in the plan, about 2,261 miles of the total arterial street system, or about 74 percent, are classified in the system preservation category. This includes 196 miles on which no work would be required; 1,545 miles on which only resurfacing would be required; and 880 miles on which reconstruction for the same capacity would be required. About 720 miles, or 20 percent, are classified in the system improvement category, including 676 miles that would be reconstructed for additional capacity and 44 miles that would involve new construction of a replacement facility. The remaining 184 miles, or 5 percent, are classified in the system expansion category, meaning that the construction of new facilities would be required.

The adopted transportation system plan includes continued public transit improvement and expansion for the three urbanized areas in the Region—Milwaukee, Kenosha and Racine. In the Milwaukee urbanized area, the plan envisions the provision of three levels of transit service: primary, secondary, and tertiary. Under the plan, primary service would be of the modified rapid transit type, provided by motor buses in mixed traffic over 80 miles of freeways and 27 miles of surface arterial streets. It is envisioned that these vehicles would provide for the collection and distribution of passengers at the end of each route. The primary transit service would be supported by the implementation of a comprehensive freeway traffic management system, including freeway ramp meters to provide preferential access for transit vehicles.

The secondary level of transit service envisioned in the plan would provide express bus service over arterial streets, with stops generally located only at intersecting bus routes. Under the recommended plan, secondary service would be provided over 14 individual transit routes with exclusive transit lanes—that is, traffic lanes where only buses would be allowed during specified hours of the day—on six arterial streets. The exclusive transit lanes would total nearly 10 miles. Shared secondary transit service would be provided over a total of about 146 miles of arterial facilities.

The tertiary level of public transit service envisioned in the plan consists of local transit service provided primarily over arterial and collector streets, with frequent stops for passenger boarding and alighting. Under the preliminary recommended plan, tertiary transit service would be extended to include all of the Milwaukee urbanized area, including the newer urban residential areas in southern Ozaukee and Washington Counties and eastern Waukesha County.

In addition to the arterial street and highway and transit facility and service recommendations described above, the final recommended regional transportation system plan for the year 2000 includes four major transportation system management recommendations. These management recommendations consist of the expansion of a freeway traffic management system in the Milwaukee area, the expansion of curb parking restrictions on major surface arterials during peak-hour travel periods, the establishment of a continuing carpooling promotional program, and the institution of a parking fee structure to encourage short-term and discourage long-term parking in the Milwaukee central business district. The management recommendations are designed to accomplish several objectives, including ensuring that maximum use is made of existing transportation facilities before commitments are made to new capital investment; encouraging the use of high-occupancy vehicles, including buses, vans, and carpools; effecting motor fuel savings; and reducing vehicle miles of travel in congested areas.

POTENTIAL EXCLUSIVE PRIMARY TRANSIT ALIGNMENTS

The ready availability of rights-of-way for exclusive primary transit guideways can significantly affect the cost and practicality of alternative primary transit system configurations and of alternative primary transit modes. Accordingly, as part of the Milwaukee area primary transit system alternatives analysis, an inventory was conducted of the extent, location, and physical characteristics of all rights-of-way suitable as a location for fixed guideways in the greater Milwaukee area. The inventory included an analysis of the physical suitability of abandoned electric interurban railway rights-of-way, electric power transmission line rights-of-way, freeway rights-of-way, and active and abandoned railway rights-of-way for busways and light rail transit and heavy rail transit guideway development. In addition, existing railway lines were analyzed as potential locations for commuter rail routes.

An extensive network of electric interurban railway lines served the Milwaukee area from 1895 to 1963. The largest of the two systems which served the area was that of The Milwaukee Electric Railway & Light Company (the Milwaukee Electric Lines), consisting of 202 miles of electric interurban railway lines operated over combinations of public streets and private rights-of-way from downtown Milwaukee north to Port Washington and Sheboygan, west to Oconomowoc and Watertown, southwest to East Troy and to Burlington, and south to Racine and Kenosha. Of these 202 miles of line, 174 miles were located within southeastern Wisconsin and 20 miles were located within the study area. Approximately 180 miles of the total were operated over private rights-of-way, the remainder being operated over public streets. Within the Region 155 miles, or 89 percent, were operated over private rights-of-way, with the remaining mileage being operated over public streets. Within the Milwaukee area 78 miles, or 86 percent, were operated over private rights-of-way, with the remaining mileage being operated over public streets. Summarized in Table 150 in Chapter VII are the findings of the inventory with respect to the potential of the former Milwaukee Electric Lines private rights-of-way to be utilized for primary transit in the Milwaukee area. For inventory purposes, the rights-of-way were divided into seven segments, according to the original railway line or operating division for which they were used. Indicated in Table 108 is the potential of the 10 private rights-of-way—ranging in length from 0.2 mile to 3.6 miles and totaling 10.1 miles in length—that were once part of the 130-miles of line of the Milwaukee area street railway system, also operated by the Milwaukee Electric Lines.

