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Rouge River Assessment

Jennifer D. Beam
and
Jeffrey J. Braunscheidel

FISHERIES DIVISION
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EXECUTIVE SUMMARY

This report is one of a series of river assessments being prepared by Fisheries Division of the Michigan Department of Natural Resources for Michigan rivers. This document describes the hydrologic characteristics and biological communities of the Rouge River and its watershed in southeast Michigan.

This assessment's purposes are first, to identify opportunities and solve problems concerning aquatic resources and fisheries values within the watershed. Second, to provide a way for public involvement in fishery management decisions. Third, to provide an organized reference for Fisheries Division personnel, other agencies and groups, and citizens who need information about a particular fishery resource.

This document consists of four parts: an introduction, a river assessment, management options, and public comments and responses. The river assessment is the nucleus of the manuscript. In thirteen sections (geography, history, biological communities, geology and hydrology, channel morphology, dams and barriers, soils and land use patterns, bridges and other stream crossings, special jurisdictions, water quality, recreational use, fishery management, and citizen involvement) we describe the characteristics of the Rouge River and its watershed.

In the management options we identify a variety of management problems and opportunities. Three types of options for responding to opportunities or problems are proposed. The first are opportunities to protect and preserve existing resources. The second require additional surveys or data gathering. The third are chances to rehabilitate degraded resources. Opportunities to improve an area or resource, above and beyond the original condition, are listed last. The options listed are not necessarily recommended by Fisheries Division, but are intended to provide a foundation for public discussion and comment and the selection of objectives for managing the Rouge River and its fisheries.

The Rouge River is located in southeastern Michigan and empties into the Detroit River, about midway between Lake St. Clair and Lake Erie. Its watershed is within portions of three counties: Wayne, Oakland, and Washtenaw. It is composed of a mainstem and three major branches, the Upper, Middle, and Lower Rouge rivers.

Discussions of the river begin at the headwaters of the mainstem, and continue through each of the branches. Any notable differences in the mainstem, between the confluences of successive branches, are mentioned as they join the mainstem.

More than 60 fish species are native to the Rouge River drainage, and the original potamodromous species can be inferred from historical records of neighboring river systems. European settlement of the watershed began in the late 1600s. This began a series of many deliberate and inadvertent changes to the river's fish communities. The Rouge River now contains at least 53 fish species. Many native species are still present and abundant; a number have declined severely and are rare; one is considered threatened (redside dace); one has been extirpated (blue pike).

Diversity of fish species is relatively low. The fish and aquatic invertebrate communities are typical of those found in aquatic systems under stress. Game fish species are few, and individuals are small. This is in part due to the small size of the watershed (467 square miles), and to human influences on the river. These influences include degraded water quality from sewage and storm water, sedimentation and erosion, widely variable flows, fragmentation from dams, paving and channelization of the stream channel near the mouth, and in-stream and riparian habitat destruction.

Rivers exist as patterns of water flow. The geology and hydrology of the watershed define the system. They determine the patterns of water flow over a landscape, reflecting watershed conditions and influenced by climate. The surficial geology of the watershed is defined by a former lake bed (or plain). Although portions of the headwaters are located in glacial outwash, most of the watershed is former lake plain. This affects availability of ground water to the system, topography of the land, and permeability and erosivity of the bed and banks. Flow stability is a determining factor in ecological and evolutionary processes. Flows are looked at annually, seasonally, and daily. The most stable streams in Michigan, the Au Sable, Manistee, and Jordan rivers rarely flood nor have low flows that are less than 80% of average. The Rouge River is very unstable, with annual flow peaks of 20-90 times base flows, summer base flows below 10 cubic feet per second (cfs), and daily fluctuations of over 500 cfs after rain events. These fluctuations destabilize banks, create abnormally large moving sediment bedloads, dislodge and destroy habitat, strand and kill organisms, and interfere with recreational uses of the river.

Gradient (defined as the drop in elevation over a specified length of river) helps determine the energy that water in the stream has to exert on its bed and banks. Stream power is a combination of gradient and discharge of water in a stream. Steeper gradients increase flow velocity, which in turn exert change upon channel depth, width, meandering, and sediment transport. The average gradient of the mainstem is 4.9 feet per mile. Average slopes for the major tributaries are Upper (21.0 ft/mi), Middle (11.2 ft/mi), and Lower Rouge (10.9 ft/mi). The gradient is naturally changing along any given river reach, which creates diverse types of channels and therefore different kinds of habitat for fish and other aquatic life. The best river habitat offers variety that supports different life functions of species. Fish and other aquatic life are typically most diverse and productive in river sections with gradient between 10 and 69.9 ft/mi. Unfortunately, such gradients are rare in Michigan due to the low-relief landscape. Areas of high gradient are also most likely to have been dammed or channelized. The mainstem of the Rouge River contains only 6.1 miles (13%) of the most desirable gradient; the Upper Branch fairs better, with 6.2 miles (44%) in this range; the Middle Branch has over 7 miles (28%), and the Lower Branch has 3.4 miles (14%). In most occurrences, the steepest gradient is located in areas with the least discharge - the headwaters.

The river system is highly fragmented by dams, 62 to date; 26 are on the mainstem and its headwater tributaries, 12 in the Upper Branch watershed, 18 in the Middle Branch watershed, and 6 in the Lower Branch watershed. The majority of the dams are on headwater tributaries, usually in areas of most desirable gradient, water quality, and habitat. Headwater streams are the source of nutrients and aquatic invertebrates (important food for fish), which tend to migrate downstream throughout their life span. Streams and their floodplains are frequently used as storm water detention areas, to the detriment of the system health. Two dams are especially devastating, isolating the watershed from the Detroit River (and Lake Erie ecosystem); these are at Wayne Road in Wayne on the Lower Rouge River and at the Henry Ford Estate in Dearborn on the mainstem.

In combination with climate, soils and land use help decide much of the hydrology and channel form in the river. Changes in land use are often the force that drives change in river habitats. The Rouge River watershed is now dominated by urban and suburban development. This type of land use has a dramatic affect on aquatic environments through increased erosion, drainage of wetlands, channelization of streams, destabilization of water flow, and increases in impervious land area that increase surface water, decrease ground water (never a large component in this watershed), and increase temperature.

As the most densely developed watershed in the state, the Rouge River is crossed by bridges and other stream crossings (i.e., utilities) approximately 1,950 times. Each crossing is a potential source of sedimentation, erosion, contamination, and constriction or relocation of stream channel. Although efforts are being made to minimize degradation to the environment during construction of stream crossings, the potential negative effects remain.

Degraded water quality remains one of the most important impediments to overall river health. Dissolved oxygen levels, temperatures, and nutrient enrichment are water quality parameters considered important to fisheries. Considering these parameters, the mainstem and three major branches have poor to fair water quality, with some headwater tributaries showing fair to good water quality. Conditions generally decline from upstream to downstream. The Lower Rouge River has the worst water quality of the four branches and the mainstem downstream of its confluence with the Lower Rouge River is only slightly better. Unfortunately most sections have identifiable degradation of water quality parameters important to aquatic organisms. Surface water contamination contributing to these degradations comes from both point and nonpoint sources. Contributions from over 150 combined sewer overflows (CSOs) affects the stream due to volume (over 10 billion gallons per year) and composition.

The Rouge River has tremendous recreational potential due to its proximity to the population of Detroit and suburbs. The extensive parkland, primarily managed by Wayne County Parks, makes this one of the most accessible watersheds in the state. Access is more limited in the headwater communities, and particularly in the higher quality reaches. Once water quality and habitat concerns are addressed, the Rouge River could potentially support the highest recreational use of any river in the state.

Fishery management has been limited, due to water quality, habitat, and hydrology limitations. After remediation of the paved section, along with fish passage at the most downstream dam, the lowest reaches of the Rouge River show the most promise for new angling opportunities. The impoundments of the Middle Branch are another area with potential, after remediation of contaminated sediments. Johnson Drain, a tributary of the Middle Branch, is now the location of brown trout stocking. Survival has been limited, mostly due to habitat constraints, but the fishery has been used by area anglers.

The Rouge River watershed does not lack for public interest and support. Large amounts of money and time have been invested in the river to address degradation caused by humans. Many projects have been undertaken to educate the public on the importance of a healthy river, clean up stretches of river affected by CSOs and other forms of pollution, and replace and protect riparian habitat.

The management options offer a variety of ways for communities, interest groups, and individuals to look at opportunities and problems that remain. Participation throughout the watershed in remediation and rehabilitation of the river will be necessary to realize the full potential of this system.

INTRODUCTION

This river assessment is one of a series of documents being prepared by Michigan Department of Natural Resources, Fisheries Division, for rivers in Michigan. We have approached this assessment from an ecosystem perspective, as we believe that fish communities and fisheries must be viewed as parts of a complex aquatic ecosystem.

As stated in the Fisheries Division Strategic Plan, our aim is to develop a better understanding of the structure and functions of various aquatic ecosystems, to appreciate their history, and to understand changes to the system. With this knowledge we will identify opportunities that provide and protect sustainable fishery benefits and maintaining, and at times rehabilitating, system structures or processes.

Healthy aquatic ecosystems have communities that are resilient to disturbance, are stable through time, and provide many important environmental functions. As habitat flow regimes and nutrient cycles are altered in watersheds, overall complexity decreases. This results in a simplified ecosystem that is unable to adapt to additional change. All of Michigan's rivers have lost some complexity due to human alterations in the channel and on the surrounding land; the amount varies. Therefore each assessment focuses on ecosystem integrity and rehabilitation.

River assessments are based on the ten guiding principles of Fisheries Division. These are: 1) recognize the limits on productivity in the ecosystem; 2) preserve and rehabilitate fish habitat; 3) preserve native species; 4) recognize naturalized species; 5) enhance natural reproduction of native and desirable naturalized fishes; 6) prevent the unintentional introduction of exotic species; 7) protect and enhance threatened and endangered species; 8) acknowledge the role of stocked fish; 9) adopt the genetic stock concept, that is protecting the genetic variation of fish stocks; and 10) recognize that fisheries are an important cultural heritage.

River assessments provide an organized approach to identifying opportunities and solving problems. They provide a mechanism for public involvement in management decisions, allowing citizens to learn, participate, and help determine decisions. These projects also provide an organized reference for Fisheries Division personnel, other agencies, and citizens who need information about a particular aspect of the river system.

The nucleus of each assessment is a description of the river and its watershed using a standard list of topics. These include:

Geography - a brief description of the location of the river and its watershed; a general overview of the river from its headwaters to its mouth. This section sets the scene.

History- a description of the river as seen by early settlers and a history of human uses and modifications of the river and the watershed.

Biological Communities - species present historically and today, in and near the river; we focus on fishes, however associated mammals and birds, key invertebrate animals, threatened and endangered species, and pest species are described where possible. This topic is the foundation for the rest of the assessment. Maintenance of biodiversity is an important goal of natural resource management and essential to many of the goals of fishery management. Species occurrence, extirpation, and distribution are also important clues to the character and location of habitat problems.

Geology and Hydrology - patterns of water flow over and through the landscape. This establishes the character of a river. River flows reflect watershed conditions and influence temperature regimes, habitat characteristics, and perturbation frequency.

Channel Morphology - the shape of the river channel: width, depth, sinuosity. River channels are often thought of as fixed, apart from changes made by people. However, river channels are dynamic, constantly changing as they are worked on by the unending, powerful flow of water. Diversity of channel form affects habitat available to fish and other aquatic life.

Dams and Barriers - affect almost all river ecosystem functions and processes, including flow patterns, water temperature, sediment transport, animal drift and migration, and recreational opportunities.

Soils and Land Use Patterns - in combination with climate, soils and land use determine much of the hydrology and thus the channel form of a river. Changes in land use often drive change in river habitats.

Special Jurisdictions - stewardship and regulatory responsibilities under which a river is managed.

Water Quality - includes temperature, and dissolved or suspended materials. Temperature and a variety of chemical constituents can affect aquatic life and river uses. Degraded water quality may be reflected in simplified biological communities, restrictions on river use, and reduced fishery productivity. Water quality problems may be due to point-source discharges (permitted or illegal), atmospheric deposition, or to nonpoint source runoff.

Recreational Use - types and patterns of use. A healthy river system provides abundant opportunities for diverse recreational activities along its mainstem and tributaries.

Fishery Management - goals are to provide diverse and sustainable game fish populations. Methods include management of fish habitat and fish populations.

Citizen Involvement - an important indication of public views of the river. Issues and activities that citizens are involved in may indicate opportunities and problems that the Fisheries Division or other agencies should address.

A section on Management Options is next. We list alternative actions that will significantly protect, rehabilitate, and enhance the integrity of the river system. These options are intended to provide a foundation for discussion, setting of priorities, and planning the future of the river system.

A section containing public comment and response is included in each assessment. These comments were obtained from written letters during a six month comment period and from three public meetings. Public meetings were held February 18, 1997 in Livonia, February 19, 1997 in Dearborn, and February 20, 1997 in Southfield. Each comment provided was considered and either adopted or rejected for stated reasons.

Although this is a final assessment, anyone wishing to submit comments is encouraged to do so. These comments will be used in future updates of this assessment. Comments should be sent to:

Michigan Department of Natural Resources
Fisheries Division
Southeast Michigan District Headquarters
38980 Seven Mile Rd.
Livonia, MI 48152-1006

RIVER ASSESSMENT

Geography

The Rouge River is a small, coastal river in southeastern Michigan. Its watershed drains 467 square miles and empties into the Detroit River at Zug Island, about midway between Lake St. Clair and Lake Erie (Figure 1). The drainage basin includes portions of Wayne, Oakland, and Washtenaw counties. The basin is bordered on the north and east by the Clinton River watershed and on the northwest and south by the Huron and Ecorse watersheds. The majority of the watershed drains across a former glacial lake bed, with headwater areas originating from a glacial moraine (see **Geology and Hydrology**).

The mainstem is approximately 44 miles long (Knutilla 1969), and is joined by three main tributaries: Upper, Middle, and Lower Rouge rivers. The mainstem originates in Troy in Sprague Ditch and flows south-southwest until joined by the Upper Branch in Redford at river mile 17. The headwaters of the mainstem, considered that area upstream of the confluence with Evans Ditch, are mostly residentially and commercially developed. Franklin Branch and Pebble Creek are two larger tributaries in the headwaters, and are both cool water streams.

The Upper Branch originates in Farmington Hills as two small tributaries: Minnow Pond and Seeley drains, and flows southeast 21 miles to the mainstem. These cool water streams originally drained wetlands in Novi and Farmington Hills. Many of these wetlands have been commercially and residentially developed.

The Rouge River mainstem continues south from river mile 17 and is joined by the Middle Branch in Dearborn Heights at river mile 9.5. The Middle Branch is 30 miles long, and begins with two main tributaries. The northern stream drains Walled Lake and has two named tributaries: Bishop Creek and Walled Lake Branch of the Middle Rouge River. These streams originate in wetland areas and run through intensively developed residential, commercial, and industrial areas. The southern arm of the Middle Rouge contains the only cold water streams (Michigan Department of Natural Resources (MDNR), Fisheries Division classification) in the watershed, Johnson and Sump drains. The headwater areas of the Middle Branch are primarily residential, with light industrial and commercial land use increasing as the stream nears its confluence with the mainstem.

The Lower Branch of the Rouge River shows the most dendritic pattern in its stream development. Virtually all of its drainage is across glacial lake plain, which results in a higher density of streams for a given drainage area. It includes 13 named tributaries (all but Fowler Creek are designated drains) that feed the easterly flowing Lower Branch, joining the mainstem in Dearborn at river mile 7.5. The Lower Branch of the Rouge River is approximately 27 miles long. The headwaters are located in primarily agricultural land, although this land use is rapidly being replaced with residential and commercial development.

The mainstem continues to the mouth at the Detroit River. Further water flow comes from two enclosed streams, Baby and Campbell creeks, which enter the mainstem as part of the storm sewer system. The majority of surface drainage from this portion of the watershed enters the Detroit storm sewer system which discharges into the river through combined and separate storm sewers. Some surface water in this drainage is sent to the Detroit Wastewater Treatment Plant, which discharges to the Detroit River (although an outfall exists which can discharge into the Rouge River under emergency situations). Four miles of the Rouge River, from Michigan Avenue to the Turning Basin, were diverted into a paved channel in the 1970s. This project, initiated for flood control, has effectively eliminated nearly all large-river habitat below the confluence of the major branches. Meanders, pools, riffles, and floodplain wetlands were replaced by a wide, shallow, smooth, cement trough. This channel acts as a deterrent to fish migrations upriver from the Great Lakes in several ways. High-velocity spring flows act as potential barriers to potamodromous fish species that would normally be migrating upstream for spawning during this time of the year. Later in the year when flows are reduced, this section of the river can present a high temperature and low oxygen barrier to other Great Lakes species that would normally use the downstream portions of a river this size. Factors such as these thus tend to discourage use of this section of the Rouge River by migrating and resident fish species through much of the year.

History

> "Michigan was totally covered by ice during the Wisconsinan glaciation of the Pleistocene Epoch. The glacier, which extended into southern Ohio and Indiana, retreated, and the extreme southern part of Michigan was ice free by about 16,000 years ago. (Farrand and Eschman 1974)." (cited by Albert et al. 1986).

> "The earliest evidence of [human] occupation in the Rouge River drainage date[s] to the Paleo-Indian period, over 10,000 years ago, when Indian people entered the area to hunt mastodon and other now-extinct game. ...By 500 BC, local peoples were experimenting with growing crops and making ceramics. This was the beginning of the Woodland period, perhaps in part due to the adoption of the bow and arrow and corn horticulture." (B. Mead, Office of the State Archaeologist, personal communication)

Native Americans called the river "mishqua sibe" or "minosagoink", both terms meaning Singeing Skin River, referring to the place where game was dressed (Gnau 1975). Burial mounds of native people (typical of the Algonquin and Huron tribes) were located at the mouth of the river, at the present site of Fort Wayne, the Edison Company, and Allied Chemical Corporation. These mounds were large - the largest was 800 feet long, 400 feet wide, and 40 feet high. Later inhabitants used sand from the mounds for building materials, as sand was scarce in the area (Gnau 1975).

The French first settled in Detroit in 1701, but the Rouge River had been discovered in 1670 by Robert Cavalier, Sieur de La Salle. He named the river the St. Agnes River because he found it on January 21, St. Agnes Day. The French later called the river "Riviere Rouge" or the Red River after the red water color attributed to rushes growing along the banks. Shortly after La Salle's expedition, French trappers and fur traders arrived in the area and formed Michigan's first European population (Gnau 1975).

> "Once the French founded Fort Pontchartrain in 1701 in what is now Detroit ... peoples from many tribes gathered there. Among these tribes were the Ottawa, Potawatomi and Wyandot [Huron]." (B. Mead, Office of the State Archaeologist, personal communication)

Antoine Laumet de la Mothe Cadillac divided land inside and outside Fort Pontchartrain; land outside the fort was to be public domain for farming. About 1707, Cadillac began to divide this land into farm grants, known today as private claims. These farm grants, measured in arpents (approximately 200 lineal feet) fronted on both sides of the Detroit River from Ecorse and Grosse Ile up to Lake St. Clair. Farms had river frontage from 1 to 5 arpents (200 to 1,000 ft) so that settlers had access to water for drinking, fishing, and transportation. Farms then ran many arpents back into the wilderness, and because of their long, narrow shape were known as “ribbon farms”. These farms soon filled the length of the Detroit River and began to move up the first body of water to the south - the Rouge River (Gnau 1975).

“The French community of Detroit grew up around Fort Pontchartrain; it came under British rule at the end of the French and Indian wars in 1763.” (B. Mead, Office of the State Archaeologist, personal communication). During British occupation a shipyard was built on the Rouge River in the present day area of Woodmere Cemetery and the Ford Motor Company’s Rouge Plant. The United States took control of the Michigan territory from the British in 1796. During the war of 1812 this shipyard became important - two of Admiral Perry’s ships were built there. By 1823 it was no longer in use (Gnau 1975).

> “American settlement began in earnest in the 1820s; within a generation the land was cleared and towns, farms and mills were built throughout the River Rouge drainage area. The Potawatomi and Wyandot lived in southeastern Michigan into the nineteenth century.
>
> “All these historical developments have left traces in the ground. Most archaeological sites are within the uppermost foot of soil, but along some major rivers in southern Michigan deep trenching has uncovered prehistoric camps as much as eight to ten feet below the present surface. Examples of the types of sites recorded thus far in the river basin are listed in Table 1.” (B. Mead, Office of the State Archaeologist, personal communication).

The Rouge River originally flowed for the last 2 miles through an extensive swamp to the mouth at the Detroit River. One defined channel was present and mapped in 1798, and was located on the North side of Zug Island (P. Comer, Michigan Department of Natural Resources, Natural Features, personal communication). The island itself was once a peninsula, but the cutting of the “Short Cut Channel” in the 1880s isolated the land into what is now Zug Island (Gnau 1975).

The Rouge River has experienced flooding that has affected human inhabitants as far back as 1893, when two young girls drowned when playing on its banks while at flood stage. In 1916 and 1918 there were severe floods submerging Michigan Avenue and halting all traffic between Detroit and Dearborn. The worst flood was in April of 1947. It was during this flood that the power supply at Fair Lane (the estate of Henry Ford) was knocked out, leaving him to die by candlelight. In March 1949, a meeting was held in Melvindale to discuss flood control measures on the Rouge River. Plans were presented proposing to straighten and pave 4 miles of river; it was not until 1975 that these plans came to fruition (Gnau 1975). This project shortened the river by 8,600 feet (1.6 miles) and destroyed habitat for fish and wildlife by removing a well-developed forest including a 12-acre stand of oak (Corps of Engineers 1972). Flood flows and frequencies have continued to increase, due to increased storm water transport and elimination of floodplain wetland from urbanization (Cantrell 1994) (see also *Annual Stream Flows*).

In 1915 Henry Ford acquired 200 acres on the east bank of the Rouge River for building blast furnaces and a tractor plant. With the first World War, this plant was used to build submarine chasers called Eagle Boats. The Rouge River was dredged from the mouth to the Ford buildings allowing transport of the completed vessels. Fordson Island was created in 1922 by the dredging and channeling of the Rouge River for these boats (Gnau 1975).

