WATER SUPPLY SERVICE

Water supplies used in the watershed are obtained from both groundwater sources and Lake Michigan. Three principal aquifers lie beneath the watershed from which groundwater is obtained. Water obtained from these aquifers is either pumped from individual wells owned by homeowners or businesses, or water is obtained by municipal pumping facilities.

Municipal water supply systems serve more than 94 percent of the area's population. The principal municipal systems are the city of Green Bay Water Utility, city of De Pere Water Utility and water utilities in the villages of Allouez, Ashwaubenon and Wrightstown; and the towns of Bellevue, Scott and the unincorporated community of Greenleaf.

NATURAL RESOURCE FEATURES

CLIMATE

The climate of northeastern Wisconsin is temperate but has marked changes common to areas in the interior of large land masses in middle latitudes. Winters are cold and snowy and summers are mostly warm with periods of hot humid conditions. The nearby waters of the bay of Green Bay and Lake Michigan reduce climate extremes which occur further inland.

The frequency, duration and amount of precipitation influences surface and groundwater quality and quantity, soil moisture content, runoff characteristics, and the physical condition of waterways. Precipitation events throughout the watershed are most frequently moderate in duration and quantity. An event is defined as a distinct period when precipitation is equal to or greater than 0.1 inch. Approximately 50 events per year occur in the watershed.

Annual precipitation averages 26 inches of rain and melted snow. The driest months are December, January and February. These are also the months of greatest snow accumulation, when about 70 percent of the average annual snowfall occurs. The wettest months are June, July, August, and September when about 50 percent of the average annual rainfall takes place. Most runoff occurs in March and April when the land surface is frozen, and in May when soil moisture is highest.

TOPOGRAPHY

Topography in the watershed reflects the impact of the last glaciation period in northeastern Wisconsin. Most of the area has gentle slopes with level to slightly rolling

topography. The most dramatic land form feature is the Niagara escarpment. The western edge of the escarpment is a large plateau running northeast to southwest parallel to the Fox River floodplain. The escarpment rises rapidly from the East River floodplain (590 feet above sea level) to a height of more than 850 feet above sea level in a distance of about two miles.

Numerous small intermittent streams crease the steeply sloped western face of the escarpment. Bedrock ledges along the stream bottoms of the East River, Bower Creek, and Wequiock Creek have created waterfalls which drop greater than 30 feet. Shallow soil cover over most of the escarpment and the fractured bedrock combine to make the underlying groundwater particularly susceptible to contamination.

SOILS

The most common soil groups occurring in the watershed are the Kewaunee-Manawa, Oshkosh-Manawa and Oshkosh-Allendale-Tedrow Associations. The erosion potential for various soils is based on texture, structure, organic matter content, permeability, slope, position on the landscape, and land use.

The characteristics of the soils in the watershed that increase their erosion potential and delivery of sediment to streams include: relatively fine soil texture with slow permeability; some areas with moderate to steep land slopes; the predominance of agricultural and developing land uses; and the location of the soil relative to a stream or other surface water.

SURFACE WATER RESOURCES

Streams: Perennial and intermittent streams are the predominant surface water features. The undulating, irregular topography resulted in the natural creation of more than 260 miles of streams.

Perennial streams maintain at least a small continuous flow throughout most of the year. The East River, which is 33 miles in length, is the principal perennial stream in the watershed. Other significant perennial streams include the Fox River (18 stream miles), Bower Creek (17 stream miles) and Baird Creek (13 stream miles).

Intermittent streams flow only when there is runoff or when groundwater discharge is highest. Intermittent waterways are the headwaters of many of the larger perennial streams and comprise the venous network of drainageways along the western slope of the Niagara escarpment.

Wetlands: Wetlands are some of the most valuable natural resource features in the watershed. Their values include wildlife habitat, fish spawning and rearing, recreation, attenuation of runoff and flood flows, and removal of pollutants. They comprise 2,500 acres, or three percent, of the watershed.

GROUNDWATER

Groundwater in the watershed moves within two principal systems: the water table system and the artesian system. The water table system is present in all parts of the project area and is recharged locally by precipitation and infiltration. The artesian system in the East River Watershed is made up of those parts of two aquifers lying beneath the relatively impermeable Maquoketa Shale. Artesian conditions can also exist just beneath the fine grained silts and clays of the unconsolidated surficial materials. Most recharge to the lower system is from west central Brown County.

An aquifer is simply an underground rock or soil formation that contains water. Four principal aquifers provide groundwater for the watershed. They are, in order from deepest to nearest the surface:

1. The lower sandstone aquifer which includes sandstone formations of the Cambrian period--this layer is topped with a confining layer Cambrian age dolomite.

2. The upper sandstone aquifer which includes sandstone and dolomite formations of the upper Ordovician period--this layer is topped with the Maquoketa Shale confining layer.