Nearly all of the former Milwaukee Electric Lines interurban rights-of-way have portions with good potential for primary transit development. The right-of-way of such portions is largely intact and is owned by the Wisconsin Electric Power Company and used for electric power transmission line location. However, the railway grade on such segments is only partially intact. Most fills have been leveled or severely altered and many cuts have been filled in. Nearly all bridges at former grade separations with highways or other railways have been removed. Of the 78.0 miles of former electric interurban railway rights-of-way operated by the Milwaukee Electric Lines on private rights-of-way in the Milwaukee urbanized area, 59.5 miles or 76.3 percent, were determined to have good potential for the location of fixed guideway facilities. Nevertheless, most of the former street railway private rights-of-way were found to have poor potential for use in the development of primary transit fixed guideways. Only one segment of private right-of-way, 0.4 mile in length, is still entirely clear, and two segments, 2.5 and 1.0 miles in length, have discontinuous portions that are still clear.

The other electric interurban railway system formerly serving the Milwaukee area was that of Chicago, North Shore & Milwaukee Railway Company (North Shore Line). Within the State of Wisconsin, this system consisted of a single route from downtown Milwaukee to Chicago by way of the Cities of Racine and Kenosha, and within the Southeastern Wisconsin Region consisted of about 36 route miles of line, of which 92 percent were operated over private rights-of-way, the remainder being operated over public streets. About 14 miles of line were located within the study area, of which 11 miles, or 80 percent, were operated over private rights-of-way. Abandoned in 1963, the 11.1-mile portion of the railway right-of-way that did not use public streets is largely, although not entirely, intact within the Milwaukee area, being owned largely by Milwaukee County (see Table 150). The railway grade is only partially intact on the right-of-way, as many fills have been leveled or severely altered and many cuts have been filled in, and bridges at former grade separations have been removed.

Electric power transmission trunkline rights-of-way were also inventoried with respect to their potential for use in the development of a fixed guideway primary transit system. There were a total of 1,987 miles of such trunk lines located in the Milwaukee area in 1978. Because more than one trunk line is typically located on an easement or right-of-way, these trunk lines were located on only 57 miles of rights-of-way owned in fee simple by the Wisconsin Electric Power Company, and 174 miles of easements obtained by the Wisconsin Electric Power Company. The owned rights-of-way in the Milwaukee area are specifically those private rights-of-way that were formerly utilized for electric interurban railway alignments by The Milwaukee Electric Railway & Light Company. All electric power transmission trunk lines in the Milwaukee area that are not located on former electric interurban railway rights-of-way were found to be located on easements, which have no potential for the development of primary transit fixed guideways. The easements generally consist only of small areas of land for the location of electric power transmission line supports connected by corridors over which only aerial rights are held by the power company. The land between the power line support structures is usually utilized in conjunction with surrounding land uses.

The Milwaukee area freeway system was also inventoried with respect to its potential for use in the provision of primary transit guideway alignments. One way to provide primary transit service over the existing freeway system is through the reservation of existing freeway lanes for the exclusive use of motor buses, operating either in a normal flow direction or in a contraflow direction. Alternatively, parts of the freeway right-of-way other than the traffic-carrying lanes could be used for the location of primary transit fixed guideway alignments, including busways, light rail guideways, and heavy rail guideways. The parts of the freeway right-of-way that could be used include the inside shoulder and median of the freeway, the outside shoulders of the freeway, and the nonroadway portions of the freeway right-of-way adjacent to the outside shoulders.

There are two major obstacles to the provision of a system of reserved bus lanes on the Milwaukee area freeway system. One is the configuration of the system and the design of its interchanges, which results in freeway entrance and exit ramps connecting to both the right- and left-hand lanes of the freeway where reserved lanes for buses would be provided. Because of the frequency of such ramps connecting to the right-hand side of the freeway, it was concluded that, in general, only median lanes should be considered for use as either normal flow or contraflow reserved bus lanes in the Milwaukee area. Unfortunately, because of the number of left-hand ramps, major portions of the median lanes of the East-West Freeway in Milwaukee County (IH 94 and IH 794) and the inner portions of the North-South Freeway (IH 94 and IH 43) approaching the central business district of Milwaukee do not lend themselves to development for reserved bus lanes, particularly in a contraflow direction.