The above history of the watershed has left physical landmarks and relics behind. The status of the archaeological record of the watershed follows:

> "...The State Archaeological Site File...lists 333 archaeological sites within the River Rouge drainage. The number of sites for each township is listed in Table 2. Many of these sites are known only from historical records, including maps and atlases. Some were reported by local residents. Professional archaeologists have systematically inspected only 1 square mile, less than 1% of the total area of the river basin. Most of the watershed is urbanized, making access to land difficult [few home or business owners want digging in their lawns; much land is covered by concrete]. Figures from elsewhere in southeast Michigan indicate a site density of about 9.5 sites per square mile. This figure allows us to estimate that there were once over 4,000 archaeological sites within the river basin. Many of these sites have already been destroyed by landscaping and construction; the stories of those who lived there will never be known.
>
> "Archaeological sites are not randomly distributed across the landscape. Prehistoric sites are most frequent along the banks of waterways, particularly the lower reaches of major rivers. Further upstream, and further upland, the sites are smaller and more widely dispersed. These represent small camps use during travel, hunting, or for short-term occupation to take advantage of locally available resources. Some of these sites are the winter camps of individual families, who gathered in larger bands along the lower river and along the Great Lakes coast in warmer weather. To completely understand prehistoric ways of life, a sample of all these site types must be studied.
>
> "Although a number of very significant archaeological sites in the Detroit metropolitan area have been listed on the National Register of Historic Places, none are within the boundaries of the River Rouge watershed." (B. Mead, Office of the State Archaeologist, personal communication)

Biological Communities

Original Fish Communities

Fish species historically documented in the Rouge River are listed in Table 3. Historical fish assemblages are those found before widespread influence of humans on the river. Species listed represent pre-impoundment communities, as impoundments are a human modification to the river.

The watershed is relatively small (467 square miles) and has always had a small ground water component to its flow (see **Geology and Hydrology**). These characteristics shape the type of fish communities expected in the system, regardless of human influences.

Of the 60 plus species historically documented, very few are considered game fish. Most are tolerant of warmer water and smaller base flows, or are associated with the larger water of the Great Lakes. Northern pike, white sucker, largemouth bass, walleye, channel catfish, white and black crappie, and various sunfishes were present. Their populations were predominantly seasonal and were found mostly in the lowest reaches of the river.

Several species were historically found in neighboring or connecting systems and were most likely present in the Rouge River drainage. Some of these species include lake sturgeon, muskellunge, white bass, lake whitefish, walleye, blue pike, smallmouth bass, and yellow perch. All of these species (except for the blue pike) are still present in the area and could return to the Rouge River, provided habitat and water quality are restored. Draining of the vast swamp that once existed along the last 2 miles of river has changed the channel character at the mouth; the spawning and nursery areas that were present are no longer there. These changes in habitat account for the absence of several fish species today.

The headwaters of the mainstem, Upper Rouge, and Middle Rouge rivers have the most stable flows and the least degradation due to human influences, and thus have had the most persistent fish communities. Even so, several darter species that were once found in the drainage have not been documented in the past ten years. These were mostly found in smaller streams. Their disappearance is probably due to affects of urbanization (see also *Factors Affecting Fish Communities*).

Two other species no longer found in the Rouge River are silver and black redhorse. Silver redhorse is found in larger streams, but does not tolerate excessive turbidity (Becker 1983). The Rouge River has historically been turbid, but its increases in sediment load (attributed to urbanization) most likely eliminated this species from the drainage. Black redhorse inhabits "swiftly flowing sections of small- to medium-sized streams. It is found in clear water over gravel, bedrock, and sand where siltation is at a minimum." (Becker 1983) These conditions were never prevalent in the Rouge River and have become scarce.

Factors Affecting Fish Communities

Many factors negatively affect fish assemblages in the Rouge River: excessive flow instability, degraded water quality due to sewage and storm water, sedimentation from erosion and storm water flows, and fragmentation from dams, paving of the stream channel, and habitat destruction. Historically, point source contaminants flowed into the Rouge River. However, these have been drastically reduced since the Clean Water Act (P.A. 401, 1972) was enacted.

All of these current factors can be attributed to humans. The geology of the watershed does not lend itself to stable hydrology (see also **Geology and Hydrology**), but this tendency is greatly amplified by increased drainage and construction of artificial hard surfaces. The percent of directly connected impervious area, i.e., area that is directly connected to a storm sewer draining into the Rouge River, is estimated to be 17 percent (Kluitenberg 1994). In addition, 31 percent of area is defined as impervious (whether directly connected to the river or not). Areas defined as impervious include buildings, structures, roads, parking areas, driveways, sidewalks and bike paths, and waterbodies. Infiltration of precipitation into the ground water is severely reduced by the above impervious surfaces. The high percentage of impervious area serves to accentuate quickness and magnitude of flood peaks and affects base flows as well. This effect is particularly concentrated in the lowest reaches of the river where the landscape is the most intensively developed and where it historically contained the most wetlands.

Nuhfer (1989) found in a study of the Rouge River and its tributaries, that "the most important variables affecting IBI [Index of Biotic Integrity] scores were the amount of oils in sediments and the discharge stability." These amounts account for 46% of the variability in the IBI and were statistically significant at $P<0.05$. A similar study in 1995 did not include the same statistical analysis, but flow fluctuations remain a substantial impediment to healthy fish populations in the Rouge River (see also **Fishery Management**).

More frequent and higher flood flows eliminated undercut banks and flushed potential organic and inorganic fish cover downstream or onto floodplains. Organic debris can be observed at some sites 10 feet above normal water levels. This material is not available as cover or a food source to invertebrates and fish inhabiting the stream during normal flow.

> "The stream cross-section is frequently bowl shaped and devoid of cover. Lack of large solid substrates and low water velocities associated with low flows reduce both the number of species and the biomass of macrobenthic invertebrates that are eaten by fish (Edwards et al. 1984)." (cited by Nuhfer 1989).

Many fish species, including smallmouth bass, have been documented to have a strong affinity with instream cover (Sechnick et al. 1986; Beam 1990). Structure in streams provides a resting place out of the current, cover from predators and light, and a food source in the macroinvertebrates which colonize such structures. The simple shape of the channel (see *Channel Cross-Section*) limits size of the fish community as well as diversity.

The majority of the watershed is served by storm sewers that lead directly to the river, with no detention or treatment. The headwater communities that are being rapidly developed in the 1990s are requiring detention, either on-site of new development or at regional storm water basins. However, most of the watershed was developed and sewers constructed before any thought or regulation concerning management of storm water.

Besides storm water flow, the river receives millions of gallons of sewage each year from combined sewers. This sewage affects the river by both its quantity and quality. The volume of effluent adds to the stream's instability, and decomposition of organic materials in the discharge lowers oxygen levels below that which most fish species can tolerate. In response to these problems, the Rouge River Remedial Action Plan (RAP) was developed. The RAP was the reason a federal grant was provided to fund the Rouge River National Wet Weather Demonstration Project (RRNWWDP). It has the following mission: "...to restore the water quality in the Rouge River to a level sufficient to provide a safe and healthy environment for ourselves and future generations." The RRNWWDP is focused on controlling water quality degradation associated with wet weather pollution. The project includes "evaluation of combined sewer overflow problems, best management practices for nonpoint source problems, data collection and field work, water quality sampling, computer modeling, development of a geographic information system, financial and institutional arrangements, [and] public involvement" (Anonymous 1991). In some locations detention basins are being constructed to capture combined sewer overflows (CSOs). These basins are designed to send CSO effluent to a treatment plant after rain events have passed. If basin capacity is exceeded, overflow will be treated through settling, skimming, and disinfection, before discharge. In other locations, sewer separation projects are being undertaken to route all sanitary sewers to treatment plants and eliminate direct discharges. As of July 1996, $288 million had been allocated to the RRNWWDP, with more funds anticipated (S. Ferman, Michigan Department of Environmental Quality (MDEQ), Surface Water Quality Division (SWQD), personal communication).

In contrast to the negative effects of sewer discharges, Wichert (1995) found in his study on urban streams in metropolitan Toronto that effluent from wastewater treatment plants is not always detrimental to fish communities. He compared fish assemblages at locales historically impaired by effluent, to their status after removal or upgrading of water pollution control plants (WPCPs). He determined that if tertiary treatment was applied before discharge, fish assemblages could recover, and in some instances be improved over areas without discharge. This was attributed to increased base flow contributed by the WPCP.

Wichert also attempted to document impairments due to increased urbanization in a watershed, and found that its negative effects could be offset by improvements to sewage treatment. This finding could be applicable to the Rouge River, as three wastewater treatment plants have recently begun discharging to the river (Commerce Township into Seeley Drain (tributary of the Upper Rouge River), Walled Lake-Novi into Finley Drain (tributary of the Middle Rouge River), Ypsilanti Community Utilities Authority (YCUA) into the Lower Rouge River). A fourth discharge from Salem Township into the Johnson Drain is pending. It is critical that any such discharges do not negatively change the temperature or chemical characteristics of the receiving waters. In two of the above examples, a threatened species, the redside dace, lives in streams receiving effluent (Seeley and Johnson drains). This species is typically found in cool, clear-water systems and is not known to be tolerant of warmer water. All available technologies necessary to ensure desired water quality characteristics must be applied to any treatment plant proposing a discharge.

Sedimentation and erosion are increased by storm water and CSO flows. Soils in the majority of the watershed are silt loam to sandy clay loam and are subject to severe erosion (Table 4). The large velocities in the river only serve to amplify the potential for erosion. A detailed discussion of soils in the watershed is in **Soils and Land Use Patterns**.

Fragmentation of the river, by 62 dams, impedes movement of fish and affects aquatic species present. The majority of these dams are located on tributary streams, whose health is critical to that of the system (Figure 30). See **Dams and Barriers**.

> "Fish require several types of habitats throughout their life cycle. Stream species need distinct spawning, feeding and growth, and refuge habitats. Equally as important is the ability to move from one habitat to another. If any one area is lacking or if the ability to migrate from one to another is restricted, the species becomes locally extinct" (Schlosser 1991).
>
> "Early construction of dams and draining of wetlands for settlement eliminated spawning areas, or access to them, for all of the original potamodromous fish species" (Hay-Chmielewski et al. 1995).

The Rouge River flows into the Detroit River and has historically contained potamodromous (fish that migrate from freshwater lakes up freshwater rivers to spawn) fish species present in the Great Lakes (see also *Original Fish Communities*). The construction of dams, dredging for boat access, and the paving of 4.2 miles of river near the mouth has reduced the ability of these species to use the Rouge River system by removing or blocking access to critical seasonal habitat.

Present Fish Communities

A comprehensive fisheries survey of the watershed was conducted by Michigan Department of Natural Resources, Fisheries Division during 1995 (Leonardi 1996). Sampling and discussion is limited to river (including impounded) habitats. A total of 53 species were identified in 1995 (Table 5). This survey represents a replication of the fisheries survey conducted in 1986 by MDNR, Fisheries Division (Nuhfer 1989). Both collections were made by electrofishing representative samples of the branches and several tributaries. Most (17) of the 1986 sites were re-sampled, with an additional 19 sites added in 1995 (Figure 2).

The distribution of each fish species within the Rouge River can be found in Appendix I. There is a Great Lakes influence in the species composition of the Rouge River, although not as great as is possible. The paving of four miles of river, along with a large dam immediately upstream of the paved section (at the Henry Ford Estate, river mile 8), make migration of Great Lakes species into the Rouge River system difficult. Fish passage at this dam would connect the rest of the river to a system with source populations of many game fish species not now abundant or present in the watershed (e.g., smallmouth bass, lake sturgeon, walleye).

There are several impoundments on the Middle Branch of the Rouge River (Figure 3). Although these dams serve to fragment the system, they also contain the most concentrated game fish populations, in a watershed with few large lakes. Newburgh Lake in particular, provides an accessible fishery for typical lake species: i.e., largemouth bass, northern pike, bluegill, pumpkinseed, and black crappie. Impoundments were the only locations (except just below the Ford Estate dam) where game fish of acceptable size were found in abundance. Unfortunately, many of these fish are unsafe to consume due to contamination (see also **Water Quality**).

Three headwater tributaries, Johnson, Minnow Pond, and Seeley drains, (Figure 1) are home to a Michigan threatened species, redside dace. These tributaries have a moderate ground water component that serves to stabilize flow and keep waters cool. As implied by their names, all three are designated county drains, subject to affects of the Drain Code (PA 40, of 1956). They are also located in areas where suburban development is occurring at a rapid pace, threatening the streams and their aquatic communities with removal of overhead cover, increased storm water flows and associated pollutants from hardened surfaces, and increased sedimentation from disturbed sites.

The Lower Branch of the Rouge River remains relatively unfragmented, except for a dam at Wayne Rd. (just below tributary mile 11). Chinook salmon have been documented below this dam, with scattered observations above the dam. If it was removed, potamodromous fish would have access to the entire Lower Rouge River, provided they could "run the gauntlet" past the pavement at the mouth of the mainstem.

To help analyze fish species present, a more community-oriented discussion must be made. The most common river species in Michigan have been grouped into 16 species associations using hierarchical cluster analysis (Table 6; T. Zorn, P. Seelbach, MDNR, Fisheries Division, personal communication). Each of these 16 groups is found in a characteristic drainage area and base flow condition (expressed as base flow yield = cubic feet per second (cfs)/km^2 of watershed). Although each species group was found to have a characteristic mean drainage area and base flow yield, each association also displayed wide variances about these means. Thus, though associations are distributed uniquely according to these important variables, in nature there exists considerable overlap among groups.

Current fish communities in the Rouge River (as identified in 1994 watershed-wide fish sampling) can be categorized by these species groups (Figure 4). The majority of the watershed is described by creek chub, green sunfish, and mottled sculpin groups. The first two groups indicate warmer, small streams with low base flow; the sculpin group requires a moderate base flow component.

The above community results are as predicted (tolerant minnows and others) in low flow headwaters, but expected increases in diversity and addition of larger fish species do not occur as Rouge River streams become mid-sized and larger. Figure 5a depicts statewide characterization of fish species associations and Figure 5b specific characteristics of the sites in the Rouge River.

Low base flow yield for the majority of the watershed is at the low edge of that needed by the majority of game fish species (Figure 5b). This is because of the buffering effect that larger water volume has on temperature. Higher base flow stabilizes temperature, making it suitable for many game species. Larger volume also results in more varied channel morphology including deeper holes, which are used as cover by larger fishes. Possible explanations to lack of base flow will be discussed in **Geology and Hydrology**.

Exceptions to this include the mainstem at the Henry Ford Estate, where a base flow yield of 0.07 and a log drainage area of 2.89, would put this reach in the smallmouth bass group. Also, the lowest portions of the main branches are fair for this group. Below the Ford Estate Dam catfishes, pikes, and redhorse could also be expected to flourish, with the best hydrology for these species found in the now-paved section. The Lower Rouge River after the recent contribution of base flow from the YCUA plant has a base flow yield 0.14 with a log drainage area of 2.33. This should result in a species composition similar to the hornyhead chub, rock bass, or burbot group. However, colonization of the Lower Rouge River is also affected by a dam at Wayne Road and the mainstem pavement habitat degradation.

Fish communities were also assessed by the Index of Biotic Integrity (IBI) (Karr 1981). Biotic integrity is defined as “a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region” (Karr and Dudley 1981). Communities having integrity are those able to withstand and survive natural and human perturbations. Fish communities respond to environmental factors and their assemblages can be used as a measurement of stream integrity. The IBI is based on assigning scores to 12 measures reflecting different attributes of stream fish assemblages. These measures fall into the three broad categories of species composition, trophic composition, and fish assemblage and health.

Despite many water quality changes in the past ten years (see **Water Quality**), the fish community of the Rouge River has remained similar to that found in 1986 (Table 7). It generally lacks integrity according to the IBI assessment except for a few stretches in headwater areas. Sites that lacked integrity were dominated by tolerant species such as creek chub and green sunfish and sites with some remaining integrity tended to support intolerant species such as mottled sculpin, redside dace, and brown trout (Leonardi 1996). Piscivorous fish were severely lacking at all sites. No new species were identified in 1995 over those identified in 1986. Two species that were located in 1986, hornyhead chub and longear sunfish, were not found in 1995. Both of these species indicate good base flow and water quality. Neither of these species were very abundant in 1986, (they were found at one location each and in small numbers). Their populations may have been present, but not located in 1995.

Aquatic Invertebrates

There is a wealth of data on aquatic invertebrates present from several biological surveys conducted by the Michigan Department of Natural Resources from 1973 through 1994. Sampling sites were along the mainstem, three major branches (Upper, Middle, and Lower), and several smaller tributaries.

Upper sections of the mainstem show “fair” invertebrate communities with a few water quality sensitive species, such as certain mayflies and caddisflies, found at several sampling sites. These species were not found downstream where the aquatic communities became dominated by more tolerant organisms and only received a “poor” rating (Evans & Nuhfer 1987). Surveys using a diversity index, based on the number of species present in a standard-sized area, support this evaluation. Indices calculated for the upper mainstem indicated “fair” invertebrate diversity and in downstream areas the index decreased, indicating a lower diversity (Jackson 1975). Overall, mainstem aquatic communities had improved slightly from 1973 to 1986, based on community changes (Table 8).

Evans Ditch, a tributary to the mainstem, has “very poor” quality invertebrate communities, based on greatly reduced diversity of organisms, with almost complete dominance of the aquatic communities by midges (chironomids) (Jackson 1975). Although no CSOs are located along Evans Ditch, its watershed is served by storm sewers that have no treatment for water quality or quantity before discharge. The very poor water quality indicated by the aquatic communities present also seems to affect communities immediately downstream of this tributary’s confluence with the mainstem, based on the organisms found in those sampling stations (Evans & Nuhfer 1987).

Invertebrate samples from the Upper Rouge River generally indicated “fair” to “poor” aquatic communities in the most upstream section (Evans & Nuhfer 1987, Oemke 1994) with “poor” to “very poor” communities in the Bell Branch and the lower section before confluence with the mainstem (Evans & Nuhfer 1987, Oemke & Stroh 1993). Urban runoff in Northville and various drains and storm sewers in the Bell Branch and its tributaries are the major reasons for the degraded aquatic communities. Comparison with earlier sampling indicated some slight improvements in aquatic communities from 1973 through 1994 in the upper sections (Table 8), but invertebrates present still indicate overall poor quality communities (Jackson 1975, Oemke 1994).

Aquatic invertebrate communities in the Middle Rouge River rate “fair” upstream of the confluence with Johnson Drain, and “good” in Johnson Drain itself and from its confluence with the Middle Rouge River to just upstream of Newburgh Lake. Quality worsens drastically to “poor” and “very poor” from Wayne Road downstream of Newburgh Lake to the confluence with the mainstem (Jackson 1975; Evans & Nuhfer 1987). These quality shifts are depicted by changes in invertebrate communities. Most upstream communities were generally composed of leeches, snails, crayfish, damselfly naiads, true bugs, beetles, and midges. There appears to be a trend toward decreasing quality above the confluence with Johnson Drain with some more sensitive invertebrate groups such as leeches, mayflies, and blackflies missing from more recent sampling (Table 8; Oemke 1994). Recent development in the area may affect aquatic communities because of increased erosion and runoff resulting from these activities. More sensitive organisms such as caddisflies, scuds, and mayflies appeared below the confluence with Johnson Drain down to Newburgh Lake (Table 8). Several of these more sensitive organisms are also present in Tonquish Creek, another tributary to the Middle Rouge River, with overall “fair” quality invertebrate communities (Oemke and Stroh 1993). Disappearance of the mayfly-caddisfly complex and the rapid decrease in species diversity below Wayne Road illustrates the dramatic drop in water quality (Table 8; Jackson 1975). Comparison of 1973 data, with that from 1985 to 1986, indicates there has been little change in the river invertebrates, with storm sewers and CSOs continuing to degrade the Middle Rouge River from Wayne Road to its confluence with the mainstem (Evans & Nuhfer 1987).

The Lower Rouge River can be separated into two distinct sections based on aquatic invertebrate communities present. From the headwater reaches to Merriman Road, diversity indices and species present indicate generally “poor” river quality (Jackson 1975). Fellows Creek, a headwater tributary of the Lower Rouge River, has a slightly better species diversity with more sensitive invertebrates such as mayflies, caddisflies, and scuds appearing in some of the samples (Table 8; Oemke and Stroh 1993). From Merriman Road downstream, the Lower Rouge River becomes even more degraded with aquatic invertebrate communities dominated by oligochaetes and diversity indices 3-10 times worse than upstream stations, for a rating of “very poor” (Jackson 1975). Comparison with 1985 and 1994 sampling shows there has been a slight improvement in the lower stretches of this river, but aquatic communities are still poor overall (Table 8; Evans & Nuhfer 1987; Oemke 1994).

Amphibians and Reptiles

There are 49 species of amphibians and reptiles associated with the Rouge River or its wetlands (Table 9). Most have been confirmed in the watershed, with the rest having a range that includes it. Two special concern (rare, may become endangered or threatened in the future) species are Blanding’s turtle and Eastern massasauga rattlesnake. Both are confirmed living within the watershed.

Birds

The Rouge River watershed serves as an important stopover point for a variety of migrating waterfowl. Over 200 acres of nature preserve located on and adjacent to University of Michigan (UM) Dearborn campus and the Henry Ford Estate in Dearborn attracts many species of water-dependent birds. Ninety-one species that have been documented, mostly at the UM Dearborn campus (Table 10). Peregrine falcons nest in the watershed, as do American egrets, and great blue herons. Floodplains and wooded corridors along the river, much which is public parkland, serve as critical habitat for some part of these species life history.

Henry Ford established a wildlife preserve on part of his 2,150 acres along the Rouge River before building his estate next to the river. Mr. Ford worked with the Michigan Audubon Society to induce many birds to stay on his property year-round (Dearborn Historian 1978).

Mammals

The river corridor provides a great deal of the natural landscape that remains. Much of this corridor is contained within an extensive public park system. It is home to many mammals that use water during some portion of their lives (Table 11). Many “urban” mammals make their home in the watershed, i.e., raccoons and opossums. There are also some species usually associated with more pristine environments: mink, red and gray fox, and flying squirrels.

Although extirpated from the watershed today, Eastern Bison were documented to inhabit the Rouge River watershed in 1701 (Cadillac 1904). Habitat degradation and hunting are the most likely factors contributing to their demise.

Other Natural Features of Concern

Other rare or unique natural features (plants, mammals, and habitats) within the watershed are listed in Table 12.

Pest Species

Pest species are defined as those aquatic species that have been introduced, either accidentally or intentionally, and pose a significant threat to native species or their habitat. High densities of fish pest species are not known to be present in the Rouge River. Those exotic species that have invaded the Detroit River and Lake Erie, (e.g., tubenose and round goby, white perch, sea lamprey) have not successfully colonized the Rouge River. The first few miles of dredged and paved river channel presents a deterrent to aquatic species entering from the Great Lakes.

Pest species of mollusks, such as zebra mussel, and crustaceans, such as European spiny water flea, have invaded Lake Erie (Mills et al. 1993), but no colonization of the Rouge River has been reported. Upstream dispersal of these species has been partly attributed to recreational boating in inland lakes and streams, which is not a common occurrence in the Rouge River (P. Marangelo, National Biological Service, Great Lakes Science Center, personal communication).