3. The Silurian or Niagara dolomite aquifer--this layer is also confined throughout much of the watershed by overlying, less permeable, fine-grained silt and clay surficial deposits.

4. The sand and gravel aquifer--in portions of the watershed this aquifer is connected to the unconfined Silurian aquifer.

Groundwater occurs in fractures in dolomite or in sandstone formations within the pore spaces between loosely cemented grains of sand. The sandstone aquifers are the source of most potable municipal groundwater in the watershed. Regional groundwater flow is generally towards the east in this aquifer. The sandstone aquifer is generally less impacted with surface contaminants in the watershed because it is overlain by the relatively impermeable Maquoketa Shale formation there.

The Silurian dolomite aquifer lies above the sandstone aquifer. It is separated from the sandstone aquifer by the Maquoketa Shale and is relatively close to the ground surface.

This aquifer is the source of potable water for private wells and most other non-municipal water systems in the watershed.

The sand and gravel aquifer is a relatively shallow aquifer consisting of permeable sediments of unconsolidated glacial deposits. Water in this aquifer is recharged locally by precipitation and is often discharged to surface drainage systems within a few miles of the point of recharge. This aquifer is locally important as a source of groundwater in areas with relatively thick, saturated, and unconsolidated surface deposits. The sand and gravel, and the dolomite aquifers are the most susceptible to contamination due to the shallow depth to the groundwater and permeable nature of the bedrock and other subsurface formations.

Water in the eastern groundwater province aquifers is generally quite hard. Chloride levels in most wells sampled in this region were below the state's drinking water standards. Concentrations exceeding the state standard for dissolved solids were found in water from more than 25 percent of the wells sampled in the Silurian dolomite aquifer. Sulfate concentrations exceeding the standard were found in water from approximately 10 percent of the wells in this aquifer. Iron concentrations can be an aesthetic problem in all three aquifers. The standard for iron was equalled or exceeded in water from half or more of the 764 wells sampled in all three geologic units.

Monitoring data suggest that nitrate contamination of the groundwater may not be a widespread problem in the East River Watershed. Nitrate concentrations exceeding the 10 milligrams per liter (mg/l) state standard were found in relatively few wells. Further site specific investigations are needed before the extent and severity is accurately defined.

Groundwater contamination has been found and documented in the watershed. Most contamination is believed to be from leaking underground storage tanks, leaking landfills, improper disposal of waste materials spills, malfunctioning septic systems, and improper use of agricultural pesticides or fertilizers. The contamination is generally localized and does not threaten the overall groundwater quality in the watershed.

An example of a localized occurrence is contamination in the Scrays Hill area (Lower Bower Creek Subwatershed). During 1984 and 1985, 19 wells in the Scrays Hill area were found to be contaminated with Trichloroethane (TCE). The source of the contamination was not identified. Homeowners with affected wells installed whole house treatment systems or purchased potable water. Typically, the DNR addresses the cleanup of this type of contamination through several state and federal environmental quality programs.

ENVIRONMENTAL CORRIDORS

Areas within northeastern Wisconsin having the highest concentrations of natural, recreational, historic, aesthetic and scenic resources are included in environmental corridors. These areas normally include rivers, streams, wetlands, floodways, and flood plains. The DNR and the Brown County Planning Commission have identified environmental corridors and isolated natural areas. Preservation of these areas is important for improving water quality in this watershed and the Fox River Basin.

NATURAL AREA SITES

Natural areas were identified statewide by the Wisconsin Scientific Areas Preservation Council and the DNR's Bureau of Endangered Resources. These areas are contained primarily in environmental corridors and isolated natural areas. They are tracts of land or water which exhibit pristine pre-settlement conditions and/or contain unique plant and animal communities.

Natural areas are classified in one of three categories: Category I--statewide or greater significance, Category II-- countywide or greater significance, and Category III--local significance. This watershed contains some of northeastern Wisconsin's finest natural features including the Waldkirch Oak Woods, Cat Island Chain of Islands in Lower Green Bay and the Duck Creek Marsh (Category I); the Scray Hill Mesic Forest and Bedrock Outcrops and Duck Creek Marsh (Category II); and the Baird Creek Park Dry Mesic Forest and Bellevue Natural Arch (Category III).

ENDANGERED SPECIES

Information on rare and endangered resources was obtained from the DNR Bureau of Endangered Resources (BER). Comprehensive endangered resource surveys have not been completed for the watershed; however, BER files were used to review recorded occurrences of endangered species. The absence of known occurrences does not preclude the possibility of their presence in the watershed.