The other major obstacle to the provision of reserved lanes for the exclusive operation of buses on the Milwaukee area freeway system is the traffic congestion that may be expected to result, based upon existing freeway traffic capacities and volumes. As shown on Map 81, if a freeway lane were reserved for bus use in the normal flow direction, the central portions of the Milwaukee area freeway system—totaling about 41 miles in the morning peak hour and 44 miles in the evening peak hour, or about 40 and 43 percent, respectively, of the total freeway system—could be expected to carry the maximum possible traffic volumes, and, in addition, require some diversion of traffic. These freeways would experience severe congestion with continuous stop-and-go driving and operating speeds of 30 to 35 miles per hour or less. In addition, the necessary diversion of existing freeway traffic to surface arterial streets, to transit, or to other times of the day would have to approach 1,000 to 1,900 vehicles during the morning and evening peak hours on parts of the East-West Freeway (IH 94), North-South Freeway (IH 43 and IH 94), Zoo Freeway (USH 45), and Airport Freeway (IH 894). Additional portions of the Milwaukee area freeway system—totaling about 28 miles in the morning peak hour and 19 miles in the evening peak hour, or about 27 and 18 percent, respectively, of the total freeway system—would have to carry the maximum possible volumes if a freeway lane were reserved for bus operation in the normal flow direction. Operating conditions on these freeways would approach unstable flow, with intermittent stop-and-go traffic conditions and operating speeds at or below 40 miles per hour.

The traffic congestion problem caused by reserving an existing freeway lane for buses would be less severe for contraflow reserved bus lanes, as shown on Map 82. Only about five miles in the morning peak hour and eight miles in the evening peak hour of the East-West Freeway (IH 94) and Zoo Freeway (USH 45)—totaling about 5 and 8 percent of the total Milwaukee area freeway system—would have insufficient capacity with reduced lanes in the nonpeak direction to accommodate existing peak-hour traffic volumes. An additional 14 miles in the morning peak hour and nine miles in the evening peak hour—or 14 percent and 9 percent of the Milwaukee area freeway system, respectively—including additional segments of the East-West Freeway and Zoo Freeway and small segments of the North-South Freeway (IH 43) and Airport Freeway (IH 894), could be expected to operate over design capacity with existing traffic volumes if a traffic lane were reserved for a contraflow bus lane. It should be recognized in this respect, however, that unlike the normal flow bus lanes, which provide automobile users with an opportunity to divert from congested freeways to the improved bus service, the contraflow reserved bus lanes provide improved transit service in the direction opposite of that which experiences the traffic congestion, and may, in fact, cause such congestion.

Thus, based upon the configuration and design of the Milwaukee area freeway system and the existing traffic volumes carried on that system, reserved bus lanes could be developed in a contraflow directin only on median lanes over parts of the system, including all freeway segments outside Milwaukee County and, within Milwaukee County, on segments located between freeway-to-freeway interchanges of the North-South Freeway (IH 43 and IH 94), Airport Freeway (IH 894), Zoo Freeway (USH 45), and Fond du Lac Freeway (USH 41 and USH 45). Normal flow reserved bus lanes could be readily developed only on a much more limited set of segments of the freeway system, including the Lake Freeway (IH 794), Fond du Lac Freeway (USH 41 and USH 45), and Rock Freeway (USH 15).

As another alternative, the median, outside shoulders, and nonroadway portions adjacent to the outside shoulders could be considered for the location of new guideway facilities. However, the inventory data indicated that freeway medians, outside shoulders, and nonroadway portions of the Milwaukee area freeway system cannot readily be used as a location for fixed guideways for motor buses, light rail vehicles, or heavy rail vehicles. A major obstacle to such use is the width available for guideway development, particularly in the median, but also in the freeway shoulders and nonroadway portion of the rights-of-way, as shown in Table 128 and on Maps 68 through 77. This problem is most severe on those parts of the freeway system located in the central portions of Milwaukee County.