Aquatic plant species in the watershed that are considered pests include purple loosestrife, Eurasian milfoil, and curly leaf pondweed (D. Kenaga, MDEQ, Land and Water Management Division, personal communication). Purple loosestrife, a perennial emergent wetland plant native to Europe and Asia, is well established in the watershed. The prime method of dispersal is by humans through landscape planting. Dispersal of seeds can be by wind, flowing water, and animals including humans (Skinner et al. 1994). This species can out-compete native wetland plants that have significantly more wildlife value as food and cover, including cattail (Eggers and Reed 1987). Eurasian milfoil, a non-native submergent plant, can grow in dense mats that crowd out native plant species, interfere with recreational activities, and reduce habitat quality for other aquatic organisms. Curly leaf pondweed, another exotic submergent plant, can also become dense enough to interfere with recreational activities and crowd out native plants, but it is not so detrimental to aquatic animals.

Gypsy moth are found within the Rouge River watershed. A management program (including integrated pest management) is operated by the Department of Agriculture to keep the population in check. In general, they are not as prevalent in this watershed as in other areas of the state (T. Payne, MDNR, Wildlife Division, personal communication).

Geology & Hydrology

Geology

The surficial geology of the Rouge River basin is primarily clay, a factor that the earliest settlers quickly discovered and put to use in making bricks. The first brickyard was established in 1799 by John Askin. Local bricks were used in most of the buildings in Detroit (Gnau 1975).

> “The River Rouge basin,...is characterized by hilly or moderately undulating topography to the north and west and by relatively flat land to the southeast. Most of the basin was covered by waters of former glacial lakes, as evidenced by old beach lines which traverse the basin. Sands and clays laid down in glacial lakes make up the surface deposits in the southeastern two-thirds of the basin. Areas to the northwest are principally morainal deposits of retreating glaciers. Altitudes in the morainal areas range from 900 to more than 1,000 feet above sea level. Altitudes gradually lessen toward the southeast to about 600 feet above sea level and down to 574 feet at the mouth of the River Rouge.

"Larger streams in the basin flow through well defined valleys having gradual[l]y sloping banks which are from 20 to 30 feet above the valley floor. In areas of intensive urbanization natural drainage patterns have been altered by ditches and drains constructed to convey runoff. In the Detroit area drainage is effected through a network of storm sewers.

"There are 404 lakes and ponds in the basin ranging in size from less than an acre to the 670 acres in Walled Lake (Humphrys and Green, Michigan Lakes Inventory Bulletins 63,81,82). Most lakes are in the morainal areas to the northwest. Elsewhere lakes are widely scattered and generally small in size. The larger lakes outside the morainal areas are the impoundments of the former hydroelectric plants" (Knutilla 1971).

..."Small to moderate quantities of water are available nearly everywhere in the River Rouge basin from wells completed in the glacial drift or bedrock aquifers. The glacial drift is composed of clay, silt, sand, gravel, and stones deposited by glaciers and glacial melt waters. The relative proportions, degree of sorting, and thickness of these materials control the availability of water from the drift aquifers. Sands and gravels will generally yield larger quantities of water than deposits of clays, silts, or fine sand [Figure 6].

"The more favorable water-bearing rocks in the glacial drift are not extensive and therefore limit the aquifer as a source of abundant water supply. Water in the drift is [of] relatively shallow depths and is easily accessible throughout the basin, thus, these rocks are important in water-supply considerations." (Knutilla 1971).

It is for this reason that the majority of the watershed is served by the Detroit Water & Sewerage water lines, which obtain their water from the Detroit River and Lake Huron.

..."(S)treams draining the moraine, outwash, and sandy lake bed areas to the northwest maintain higher base flows than do streams draining the large areas of clay lake beds to the south and east. Franklin Branch has significantly higher base flows which may reflect, in part, interflow from the Clinton River basin to the north. Tarabusi Creek also [h]as higher flow as may be attributed to more permeable clay soils or to significant contributions to streamflow from the sandy lake bed part of the basin. The Lower River Rouge has the lowest base-flow runoff reflecting the proportionately larger area of impermeable clayey lake beds" (Knutilla 1971).

Table 13 has a detailed list of surface geology type by river branch.

Climate

The climate of Michigan is described in Albert et al. (1986):

"The climate of Michigan is a product of its latitude, position on the North American continent, and its position relative to the Great Lakes.

..."The weather of Michigan is controlled largely by...shifting air masses and the boundaries between them. The major types of air masses affecting the state are warm, humid ones originating in the Gulf of Mexico, dry cold ones originating in northwestern Canada, and moist cool ones from the northern Pacific. The latter are highly modified before reaching the state. The degree of contrast between air masses is greatest during the winter and least during the summer.

..."The Great Lakes are another major control on climate in Michigan. Water has a much higher heat capacity [ability to store heat] than land. As a result, more energy is required to warm it, and more energy is released when it cools. The lakes warm the air that passes over them in the winter and cool the air that crosses over them in the summer. During the winter, surface air crossing the lakes picks up moisture as it warms. The surface air becomes warmer than the air above it [becomes unstable] and rises. As it rises, it cools, and loses its ability to hold moisture. The moisture condenses forming clouds, rainfall, or snowfall [lake-effect precipitation]."

Description of Washtenaw District: ... "The Great Lakes have less influence on climate [here] than in districts to the west. Possibly the most noticeable effect is the prevalence of cloud cover during the winter months. Typical winds are westerly, so Lake Erie has relatively little influence on the weather. However, during periods of high water in Lake Erie, strong easterly winds can cause ice jams at river mouths and flooding of low shoreline areas." Lake Erie does have a warming effect in the winter and a cooling effect in the summer during periods when the normally westerly prevailing winds shift to the east.

..."The Detroit subdistrict is a climatic unit whose boundaries outline the most highly urbanized areas of the Washtenaw District, principally Detroit and its suburbs [this area approximates the Rouge River watershed]. Other urban areas including Ann Arbor, Monroe, and Windsor, Ontario have similar climates.

"The subdistrict is markedly warmer than surrounding non-urban areas. Increased temperatures on cold clear nights reduce the chance of freezing temperatures and frost in spring and fall. The growing season [175 days] is 17 days longer in the sub-district than in the remainder of the district. The growing season heat sum is higher [2700 degree C-days] and annual average extreme minimum winter temperatures are higher [-20C]. These temperature differences have important implications for plant growth. Southern cultivars that are sensitive to either late spring freezes or winter cold or that need a long growing season may survive or grow better in the metropolitan area than elsewhere in the district. Precipitation differences between the subdistrict and the remainder of the district are minimal and probably not biologically significant. However, the combination of warmer growing season temperatures, lower relative humidity, and similar precipitation regimes may result in greater potential for moisture stress."

The Rouge River watershed receives an average of 30 inches of rainfall annually (Michigan State University, Center for Remote Sensing). Snow contributes roughly 10% to 15% of annual precipitation in the watershed (Eichenlaub 1990).

Seasonal distribution of precipitation is fairly even, with no prominent wet and dry seasons within the state or the watershed. Eichenlaub (1990) states:

> "Thunderstorms associated with atmospheric disturbances are responsible for much of the warm season precipitation, particularly in the southern portions of the state. As a result, warm season precipitation is more intense, occurs on fewer days, and exhibits an erratic distributional pattern.
>
> "During the cold season, precipitation results from low pressure areas, fronts, and their jet stream associations. It is less intense, occurs on more days, and is less erratic in distribution.
>
> ..."February is the month of minimum precipitation with amounts less than 2.00 inches. The month of maximum precipitation...is...June at Detroit.
>
> "Winter precipitation averages 6 inches, spring 8 inches, summer 10 inches, and fall 7 inches."

Evaporation in the watershed is higher than most areas of the state. This is due to a combination of lower precipitation during the growing season (when most evaporation occurs) and higher average temperatures during this period (Sommers 1977).

Annual Stream Flows

Flow instability in the Rouge River is a major determinant of fish species composition and density. Not only are flows extremely responsive to even small amounts of precipitation, but low flow during times of drought is limiting. As described earlier (*Factors Affecting Fish Communities*), the flow regime has been influenced by human development. The Rouge Program Office (RPO) has compiled comparisons of maximum, mean, and minimum annual flows, as well as annual standard deviation (an estimate of flow stability) for the period of record for the seven United States Geological Survey (USGS) gauging stations. For every parameter, the values have increased over recorded time, except for the station on the Lower Rouge River (the least developed branch). Their conclusion was that the increase in flow variability was "directly related to the amount of developed area tributary to the gauging stations. As undeveloped area is urbanized the amount of impervious area is significantly increased and the resultant effect is a significant increase in the amount and intensity of runoff, from wet weather events, to the river" (Cantrell 1994).

Seasonally high flows are typically in March and April, with low (base) flows in July through September. Figure 7 depicts mean monthly flows in the mainstem at Southfield. Plots of three branches of the Rouge River reveal a similar pattern. Although the peak precipitation month is June, as stated earlier, the peak discharge month is March. High discharge in early spring is a function of snowmelt and storm water flowing over frozen soils. Evapotranspiration and infiltration serve to capture and slow the delivery of storm water to the stream in summer and autumn.

Summaries of USGS gauge data follow. Gauge station locations are identified in Figure 8. All data discussed are through water year 1994.

Mean annual discharge of the mainstem at Birmingham was 24.3 cfs (0.73 cfs per square mile over 33.3 square miles). This station is downstream of several CSOs and is influenced by their discharge (Figure 9).

Continuing downstream on the mainstem to Southfield, the mean annual discharge was 67.1 cfs (0.76 cfs per square mile over 87.9 square miles). Several small tributaries enter the mainstem between these two sites and the river flows through dense development (both residential and urban). Evans Ditch, a tributary to the mainstem, had an average discharge of 8.74 cfs (mean water yield was unusually high at 0.92 cfs per square mile over 9.49 square miles).

The only gauging station in the Upper Rouge River is located in Farmington, about midway on the branch. Average discharge was 13.2 cfs (0.75 cfs per square mile over 17.5 square miles). There are no CSOs upstream of this station and predominant land use in the area is residential. This subwatershed is undergoing rapid suburban development.

The next station is on the mainstem downstream of the confluence with the Upper Rouge River. Average discharge was 122 cfs (0.65 cfs per square mile over 187 square miles). Many CSO outfalls enter upstream of this station and the area is heavily developed with homes and industry. The CSOs act to decrease the actual drainage area by shunting surface water to the treatment plant instead of the river, hence the low flow yield.

The Middle Rouge River has a gauging station near its confluence with the mainstem with a mean annual discharge of 75.1 cfs (0.75 cfs per square mile over 99.9 square miles). This branch has the most and largest impoundments. It is also influenced by CSOs.

The Lower Rouge River gauging station is located more than halfway to the confluence with the mainstem, but upstream of most CSO outfalls. Mean annual discharge is 53.9 cfs (0.65 cfs per square mile over 83.2 square miles). In July 1995, the YCUA began discharging effluent to the Lower Rouge River. This will add approximately 17 million gallons per day (26.3 cfs, which equals 0.96 cfs/mi^2) to the Lower Rouge, which should have a measurable effect on average discharge, particularly base flow.

There is no gauging station at the mouth of the Rouge River below the confluence of the Lower Rouge.

Seasonal Flow

Besides the USGS gauging stations in the Rouge River, RPO has installed and continually monitored 17 gauging stations since 1994 (Figure 8).

Water flow in the Rouge River is not stable. Hydrographs (graphs of daily discharge over time) of the seven USGS gauging stations illustrate lack of stability in flow (Figures 10 - 16). They can be used to examine many characteristics of a river, including source of flow, channel characteristics, and temperature. As climate is relatively constant within the watershed, differences in flow at the various gauges at any one time can be attributed to geology, land use, or human effects through storm or sanitary sewers.

Absence of a large ground water component is apparent in all hydrographs. Base flow is small and not stable throughout the year, indicating reliance on surface water flow. Throughout summer, when surface water flow is lower (after evaporation and evapotranspiration), the base discharge falls. By late August, streams such as the Lower Rouge River have all but stopped flowing.

During March and April flow instability increases throughout the Rouge River watershed. Rapid increases in flow followed by almost equally rapid drops are common. At this time of year the ground is usually frozen and thus less permeable than in other seasons. The amount of water attributed to snow melt varies with accumulation, but it generally constitutes more water entering a river (at a faster rate) than rainfall.

That flow peaks are very narrow and fairly symmetrical (except in the mainstem at Birmingham), supports the hypothesis that the watershed is primarily driven by surface water. Asymmetrical and wider peaks indicate a source of throughflow to the stream (through soils and surfaces that can absorb water). In such systems, after a rain event, the peaks are usually less extreme, high flows last longer, and they gradually taper off due to the slow release of water from the surrounding soils. This is illustrated in a hydrograph from the Huron River, which has a larger ground water component (Figure 17). In the Rouge River, peaks are usually extreme, flows increase rapidly, and fall off almost as quickly, since most watershed surfaces have not absorbed water in any quantity (and if they have, they cannot release it to the stream due to lack of connection to the river). This will be discussed in more detail in **Soils and Land Use Patterns**.

Temperature regimes of the main branches can also be predicted by hydrographs. The large relative contribution of surface water to the system should result in wide temperature variations both night-to-day and seasonally. Ground water has a relatively constant temperature of about 10°C, and throughflow will also have moderated temperature. Surface water tends to reflect air temperature more closely. Amount of riparian cover can buffer temperature fluctuation through shading, particularly in smaller streams. The large amount of forested riparian zone (as described in *Channel Cross-Section*), protected as public parkland and otherwise, helps to account for cooler and more stable temperatures than expected. July temperature regimes have been determined to be useful in determining species distribution (P. Seelbach, MDNR, Fisheries Division, personal communication; Table 14). Considering values of listed species, higher variable temperatures are not limiting the development of healthy fish communities in the Rouge River.

May, June, and July flow stability is important for most warm water fish species to ensure adequate reproduction. High flows can wash away nests, eggs, and newly hatched fry (P. Seelbach, MDNR, Fisheries Division, personal communication). The early part of this time is unfortunately when the Rouge River is at its flashiest. Destructive peaks flows, typically 5-10 times per month, do not leave a window for fish nesting and hatching (this usually requires 2 or more weeks). CSO improvement projects and storm water management planned by SWQD may be able to dampen the instability now seen in the river.

Changes in discharge over seasons reveal much about a stream. Published information includes mean daily values and various exceedence values. Exceedence values are discharge values that are exceeded a given percentage of the time. For example, a 10% exceedence value is that discharge which has been exceeded 10% of the time within a given water year (October - September). Any extraordinary storm events or snowmelts would be represented in this discharge range. The 50% exceedence value represents median discharge for a particular station, as it was exceeded half the time (and the flow was less than this value half the time). The 90% exceedence value represents base flow, as most of the time, discharge was greater than this value.

When comparing exceedence values for streams of varying sizes, it is necessary to standardize values so that direct comparisons can be made. One method of standardization entails dividing exceedence values by median exceedence to arrive at a factor. This number represents the magnitude of discharge variance from the median flow at each exceedence range. For exceedence flow under 50% (5%, 10%, and 25% in our data), the smaller the standardized value, the more stable the stream. e.g., (5% exceedence)/(50% exceedence)=standardized discharge at the 5% exceedence level - if this value is equal to 2, then flood flow is two times greater than median flow. The most stable USGS station, the mainstem at Birmingham (Figure 18), has a standardized discharge at this exceedence of 5.3, i.e., flood flow is 5.3 times greater than median flow. This does not indicate a stable system, regardless of watershed size at this location. For comparison, the most stable streams in Michigan (Au Sable, Manistee, and Jordan rivers) have 5% exceedence (high) flows that are less than twice their median flows.

The majority of high flow exceedence data are grouped in a fairly narrow band. Two high outliers in the data are Evans Ditch and the Lower Rouge River. Evans Ditch is a small stream (drainage area of 9.5 square miles), located in a highly developed (residential and commercial) area. This stream has an exceptionally high annual yield per square mile (0.92 cfs per square mile), which indicates a high overall drainage efficiency. Storm sewers were constructed in this subwatershed before current knowledge of storm water management and do not include any detention or retention. The Lower Rouge River shows the worst 5% standardized exceedence of 13.7. This stream is influenced by heavy soils, residential and commercial storm water flow, and agricultural practices in the headwaters. It is also the only branch that does not capture any portion of the base flow available in the glacial moraine located at the northern and northwestern edges of the watershed. A glacial drainage channel captures this water and shunts it to Fleming Creek in the Huron River watershed.

In analyzing low flow regimes, the higher the base flow, the more stable the stream. Therefore, the higher the ratio between each exceedence rate and median discharge (for exceedences above the 50% rate i.e., 75%, 90%, 95% in our data set), the less variation in flow in the stream. For the USGS stations in the Rouge River the standardized 95% exceedence ranges from 0.1 - 0.2 (Figure 19). The neighboring Huron River has a standardized 95% exceedence of 0.4 and the ground water fed Au Sable River at Mio has 0.7 for this parameter.

Standardized low flow patterns in the Rouge River are more tightly grouped, with Evans Ditch fairing in the middle for this characteristic. Apparently enough of the original ground water flow has survived development to make this stream at least no worse than the rest of the Rouge River branches. The Lower Rouge River, however, shows a very extreme low flow. The standardized 95% exceedence is 0.09. There is little, if any ground water flow into this stream, except in the highest headwater sections of Fowler and Fellows Creeks. However, as stated earlier, there has been a recent large addition of base flow from the Ypsilanti Community Utilities Authority. As long as the water quality of this discharge is acceptable, it should provide substantial improvement in base flow to this branch of the Rouge River.

> “ Low flows…inhibit aeration of the water, and when organic materials decompose, dissolved oxygen levels are lowered. This oxygen deficit is exacerbated by input of raw sewage from combined and separate sanitary sewers. This affect of low flow is most evident in downstream reaches of the Rouge River where river gradient is low and organic loading is high (Michigan Water Resources Commission 1974).” (cited by Nuhfer 1989).

Another index of flow stability is defined by mean high flow divided by mean low flow. For this ratio, 1.0-2.0 = very good (typical of self-sustaining trout streams), 2.1-5.0 = good (better warm water rivers), 5.1-10.0 = fair, and >10.0 = poor (P. Seelbach, MDNR, Fisheries Division, personal communication). There is insufficient flow data from the tributaries to calculate this ratio. For the USGS stations located on the main branches, the entire watershed except for the mainstem above

Birmingham and Johnson Drain fall into the “poor” classification. These two were just inside the “fair” category.

Daily Flow

There are no active hydroelectric dams on the Rouge River and no lake-level control structures that have fluctuating water levels, i.e., they are all fixed crest. All major impoundments are managed at run-of-the-river and usually have little effect on daily flow stability. During summer months however, when water levels are somewhat lower than normal and the ground is not saturated, there is a noticeable moderating effect on daily flow fluctuations by the larger impoundments (Newburgh and Wilcox Lakes) (P. Seelbach, MDNR, Fisheries Division, personal communication).

However, urbanization and its increase in impervious area and construction of storm sewers, sanitary sewers, and combined sewers, has a destabilizing affect on flow on a daily and hourly basis.

> “...(S)mall basins [such as the Rouge River watershed] are most strongly affected by the rate at which water is introduced to the basin and transported to the outlet stream. [In these systems]...urban development does more than simply magnify peak discharges; it also creates entirely new peak runoff events. As a result, floods of any given discharge will occur more frequently after urbanization.” (Booth 1991)

Response to rain events at selected flow gauges is illustrated below. The mainstem gauge is located in the headwaters and should show a fairly stable flow regime in the absence of human influences. However, a rain event of less than 2 inches results in an increase in flow from 12 cubic feet per second (cfs) to 246 cfs in three hours (Figure 20). There are many CSOs upstream of this gauge, which explains this dramatic response. Similar responses are documented throughout the watershed. Less than 1.5 inches of rain resulted in a flow response from 26 cfs to 497 cfs in 12 hours in the Upper Rouge River (Figure 21), less than 1 inch of rain caused a change in flow from 28 cfs to 530 cfs in 4 hours on the Middle Rouge River (Figure 22), and slightly over 1 inch of rain increased the Lower Rouge River flow from 8 cfs to 562 cfs in 10 hours (Figure 23).

> “These extreme flow variations [of 20 times the base flow over short time periods] are extremely degrading to natural systems. They destabilize banks, create abnormally large moving sediment bedloads, disrupt habitat, strand organisms, and interfere with recreational uses of the river. Aquatic production and diversity are profoundly reduced by such daily fluctuations (Cushman 1985; Gislason 1985; Nelson 1986; Bain et al. 1988).” (cited by Hay-Chmielewski et al. 1995).

Channel Morphology

Gradient

Gradient is defined as the drop in elevation over a specified length of river. It is usually expressed in feet per mile. Gradient helps determines the energy that water in the stream has to exert on its bed and banks. Stream power is a combination of gradient and discharge of water in a stream. Steeper gradients increase flow velocity, which in turn exert change upon channel depth, width, meandering, and sediment transport (Knighton 1984).

> "Stream gradients in the River Rouge basin are relatively steep except in the lower reaches where they are low. The average slope for the River Rouge is 4.9 feet per mile. Average slopes for the Upper, Middle and Lower River Rouge are 21.0, 11.2 and 10.9 feet per mile, respectively. Tributary streams such as Pebble Creek, Franklin Branch, Bell Branch, Johnson Drain, and others not illustrated have average slopes ranging from 17 to 36 feet per mile, and, for some reaches, have gradients approaching 100 feet per mile." (Knutilla 1971)

Channel shape and flow characteristics can be predicted based on gradient (in the absence of human modification). Generalized gradient classes and their characteristics are listed below as defined by G. Whelan (MDNR, Fisheries Division, unpublished data). In these descriptions, hydraulic diversity refers to the variety of water velocities and depths found in the river for each class. Fish and other aquatic life are typically most diverse and productive in those parts of a river with gradient between 10 and 69.9 ft/mi (Trautman 1942; G. Whelan, MDNR, Fisheries Division, personal communication). Gradients such as these are rare in Michigan due to low-relief landscape. Typically, reaches of a stream with the highest localized gradient are those where dams are most likely to be sighted.