BER records indicate that four endangered animals (Blanchard Cricket Frog, Peregrin Falcon, Forester's Tern, and Redside Dace) and two endangered plants (Seaside Crowfoot and Lake Cress) occur in the watershed. In addition, six threatened animals (Blandings Turtle, Red Shouldered Hawk, Longear Sunfish, Wood Turtle, Greater Redhorse, Great Egret) occur in the watershed. Animals residing in or near the watershed project area on the State "watch list" include the Cooper's Hawk, American Eel, Lake Sturgeon, Common Tern and the Black-Crowned Night Heron. Four plant species (Seaside Crowfoot, Handsome Sedge, Dwarf Lake Iris, Snow Trillium) are on the state's endangered or threatened species list.

CHAPTER III
WATER QUALITY CONDITIONS, OBJECTIVES AND NONPOINT SOURCES

INTRODUCTION

Nonpoint sources of pollution are significant contributors of sediment, nutrients, and other pollutants to the East River, its tributary streams and the lower portion of the bay of Green Bay. These pollutants are contributing to a decline in water quality and degradation of aquatic habitats. Under certain conditions, they also may have the potential to impact groundwater quality. The nonpoint sources inventoried and the methods for evaluating their impact on surface and groundwater resources are discussed in Appendix B, "Watershed Assessment Methods".

Activities in the watershed, other than nonpoint sources, have the potential to impact surface or ground waters. These sources include industrial and municipal wastewater treatment facilities, landfills, abandoned landfills, private septic systems, and toxic or hazardous waste spills. Many of these are regulated by the State of Wisconsin--Department of Natural Resources or other governmental agencies. Permits define the conditions that must be met for each facility that contributes pollutants. If the conditions are met, the adverse impacts on water quality are minimized. These other potential sources of pollution are described in detail for the watershed in the ***East River Water Quality Appraisal Report*** (Herman, 1990).

The first part of this chapter presents a general overview of water quality conditions and nonpoint sources of pollution in the East River Watershed. The remainder of the chapter presents a discussion of the findings (actual quantities of pollutants generated from each source) of the urban and rural nonpoint source inventories. Subwatershed-specific water quality conditions, water quality objectives and other pollution sources are also discussed.

OVERVIEW OF WATER QUALITY CONDITIONS AND GOALS

Historically, the lower portions of the Fox River and Green Bay and downstream portions of the East River have been classified as some of the most badly polluted surface water in Wisconsin. A stream survey was conducted in 1927 on the East River from Mason Street to the confluence with the Fox River. It revealed that the East River

was little more than an open sewer unable to support fish or any recreational uses. Toxic pollutants in the sediments of the Fox River and Green Bay identifies this area as one of 42 Areas of Concern in the Great Lakes for a remedial action plan.

Nonpoint sources are responsible in part for the continuing degraded conditions of the streams and Green Bay. Excessive loading of sediment, nutrients, bacteria, and heavy metals have resulted in: degraded aquatic habitat and an unbalanced fish community with low populations and limited diversity; sedimentation and excessive nutrient levels resulting in an advanced state of eutrophication; and high levels of toxic materials in bottom sediments and invertebrate organisms consumed by fish requiring strict advisories regarding human fish consumption.

During an average year 10.5 percent of the total suspended sediment and up to 8.9 percent of the total phosphorus load transported to the mouth of the Fox River comes from the East River (Hughes, 1988). The East River Watershed contains only three percent of the area draining to lower Green Bay. The flow and water quality conditions of the Fox and East Rivers is strongly influenced by Green Bay. A seiche effect exists in the lower portion of the Fox River (to the De Pere Dam) and the lower portion of the East River (to the confluence of Bower Creek). The seiche is a hydrologic influence occurring when the wind forces the bay water into the downstream portions of the East River causing water level fluctuations. The result is periodic flow reversal with the incoming seiche and streambank exposure on the outgoing seiche (Quinlan, 1989).

WATER QUALITY OBJECTIVES

The water quality objectives for surface waters in the watershed project area are displayed in Figure III-1. Researchers studying the trophic dynamics of Green Bay generally conclude that high levels of phosphorus load reductions (40 to 50 percent) are needed to improve water quality and aquatic habitat (Harris and Christie, 1987). These reductions will reduce the prevalence of algae and allow aquatic plants to become reestablished and enhance a balanced aquatic community in lower Green Bay.

Significant sediment reductions are also needed to improve water clarity and lower the rate of siltation in the East River, lower Fox River and Green Bay. Approximately 470,000 cubic yards of sediment are removed annually from the Green Bay harbor at a cost of over one million dollars per year (Johnson, 1992). Sediment deposition results in the loss of spawning habitat, burial of fish eggs and embryos, reduction of adequate forage fish, decreased fish and invertebrate diversity and altered channel morphology. Suspended sediment and excessive algae growth: decreases light available for aquatic plants; reduces effectiveness of visual predators for capturing prey; contributes to water temperature increases by light absorption; and can cause fish kills through abrasion and clogging of gills (Quinlan, 1989).