Another major obstacle to the use of existing freeway rights-of-way as a location for fixed guideway facilities is the frequency with which freeway-to-freeway ramps and freeway entrance and exit ramps would have to cross the primary transit guideway alignments in the freeway right-of-way. This problem would be particularly severe for use of the freeway shoulders and nonroadway portions of the right-of-way, as there would be a need to grade-separate the guideways from the many right-hand freeway ramps which would cross the potential guideway alignments, as shown on Maps 65 and 66. The construction of elevated guideways in the freeway right-of-way to provide such grade separation, however, may be expected to be particularly difficult and costly since the elevated guideway would need to be constructed through, over, or around freeway-to-freeway interchanges, and over other overpasses to the freeway. Consequently, only the outer reaches of the Milwaukee area freeway system—generally outside Milwaukee County—where freeway ramps, particularly those on the right-hand side, are relatively infrequent and where freeway medians, shoulders, and nonroadway portions are of sufficient width to support an at-grade dual guideway, may be considered practical for further consideration as primary transit corridors.

There are, however, two freeway corridors in the Milwaukee urbanized area with excellent potential for fixed guideway primary transit development. Both of these corridors have been cleared in anticipation of freeway construction, but such construction is not recommended in the adopted regional transportation system plan for a period of at least a decade. These two freeways are the Park Freeway-East and the Stadium Freeway-South, both of which have cleared rights-of-way for distances of about 1.2 miles and 0.5 mile, respectively. There is one other cleared freeway corridor in the Milwaukee area, that of the no longer recommended Park West Freeway. This corridor is approximately 2.2 miles in length, and 320 to 420 feet wide, and could readily accommodate fixed guideway development.

The railway system rights-of-way within the Milwaukee area were also inventoried with respect to their potential to accommodate primary transit guideways. For the purposes of this inventory, the railway system was divided into 23 right-of-way segments, based upon the operating divisions and subdivisions currently or historically in effect on the Chicago, Milwaukee, St. Paul & Pacific Railroad (Milwaukee Road), the Chicago & North Western Railway (C&NW), and the Soo Line Railroad. Tables 151 and 152 summarize the physical characteristics and potential for primary transit use of each active and abandoned railway right-of-way in the study area.

As indicated in Table 151, 14 of the 20 active railway lines that have been inventoried were determined to have, overall or in major segments, good or fair potential for the location of bus, light rail transit, heavy rail rapid transit, or exclusive busway fixed guideway facilities, as sufficient right-of-way was available outside the existing railway trackage to accommodate a dual fixed guideway. In addition, of the three active railway lines which were assessed overall as having either poor or no potential for the development of fixed guideway facilities, all had limited portions suitable for the location of at-grade fixed guideway facilities. Those railway rights-of-way determined not to be suitable for the location of at-grade, fixed guideway, primary transit facility development generally had a large concentration of industrial sidings and lead tracks on both sides of the right-of-way; additional railway trackage for passing, storage, and station facilities within the right-of-way; and intensive industrial development located immediately adjacent to the right-of-way.

With respect to the three abandoned railway rights-of-way in the study area, there is potential to locate primary transit fixed guideway facilities only within the right-of-way of the former Chicago & North Western Railroad Company lakefront main line. The right-of-way of the former Milwaukee Road North Lake branch line is not direct in alignment. The right-of-way of the Chicago & North Western Railway Whitefish Bay main line has been converted to other uses, including public street rights-of-way and commercial and residential development.

A total of six railway routes within the seven-county Southeastern Wisconsin Region were identified in the inventory and assessment of readily available primary transit system rights-of-way as having the potential to be utilized for the operation of commuter rail service (see Map 114). In the identification of these commuter rail routes, the following characteristics of the routes were considered: construction to railway mainline engineering standards; access to the Milwaukee central business district and other major trip generators with concentrations of residential development; and the existence of double track. The six potential commuter rail routes radiate from downtown Milwaukee to Port Washington, Saukville, West Bend, Oconomowoc, Kenosha, and Waukesha.

Five of these six potential commuter rail routes appear to have good potential for such operation insofar as the engineering standards and physical condition of the trackage are concerned, as they would require between $251,000 and $484,000 per mile for the work necessary to permit commuter rail operation. This work would include a significant amount of track rehabilitation on each route, the construction of storage and servicing facilities for the trains at the outermost station on each route, the installation of automatic crossing gates at all public at-grade street and highway crossings, and—on three of the routes—the construction of a connecting track between the trackage of Milwaukee Road and the C&NW railway lines. The route between Milwaukee and Oconomowoc appears to have excellent potential for such operation since most of the trackage that would be utilized is presently in very good condition and would allow commuter train speeds of 60 miles per hour. The restoration of this route for commuter rail operation would require only $118,000 per mile in track rehabilitation costs. Table 153 summarizes the work required and the cost thereof to operate commuter trains over each route.