Gradient Class	Channel Characteristics
0.0-2.9 ft/mi	mostly run habitat with low hydraulic diversity
3.0-4.9 ft/mi	some riffles with modest hydraulic diversity
5.0-9.9 ft/mi	riffle-pool sequences with good hydraulic diversity
10.0-69.9 ft/mi	established, regular riffle-pool sequences with excellent hydraulic diversity
70.0-149.9 ft/mi	chute and pool habitats with only fair diversity
>150 ft/mi	falls and rapids with poor hydraulic diversity

The mainstem of the Rouge River is predominantly low gradient, with 20.6 river miles (43.4%) described by the lowest gradient class (<3.0 ft/mi) (Figures 24 & 25). In general, gradient decreases downstream toward the mouth (Figure 26). There is one spike at river mile 34, in Beverly Hills, but it is a short stretch. The most desirable gradient (10.0 - 69.9 ft/mi) can be found in 6.1 miles (12.8%) of the mainstem. This gradient is located in the headwaters and is most likely used by migratory populations of river and lacustrine fish species for spawning, provided dams do not impede access. (This statement is true for the other branches as well.) The largest dam on the mainstem is located at river mile 8.5 (at the Henry Ford Estate) with a head of 12 feet; it impounds 13 acres. It was once a functioning hydroelectric dam, which supplied power to the estate.

The Upper Branch of the Rouge River contains the most favorable gradient profile of all the branches. Forty-four percent of the stream (6.2 miles) falls into the most favorable gradient class (Figures 24 & 25). Although the majority of this steeper section is located in the headwaters, it is also evident at river mile 6 (at 8 Mile Rd.) and mile 2.5 (in Redford) (Figure 27). Although three of the tributaries to this branch (Seeley, Tarabusi, and Bell) have been impounded, the Upper Rouge River is not impounded to any extent for power generation purposes due to its small size. Stream power is a function of gradient and discharge (proportional to drainage area) and this stream is too small to produce enough power to impound for hydroelectric purposes.

The Middle Branch of the Rouge River contains the most undulating gradient (Figure 28). The steepest stretches are in the headwaters, but there are also several reaches throughout the stream where gradient locally is high. Over 7 miles (27.5%) of the stream are in the 10.0-69.9 ft/mi class (Figures 24 & 25). It is this characteristic which drew Henry Ford to construct several hydroelectric dams on the Middle Rouge River. Mr. Ford had plans to use the dams to generate power for small factories (parts and other components), but the dams did not generate enough consistent power to be profitable. None of the dams are now used to generate power.

Gradient in the Lower Rouge River is consistent with the other branches, in that the steepest reaches are in the headwaters (Figure 29). There is a moderate amount of ideal gradient, 3.4 miles, which constitutes 14% of the total stream length (Figures 24 & 25). However, this gradient is found in the headwaters, where the stream size is very small and does not support large or diverse populations of fish. The gradient of this stream did not draw significant interest from those involved in constructing dams. There is one remaining dam (of two originally constructed on this branch (see **Dams and Barriers**) at river mile 10.5 (Wayne Road in Wayne). This dam was originally constructed as a mill dam in the late 1800s (estimated), but it probably was not very successful due to low base flows and the small drainage area of the Lower Rouge River.

Channel Cross-Section

In general, the channel of the Rouge River is over-wide, shallow, and lacking in structure (Table 15). This is due to extremely variable flows (particularly large peak flows) and high amounts of sedimentation from storm water flows. However, channels are not as degraded as they might be due to several factors. Areas of clay soils are resistant to erosion, and generally have deep, narrow u-shaped channels (Knighton 1984). This trait, along with the extensive forested riparian buffer that exists along much of the river, has probably lessened the expected effects of flashy flows on the Rouge River channel. This riparian corridor has provided tree roots that buffer streambanks against erosive actions of flood flows, and an active floodplain that greatly aids in dissipation of energy contained in floodwaters.

The Shannon-Weiner diversity index was applied to channel shape data to determine the hydraulic diversity of the channel. For this index, simple channels will have a diversity value of less than 1.0 and complex channels will be greater than 2.5 (values in between are of moderate diversity). No location on the Rouge River or its tributaries had a diversity of greater than 1.0. The Rouge River mainstem at the Henry Ford Estate had the highest diversity (1.0), but this area is impounded and not flowing water. It may be that storm flows are too frequent and large to allow the normal deposition and erosion processes that create increased channel (and thus hydraulic) diversity. More study is needed to understand the hydraulics and channel morphology of streams that cut through clay soil as these relations are not well understood.

The RPO surveyed the three branches and mainstem of the Rouge River in 1993 (Regenmorter 1994). Their descriptions of the stream channel are included below (direct quotations as noted):

<u>Rouge River mainstem</u>
The channel is well-defined with a meandering pattern, except for the lowest reaches, where it has been channelized and paved into a broad, shallow flume. The lowest reach has been dredged and straightened to allow industrial shipping. “The banks were relatively low in the upstream and downstream portions of the river. In the middle portion, Eight Mile Road to I-96, the banks were higher and steeper. Where the banks were low, ground cover comprised either open areas with

maintained lawns or trees with dense underbrush. Where the banks were steeper, the growth on the banks comprised trees with little or no undergrowth. Log jams were found along the mainstem but not as many as on the other branches. Most were found in the upstream areas where the river meandered more and the flow rate was less. Some evidence was found where jams had been removed."

Upper Rouge River
"The course meandered greatly, more than on the other branches. The channel was well defined, but the banks were relatively low. The lowness of the flood plain relative to the surface of the flow in the river caused the flood plain to be very wet; to the point of being swampy in some areas. The banks were comprised of sand and loamy soils. Where the land was flat and low, the area was covered with thick brush interspersed with large trees. Where the banks were higher and more steep, trees dominated with much less underbrush. Log jams occurred frequently along the Upper Rouge, probably the most per mile of all the rivers included in the survey. (In some areas) a jam or, at least, a partial blockage was found at almost every bend...The cause was trees falling into the river due to erosion of the stream bank."

Middle Rouge River
This branch has the greatest number and largest impoundments in the watershed. "In the free flowing section, the characteristics of the river channel were very similar to the channel found on the Lower Rouge. It meandered, but the banks remained intact with relatively steep slopes. The banks comprised silt and clay mixture. Ground cover comprised trees and some bushes. Often the banks were exposed." The river is enclosed for approximately 300 yards, where it passes under the Northville Downs Race Track. "The hydraulics of the free flowing sections consisted of a series of shallow pools and naturally occurring controls. Below Wilcox Lake the velocity picked up and no pooling was observed. This condition persisted until the Haggerty Road crossing. As the river approached each impoundment, the velocity would drop and the river's width, depth, or both would increase. The same conditions occurred over the last two or three miles as the river approached its confluence with the mainstem. Log jams were found along the Middle Rouge but not in the numbers that were found on the Lower Rouge. One of the reasons for less jams could have been that a portion of the floatable materials were trapped by the impoundments and prevented from moving downstream. A second reason could be that the majority of the Middle Rouge flowed through parkland and this entire area, including the river, appeared to be maintained by the [Wayne County] Parks Department."

Lower Rouge River
"The Lower Rouge River flowed along in a well defined channel. The channel meandered, but the banks remained intact with relatively steep slopes. The banks usually consisted of a silt and clay mixture. Ground cover consisted of trees and some bushes. Often the banks were exposed due to the scouring action of high flows and dense tree cover blocking the sun. The river was channelized as it passed under I-275 and for a short section upstream of Inkster Road where the river cuts along a high bank. In the very upper portion, the flow in the Lower Rouge River was free flowing. Further downstream, the hydraulics consisted of a series of pools and riffles. The flow would pool up behind a naturally occurring control, spill over the control, and then pool up behind the next control. The pools were normally an eighth to a quarter mile in length but less than two feet in depth. The last two miles before the confluence with the mainstem, the river was very slow and relatively deep (two to five feet deep). The majority or the land adjacent to the Lower Rouge River has remained in its natural state. Very little development has occurred along the stream bank and in the flood plain."

As noted above, log jams and woody debris are frequently removed from the river in the interest of flood control. This practice, if not carefully limited, can have a detrimental effect on the fish and benthic invertebrate community. Hickman (1975) found a 25 percent reduction in total fish population and a 51 percent reduction of catchable-size fish after snagging and clearing of woody debris. This phenomenon may be even more dramatic in streams such as the Rouge River, where structure is lacking due to small substrate size and flashy flows.

Dams and Barriers

There are 62 dams on the river (Table 16; Figure 30), with 26 on the mainstem and its headwater subwatershed, 12 on the Upper Branch watershed, 18 on the Middle Branch watershed, and 6 in the Lower Branch watershed.

Two dams of critical importance are those first encountered by fish entering the system at the mouth. The first dam is on the mainstem at the Henry Ford Estate in Dearborn, located just upstream of the confluence with the Lower Rouge River at river mile 7.5. This former hydroelectric dam, constructed by Henry Ford in 1909, has a head of 12 ft and effectively bars nearly all fish passage upstream of this point. The first dam on the Lower Rouge River is at Wayne Road in the city of Wayne, at river mile 10.5 of the Lower Rouge River. This dam was constructed in the late 1800s, and is believed to be the former site of a mill (T. O'Connor, Wayne County Parks & Recreation, personal communication). It has a head of 3 ft. and blocks all but the largest salmonids from upstream passage. A second dam (located just downstream of Outer Drive in Dearborn) has failed, and no longer impounds water or blocks fish passage. No data are available on the date of construction of this dam.

As discussed in *Factors Affecting Fish Communities*, the many dams on the tributaries to the main branches serve to fragment the system and block movement of aquatic organisms. Construction and proposal of in-line storm water detention basins threaten to disconnect critical areas. Water sent to storm water detention basins contains pollutants such as sediment associated with construction, oil and grease from road surfaces, and fertilizers and herbicides. Water impounded behind detention basin dams is warmed, eliminating one of the important characteristics of headwater streams (cool water).

Headwater streams are a source of nutrients and aquatic invertebrates (important food for fish), which tend to migrate downstream throughout their life spans. Streams and their floodplains are frequently used as storm water detention areas, to the detriment of the health of the system. These concerns were stated by James Waybrant, MDNR, Fisheries Division, personal communication:

> "Headwater and tributary streams must be protected. They must not be considered as merely runoff-removal devices. The ability of a stream to assimilate nutrients on a per unit area basis is frequently greater in small streams than in larger rivers since primary production is less likely to be limited by light penetration."

Fishes (and other aquatic organisms) require multiple habitats to complete their life cycle. Specialized spawning, rearing, feeding, and seasonal refuge habitats are crucial to survival -- and maximum productivity -- of each species. Equally critical are migration routes among these habitats (Schlosser 1991). Migrations occur between Great Lakes and river habitats, and among river habitats. Small river fragments may contain only a fraction of the potential diversity and productivity for that river segment.

There are no dams that fall under the jurisdiction of the Federal Energy Regulatory Commission. Many dams constructed were originally hydroelectric dams, including six on the Middle Rouge River and one on the mainstem (Corps of Engineers 1959). Fisheries Division files do not identify any active hydroelectric dams. However, the dam at the Henry Ford Estate is possibly going to be updated and re-activated by its present owner, UM Dearborn.

Soils and Land Use Patterns

The breakdown of watershed soils by branch is identified in Table 4. The mainstem includes that area not flowing to the Upper, Middle, or Lower branches (identified as subwatersheds). Almost 95% of the watershed contains silt loam (Group B) or smaller particles. Heavier soils, such as these, have low permeability and do not lend themselves to percolation of rainwater into the ground and later slow release to the stream. Rather, they function as relatively impermeable surfaces which shunt surface water over contours into the lowest point -- the stream. Group A soils are porous, capturing storm water, releasing it slowly to the stream by way of throughflow and ground water.

As soil particle size decreases, erosive potential increases. This continues until particle size is small enough that particles bind together tightly and are not easily eroded. Thus, although silt is the most highly erosive soil, clay is the least.

Headwaters of the mainstem (defined as that area upstream of the confluence with Evans Ditch) contain a high percentage (49%) of Group B soils (silt loam or loam) , and 3% Group A (sandy, loamy sand, or sandy loam). Continuing downstream, the rest of the mainstem watershed (not including the three branches) is almost entirely Group C soils (sandy clay loam). The area within the city of Detroit is almost 100% this material, although most of this area has now been intensively developed and sewers constructed, minimizing effects soils have on the river. This shows that traditionally the Rouge has been a surface water stream with flows greatly affected by precipitation.

The highest percentage of sandy soils are in the Upper (7%) and Middle branches (10%) and these are located in a glacial moraine in the northwestern corners of the watershed. The percentage of sandy clay loam increases in both streams in the most downstream regions. The headwater region of the Upper Rouge River contains a high percentage (41%) of silt loam or loam, mostly located along the main branch of the river. These more permeable soils provide the streams with more throughflow then surface runoff.

Soils of the Middle Rouge River are the most sandy of all branches. Percentage of Group A soils in the middle reaches of this branch (between Northville and just downstream of Nankin Mills impoundment) is 25%. Therefore permeability of rain is highest in this area.

Development in the Upper and Middle Rouge River are threatening the stabilizing value of headwater subwatersheds. As more impervious surfaces are added to the system, rate of delivery of storm water to the streams will increase. It is imperative that these developing communities manage their storm water in a way that approximates pre-development rates and pathways. Also critical is protection of the vegetated riparian corridor, which shades the stream and keeps temperatures moderated, and prevents excessive streambank erosion.

The Lower Rouge River has the highest percentage of Group D soils (clay loam, silty clay loam, sandy clay, silty clay or clay). These soils represent glacial lake bed and can be found at the mouths of most southeastern Michigan rivers. They are highly impermeable, which helps account for low base flows in the Lower Rouge River. They are made up of fine particles, that once suspended are difficult to get out of suspension. This branch has the lowest dissolved oxygen and most unstable flows of all branches. The presence of dense riparian cover keeps temperatures and channel forms moderated. Much of the headwaters have been in agricultural use, but this land use is gradually shifting to residential and suburban. The large amount of public parkland next to the river has protected this stream thus far. The communities in this subwatershed must be particularly sensitive to management of storm water, to ensure that they do not further degrade this already stressed system. This branch has the fewest dams and could represent the best opportunity for seasonal fisheries for Lake Erie species, if water quality can be improved.

Present land use in the Rouge River watershed as of 1995 is (Rouge Program Office, Modeling Unit graphic 8/10/95):

Land use	Percentage
Commercial	9.65%
Industrial	7.54%
Highway	2.01%
High Density Residential	2.78%
Medium Density Residential	37.17%
Low Density Residential	7.27%
Water/Wetlands	2.12%
Forest/Rural Open	17.72%
Urban Open	4.20%
Agricultural/Pasture	9.54%

The Southeast Michigan Council of Governments (SEMCOG) found in their 1994 report on the history of development in the area:

> "Up to 1950, the urbanized* area was largely concentrated inside the present Detroit city limits, with some extensions along the old inter-urban routes to Mt. Clemens, Pontiac, Farmington, Dearborn, Wayne and the Downriver communities. By 1980, the area covered by urban development extended beyond the boundaries of Detroit approximately two townships, or 12 miles. Similar patterns were evident in the other urban areas of the region - Port Huron, Pontiac, Ann Arbor, Monroe and the Monroe County portion of the Toledo urbanized area.
>
> "...By 2010, the urbanized area will extend north along the Van Dyke corridor in Macomb, well past Pontiac in Oakland County and will include almost all of Wayne County. The Brighton-Howell corridor in Livingston County will join the fast-growing Ann Arbor area and the slower-growing areas around Port Huron and Monroe as newly urbanized territory."
>
> *Urbanized land is generally defined as areas with a population density of at least 1,000 persons per square mile.

Land use in the mainstem watershed (not including the branches) is primarily urban, and high and medium residential development. As of 1990 there were limited open lands in some headwater areas. These areas are developing rapidly, and any current open space will probably soon be residentially or commercially developed.

The Upper Rouge River subwatershed contains little industrial land and is mostly residential. There is very little undeveloped land, similar to the mainstem. The few remaining open areas are also rapidly becoming residentially and commercially developed.

The Middle Rouge River subwatershed contains substantially more open land, represented by forest/rural open, urban open (i.e., parkland), and agriculture/pasture. However, the townships of Novi, Salem, and Northville are all experiencing rapid growth. Sedimentation in headwater tributaries is of critical concern. Construction sites with large areas of disturbed soil are common in headwater communities. Rate and path of storm water from these sites, during construction and after, will determine the long-term prognosis for headwater streams, which are critical to the health of the watershed as a whole.

The Lower Rouge River contains the most open area of all subwatersheds. As of 1990, about one third was characterized as agriculture/pasture or forest/rural open. The largest urban area is in the southwestern corner and is represented by Willow Run Airport and Ford Motor Company Willow Run plant. The western edge of this subwatershed lies adjacent to the Huron River watershed and the cities of Ann Arbor and Ypsilanti. Both of these communities are experiencing growth and open areas are being developed.

Bridges and Other Stream Crossings

There are approximately 1,950 road and railway crossings of the Rouge River and its tributaries (S. Perry, SEMCOG, personal communication). It is not feasible to list all of these crossings, therefore they have been summarized by type (Table 17).

Road and railway crossings are a potential source of sediments, especially if roads are unpaved. Crossings can add sediment if approaches are not properly stabilized and maintained, as banks are typically steep. Contaminants: road salt, oil, grease, brake liner and gear filings, and assorted fluids from vehicles; can enter the water at road crossings. These materials also enter the Rouge River through the extensive storm sewer system.

Bridge crossings can affect streams because of their design. If placed on a bend or not sized correctly, they can cause erosion up-or downstream by deflection of stream flow. They can also aggravate flooding by constricting river channels and floodplains. Abutments and pillars can trap large debris that can facilitate formation of logjams, thus exacerbating flooding. If crossings are made through culverts, they can restrict fish passage if the culvert elevations are not even with the river bottom or if flow is constricted and velocity increased beyond fish swimming speeds.

The number and location of submerged crossings in the Rouge River are unknown. Underground Storage Tank Division (USTD) and SWQD of Michigan Department of Environmental Quality, Miss Dig, SEMCOG, and the RPO have agreed that this would be excellent information to have. Some of these groups have begun compiling this data, though this process is not complete.

Submerged crossings of all utilities probably number in the thousands. Most would not be visually evident, except in locations where erosion of the stream bottom has exposed them. Crossings installed since Part 301 of the Natural Resources and Environmental Protection Act (1994 PA 451, formerly the Inland Lakes and Streams Act, P.A. 346 of 1978) have been designed to minimize degradation to the environment. Construction practices such as jack-and-bore when soils and clearance to stream bottom allow, stockpiling of materials on-site and continuous construction until the crossing is complete, and erosion control and stabilization practices after completion of crossings, have helped minimize sedimentation during installation. Maximizing cover over installed utilities and use of non-erodible materials have also limited environmental degradation for the life of the crossing.

Special Jurisdictions

Jurisdictions regarding the river, its riparian zones, and floodplain are administered by federal, state, and local authorities. Some federal laws and several state statutes are administered by the Land and Water Management Division (LWMD) and Surface Water Quality Division of MDEQ (Table 18).

Navigability

The majority of the mainstem is large enough to be physically navigable by small boats or canoes, as are the branches for most of their length. Only the first 15 miles upstream from the mouth however, are legally defined as navigable as adjudicated by the Michigan Supreme Court (MDNR 1993). This lower portion therefore is public and subject to public trust protection. The mainstem downstream of the Henry Ford Estate (in Dearborn) is also under the jurisdiction of Section 10 of the River and Harbor Act, 1899, administered by the United States Army Corps of Engineers.

Storm Water Management

MDEQ, SWQD regulates discharges to water and manages storm water. Amendments to the Clean Water Act, passed in 1987 (40 CFR Parts 122, 123, and 124, National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharges; Final Rule) affects the following types of storm water management: 1) separate municipal storm water drainage systems that serve populations of 100,000 or more people (no communities in the watershed meet the criteria for a permit at this time); 2) industrial sites with certain industrial classification codes which have been determined to have the potential to discharge to surface waters; 3) construction sites with greater than 5 acres of exposed area. (T. Jaske, MDEQ, SWQD, personal communication)

SWQD, Wayne County, and the communities within the Rouge River watershed are working together to develop storm water management guidelines, as a general storm water permit. The permit will be issued on a voluntary basis to municipalities in the watershed, and will require development of an illicit connection elimination program, public education, a watershed management plan, and a community based storm water pollution prevention plan. (R. Schrameck, MDEQ, SWQD, personal communication) In areas not served by CSOs, but developed before the practice of storm water management, attempts to develop remediation methods to stabilize effects of rain events on the system are being made (R. Reznick, MDEQ, SWQD, personal communication.).

Local administration of storm water regulations also occurs in many municipalities. Communities have adopted storm water management plans and require specific discharge rates from newly developed sites (Toffaleti and Bobrin 1991). Some ordinances also require partial treatment of storm water for improved water quality before discharge. Washtenaw County has developed storm water regulations for new developments that address water quality and quantity concerns (Bobrin 1994). Many communities within the watershed (27 of 45 surveyed) have local ordinances, design criteria, construction standards, master plans, or local codes that address storm water management issues (K. Cave, RPO, personal communication).

County Drain Commissioners

There are over 400 designated drains in the Rouge River watershed (Table 19). County Drain Commissioners have authority to establish designated county drains under the Drain Code (PA 40 of 1956). This allows for construction, maintenance, or improvement of all designated reaches for drainage. Maintenance and improvement activities include: straightening, deepening, widening, relocating, dredging, and enclosing. Activities carried out under authority of this act do not require MDEQ approval, if applied to drains designated before 1972.

Wayne County does not have an elected Drain Commissioner. The Director of the Division of Public Works, under the Department of Environment, is the designated County Drain Commissioner. Oakland and Washtenaw Counties have drain commissioners that are elected officials, as are most others in the state.

Drain commissioners are also responsible for maintenance and operation of many lake-level control structures, particularly those set by Part 307 of the Natural Resources and Environmental Protection Act (1994 PA 451), formerly the Inland Lake Level Act (PA 146 of 1961). Methods of operation are at the discretion of each drain commissioner.

State and Local Parklands

The State of Michigan operates one state park, Maybury State Park in Northville. This park is in headwaters of the Middle Rouge River and contains one small impoundment on a tributary of Johnson Drain.

Wayne County Parks owns and administers 4,069 acres of land along 50 miles of river, making this the most protected and accessible river in southeast Michigan (Figure 31). Most of this land is located along the Middle Branch of the Rouge River, including the impounded sections between Wilcox and Nankin Mills, and along the Lower Rouge River. One hundred acres have recently been turned over to municipalities for construction of CSO basins; another 40 acres will be relegated for that purpose by 1998.

Many local municipalities also operate parks next to the Rouge River and its tributaries. Many of these lands are set aside for public use due to their location within the floodplain.

All of these areas offer critical riparian protection through their vegetative buffer. The undeveloped floodplains dissipate erosive stream energy during high flows, and the trees protect channel integrity through bank stabilization and provide shading that moderates temperatures. This protected riparian greenbelt is the major factor maintaining some aspects of ecological integrity in the Rouge River, within what is otherwise a highly disturbed urban ecosystem (Booth 1991). Maintaining and adding to this greenbelt should be of the highest priority.

Water Quality

Overview

Dissolved oxygen levels, temperatures, and nutrient enrichment are water quality parameters considered important to fisheries concerns. Considering these parameters, the mainstem and three major branches (Upper, Middle, and Lower) (Figure 1) have “poor” to “fair” water quality with some headwater tributaries showing “fair” to “good” water quality (RPO 1994). Conditions generally decline from upstream to downstream. The Lower Rouge River has the worst water quality of the four branches and the mainstem downstream of its confluence with the Lower Rouge River is only slightly better. Surface water contamination contributing to these degradations comes from both point and nonpoint sources.

Rouge River water is slightly alkaline as are many of southeast Michigan’s water bodies, with pH of the water normally ranging from 7.2 to 8.5 (RPO 1994). Whereas pH is fairly consistent throughout the watershed, except for isolated events that cause temporary increases to levels as high as 9-12, temperatures and dissolved oxygen levels vary both on a geographic and temporal basis. Temperatures up to 90^{o}F and dissolved oxygen levels well below the water quality standard (WQS) for warm water streams of 5.0 parts per million (ppm) are common occurrences in those river sections with poorer water quality (RPO 1994). Changes are expected on a seasonal basis, however there are significant short-term fluctuations that tend to correspond to both extremely low flows and periods when large amounts of storm water and combined sewage are discharged into the river.

Nutrient enrichment (based on total phosphorus analyses) is also prevalent with phosphorus levels averaging 0.1-0.4 ppm in most reaches of the river. Phosphorus levels in unpolluted warm water streams in this area are normally less than 0.05 ppm from natural sources, and cold water streams would have even less (M. Oemke, MDEQ, SWQD, personal communication). Peaks reaching as high as 3-7 ppm are found in some areas located immediately downstream of combined sewer overflows (RPO 1994). See *Nonpoint Pollution Sources* for an explanation of nutrient effects.

Point Source Pollution

Point sources are governed by the Clean Water Act (PA of 1972). These sources are regulated by National Pollution Discharge Elimination System (NPDES) permits that are issued by SWQD, MDEQ. There are 75 permitted dischargers in this watershed (Table 20). These include municipal wastewater control facilities, industrial discharges, CSOs, and treated ground water discharges. In addition, there are almost 500 storm water discharge permits, many with multiple discharge locations. The majority of municipal and industrial dischargers are in compliance with their permits and do not cause degradation of water quality beyond that allowed by the permits. Most storm water discharges and CSOs however, have little or no treatment before discharging to the stream (Figure 32), and can have significant affects on water quality for some distance below their outfall. These are especially noticeable in sections of the river downstream from communities with many such discharges.

Combined Sewage Overflows

There are over 150 permitted CSOs that discharge, as an annual average, over ten billion gallons per year of combined storm water and raw sewage to the Rouge River or its tributaries (Camp, Dresser, and McKee Inc. 1994; Table 21; Figure 9). These discharges have the potential to increase nutrient loadings to the river. They may also cause significant and sometimes extended periods of dissolved oxygen depletions downstream as organic materials exert an oxygen demand. Other effects such as short-term pH changes and increases in turbidity and suspended solids can also occur. Habitat is often affected as organic materials and sediments accumulate in slower stretches of the river and cover any hard or rocky substrates normally present. This can negatively affect invertebrate populations and reduce the food supply available for fish in the area.

Several communities have initiated projects to address CSO discharges. Ten retention and treatment basins are planned or under construction and six sewer separation projects are underway (Figure 33, RPO 1995). The basins are designed to detain a portion of the flow for later transport to and treatment at the wastewater treatment plant after the storm event subsides. Remaining flows that discharge to the river through the basin will be treated by sedimentation, skimming, and disinfection before discharge. Sewer separation projects will eliminate discharges of sanitary sewage by providing separate storm sewers to handle rain events. These 16 projects will result in elimination of about one third of the CSOs. The remaining CSOs are scheduled to be corrected by the year 2005 according to the NPDES discharge permits now in effect.

Nonpoint Pollution Sources

Nonpoint sources are defined as pollutant loadings that do not originate at a specific point of discharge. Nonpoint source loads enter surface water through either atmospheric deposition or water transport. They are diffuse and often intermittent, and are difficult to identify or quantify. Airborne pollutants are picked up, carried by winds, and deposited in watercourses directly or on land to become part of runoff into surface waters during rain or snow melt. Sources of nonpoint waterborne pollutants include runoff from urban and agricultural areas, highways and roads, industrial stockpiles, old solid waste and hazardous waste landfills, golf courses, septic systems, and erosion from construction projects and stream banks. Pollutants from these sources include fertilizers, pesticides, animal wastes, nutrients, metals, toxic substances, road salt, oils and fuels, and eroded soils (Bean et al. 1994).

Many pollutants from these nonpoint sources require oxygen in order for them to break down. This uses up oxygen needed by fish and other aquatic organisms. Excessive nutrient loadings can lead to increased amounts of algae. Through its respiration or decay, algae can create oxygen depletions and cause fish kills or induce stress that inhibits development of the fish community. These problems can be accentuated during warm weather when stream flows are lowest. Water is less capable of holding oxygen at higher temperatures and safety margins for aquatic organisms are reduced. Metals, pesticides, and toxics accumulations can be incorporated into food chains, and eventually lead to harmful effects in fish or consumption advisories for anglers.

Nonpoint source issues are being addressed state-wide through recommended best management practices (BMP) that have been developed and distributed by SWQD (Peterson et al. 1993). BMPs are any structural, vegetative, or managerial practice used to treat, prevent, or reduce water pollution. Local units of government are also working on their strategies for addressing nonpoint pollution. Studies, plans, and actual projects are being developed and implemented to deal with polluted storm water, erosion control, on-site sewage disposal systems, contaminated sites, household hazardous waste disposal, air deposition, landfills and hazardous waste facilities, and animal wastes. Along with these activities, the RRNWWDP has established an extensive watershed-wide baseline water quality monitoring that is designed to document existing conditions, measure effectiveness of control measures, and measure progress of the Rouge River restoration (Bean et al 1994).

Contaminated Ground water and 307 Sites

Contaminated ground water presents another potential source of point and nonpoint pollution. Although ground water quality is generally excellent throughout the state, there are a large number of localized areas that are adversely affected by past and present human activities. Point sources such as leaking underground storage tanks, spills or leaks of liquid products or wastes at industries and businesses or during their transportation, leaking solid waste management facilities such as landfills, and improperly constructed or operated wastewater treatment and disposal facilities are some of these. Nonpoint sources include excessive or improper application of agricultural fertilizers, pesticides, and animal wastes (Anonymous 1990).

Contaminated land sites in Michigan are also potential sources of water quality degradation. These areas are diverse and can include leaking storage barrels, gas stations, landfills, and manufacturing sites. In response to this problem, the Michigan Environmental Response Act, 1982 PA 307,as amended, was enacted. This act provides for identification of contamination, any potentially responsible parties, a risk assessment, evaluation, and cleanup of these sites. As of 1994, there were 100 known Act 307 sites (Table 22). This does not include sites known to be contaminated that do not meet the criteria for inclusion on the 307 list.

Dissolved Oxygen, Temperature, Nutrients, and Bacteria

Dissolved oxygen (DO) and temperature are two of the most critical water quality factors affecting aquatic communities (Hynes 1970). They determine the type of aquatic community that can survive in a given water body provided other necessary conditions are present. Water quality standards for dissolved oxygen and other parameters have been established by law to protect fish and other aquatic organisms in different types of water bodies. These standards are used in developing permit limits for discharges and planning management of the resources involved. The WQS for DO in warm water streams in Michigan is 5.0 ppm. Temperatures in a typical “good” quality warm water stream average lower to upper 70s through summer and a cold water stream usually averages no higher than upper 60s.

Nutrients and bacteria, have some importance to fish populations, but are of more concern for human contact. Major sources of nutrients to a stream are runoff (nonpoint) and point source discharges. Plant and algae growth within a stream are dependent on nutrients from sources such as these. Excess nutrients can contribute to nuisance levels of aquatic vegetation and algae, which can also lead to DO problems. Total phosphorus is one of the nutrients commonly used to indicate overall nutrient levels. Unpolluted warm water streams in this area would be expected to have less than 0.05 ppm phosphorus from natural sources and cold water streams would have even less (M. Oemke, MDEQ, SWQD, personal communication).

Bacteria are of importance as potential health hazards to humans and animals. An indicator species is usually selected for monitoring as it is too difficult to measure all harmful bacteria directly. The most commonly used bacterial indicator is fecal coliform. Fecal coliform, although not harmful in itself, is an indicator of the presence of human sewage and the bacteria potentially contained in it. The State Health Department has set health standards based on these bacteria. Water bodies with levels of fecal coliform greater than 200/100 ml of sample are restricted for total body contact, such as swimming. Levels exceeding 1000/100ml would result in restrictions on fishing, boating, and other partial contact activities.

Summaries by River Segment

The Rouge River mainstem and its major tributaries have been broken into segments to more specifically describing water quality in the watershed. These segments and the order they are presented are 1) the Rouge River mainstem downstream to its confluence with the Upper Rouge River (MAIN-1), 2) the Upper Rouge River, 3) the mainstem between its confluences with the Upper and Middle Rouge rivers (MAIN-2), 4) the Middle Rouge River, 5) the mainstem between its confluences with the Middle and Lower Rouge rivers (MAIN-3), 6) the Lower Rouge River, and 7) the mainstem from its confluence with the Lower Rouge River down to its mouth at the Detroit River (MAIN-4). Refer to Figure 1 for generally locating these segments. Water quality ratings in the following sections are based on a combination of factors described above (dissolved oxygen, temperature, nutrients and bacteria).

Rouge River Mainstem Upstream of Confluence with Upper Rouge River (MAIN-1)

The most upstream section of MAIN-1 (that portion upstream of Birmingham) does not receive any CSO flows and water quality should be better than stretches with CSOs. Dissolved oxygen levels do not reflect this as they dropped below water quality standard about one-half of the time (down to as low as 3 ppm, but not as low as stretches with CSOs) from June through September 1994 (RPO 1994). Summer temperatures were cool and fairly stable, averaging in the low 70s with a few days peaking up into the 80s. Total phosphorus levels were elevated to 0.5 ppm. Fecal coliform levels often were in the 1000s, which along with elevated nutrient levels, indicates illegal sewage connections to storm sewers or failing septic systems. Water quality is rated “poor” in this river segment.

In the Birmingham area there are 33 permitted CSOs that discharge a total annual average of more than 800 million gallons to the river. Effects from these discharges are evident downstream. Dissolved oxygen levels frequently dropped below WQS during May through September 1994, with hourly measurements as low as 2.5 ppm (RPO 1994). Although dissolved oxygen monthly averages were higher than upstream of the CSOs, minimum DOs were significantly lower than the upper section. Water temperatures averaged in the mid-70s through summer with occasional peaks as high as mid-80s. Water quality is rated “poor” in this segment of the river.

Birmingham, Bloomfield Hills, Bloomfield Village, and Acacia Park are scheduled to complete three retention basins and a sewer separation project by early 1997. This will eliminate most of the 33 CSOs and approximately 800 million gallons a year of combined sewage that are discharged to the upper sections of MAIN-1. Water quality and aquatic communities in the area should improve significantly.

Downstream, between 7 and 8 Mile Roads, there was a marked increase in water quality to a “fair” rating. Monthly dissolved oxygen averages were above 6 ppm with only occasional exceedences of WQS. Temperatures cooled noticeably, exceeding 70^{o}F only a few days in June and July, with monthly averages slightly below 70^{o}F even during the warmest part of the year. Total phosphorus was only slightly elevated at 0.1 ppm (RPO 1994). Bacteria levels were still high with samples of more than 1000 counts not unusual. It appears there are either additional unidentified sources of sewage or discharges upstream, or they are having an effect well below their discharge point, or both.

There are additional CSOs located from 7 Mile Road downstream to the confluence with the Upper Rouge River just south of Fenkel Ave., but no monitoring stations were located in this area during 1994 sampling. Results from 1987 found elevated phosphorus levels and more frequent occurrences of DO levels below 5.0 ppm as compared to upstream of 7 Mile Road (Peterson and Bredin 1989). The Puritan-Fenkel and Seven Mile retention basin projects are underway and scheduled to be completed sometime in 1997. There is also a control gate project planned for the Six Mile CSO.

Upper Rouge River

Dissolved oxygen levels and temperatures in the upstream portion of this tributary indicate “fair” water quality downstream through the City of Farmington. DO levels did not drop below the water quality standard of 5.0 ppm anytime during monitoring periods in 1987 and 1994. Summer temperatures averaging in the mid-60s with peaks to the mid-70s a few days in June and July (Peterson and Bredin 1989; RPO 1994). Seeley and Minnow Pond drains, two tributaries that form the Upper Rouge River, have the best water quality in this branch of the Rouge River with dissolved oxygen averaging over 8.0 ppm.

The Bell Branch tributary had several instances during the summers of 1987 and 1994 where dissolved oxygen levels dropped as low as 3-4 ppm, but monthly averages remained at or above 6.0 ppm. A significant sanitary-industrial connection to the storm sewers was recently located in this area and probably contributed to the occurrences of low DO. Temperatures were surprisingly cool, averaging in the upper 60s to 70^{o}F through the summer with peaks to mid and upper 70s (Peterson and Bredin 1989; RPO 1994). Water quality is only rated “poor” to “fair” in this tributary despite the cool water temperatures.

There are 11 permitted CSOs on the Upper Rouge River and the Bell Branch as they pass through Redford downstream of Inkster Road (Figure 9). Total annual CSO discharges average 325 million gallons per year (Camp, Dresser, & McKee Inc. 1994). This may account for reduced oxygen levels and occasional WQS exceedences (DO extremes down to 3 ppm) that occurred from May through August 1994 (RPO 1994). Total phosphorus levels were slightly elevated with averages around 0.1 ppm and some peaking at 0.5-0.9 ppm. Water quality in this lower portion of the Upper Rouge River and Bell Branch is rated “poor”. A retention basin project is underway in the Redford area and scheduled for completion by 1997. This should significantly reduce or eliminate CSOs in the Upper Rouge River.

Rouge River Mainstem between Confluences with Upper and Middle Rouge River (MAIN-2)

Water quality is rated “poor” in this reach. Dissolved oxygen was below WQS of 5 ppm for most of June through August, with monthly averages of 4-5 ppm and lows ranging from 0-1.5 ppm. April, May, and September 1994 were slightly better with monthly average DOs of 5.5-9.5 ppm, but levels from 1-5 ppm occurred in 5-20% of the samples (RPO 1994). Cool temperatures peaked in the mid 70s and averaged in the upper 60s to 70^{o}F. Nutrients were slightly elevated with levels of total phosphorus from 0.1-0.4 ppm (RPO 1994).

Poor DO levels were not surprising since this river portion is affected by many CSOs located in the Upper Rouge River (11 CSOs) and mainstem sections MAIN-1 (10 CSOs) and MAIN-2 (13 CSOs) (see Figure 9). Annual average discharges from these 34 CSOs total over 3.3 billion gallons per year. Other effects are reflected in data obtained after rain events that show fecal coliform levels ranging from thousands to hundreds of thousands in this stretch (RPO 1994).

Middle Rouge River

This river contains the headwater tributary with the best water quality (Johnson Drain). In the upper portion there are no known CSOs and water quality standards are consistently met even during summer months (RPO 1994). Higher dissolved oxygen levels (7 ppm minimum in Johnson Drain and averages of 6 ppm or more in other tributaries) and low water temperatures (mid 60s summer average in Johnson Drain) have enabled diverse aquatic communities to develop. Cool and cold water species such as brown trout, mottled sculpins, dace, and darters are found in the headwaters. Johnson Drain is one of three streams in the Rouge River that contain redside dace, a threatened species that requires clean and cool water. Turbidity and sedimentation from construction and urban runoff are increasing rapidly as development of the area continues. Nutrient levels are slightly elevated (0.1-0.4 ppm total phosphorus) and may be due to runoff from remaining agricultural areas or flows from failing septic systems in the most upstream portion. Overall, this upper portion has “fair” to “good” water quality.

The central portion, extending from Northville Township downstream below Newburg Lake into Westland, has “fair” water quality. Dissolved oxygen dropped below the WQS of 5 ppm during 6 days in July and August 1994. Temperatures averaged in the high 60s to 70^{o}F during summer months with peaks into the low 80s for six days in June and July 1994 in downstream reaches (Peterson and Bredin 1989; RPO 1994). Nutrient levels are lower than upstream areas (0.1 ppm total phosphorus) possibly due to nutrient removal effects of four impoundments located in this stretch (Phoenix, Nankin, Wilcox and Newburg Lakes) (RPO 1994). Six CSOs are located here as well as significant storm water flows from highly developed areas. These discharges, along with effects from impoundments, contribute to higher temperatures and increased oxygen demands. Two sewer separation projects are underway in Plymouth Township upstream of Newburg Lake with scheduled completion in 1997.

Downstream reaches of the Middle Rouge River continue the decreasing trend in water quality with a “poor” rating. Dissolved oxygen levels frequently drop below 5 ppm during summer months with extremes down to 1 ppm (RPO 1994). Total phosphorus was elevated slightly at 0.1-0.4 ppm in 1994. There is a concentration of CSOs (16) in this river stretch that have an average total discharge close to 500 million gallons per year (Camp, Dresser, and McKee Inc. 1994). Poor water quality is caused by flows from CSOs and urban runoff. Three sewer separation projects in Livonia, Westland and Garden City, along with a retention basin in Dearborn Heights, are underway and scheduled for completion by 1999.

Rouge River Mainstem between Middle and Lower Rouge River (MAIN-3)

An average of almost 4 billion gallons of combined sewage is discharged upstream of this reach annually. Effects of the many CSO discharges seem to peak in this stretch. Lowest monthly average dissolved oxygen levels and most frequent violations of water quality standards occurred in this section. Monthly DO averages for June through September 1994 ranged from 2.7 to 4.4 ppm with extreme lows of 0 to 2.2 ppm experienced many days each month from April through October 1994 (RPO 1994). Summer temperatures averaged in upper 60s to low 70s with peaks in the mid-70s to 80^{o}F occurring a few days each month.

Although no bacteria sampling data are available from the 1994 monitoring period, earlier sampling showed levels of fecal coliform in the 1000s from April 1987 through April 1988 with very few samples even coming close to the WQS of 200 counts/100 ml (Peterson and Bredin 1989). Mainstem sampling just upstream of the confluence with the Middle Rouge River found fecal coliform levels ranging into the tens and even hundreds of thousands after rain events. High bacteria levels similar to these are probably also present in this stretch of the river. Water quality is “very poor” due to the low DOs and bacteria problems.

Lower Rouge River

Water quality is characterized as “poor” in the upper section of this segment mainly as a result of DO problems. Frequent and extended periods occurred when water quality standards were not met (Peterson and Bredin 1989; RPO 1994). Dissolved oxygen was found to be less than the WQS of 5.0 ppm for one-half of the samples from June and October 1994 and anywhere from 5-15% of the samples from May, July and August 1994. Monthly average temperatures were in the mid to upper 60s during summer months with peaks in the low to mid 70s occurring only a few days each month (RPO 1994). These fairly cold temperatures were maintained by the extensive shading along the banks of the Lower Rouge River, not due to a large proportion of ground water.

The frequency of DO levels below 5 ppm increased to 50-90% further downstream during May through October 1994 with extremes close to 0 ppm not uncommon (RPO 1994). This is similar to 1987 where levels of dissolved oxygen less than 1.0 ppm were recorded several times in various stretches (Peterson and Bredin 1989). Extremely low levels of dissolved oxygen were more frequent, more extreme, and of longer duration in the downstream portion of this tributary. This corresponds with no CSOs in the upper reaches whereas there are 35 spread throughout the downstream stretch. Discharges from these CSOs average over 1 billion gallons annually. Monthly average temperatures again were surprisingly cool, ranging from the mid-60s to 70^{o}F during summer months with maximums in the mid to upper 70s (RPO 1994). Water quality in this downstream section of the Lower Rouge River is characterized as “very poor” mainly due to DO and combined sewage problems. Sewer separation projects are scheduled for completion in Wayne (1997) and Westland (1999) and a retention basin in Inkster by 1997.

CSO flows are not the only factors affecting oxygen levels as there are water quality problems in upstream areas where none exist. Storm water runoff with its suspended solids, agricultural runoff and direct discharges, other nonpoint pollution, very little base flow, and extreme flow fluctuations, all play a significant role in dissolved oxygen levels. Total suspended solids show rapid increases with flow from storm events (RPO 1994). Temperatures reach their highest levels during extremely low flow periods when many of the low oxygen levels also occur (RPO 1994). Nutrient enrichment present from agricultural and urban runoff encourages algae growth which further depletes DO levels during warm periods when the water is least capable of holding dissolved oxygen. All these factors play a part in the generally “poor” water quality present here. Recent introduction of the discharge from the Ypsilanti Wastewater Treatment Plant to the headwaters may help by providing a constant base flow (17 million gallons/day or about 26 cfs) of water that has received tertiary treatment and is thus relatively free from pollutants, provided the treatment plant stays within its permit limits.

Rouge River Mainstem from Confluence with the Lower Rouge River to Mouth (MAIN-4)

Water quality ranges from “poor” to slightly better than poor in this most downstream stretch before entering the Detroit River. Monthly average DO dropped below the WQS of 5.0 ppm in only 2 months of 1994, but lows of 0-2.5 ppm occurred in every month that data were available (April to

November 1994). Dissolved oxygen level drops of 4-6 ppm occurred in as short a period as 4 hours during the summer months, with daily variations of 2-8 ppm not unusual. CSO discharges to the Rouge River upstream and within section MAIN-4 total an average of over 5 billion gallons per year. Two large retention and treatment projects at Hubbell-Southfield and River Rouge are underway and scheduled for completion by 1998.

Water temperatures were typical of a larger warm water river. Maximum temperatures exceeded 85°F in June through September with monthly averages in the low to mid 70s from May through September 1994 (RPO 1994). Total phosphorus levels were slightly elevated (0.1-0.4 ppm), but this is with flows up to six times that of upstream stretches with similar nutrient levels. Dilution from large storm water flows is probably a factor in the low nutrient levels. Water clarity is generally poorest in this river segment and ranges from fairly turbid (visibility 1-2 feet) to extremely turbid (visibility of 1-2 inches) (personal observations). Visibility, measured in inches rather than feet, is typical throughout most of the year.