Some segments of the six commuter rail routes considered utilize common trackage to gain access to the passenger station at Milwaukee. If a commuter rail system were implemented that used such a combination of routes, certain segments of rehabilitated railway track could be used by trains of more than one route. Accordingly, the total cost of track rehabilitation for a commuter rail system would be $35,738,000.

CONCLUSIONS

Because of its important impacts on daily life and on regional development, transportation is, and may be expected to remain, one of the principal areas of public policy determination facing public officials, citizen leaders, and technicians within the Region. The preceding chapters have summarized the most critical aspects of the massive data base most relevant to the Milwaukee area primary transit system alternatives analysis. The following summary of major inventory findings suggests several conclusions with respect to the development of southeastern Wisconsin in the

1970's, and particularly with respect to the future development of the regional transportation system.

- The scale of regional growth and urbanization within the Region is changing. The very high post-World War II rates of population increase and rural to urban migration appear to have diminished. These very high rates appear to have been replaced with more modest growth rates which are similar to those experienced by the Region in the 1930's and early 1940's.

- The pattern of urban development within the Region is continuing to change from one of compact, concentric growth centered on the oldest and largest central cities of the Region to one of highly diffused, multi-centered and low-density development. This areawide diffusion of urban land uses and of population and economic activity has been accompanied by declines in the population levels of the older central cities and first-ring suburbs. Factors contributing to this diffusion include changing preferences in residential location and density, the widespread availability of electric power and electronic communication facilities, the availability of the septic tank and private well as substitutes for centralized sanitary sewerage and water supply facilities, the convenience and attractiveness of personal automotive transportation and the development of all-weather highway systems, and the rising cost of land in close proximity to existing urban centers. Other contributing factors are the availability of relatively low-cost land on the urban periphery and the relatively high personal mobility offered by outlying areas.

- Despite the fact that the Region's population increased by only 1 percent between 1970 and 1978, the number of jobs increased by 15 percent because of the increased female labor force participation rates, an apparent trend toward individuals holding more than one job, and a changing age structure within the Region's population wherein a larger proportion of the total population is presently in the work force.

- The highly dispersed, low-density residential development pattern which has occurred within the Region since 1950, and particularly since 1963, has resulted in the encroachment of incompatible forms of urban development into many ecologically important and environmentally sensitive areas, including floodland and shoreland areas, groundwater recharge and discharge areas, woodland and wetland areas, wildlife habitat areas, and prime agricultural areas. This encroachment has, in turn, resulted in the creation of costly drainage and flooding problems, a general deterioration of surface water quality, the potential contamination of groundwater supplies, and the destruction of scenic portions of the rural landscape. However, with the exception of the continued deterioration of surface water quality, the total impact of urban encroachment on the regional resource base from 1963 through 1970 appears to be relatively modest if changes in individual natural resource elements are compared with the total qualitative and quantitative aspects of those resource elements within the Region. Indeed, far more has been accomplished toward preservation and enhancement of the natural resource base since 1963 through sound land use planning and plan implementation than toward its destruction.

  Based upon a growing public awareness of the need for environmental protection and enhancement, a general recognition of the important attributes of the natural resource base, and mandates from state and federal government agencies related to environmental protection, it appears that the trend toward preservation and protection of natural resource base elements which occurred from 1963 to 1970 will continue. Through implementation of well-conceived land use and transportation plans and of such related plans as watershed, water quality management, and air quality attainment and maintenance plans, the recreational, aesthetic, ecological, and cultural attributes of the natural resource base not only can be maintained, but may, in some cases, even be enhanced.

- In the last 15 years, the freeway has emerged as the singularly most important element of the area's transportation system. During this time, intercity railroad service has been significantly reduced and use of urban public transit service has suffered a substantial decline. Freeways comprise about 7 percent of the arterial street and highway system in the Region but carry about one-third of the total trips.