Sediment Contamination

Metals concentrations in sediments of the Rouge River are generally low, although six metals (zinc, lead, nickel, chromium, antimony, and copper) were present in concentrations that exceeded the toxicity-based sediment criteria developed by Long and Morgan (1990) and may therefore cause toxic effects in aquatic organisms (Smith et al. 1995). Overall, zinc and lead were present in highest concentrations and were most widespread. Higher concentrations were generally found in downstream reaches of each branch. Highest concentrations were found in the mainstem below its confluence with the Lower Rouge River and in the downstream portions of the Lower Rouge River (Smith et al. 1995). The last 5.5 miles of the mainstem has been designated a site of environmental contamination (307 site) because of pollutants such as lead, cyanide, barium, chromium, copper, zinc, and many organic chemicals contained in sediments at levels warranting listing according to Act 307 guidelines (RAP 1994).

Total PCB concentrations in sediments were generally low. In 90% of samples from a 1993 RPO study, PCB concentrations were below the detection limit of 0.12 mg/kg. However, a concentration of 12 mg/kg was found upstream of Newburgh Lake on the Middle Rouge River and PCB levels exceeding 50 mg/kg were found in lake sediments from an earlier RPO-sponsored survey (Smith et al. 1995). Elevated PCB levels also occurred along the Lower Rouge River near two groups of landfills (one near Lilley Road and one near Wayne Road) and near groups of CSO and storm water outfalls in section MAIN-4 of the mainstem (Smith et al. 1995).

Metal and PCB levels in sediment core samples generally increased from the bottom to the highest level in the middle and then decreased towards the sediment surface (Kosek 1992). This gives a temporal indication of concentration over time and indicates that sources of contamination have decreased during recent years. Increased watershed development upstream may have diluted the more recent metal deposition by adding sediment to the bottom at a greater rate. Decreases in lead and PCB deposition may be attributed to phasing out of leaded gasoline use and PCB production.

Fish Contaminants

Fish contaminant sampling has been conducted by MDEQ, SWQD at various sites from 1985 through 1995. Possible sources for contaminants include discharges from previously discussed Act

307 sites, contaminated sediments from historic point source discharges, and other point and nonpoint pollution entering the river. Data from these analyses indicate that several contaminants such as mercury, chlordane, DDT, toxaphene, and PCBs are still present, but only PCBs are at levels warranting fish consumption advisories (Table 23). Analysis results show PCB levels in fish tissue from portions of the Middle Rouge River and Rouge River Mainstem, that exceed the State Health Department criteria of 2.0 ppm. Highest PCB levels were found in fish tissue collected from Newburg Lake in 1988 (19 fish average of 8.9 mg/kg). Later samplings from Newburg Lake showed levels of 2.9 mg/kg in 1993 and 3.0 mg/kg in 1995 (Duling 1988; R. Day, MDEQ, SWQD, personal communication; Table 23).

The Middle Rouge River downstream from Phoenix Lake and the mainstem of the Rouge River downstream from M-153/Ford Road are under a “no consumption” fish advisory due to PCB concerns for: northern pike, largemouth and smallmouth bass, catfish, bullheads, carp, and white suckers. These sections are also under a “restricted consumption” advisory for all other fish species. The Lower Rouge River has a “no consumption” advisory for carp and white suckers.

River Classification by Fisheries Division

In 1964, Fisheries Division classified water quality throughout Michigan for fishery management based on water temperature (Figure 34). According to this classification, no top-quality trout waters are found in this watershed. A small portion of the Middle Rouge River from its confluence with Johnson Drain downstream to Wilcox Impoundment is classified as second quality cold water. This indicates it could sustain significant trout populations, but is appreciably limited by factors that prevent natural reproduction such as sedimentation, occasional temperature extremes, and flow variability. It has recently been proposed that Johnson Drain be upgraded from top-quality warm water to second quality cold water based on information from recent temperature monitoring and ongoing MDNR, Fisheries Division trout stocking.

The only other portion of the watershed designated as top-quality warm water (contains significant self-sustaining warm water fish populations) is a portion of the Middle Rouge River from Wilcox Impoundment downstream to about 1 mile below Newburg Lake. The rest of the Rouge River is classified as second-quality warm water (contains significant populations of warm water fish that are appreciably limited by turbidity, competition, lack of cover, or habitat). There are a few tributaries and small portions of the Middle and Upper Rouge Rivers that could probably be reclassified as top-quality warm water or possibly second-quality cold water, but these have not yet been formally evaluated.

A new method of stream classification, Valley Segment Ecological Classification, is being developed by Fisheries Division research staff in collaboration with the University of Michigan, (for an overview see http://www.dnr.state.mi.us/www/ifr/ifrlibra/Research/abstracts/2036abs.htm). This new system is based on both physical and biological characteristics: a stream is broken into valley segments that are each ecologically homogeneous based on computer mapping of watershed landscapes, modeling of significant attributes, fish data, and consultation with fisheries biologists. Features evaluated include hydrology patterns, chemistry, temperature, channel characteristics, and fish communities (P. Seelbach, MDNR, Fisheries Division, personal communication, unpublished data). This will be a valuable tool in future assessment and management of rivers across the state and will be used in future work on the Rouge River.

Recreational Use

Historic accounts of river recreational uses include fishing, boating, swimming, and ice-skating. The river was also used for transportation and irrigation. An account of life in the late 1700s describes yet another use of the river.

> "One of the favorite pastimes of the French members of the community was that of pony-racing on the frozen rivers. As the roads of the area were poor to non-existent the residents depended upon the rivers for transportation. The French hitched small horses to carioles and sleighs. This was not only a means of transport, but it soon developed into a sport" (Gnau 1975).

Redford Center, now the intersection of Fenkell and Telegraph in Detroit, was once a starting point for float-fishing trips down the Rouge River (Gnau 1975). There is no mention of the species sought, but warm water fish were probably the most common, except when migrating populations of Lake Erie fish were present in the river.

Recent recreation in the Rouge River has been limited due to water quality concerns (see **Water Quality**). Full body contact is not advised for much of the river, except for the tributaries and lakes. Fish consumption advisories severely limit intake of fish in virtually all waters that might hold larger game fishes: the mainstem from M153 (Ford Rd), in Dearborn downstream, in the Middle Branch from Phoenix Lake in Northville downstream, and in the Lower Branch in its entirety (Michigan Department of Public Health).

Southfield, Farmington Hills, and Wayne County Parks have all held fishing derbies for stocked trout. Any fish not caught during the event remain in the river. These fish most likely do not survive for long periods, although some are reportedly caught throughout most summers (R. Spitler, MDNR, Fisheries Division, personal communication).

The impoundments of the Middle Rouge, particularly Newburgh Lake, receive extensive fishing pressure. Fishing piers, paddle boat rental, and a boat ramp allow significant access to this 114 acre impoundment. Wayne County Parks is planning to promote canoeing opportunities on the Middle Rouge River also, and has initiated a bank stabilization and stream clean-up within its park boundaries.

The extensive parkland referenced throughout this report provides unprecedented access. Recreational potential is limited only by current water quality and habitat. As rehabilitation progresses, the Rouge River could receive the most recreational use of any river in the state.

The 1994 Rouge RAP Update (Bean et al. 1994) describes recent recreational events and projects sponsored within the Rouge River watershed:

> "Wayne County Parks Department has completed the $567,000 Middle Rouge Parkway Improvement Project for Newburgh Lake. The project included renovating a comfort station, creating a river walk, stabilizing the shoreline, building a boat launch for non-motorized boats, and re-opening of the paddle-boat concession.
>
> "Wayne County Parks Department renovated Sumac Fishing Point on Newburgh Lake by improving its parking lot, creating a split rail fence to keep people off the bank area, and planting trees to stabilize the bank.

"In 1992, the City of Wayne constructed a mile-long, eight foot wide lighted asphalt path with three observation decks along the south river bank between Josephine and Elizabeth streets for walkers, joggers, and bikers to enjoy views of the river as they exercise.

"The Friends of the Rouge (FOTR) holds an annual "pedalfest" along the Middle Branch of the river in western Wayne County to raise funds for its education activities.

"The Dearborn Historical Museum holds an Annual Heritage Festival on the banks of the river at Ford Field Park. The weekend's activities include demonstrations of life in the eighteenth century and re-enactments of revolutionary war battles.

"The City of Detroit and the MDNR completed a $1.3 million renovation project to reopen the Olympic-sized swimming pools in Detroit's River Rouge Park on June 18, 1994. The pools were closed four years ago when the city could not afford to operate and maintain the facility.

"(In partnership with)…Wayne County Parks Department…the Holliday (Nature) Preserve (Association conducts trial improvement projects, floodplain, woodland and creek cleanups,)…remov(ing) illegally dumped tires (and clearing logjams).

"The City of Melvindale acquired an additional three acres of land for recreational purposes along the river next to their ice arena through the state's recreation bond fund.

"The Friends of the Mill Pond are helping to educate the residents of their community about the Mill Pond impoundment located in Northville. They have formed their own nonprofit organization and have sold T-shirts and coffee mugs in order to raise much needed funds to clean up the Mill Pond. They want the pond to become a better recreational and educational tool for the local schools and residents."

Fishery Management

MDNR, Fisheries Division does not actively manage game fish in most of the Rouge River at this time. A summary of fish stocking within the Rouge River is found in Table 24. Johnson Drain is the only stream where fish (brown trout) are now stocked by the State. This stocking was begun in 1992, and has met with limited success. Survival of the stocked trout beyond one winter in the stream has been extremely low. This is due to lack of over-winter habitat, severe winter temperatures, extreme sedimentation during rain events from on-going residential development and other construction activities, and moderately-low base flow. There is a proposal to discharge effluent from a sewage treatment plant into Johnson Drain, which would increase the base flow. This addition could have a positive effect on the stream, as long as the water quality and temperature are suitable.

A description of past management follows:

Mainstem

Quarton Lake in the city of Birmingham has undergone several chemical treatments and managerial actions. Starting in July of 1952, it was treated for aquatic plant control. Sodium arsenite was used and this treatment was continued in May, June, and August of 1953, in May and August of 1954, and in May of 1955. In 1972, the lake was drawn down and re-contoured. In 1974, it was again drawn down and dredged. Its silt was removed and rotenone was used to remove fish. It was restocked with largemouth bass and panfish. Two years later, the lake was contained carp and other rough fish that were not desired.

On July 4, 1981, two hundred smallmouth bass fingerlings were planted in the Rouge River at Southfield after installation of instream habitat and erosion control, and one hundred fingerlings were planted in the river in Beverly Hills.

In 1987 the Michigan Wildlife Habitat Foundation placed stream improvement structures along 2000 feet of the river to narrow the stream channel and provide habitat. Triangular wing deflectors and bank revetments were installed. On May 9, 1989, seventeen smallmouth bass were planted at Southfield and 10 1/2 Mile Road. These fish were jaw-tagged and averaged 37.6 cm in length. On Sept. 25, 1991, sixty-four smallmouth bass were collected from the Raisin River and stocked in the Rouge at Southfield and 10 1/2 Mile Road, seventeen were of legal size at the time. No tagged fish have been reported, and this stocking did not result in a resident population.

Upper Rouge River

Other than a trout fishing derby in 1982-83, no fisheries management has been undertaken. However, two of the tributaries (Seeley and Minnow Pond drains) are receiving special consideration due to the presence of the threatened redside dace. West Bloomfield township is developing a plan to minimize effects of development on these streams through best management practices during construction activities.

Middle Rouge River

Two of the largest lakes in this subwatershed, Walled and Walnut lakes, were planted with various game species in the 1930s and 40s. No stocking of either system has been undertaken by MDNR, Fisheries Division since 1945. Neither of these lakes has assured public access and so they have not been surveyed by MDNR, Fisheries Division in recent years. Anecdotal reports indicate healthy game fish populations in both lakes (R. Spitler, MDNR Fisheries, personal communication).

Three of the larger impoundments on the Middle Rouge River, Phoenix, Newburgh, and Wilcox lakes, were chemically treated in 1967 through 1968 to remove nuisance populations of fishes. Newburgh and Wilcox are located within Wayne County Parks boundaries. After treatment, Phoenix Lake was planted with 7,000 brown trout averaging 4.7 inches and 7,000 rainbow trout averaging 5.3 inches to provide an interim fishery until a warm water fishery could develop. Recruitment from upstream showed good warm water species fishing potential without further stocking. Newburgh Lake was planted with 20,000 brown trout fingerlings. Largemouth bass, bluegill, crappie, and channel catfish fingerlings and adults were also stocked over a two year period. The brown trout fishery was not intended to carry over, and has not, but the others showed excellent growth and reproduction. Wilcox Lake was stocked with largemouth bass and bluegill fingerlings and adults. Both species are present in the lake today.

MDNR, Fisheries Division and Michigan Civilian Conservation Corps cleared log jams and stabilized banks in a section of river in the Middlebelt and Hines Drive area in 1987. Three quarters of a mile was cleared, containing five log jams. Banks were stabilized at six locations and other blocking materials were removed at several locations. There have been other streambank erosion control projects in the Rouge Parkway area, providing mixed results.

Johnson Drain was once the home of Michigan's second hatchery, the Northville Fish Hatchery, built in 1874 by Nelson Clark. This hatchery raised whitefish, then brown and rainbow trout, which were stocked in Michigan until the hatchery closed in the late 1960s. In 1992, MDNR, Fisheries Division began stocking brown trout in the stream. These plantings have continued annually at approximately 4500 fingerlings spread over 8 miles. In 1996, stocking locations were eliminated in the two most upstream sites due to poor survival. It was determined that there was better cover and habitat for the brown trout in the downstream areas. A bank stabilization project is partially completed. It should benefit the brown trout and other endemic fish, especially the redside dace, by controlling erosion of the banks and narrowing the base flow channel.

Some management proposed for the future include:

Wayne County Parks constructing a Hines Parkway pond to correct problems within a wetland caused by sewer construction. It would act as a "pressure relief" for the exposed aquifer. There is a proposal to turn the pond into a fishing concession for trout. It would provide cooler, and better oxygenated water during warm water periods or those of low flow.

Management of the river fishery in the future will depend on the progress made on impediments to fish health. Water quality has improved, but not enough to substantially shift species compositions of either fishes or aquatic invertebrates. Completion of CSO remediation projects should improve DO and nutrient levels, but separate storm sewers remain as sources of contamination. Urbanization has affected the hydrology extensively, and it may not be possible to restore the river to its original flows. Unstable flows continue to hamper managing fish populations. Extremely variable and large flows work to: create smooth channels, remove structure, and wash away eggs and newly hatched fry. All methods available should be used to dampen effects of urbanization on this system to allow it to reach its fishery potential.

Connection to the Great Lakes is the most important management goal once the above issues are addressed. Effects of paving and channelization of 4 miles in the lower river must be assessed. It may not be feasible to restore historic meanders and floodplain wetlands, due to changes in land use, but improvements can be made to the channel to make it more likely to attract and pass potamodromous species, as well as hold resident warm water fishes. Edwards et al. (1984) found an increase in diversity and abundance of game fish in channelized areas of the Olentangy River that had been mitigated by construction of artificial habitat. They also measured a significant change in macroinvertebrates in the section of the river that had been mitigated. Similar results could be possible for the Rouge River, and possibly even greater, given the Great Lakes stock source.

Once this impairment has been addressed, fish passage beyond the two most downstream dams (particularly that at the Henry Ford Estate) is imperative. They eliminate an immense potential for colonization by Great Lakes fish (e.g., smallmouth bass, channel catfish, northern pike, walleye, and salmonids).

Habitat restoration and protection are another fisheries management goal. If flows can be moderated, the channel can be restored through addition of cover, stabilization of banks (with materials that absorb energy, not deflect it), and narrowing of base flow channels. Also, maximum protection of riparian floodplain and forests would be achieved. These types of projects should be encouraged regardless of any other progress concerning flow and water quality, but results such as healthier fish communities would be more apparent if all issues were addressed concurrently.

Citizen Involvement

The Rouge River watershed is home to a very interested citizen contingent. As a watershed with a Remedial Action Plan, virtually all communities are involved to some extent in studying or remediating the river. A list of public and private organizations actively involved in the watershed, and a description of their activities was compiled by Bean et al. (1994) (Table 25).

Although the Rouge River has had an active watershed council, it was regrettably disbanded. Now, the Rouge Program Office is fulfilling many of these functions with its primary mission to coordinate the RRNWWDP. Once the mission of the RPO has been completed, the need for a watershed council will once again be apparent.

MANAGEMENT OPTIONS

The Rouge River is a small, coastal stream, with its greatest fish community asset being its connection to the waters of the Great Lakes. It is one of the most urban streams in Michigan, with a population within the watershed of over 2 million people. This also means that it has the potential to provide recreation and enjoyment to a large number of people. Almost half of the riparian corridor of the main branches is in public ownership, accessible as parkland. These areas have served to buffer the river from some urbanizing forces, e.g. channelization, clearing of vegetation.

The watershed has been influenced by humans for over 200 years, and many negative effects cannot easily be remedied, e.g., hardening of surfaces, draining and filling of coastal wetlands, shunting of storm water through enclosed tubes to the stream. However, progress has been made on those which can be reduced, and many interested parties are ensuring that progress continues.

The management options presented will focus on those areas that have been identified by the Rouge River Remedial Action Plan, other MDNR Rouge River management plans, along with newly identified options.

Biological Communities

Although 53 fish species were identified in 1995 in the Rouge River, most species indicate flashy, warm water streams. The only game fish (other than in the impoundments) were of insignificant size to support a fishery. The unstable flows, sedimentation, and erosion in the river are a major determinant to the species composition. Although much of the flow instability can be attributed to geology, some component is due to the hardening of surfaces from human development. As well, low dissolved oxygen is a limiting factor.

Aquatic invertebrates have been affected by poor water quality from CSOs. Headwater sections are generally less degraded than the main branches. Invertebrate communities have been severely degraded in the three major branches and most of the mainstem.

Option: Preserve headwater reaches through storm water management that addresses both water quality and quantity. Avoid in-stream detention or retention basins and stabilize stream flows by slow release (e.g., percolation) discharges from off-line detention or retention basins.

Option: Preserve stream margin habitats, including floodplains and wetlands, by requiring setbacks and vegetative buffer strips in zoning regulations, controlling development in the stream corridor, and acquiring additional greenbelt.

Option: Continue to preserve and protect riparian corridor through the existing park system.

Option: Identify reasonable targets for fish assemblages, hydrologic parameters, and water temperatures based on a large-scale assessment of Rouge River potentials, and state-wide databases and models.

Option: Survey distribution and status of mussel populations and develop strategies for protection and recovery of these species.

Option: Survey distribution and status of species of concern and develop protection and recovery strategies for those species.

Option: Survey historic records to determine past populations and their distribution.

Option: Survey and map Johnson, Sump, Seeley, and Fowler creeks for nonpoint sources causing sedimentation. Develop and implement management plans for these priority areas.

Option: Rehabilitate rare, high-gradient areas and fragmented habitats by removal of unnecessary dams (e.g., removal of the Nankin Mills dam would open up 3 miles of better quality stream).

Option: Rehabilitate gravel habitats through reduction of sediment loads by stringent enforcement of local construction codes, existing soil erosion laws, and implementing nonpoint source best management practices. Explore options for removal of fine sediment.

Option: Rehabilitate populations of potamodromous fish by: removal of the Wayne Road dam on the Lower Rouge; removal of, or addition of fish passage measures on the Henry Ford Estate dam; removal of the paved section of the mainstem or additions of fish passage measures and fish cover to this section.

Option: Rehabilitate in-stream migration ability for fishes by installing upstream and downstream passage at other dams and barriers.

Option: Rehabilitate lower big river habitats and wetland areas.

Geology & Hydrology

The Rouge River flow regime is unstable. Base flows are low due to basin surficial geology, and flood flows are high and frequent, due to both geology and affects of urban development. Although the geology cannot be changed, base flow can be augmented and urban storm flow affects can be mitigated.

Option: Protect and rehabilitate the function of remaining wetlands and floodplains as water retention structures for high flow conditions. Develop an inventory of existing and potential areas for creation or protection of wetlands, with emphasis on riparian areas.

Option: Protect critical ground water recharge areas by identifying and developing a strategy to protect them. Also identify any major removals of ground water and work toward eliminating them.

Option: Protect and rehabilitate flow stability by developing an operational hydrologic routing model for the entire river system, that describes both ground and surface water routes in response to changes on the landscape. Such a model should allow various alternatives to be examined and drive future planning processes by providing fundamental information critical for proactive landscape and storm water management planning. It could also be used to identify critical tributary watersheds.

Option: Improve base flow by controlling water withdrawals and capitalizing on opportunities to augment flow through artificial means; e.g., addition of water from wastewater treatment plants (provided water quality and temperature are adequate) and installation of ground water pumping stations to be started during periods of low flow. Stream reaches in need of augmenting to be determined.

Option: Rehabilitate headwater and tributary flow stability by working with county drain commissioners to incorporate flow routing patterns into criteria for drain design and storm water management. Consider watershed-wide use of storm water regulations similar to those developed by Washtenaw County (Bobrin, 1994).

Option: Rehabilitate flow stability by removing or plugging drain tile fields located in areas where soil permeabilities would allow water to slowly percolate into the stream without significantly interfering with current land uses.

Option: Rehabilitate fisheries communities to above defined target species by finalizing flow criteria incorporating modeling of 1) Rouge River channel geometry; and 2) affects of shear stress magnitude and timing on fish reproduction and recruitment.

Option: Develop preliminary flow criteria, based on landscape-scale modeling (by state-wide Michigan River Inventory models), of flow regimes required to produce target temperatures and fish assemblages. Refine these criteria as more detailed data and models become available.

Channel Morphology

The channel of the Rouge River has been altered by human influences and its flow regime. High peak flows have resulted in over-wide channels with little to no diversity or structure present. Dredging, straightening, and enclosure of reaches, and paving and straightening of 4 miles near the mouth have severely affected the channel.

Option: Protect tributaries from further degradation by developing alternatives to current drainage practices (dredging and enclosure).

Option: Rehabilitate the channel shape of the paved section of the mainstem to include structure and cover for fish and other aquatic life. This could be accomplished through: removal of concrete section (all or part); adding roughness to channel through addition of large particle substrate; constructing habitat structures to provide flow refuges; and creating floodplain wetlands.

Option: Rehabilitate rare high-gradient habitats by removing dams no longer used for their original purpose (e.g., retired hydroelectric facilities) and dams that are safety hazards. Failed dams should be thoroughly evaluated considering environmental and ecological, not political factors, to determine the need to re-construct (e.g., Waterford Pond - build a bridge at the site instead of a dam).

Option: Rehabilitate recruitment of woody debris by developing and managing wooded greenbelts on riparian lands and managing amounts of wood in the channel (e.g., river clean-ups should be carefully carried out to ensure that some structure remains).

Option: Rehabilitate channel form by lowering flood peaks through addressing hydrologic concerns discussed in **Geology and Hydrology**.

Option: Rehabilitate channel form by managing sediment runoff, especially from construction activities and remaining agricultural activities.

Dams and Barriers

The 62 dams impound most of the river's high-gradient habitat, eliminate vegetated stream habitat at lake outlets, trap sediments and woody debris, fragment habitat for resident fishes, and block potamodromous fishes from much of the river. Some dams provide impoundments with existing and future potential for lentic fisheries development and other recreational uses.

Option: Protect the biological communities of the river by providing upstream and downstream passage at dams for all species of fish to mitigate for habitat fragmentation.

Option: Protect remaining connectivity of system by prohibiting construction of in-line storm water detention basins and any future dams.

Option: Survey and develop an inventory of barriers to fish passage, such as culverts.

Option: Survey and develop a watershed list of the most environmentally damaging dams and barriers to fish passage in the river, with recommendations to mitigate the damage, e.g., Ford Estate dam, Wayne Road dam, paved section of the mainstem.

Option: Rehabilitate free-flowing river conditions by requiring dam owners to make appropriate financial provisions for future dam removal.

Option: Rehabilitate free-flowing river conditions by either: removing dams, or: requiring dam owners to operate at run-of-the-river; and modifying any dams not already designed as such to fixed-crest structures.

Soils and Land Use Patterns

Agricultural and urban land uses have altered the river system, however, remaining undeveloped lands in headwater subwatersheds have partly buffered these changes. Projected urban sprawl threatens the integrity of this buffer.

Option: Protect undeveloped landscapes through property tax incentives, transportation policies, integrated land use planning, and redevelopment of urban areas.

Option: Protect developed lands through land-use planning and zoning guidelines that emphasize protection of critical areas, minimize impervious surfaces, and improve storm water management concerning quality and quantity of storm water.

Option: Protect, rehabilitate, and enhance functions of wetlands and floodplains by identifying remaining areas and tracking their rate of loss and restoration.

Option: Protect, rehabilitate, and enhance the forested corridor along the river and its tributaries.

Option: Protect and rehabilitate critical areas through maintenance of current storm water management systems. Retrofit areas that are in need of storm water management systems through projects carried out by the Rouge River National Wet Weather Demonstration Project and other similar programs.

Bridges and Other Stream Crossings

With approximately 2000 road and railway crossings, adverse affects attributable to these sources are significant. In addition, sewers, pipelines, and other submerged crossings affect the stream during placement, and potentially afterward.

Option: Survey watershed and create a map of all known submerged pipelines; include information regarding the diameter of the pipe, contents, and location as built beneath the stream.

Option: Survey the watershed to locate crossings that are degrading the stream through sedimentation, disruption of stream flow, or creation of barriers to fish passage.

Option: Rehabilitate any crossings identified above through erosion control measures, reconstruction of poorly placed crossings, and replacement of perched culverts.

Special Jurisdictions

County drain commissioners and their agents have authority over designated drains and many lake-level control structures. Wayne County Parks department and many local municipalities control large amounts of riparian land and many dams.

Option: Protect and rehabilitate the river system by supporting cooperative planning and decision making.

Option: Protect and rehabilitate designated drains and other streams through continuing education of people with potential to affect stream dynamics (e.g., drain commission staff, planners, road commissions). Information should include stream processes and biological functions of flowing water systems.

Option: Survey and review management of land and dams owned by Wayne County (Parks and Road Commission).

Option: Rehabilitate designated drains to natural stream status where such designation is no longer appropriate or where past drainage modifications have been excessive, e.g., Johnson, Seeley, Minnow Pond, and Sump drains.

Option: Rehabilitate designated drains by encouraging drain commissioners to use stream management approaches that protect and rehabilitate natural processes rather than traditional deepening, straightening, widening, and enclosing practices that emphasize moving water away most quickly with little consideration for effects on the natural stream.

Water Quality

Water quality is poor to very poor in most parts of the watershed. A few stretches of fair to good water quality are present in some of the upstream areas and a few tributaries. Flows from CSOs, sanitary and storm sewers, NPDES discharges, and nonpoint sources have significant effects on dissolved oxygen levels in many parts of the river. The many Act 307 sites raise concern about future and current loadings of toxic materials to the river. These effects are reflected in contaminated sediments, high fecal coliform levels, extreme temperature variation, and flow fluctuation attributed to point discharges.

Option: Protect the river by implementing improved storm water and nonpoint source best management practices.

Option: Protect and enhance water quality by protecting existing wetlands and riparian corridors, rehabilitating former wetlands, and maximizing use of constructed wetlands as natural filters.

Option: Survey the river for sources of elevated PCB and mercury levels in fish in the lower parts of the mainstem, Middle, and Lower Rouge River by performing outfall and sediment surveys. Eliminate identified sources.

Option: Survey loadings of nutrients and sediments to the river and develop strategies to reduce identified problems.

Option: Survey for contaminants in fish in areas of the watershed with the potential for fisheries development. Areas to be sampled should include: 1) lower and middle mainstem and resample carp and suckers in lower mainstem; 2) lower Middle Rouge below Newburg Lake; 3) update the upper Middle Rouge at and above 9 Mile Road; 4) resample fish in Newburg Lake and the river upstream 2-3 years after the reclamation; 5) update Lower Rouge. Increased sampling area and sample size should provide confidence in health advisories and baseline information on areas of the watershed with no data now available.

Option: Rehabilitate and protect water quality by supporting Act 307 site cleanups, especially that area located within the stream, e.g., the last 5.5 miles of river.

Option: Rehabilitate water quality by continuing to implement requirements in community NPDES discharge permits to eliminate untreated discharges of sewage from combined sewer overflows.

Option: Rehabilitate existing degraded wetlands by rigorous enforcement of Part 303 (and parts 13, 91, 301) of the NREP Act (Table 18).

Recreational Use

With over 50 miles of the river bordered by public land, the Rouge River is one of the most accessible in Michigan. The major impoundments on the Middle Rouge River support a large recreational component of anglers and boaters where public access is available.

Option: Protect, encourage, and support existing park system and promote responsible management of riparian areas in public ownership.

Option: Rehabilitate the most downstream reaches of the mainstem to include fishing access (both shore and boat) after rehabilitation of the paved and river mouth industrial sections. As this is the area where the river is the largest, it has the greatest recreational potential.

Option: Improve small-scale public access where lacking through MDNR, county, township, and other municipal recreation departments, as well as private organizations. Initial access projects could be along Johnson Drain, where public access is limited at this time.

Option: Improve public access along the Lower Rouge River after removal or remediation of Wayne Rd. Dam.

Fishery Management

Angling for game fish in the Rouge River is limited by the size and poor flow regime of the river and by contaminant burdens in larger fishes (except for Johnson Drain fish). Johnson Drain, the Lower Rouge River below Wayne Road, the section of the mainstem below the Henry Ford Estate, and the impoundments of the Middle Rouge River are the only areas with angling opportunity at this time.

Option: Protect existing populations of redside dace by determining habitat, flow, and temperature requirements and protecting stream characteristics that are beneficial to this species.

Option: Survey the Rouge River habitat conditions and biotic communities on a 10 year schedule to track response to anticipated progress in water quality (e.g., in the Lower Rouge River after the addition of the YCUA discharge, in the mainstem after completion of planned CSO improvement projects) and continued development of the watershed.

Option: Survey temperature, trout survival, and redside dace predominance in the Johnson Drain to determine if brown trout stocking should continue.

Option: Rehabilitate habitat continuity by removing unnecessary dams. Require upstream and downstream fish passage at those dams that remain and incorporate bottom-draw discharges (where feasible) to mitigate warming effects of impoundments.

Option: Rehabilitate in-stream habitat for trout in Johnson Drain through completion of planned sedimentation control structures, channel modifications, and addition of habitat in other reaches.

Option: Rehabilitate the connection to the Great Lakes through addition of in-stream habitat and current refuges to the paved section of the mainstem. Determine potential fish species that may use the channel, and adapt any restoration to their needs.

Option: Rehabilitate potamodromous fish runs, through stocking if needed, and connection to Great Lakes fish stocks (after habitat rehabilitation of the paved section). Species that are best suited are: white bass, channel catfish, white sucker, smallmouth bass, and steelhead.

Option: Rehabilitate fisheries in Wilcox and Phoenix lakes. Stock northern pike and channel catfish in Wilcox Lake and channel catfish in Phoenix Lake. Re-survey impoundments the third year after initiating stocking to evaluate success and effects.

Option: Rehabilitate PCB contaminated fishery in Newburgh Lake by chemically removing all fish up to next upstream dam (Wilcox) and removing contaminated sediments. Follow by stocking impoundment with fathead minnows, largemouth bass, northern pike, walleye, channel catfish, bluegill, black crappie, and pumpkinseed sunfish. Re-survey impoundment in first, third, and fifth year after above activities to evaluate results.

Option: Improve angling opportunities in the impoundments and larger reaches of the tributaries by continued improvement and acquisition of public access.

Option: Improve angling opportunities, and public awareness of the river, in the larger reaches by continuing and expanding existing fishing derbies held by local parks departments.

Option: Improve flood plain benefits through construction of off-line retention basins, which could also serve as angling opportunities. Include wetland fringe for water treatment and fishing piers for access.

Option: Improve fisheries habitat by reducing flood flows through long-term detention of storm water, and implementing runoff management designed to increase seasonal flow stability.

Option: Improve fish habitat by increasing base stream flow by artificially adding cool, high quality, water in headwater areas during low flow periods in summer and winter and controlling water withdrawals during low flow periods.

Citizen Involvement

The Rouge River watershed is home to a very active citizen component. Their efforts should be continued and expanded.

Option: Protect and rehabilitate watershed integrity by supporting Rouge River National Wet Weather Demonstration Project efforts to build public support (e.g., educational kiosks).

Option: Protect and rehabilitate water quality through public education regarding use of high phosphorous fertilizers and excessive pesticides on land that is either next to water or drains to storm drains that discharge to streams.

Option: Encourage reformation of the Rouge River Watershed Council or similar watershed-wide group to serve as a conduit for all existing groups and an avenue for public comment into watershed projects. This will be especially important when the Rouge Program Office is disbanded.

Option: Encourage and support more studies by elementary and secondary school students within the watershed to monitor local stream conditions and educate them on stream and watershed issues.

Option: Improve and implement strategies to educate the community concerning the benefits of river ecosystems, wetlands, floodplains, and in-stream structure.

Option: Improve community involvement in river “adoption” programs, by promoting the Friends of the Rouge “River Watch” program; a neighborhood-level citizen watch with an educational component. The program should include a reporting and follow-up mechanism for violations and problems such as erosion from construction sites.

Option: Improve community awareness of watershed issues by placing watershed boundary signs and labeling streams at all major road crossings.

PUBLIC COMMENT AND RESPONSE

Comments were received on the draft of this assessment from October 1996, through March 1997. Three public meetings were held requesting comments on the draft document: February 18 at the Livonia Civic Center Library Auditorium in Livonia; February 19 at the University of Michigan - Dearborn, Recreation & Organization Center Building in Dearborn; and February 20 at the Southfield Center for the Arts in Southfield.

Copies of this draft assessment were placed in twelve public libraries: Birmingham, Canton, Dearborn Heights, Detroit, Farmington, Dearborn, Inkster, Livonia, Plymouth, Redford, Southfield, and Westland. These draft assessments were kept in the reference section of the library so they would always be available. Copies for distribution were available at the District 10 office in Livonia. A copy was sent to public leaders in each municipality in the watershed, as well as many other individuals and groups identified as interest parties. In addition, a copy was sent to any individual or group requesting one.

Public notices were sent to local newspapers in the watershed stating that a draft of the assessment was available and comments on it were requested. Notices were also sent out regarding the public meetings.

All comments received were considered. The suggested change was either incorporated into the assessment or listed with the reason it was not included.

Several grammatical and typographical comments were received. These were incorporated as appropriate.

Comment: Report should include an acetate or plastic version of the maps to be used as an overlay.

Response: It would be cost-prohibitive to include such material in the assessment. Due to restrictions placed on printing of public documents, we were not able to use color in the assessment either, which would have been helpful. The reader is encouraged to copy, mark, and otherwise annotate their copy of the assessment to make it more useful for them.

Comment: Comments on the content of the base map were received, both on its level of detail and size: include roads on the base map, with river miles; label Walled Lake Branch and Bishop Creek; include more maps of the scale of Figure 3.

Response: There were many iterations of the base map, with varying degrees of detail. County lines, municipalities, and road names were omitted for two reasons: 1) in the interest of clarity, it was too cluttered when these labels and lines were included; and what is more important 2) the theme of the report is to view the watershed as one entity. A river and its watershed does not recognize municipal borders, drain commission jurisdictions, or interest group boundaries. What happens in one area of the watershed affects the rest of the watershed. Therefore, reference to artificial borders within the watershed were kept to a minimum. It is understood that the reader may have to refer to a county map or other reference to get their bearings. Perhaps in doing so, they will find the Rouge River in places they did not realize it existed before the report. The report has been amended to include place references whenever river miles are mentioned. Several of the tributaries were not labeled, however an attempt was made to label those that were referred to several times in the document. Figure 3 was included because of the significance of the major impoundments in that reach of the Middle Rouge River. Detailed maps for the entire watershed would have served to fragment the reader's attention and defeated the purpose of the report.

Comment: Put the document into a larger perspective; tell how it relates to other aspects of the Rouge River restoration. This report was requested by the Rouge Remedial Action Plan (RAP), and should be identified as such, perhaps even via a RAP logo on the cover. Should include background of the RRNWWDP. List all of the grant projects in the watershed and describe their effects.

Response: The assessment was not written by request of the Rouge RAP. The assessment is part of a Fisheries Division process to research and gather information about all major watersheds of the state, regardless of whether they also are included in an Area of Concern. Assessments are meant to be tools for any other program, group, or individual, to assist in restoring fisheries values to the waters of the state. Information is focused on the needs of the fishery. The assessment relates to the RAP in that one goal of the Rouge RAP is to restore a healthy fishery, which is also a goal of this assessment. The RRNWWDP is focused on improving water quality, which is also important for a healthy fishery. A list of grant projects would be more appropriate in the upcoming RAP Update, as the RAP is more all-inclusive in its focus.

Comment: (related to above) Recommend summary tables and figures to be included in the upcoming Rouge River RAP Update.

Response: It is up to the RAP committee members to determine which information will be useful for their report.

Comment: Will the information in the assessment be put into the GIS established for the watershed?

Response: Much of it already is, as many of the figures were generated by the Rouge Program Office (RPO), which is responsible for the GIS database for the watershed. Any information published in the assessment not generated by RPO may certainly be used by them if they choose.

Comment: Prioritize the management options section. Several requests were made for this.

Response: The management options included in the assessment are not prioritized intentionally. The report is intended to be used as a tool by any individual or groups able to act on any options presented. A prioritized list can be limiting if the opportunity presents itself to act on one option before another previously listed option has been addressed. By not prioritizing the options, as the opportunity or interest arises to address a particular issue in a certain area of the watershed, it is hoped that the project will continue without the need to wait for a higher priority issue to be resolved.

Comment: Identify who should do what, name some time frames, set specific goals, identify specific attainable goals. List any other studies to be prepared and note any implementation of management options which have been scheduled.

Response: The assessment is meant to be a document that will be useful for many years. It is an encyclopedic report of the status of the watershed as well as the options available given that status. The assessment will be followed by a fisheries management plan. This document will specifically itemize projects to be undertaken by Fisheries Division of the Department of Natural Resources. It will not identify those projects beyond the jurisdiction or control of Fisheries Division. Neither document would presume to tell municipalities, interest groups, or citizens what to do. They are intended to present options, to be acted on by any group or individual who is able to do so.

Comment: Present specific fish community and habitat targets. One of the requesters referenced an interim report authored by Wiley and Seelbach. Another comment wished to constrain the fisheries objectives which are "reasonably attainable in light of the practical constraints such as channelization of the lower end of the main stem, the large amount of impervious acreage in the drainage basin, dams and other impedance devices, highly variable flow regimes, etc."

Response: The development of the Wiley and Seelbach report (University of Michigan, not MDNR, Fisheries Division) was listed as an option in the Geology and Hydrology section of Management Options. The assessment certainly encourages development of specific targets, but it is not meant to be the place to find them, as they will hopefully be changing as the watershed is rehabilitated. Fisheries Division does not believe that any of the present impairments of the Rouge River are insurmountable, therefore limiting fisheries goals to the river as it stands is not acceptable. The assessment is meant to be useful after many, if not all, of these "constraints" have been remediated.

Comment: Add Holliday Nature Preserve Association and their work to table 25 and clarify their contributions on page 48 of the draft.

Response: Information submitted was incorporated in both in locations in the assessment.

Comment: Several groups were omitted from Table 25. Table is comprised mostly of municipalities, therefore heading should be changed to reflect this.

Response: Groups and their actions were added. Heading was reworded.

Comment: Several comments were received in response to the suggestion to reform the Rouge River watershed council or similar watershed-wide group (in the Citizen Involvement section of Management Options). One suggested that the Rouge River RAP Advisory Council is filling the watershed councils' purpose. Another felt that Friends of the Rouge has taken their place, as well as the Rouge River National Wet Weather Demonstration Project and the Rouge RAP Public Education Subcommittee.

Response: Watershed councils are a proven way to garner public support for, and continue with, watershed-wide projects and issues; they are not the only way to do so. The Rouge River is blessed with a very active citizen component. A watershed council could serve to coordinate all efforts in the watershed, and to act as a single sounding board and source of education for the public. The text was revised to clarify intent.

Comment: Reword sentence on pages 17-18 beginning with "All available technologies must be applied…" to something less strong. The suggestion was, "Appropriate technologies including source controls, pollution prevention measures and cost effective end-of-pipe treatment of discharges should be applied to ensure that desired water quality characteristics are met."

Response: It was not the intent of the authors that all available technologies be applied simultaneously if only a few are needed to achieve a resulting water quality. The intent is that all technologies available be used to ensure that water entering the stream is as good as, or better than, that flowing past the pipe. This is true regardless of cost. In order for Fisheries Division to support the idea of using wastewater treatment plant effluent to augment base flows, it has to be confident that the quality of the water will always be appropriate. Fish kills of a rare species are not acceptable. The sentence was reworded to clarify the intent.

Comment: Figures 25-28, "Values are of stream bottom in tenths of river mile." was confusing. Figures 25b-28b all have different River mile graduations.

Response: The sentence in question has been removed as it was not determined to add anything to the figure. Each figure refers to a different stream reach, and therefore is of a different length. River mile has been included in the Glossary (which was not included in the draft assessment due to time constraints) to help clarify the meaning. Gradient axis has been changed to the same range for each figure for ease in comparison between reaches.

Comment: Add alternative to phosphates in fertilizers, and nonpoint source pollution in the Citizen Involvement section of Management Options. Also to strictly regulate both pesticide and fertilizer use at golf courses.

Response: Nonpoint source pollution controlled by citizens would be in the form of fertilizers and pesticides. Stream bank erosion can be monitored by riparian property owners. Sediment from disturbed sites can best be controlled by municipalities, with the help of the MDEQ. Option was added to citizen involvement section; it is already found in the water quality section.

Comment: Table 10 inaccurately represents the avian life of the Rouge River watershed and the importance of the watershed to regional bird life. It needs to focus more on migrant and nesting birds, and less on birds that are incidental or those that strictly require aquatic or wetland habitat. Woodlands are much more important to birds of the watershed. Several scientific names of bird species were incorrect.

Response: Suggested changes were incorporated into Table 10.

Comment: What is the percentage of wetlands left in each watershed community? A map of remaining wetlands would be interesting. What is the rate of loss?

Response: Wetland maps are available through MDEQ, Land and Water Management Division and through National Wetland Inventory. These maps are being incorporated into the GIS database for the Rouge River watershed. Although a wetland map of the watershed would be interesting, a land use map would have been even more helpful. However, the inability to print the assessment in color rendered the land use map impossible to decipher. There is no data available on the rate of loss of wetlands; it was added as an option on the Soils and Land Use section.

Comment: Reference to storm water management by SWQD, MDEQ was in error.

Response: Corrections have been incorporated.

Comment: Cooperative effort of the Rouge River watershed communities concerning a general storm water permit was not included in Storm Water Management section of Special Jurisdictions.

Response: Information was obtained on the project from staff of SWQD and incorporated into text.

Comment: List page numbers in report where tables and figures can be found.

Response: This was added to the index.

Comment: The Introduction lists Johnson and Sump drains as cold water streams. Question was asked if this was an official designation. Has Johnson Drain name been changed to Creek?

Response: The classification referred to is a Fisheries Division one, further described in the Water Quality section of the report and Figure 32. It is not meant for purposes of MDEQ. Text has been modified to clarify the intent. As of the date of the assessment, Johnson Drain remains a designated drain. If it is officially reclassified, it will be referred to as Johnson Creek in future documents.

Comment: Factor P in Factors Affecting Fish Communities needs to be defined.

Response: This statistical term has been defined in the glossary.

Comment: Clarification is needed in the discussion of CSOs in Factors Affecting fish Communities. Mention should be made of the treatment that will occur if the basin capacity is exceeded.

Response: Comments were incorporated into text.

Comment: Background of the RRNWWDP needs to be clarified.

Response: Comments were incorporated into text.

Comment: Add Walled Lake-Novi WWTP discharge into the Middle Rouge to the list of WWTPs discharging to the Rouge River watershed.

Response: Comment was incorporated into text.

Comment: Not sure what "wastewater" refers to in discussion of sedimentation and erosion on page 18.

Response: Sentence was reworded to CSO flow for clarification.

Comment: Is the statement "It appears the system is still limited by oxygen flux…" (in Present Fish Communities) a sound conclusion based on data or a speculation?

Response: Most of this section was rewritten. The oxygen flux passage was removed as part of the editing.

Comment: Figure 5b, did you forget the corresponding numbers to the dots?

Response: The above mentioned re-write of this portion of *Present Fish Communities*, hopefully clarified the lack of "dots" on Figure 5b.

Comment: Definition of "special concern" species should be given in text of Amphibians and Reptiles. Table 9 would benefit from a definition also.

Response: Comments were incorporated into text.

Comment: Explain the probable cause for the low flow yield in the Rouge River downstream of the confluence with the Upper Rouge River (in Annual Stream Flows). CSOs are mentioned, but not tied to the yield.

Response: Comments were incorporated into text.

Comment: In the Seasonal Flow section, the Lower Rouge River was said to "have all but stopped flowing" in mid August. This statement raised some concern that the Lower Rouge River may be considered an intermittent stream, and thus receive a different level of protection.