- The significant decline in public transit utilization, which extends back to the 1950's and which occurred long before the emergence of the freeway as the dominant element of the regional transportation system, holds important implications for regional transportation system planning and development. The overwhelming usage and increasing predominance of the automobile present a formidable obstacle to the reestablishment of high-quality, widely used urban public transit services. The continuing trends toward regional land use decentralization and declining urban densities work directly against the development of public transit services. If these trends change in response to energy price increases and supply shortages and to recent national and long-standing regional public policy which favors the redevelopment of the central cities, then the market for public transit services perhaps can be expanded significantly.

- Inventories of the abandoned electric interurban railway rights-of-way and active and abandoned railway rights-of-way in the Milwaukee area indicate that such rights-of-way have significant potential for the location of primary transit busways and light and heavy rail rapid transit guideways. Of the 104 miles of former electric interurban railway rights-of-way in the Milwaukee area, nearly 65 miles are still largely open and intact. Of this 65 miles, nearly 59 miles, or 91 percent, is owned by the Wisconsin Electric Power Company and used for electric power transmission lines, and the remainder is owned by Milwaukee County. Of the 196 miles of active railway rights-of-way in the Milwaukee area, about 126 miles have sufficient right-of-way outside the existing trackage to permit fixed guideway development. In addition, two miles of abandoned railway right-of-way are suitable for guideway development. However, only one existing railway right-of-way, and the abandoned railway right-of-way connected to it which approaches the Milwaukee central business district, has sufficient right-of-way and adequate vertical alignment to permit the ready development of fixed guideway facilities: the Capitol Drive spur track and the former Chicago & North Western lakefront main line.

  Six of the mainline railway routes connecting the Milwaukee central business district with major outlying concentrations of residential, commercial, and industrial development could be used in the provision of commuter rail primary transit service. The cost of the track rehabilitation, end-of-line vehicle storage, and grade-crossing protection necessary for commuter rail operation on a system of these six lines would total \$35,738,000, or \$231,000 per mile, with the cost varying from a low of \$118,000 per mile on the route from Milwaukee to Oconomowoc to a high of \$484,000 per mile on the route from Milwaukee to Saukville.

  The freeways of the Milwaukee area generally do not have sufficient excess right-of-way in the median or outside shoulder and adjacent areas to permit fixed guideway development, and the frequency and design of freeway-to-arterial street and freeway-to-freeway interchanges further limits any use of freeway medians, and particularly outside shoulders and adjacent right-of-way, for fixed guideway development. In addition, the frequency and design of arterial street interchanges and freeway-to-freeway interchanges limit the segments of the existing freeway system on which lanes could be reserved for primary transit use principally to those between freeway-to-freeway interchanges, unless selected interchanges are closed or reconstructed. The freeway congestion and unavoidable diversion of freeway traffic which would result from reserved lanes on freeways on the central parts of the Milwaukee area freeway system—including the East-West Freeway (IH 94), the North-South Freeway (IH 94 and IH 43), the Zoo and Airport Freeways (IH 894 and USH 45) if normal flow reserved lanes were used, and the East-West Freeway (IH 94) and Zoo Freeway (USH 45) if contraflow reserved lanes were used—further limits the feasible use of reserved freeway lanes.

  Median lanes could be used for contraflow reserved bus lanes over parts of the system, including nearly all freeway segments outside Milwaukee County and, within Milwaukee County, on segments between freeway-to-freeway interchanges of the North-South Freeway (IH 43 and IH 94), Airport Freeway (IH 894), Zoo Freeway (USH 45), and Fond du Lac Freeway (USH 41 and USH 45). Thus, of a total of 102.9 miles of freeways within the study area, about 61 miles, or 59 percent, could be utilized to provide reserved bus lanes in the contraflow direction. Normal flow reserved bus lanes could be readily developed on a much more limited set of segments of the freeway system, including the Lake Freeway (IH 794), Fond du Lac Freeway (USH 41 and USH 45), and Rock Freeway (USH 15), for a total of about 18 miles, or 17 percent of the total system.

There are two freeway corridors in the Milwaukee urbanized area that have excellent potential for fixed guideway primary transit development. Both of these corridors have been cleared in anticipation of freeway construction, but such construction is not recommended in the adopted regional transportation system plan for a period of at least a decade. These two freeways are the Park Freeway-East and the Stadium Freeway-South, both of which have cleared rights-of-way of 250 to 350 feet in width for distances of about 1.2 miles and 0.5 mile, respectively. The Park West Freeway, which is no longer proposed to be constructed in the adopted regional transportation system plan and for which redevelopment plans have been proposed, could also readily accommodate primary transit fixed guideway development, being 2.2 miles in length and 320 to 420 feet wide.