Response: There is a difference between "stopped flowing" and "dried up". Although the Lower Rouge River shows extremely low flows in August (see Figure 15), it still contains water and is thus not intermittent. Several streams which discharge to Lake Erie have flows that actually reverse near the mouth, depending on wind direction. However, they are not listed as intermittent simply because their flow stops and changes direction periodically. The text was not revised, as the statement is accurate.

Comment: In Factors Affecting Fish Communities, clays are described as subject to severe erosion, yet in Channel Cross-Section they are said to be resistant to erosion. Which is right?

Response: This inaccuracy has been rectified, and a separate clarification was added in the Soils and Land Use section of the assessment.

Comment: What is meant by "channel diversity" in the Channel Cross-Section section of the report? Is it speaking to animal diversity or something else?

Response: Channel diversity was referring to diversity of the shape of the channel bottom. The size and amount of interstitial spaces, the existence of varied depth and velocity. This statement was reworded for clarification.

Comment: The statement regarding Wayne County and their Drain Commissioner is incorrect. The Director of the Division of Public Works, under the Department of Environment, is the designated County Drain Commissioner.

Response: Text was modified to reflect the comment.

Comment: Objection was made to reference of separate storm sewers as sources of contamination in the Fishery Management section. Data are not available to support the conclusion that dissolved oxygen problems are due to separate storm sewer discharges.

Response: The draft does not claim that separate storm sewers are a source of dissolved oxygen problems, but that they will "remain as sources of contamination". This contamination is in the form of oil and grease, sediment, pesticides and fertilizers, and all other materials found on road surfaces. The text was not changed, as it does not make a false claim.

Comment: In the Citizen Involvement section, the sentence "Currently the Rouge Program Office is fulfilling many of these functions…" was challenged. The sentence was believed to "imply that it is now playing the role of the former Rouge River Watershed Council".

Response: No implication was intended. The sentence was meant as it was written, that many, not all, of the functions of the former Rouge River Watershed Council are being fulfilled by RPO. Other functions are being addressed by Friends of the Rouge, the Rouge River Advisory Council, and probably other entities as well.

Comment: In the introduction of the Management Options section, it was requested that MDEQ be added as a source of options presented in the section.

Response: Although MDEQ was certainly instrumental in formulating the plans and options contained in the Rouge River Remedial Action Plan (which is listed as a source of options in the text), there were no existing MDEQ management plans used in the formulation of the Management Options section. MDEQ staff contributed to the "newly identified options" through comments received in the Public Comment and Response section. Text in assessment remains unchanged.

Comment: Why do we need to do more surveying of historical records for past populations and densities (as stated in Biological Communities section of the Management Options)? We already have much of that information and the current status of the river and the fishery it can support are not really related to the historic populations, densities, or distribution.

Response: There is virtually no historic fisheries information in the draft assessment, as it proved too difficult to find in the allotted time. To set fisheries goals for a future Rouge River, it is critical to understand the dynamics of the Rouge River of the past. Although Fisheries Division needs to set fisheries goals for the river as it is today, we must know what is realistic to expect as the river is brought closer to Rouge River of yesterday. This is possible to a certain extent through modeling, and through comparison with other rivers of similar size and geology. However, the best indicator of possible future options for fish species in the Rouge River, is to track their numbers and distribution in the river before human influence. This will not be an easy task, but it remains a goal.

Comment: Several objections were received to the recommendation to augment the base flow with effluent from WWTPs.

Response: This recommendation is based, in part, on the findings presented in the Wichert 1995 article that in the authors' professional opinion has merit. The authors disagree with the objections and the recommendation will not be removed.

Comment: Related to the above, objections were made to the use of Detroit City water to augment flow.

Response: Reference to Detroit city water was removed from text.

Comment: What does "rehabilitate recruitment of woody debris" mean? (Found in Channel Morphology section of Management Options)

Response: "Recruitment" was added to the glossary.

Comment: I am not sure what efforts the RRNWWDP is doing to build public support and how that relates to protecting and rehabilitating watershed integrity.

Response: Watershed integrity in this instance refers to the public identity of the watershed. An example (educational kiosks) was added to the option to clarify the intent.

Comment: Tables should identify the dates that the data was collected.

Response: Dates were added where appropriate. Where absent, reader should assume data to be current as of date report was printed.

Comment: What efforts are being undertaken to protect the redside dace? Are these efforts working?

Response: Option was added in Fishery Management section of Management Options to identify the habitat characteristics needed for the species and to protect it.

Comment: In the Introduction, ecosystem maintenance and rehabilitation was referenced and defined. Clarification was requested of the terms and their definition.

Response: Section was reworded, and ecosystem maintenance was removed from text.

Comment: Could you include Part 303 (and parts 13, 91, 301) of the NAP Act in the finished document?

Response: This was a typographical error that should have referenced Natural Resources and Environmental Protection Act (NREP). The error has been rectified in the text. The NREP is a public document, available at any MDEQ office, therefore it will not be reprinted in the assessment.

Comment: Pollutants in the paved section of the stream must be acknowledged when discussing habitat rehabilitation options.

Response: Elaboration was made in the Water Quality section of Management Options to identify this stretch as a priority 307 site. Habitat improvements suggested in the Fishery Management section are proposed assuming the contamination has been remediated or is taken into account.

Comment: The report could be enhanced by adding an executive summary.

Response: None was included in the draft due to time constraints. Executive summary has been added to text.

Comment: Add atmospheric deposition to Water Quality section of Introduction.

Response: Comment was incorporated into text.

Comment: Add Rouge River emergency outfall of Detroit Wastewater Treatment Plant to Geography section.

Response: Information was incorporated into text.

Comment: I'm not sure what "chemically" removing fish means. Is this a typo?

Response: This refers to the use of the fish toxicant rotenone. It is a chemical that is added to the to remove all fish from the water body.

Comment: Omit mention of Wayne County Parks Hines Parkway pond. It is not valid.

Response: Wayne County Parks verified that the project is still in the conceptual stages, but that it has not been abandoned.

Comment: Comment objected to generalizing that water quality standard exceedences are common occurrences in the watershed when much of the watershed does not exhibit these exceedences.

Response: Text was modified to address this comment.

Comment: Comment was that CSOs not only have the potential to cause dissolve oxygen depletions, but the data shows they routinely cause drops to zero, or near zero, for several hours and sometimes below the water quality standard for days after a single significant rain event.

Response: Text was modified to incorporate the concerns expressed in the comment.

Comment: Comment noted that while average DO below Birmingham CSOs was higher than above, the minimum DO's were significantly lower than the minimums in the upper section.

Response: Text was modified to reflect the comment.

Comment: A few instances of significant unpermitted discharges in the Bell Branch and Lower Rouge River were brought to our attention as well as potential effects they might have had on the water quality sampling in these areas.

Response: Text was modified to incorporate this information as appropriate.

Comment: Source of elevated nutrients in Johnson Creek could be the failing septic systems in Salem Township which are the reason for the proposed wastewater treatment plant there.

Response: Text was modified to incorporate this information.

Comment: Comment objected to referring to Ypsilanti WWTP effluent as “relatively clean water” as being misleading. It is just highly treated wastewater.

Response: Text modified to address this objection.

Comment: Actions to remediate the anthropogenic alterations (reducing flow variation and erosion, installing instream habitat structures, etc.) should be strongly supported.

Response: The management options included at the end of the report are intended to address this concern as well as other actions needed.

Comment: Check the date of the cutting of the “short cut channel”.

Response: The date in the report is what our reference stated.

Comment: Flow should be included as a pollutant in the Water Quality section to be consistent with the approach being used by MDEQ, SWQD.

Response: This is a Fisheries Division report and the parameters included in this section are those selected as most important to the fisheries resource from a water quality viewpoint. Flow is addressed in the “Geology and Hydrology” section.

Comment: Arithmetic averages for pH are an incorrect expression since pH is a logarithmic function. Geometric mean, median, or a range may be more appropriate.

Response: This section was modified to express ranges rather than averages as suggested.

Comment: The description of CSO retention basins and how they will function in the system is inaccurate and should be modified to better express how they will operate.

Response: The text was modified to address this concern.

Comment: The combined sewer overflows section indicates 10 CSO facilities under construction when there are really 11.

Response: The reference clearly lists only 10 such facilities and these are listed and located in the figure showing the location of the CSO abatement projects.

Comment: The number given of 157 CSOs in the watershed seems rather high.

Response: Sources along with the listing in the table of CSOs confirm there are over 150 CSOs in the watershed at this time.

Comment: Add the acronym “BMP” after the words “best management practices” since the term BMP is how they are generally referred to. Also include the definition of BMP as given.

Response: Text was modified to incorporate this comment.

Comment: It has not yet been determined if the baseline water quality monitoring network established by RPO will be able to meet all the stated goals.

Response: The text was modified to address this comment.

Comment: There should be some indication that the water quality standard is now based on E. Coli rather than fecal coliform.

Response: All sampling to date has been fecal coliform to address the standard based on fecal coliform so this portion of the report will not be changed at this time. Future report updates when E. Coli data are available will address this standard change.

Comment: There should be a map showing MAIN-1, MAIN-2, etc. or the reader should be referred to the base map figure to locate these river segments.

Response: The reference has been added as suggested.

Comment: Suggest identifying some of the other cross streets between 7 and 8 Mile Roads to help with reader clarity in the water quality summaries by river segment section of the report.

Response: Text was modified to address this comment.

Comment: Summary of Upper Rouge River water quality should indicate the location of additional CSOs and specifically locate the remediation projects underway in the area.

Response: The text was revised to incorporate this information.

Comment: Only one retention/treatment basin is planned in the Redford area, not two as stated.

Response: Text was revised to address this comment.

Comment: The lack of recent bacti data for the Lower Rouge River was noted.

Response: If more recent information becomes available it will be incorporated into the next update of this assessment.

Comment: While permitted dischargers may be in compliance with their permit, this does not mean they are not degrading the water quality in the river.

Response: Text was revised to reflect this comment.

Comment: A map showing the locations of the 307 sites would be very informative.

Response: A map of the sites is not necessary for the purposes of this report. This information can be obtained from MDEQ.

Comment: What is the estimated number of contaminated sites in the watershed that do not meet the criteria for the 307 list?

Response: This information was not readily available and the number is changing every day as new sites are found and old ones are cleaned. It is estimated they probably number several hundred depending on size and severity criteria used.

Comment: It was requested that the two groups of landfills near which Lower Rouge River sediments had elevated PCBs be identified.

Response: Text was modified to include this information.

Comment: Separate storm sewer impacts should be specifically discussed in a separate section under Water Quality similar to point sources and combined sewer overflows

Response: Effects from untreated separate storm sewer discharges are adequately covered in the point source section and elsewhere under water quality.

Comment: The toxicity-based sediment criteria mentioned under “Sediment Contamination” could be misconstrued as indicating there are legally established sediment criteria in Michigan, even though no such requirements have been adopted.

Response: The criteria mentioned were developed for use in the listed reference and this report makes no mention of or attempt at implying there are legally established sediment criteria in Michigan. Text was modified to address this concern.

Comment: Question raised whether base flows are really going down due to impervious area increasing in the watershed.

Response: Data were reviewed and text modified to more accurately address the issue in this comment.

Comment: Southern shore of Newburg Lake is County-owned and undeveloped with no public access. Concerns were expressed as to preserving this as a natural area instead of the county selling it to private developers.

Response: This is County property and we do not have control over what municipalities do with their resources. We are not aware of any plans by the County to sell or develop this property.

Comment: It would be nice to get more public access to Newburg Lake and the river after the cleanup is finished. The public needs to be made aware of the recreational opportunities present in the watershed.

Response: We will be working with Wayne County to improve access. Possibilities include an improved small boat access, more shore-fishing opportunities, etc.

Comment: More effort needs to be put into making people aware of information such as that contained in the assessment. Perhaps the report could be placed on the internet or made available in some other electronic manner.

Response: The executive summary of this report will be available on the Internet at: http://www.dnr.state.mi.us/www/ifr/ifrlibra/special.htm

Comment: The storm water management section mentions Washtenaw County regulations. What about including where other communities in the watershed stand.

Response: Text was modified to incorporate information about other local communities.

Comment: Concern was expressed about the effect on the natural areas from developing recreational opportunities on Wayne County land (specifically around Newburg Lake). Suggestion was made that some areas should be reserved as natural areas.

Response: Wayne County has a master park plan and people with concerns should send written comments to the County directly.

GLOSSARY

assimilate - to take in and make use of

base flow - ground water discharge to a stream system

basin - a drainage area, both land and water, from which water flows toward a central collector such as a stream, river, or lake at a lower elevation; synonymous with watershed

biodiversity - the number and type of biological organisms in a system

biomass - weight of living material

channelization - a process of altering natural stream channels by straightening, widening, and deepening to improve water drainage

channel morphology - a study of structure and form of stream and river channels including width, depth, and bottom type

confluence - place where two or more streams join into one

degradation - reduction in quality

dendritic - a branching tree-like pattern

detention basin - a structure designed to delay and sometimes reduce the discharge of storm water runoff to a waterway

detrimental - harmful

drainage basin - land drained by a river system

ecosystem - a biological community considered together with the non-living factors of its environment as a unit

electrofishing - the process of putting an electric current through water for the purpose of stunning and collecting fish

emergent - protruding above the water surface

evapotranspiration - sum of water taken in by plants and that evaporated into the air

exacerbate - to make more intense, aggravate

exceedence curves - the probability of a discharge exceeding a given value

exotic species - successfully reproducing organisms transported into regions where they did not previously exist

extirpation - to make extinct, remove completely

fixed-crest - a dam that is fixed at an elevation and has no ability to change from that elevation

flashy - streams and rivers characterized by rapid and substantial fluctuations in stream flow

flux - rate and magnitude of change

glacial - of or produced by a glacier or a glacial period

glacial drift - clay, silt, sand, gravel, and stones deposited by glaciers and glacial melt waters

glacial moraine - a mass of rocks, gravel, sand, clay, etc. carried and deposited directly by a glacier

gradient - drop in elevation over a specified length of river

hydraulic diversity - the variability of water depths and velocities in a stream or river channel

hydroelectric dam - a dam designed and placed to produce electrical power production

hydrograph - a graph of stream discharge plotted against time

hydrology - the science dealing with properties, distribution, and circulation of water

impervious - a surface through which water cannot easily penetrate

impoundment - an artificial body of water created behind a dam

indicator species - a plant or animal species that has very specific habitat requirements; hence, its presence indicates a restrictive habitat requirement is being satisfied

infiltration - a process of water moving through soil particles

invertebrate - an animal having no backbone or internal skeleton

lake-level control structure - low-head dam placed at the outlet of lakes to control the water level

loam - a soil consisting of an easily crumbled mixture containing from 7 to 27% clay, 28 to 50% silt, and less than 52% sand

meander - a winding, curving stream segment

median - a value such that one-half of all other related values are either below or above it

moraine - a mass of rocks, gravel, sand, clay, etc. carried and deposited directly by a glacier

P: P value - a statistical term indicating the level of significance at which the observed value of a test statistic would just be significant, that is, would just fall into the critical region

perched culvert - improperly placed culvert that fragments habitat by creating a significant drop between a culvert outlet and the stream surface

permeable - soils with coarse particles that allow passage of water

perturbation - disturbance

potamodromous - fish that migrate from fresh water lakes up fresh water rivers to spawn; in the context of this report, it refers to fish that migrate into the Rouge River from the Detroit River and Lake Erie

recruitment - addition of new individuals to a population through reproduction or migration

regime - condition of a river with respect to the rate of flow as measured by the volume of water passing different cross-sections in a given time

retention basin - a structure designed to capture storm water flows for treatment before discharge

riffle - a shallow area extending across the bed of a stream where water flows swiftly so that the surface is broken in waves

riparian - adjacent to or living on the bank of a river, lake or stream; also refers to the owner of stream or lakefront property

river mile - the distance along a river channel measured from its mouth or confluence with a larger water body, in miles

rotenone - a natural substance found in roots of plants of the pea family and used as a toxicant to gill-breathing animals

run-of-the-river - inflow of water equals outflow of water; this flow regime mimics the natural flow regime of a river on impounded systems

run habitat - fast, non-turbulent water

salmonid - species of fish in the Salmonidae family, trout, salmon, and whitefish

sedimentation - a process of depositing silt, sand, and gravel on a stream or river bottom

sinuosity - the degree of bending, winding, or curving of a river or stream

topography - configuration of the earth’s surface including its relief and position of its natural features

tributary - a smaller stream feeding into a larger stream, river, or lake

turbid - water that has large amounts of suspended sediments in the water column

watershed - a drainage area or basin, both land and water, from where water flows toward a central collector such as a stream, river, or lake at a lower elevation

wetland - those areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support types of vegetation typically adapted for life in saturated soil; includes swamps, marshes, and bogs

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Table 1.–Types of archaeological sites within River Rouge drainage. Compiled by: B. Mead, Office of the State Archaeologist, personal communication.

Prehistoric period
- About half the sites in the River Rouge drainage are from the prehistoric period
- About 60% of these cannot be further identified to periods, usually because they have not yet been studied in detail or the artifacts known so far are not distinctive enough to provide necessary clues

Paleo-Indian period
- Stray finds of distinctive fluted points

Archaic period
- Camps
- Cemeteries

Woodland period
- Camps and villages; distinctive styles of ceramics on some of these sites can help to identify cultural groups
- Earthworks (the remains of circular palisades that surrounded villages)
- Burial mounds
- Cemeteries

Historic (post-1600) period
- Indian camps, villages and cemeteries
- French and British trading post, burials, fort
- American (non-Indian) farmsteads, residences, abandoned towns, mills, brick yards, dumps, cemeteries, plank road, schoolhouses, taverns, and commercial structures

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Table 2.–Number of archeological sites within River Rouge drainage, listed by congressional township. Compiled by: B. Mead, Office of the State Archaeologist, personal communication.

County	Township	Number of Sites
Oakland	T2N, R8E	3
"	T2N, R9E	11
"	T2N, R10E	16
"	T2N, R11E	3
"	T1N, R8E	14
"	T1N, R9E	9
"	T1N, R10E	46
Wayne	T1S, R8E	27
"	T1S, R9E	12
"	T1S, R10E	49
"	T1S, R11E	9
"	T2S, R8E	35
"	T2S, R9E	34
"	T2S, R10E	34
"	T2S, R11E	20
"	T3S, R8E	1
"	T3S, R9E	2
"	T3S, R10E	1
Washtenaw	T1S, R7E	3
"	T2S, R7E	4
TOTAL		333

Table 3.–List of fishes historically found in the Rouge River. Compiled by G.R. Smith, University of Michigan, Museum of Zoology, E.M. Hay-Chmielewski and Jennifer Beam, Michigan Department of Natural Resources, Fisheries Division. Data from: University of Michigan Museums Fisheries Library, Michigan Department of Natural Resources, Institute for Fisheries Research and Livonia Office.

Common name	Scientific name
Lampreys	
American brook lamprey	*Lampetra appendix*
Freshwater eels	
American eel	*Anguilla rostrata*
Herrings	
Gizzard shad	*Dorosoma cepedianum*
Carps & Minnows	
Central stoneroller	*Campostoma anomalum*
Goldfish	*Carassius auratus*
Redside dace	*Clinostomus elongatus*
Spotfin shiner	*Cyprinella spiloptera*
Common carp	*Cyprinus carpio*
Striped shiner	*Luxilus chrysocephalus*
Common shiner	*Luxilus cornutus*
Redfin shiner	*Lythrurus umbratilis*
Hornyhead chub	*Nocomis biguttatus*
Golden shiner	*Notemigonus crysoleucas*
Bigeye chub	*Notropis amblops* (extirpated)
Blackchin shiner	*Notropis heterodon*
Blacknose shiner	*Notropis heterolepis*
Spottail shiner	*Notropis hudsonius*
Minnow, sp.	*Notropis hybrid*
Mimic shiner	*Notropis volucellus*
Northern redbelly dace	*Phoxinus eos*
Bluntnose minnow	*Pimephales notatus*
Fathead minnow	*Pimephales promelas*
Blacknose dace	*Rhinichthys atratulus*
Creek chub	*Semotilus atromaculatus*
Suckers	
White sucker	*Catostomus commersoni*
Lake chubsucker	*Erimyzon sucetta*
Northern hog sucker	*Hypentelium nigricans*
Spotted sucker	*Minytrema melanops*
Silver redhorse	*Moxostoma anisurum*
Golden redhorse	*Moxostoma erythrurum*
Black redhorse	*Moxostoma duquesnei*

Table 3.–Continued.

Common name	Scientific name
Catfishes	
Black bullhead	*Ameiurus melas*
Yellow bullhead	*Ameiurus natalis*
Brown bullhead	*Ameiurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Tadpole madtom	*Noturus gyrinus*
Pikes	
Grass pickerel	*Esox americanus*
Northern pike	*Esox lucius*
Mudminnows	
Central mudminnow	*Umbra limi*
Silversides	
Brook silverside	*Labidesthes sicculus*
Sticklebacks	
Brook stickleback	*Culaea inconstans*
Sculpins	
Mottled sculpin	*Cottus bairdi*
Sunfishes	
Rock bass	*Ambloplites rupestris*
Green sunfish	*Lepomis cyanellus*
Pumpkinseed	*Lepomis gibbosus*
Warmouth	*Lepomis gulosus*
Sunfish, sp.	*Lepomis hybrid*
Bluegill	*Lepomis macrochirus*
Longear sunfish	*Lepomis megalotis*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Perches	
Eastern sand darter	*Ammocrypta pellucida*
Greenside darter	*Etheostoma blennioides*
Rainbow darter	*Etheostoma caeruleum*
Iowa darter	*Etheostoma exile*
Fantail darter	*Etheostoma flabellare*
Least darter	*Etheostoma microperca*
Johnny darter	*Etheostoma nigrum*
Yellow perch	*Perca flavescens*
Logperch	*Percina caprodes*
Blackside darter	*Percina maculata*
Walleye	*Stizostedion vitreum*

Table 4.–Soils in the Rouge River watershed. Data from: Rouge Program Office Modeling Team, 1995. No measured soil group data in urban areas of Wayne County (i.e. Detroit and most of the eastern half of the county); soils assigned Group C classification for modeling purposes. Hydrologic soil groups as defined by U.S. Department of Agriculture Technical Release 55, 1986. Group A: sandy, loamy sand, or sandy loam; Group B: silt loam or loam; Group C: sandy clay loam; Group D: clay loam, silty clay loam, sandy clay, silty clay, or clay.

	Group A		Group B		Group C		Group D	
Branch	Acreage	% total	Acreage	% total	Acreage	% total	Acreage	% total
Mainstem	2,299	2	31,655	25	73,154	59	17,246	14
Upper	2,980	7	12,872	32	19,560	48	5,357	13
Middle	7,455	10	24,673	34	25,360	35	14,827	21
Lower	4,052	7	18,368	30	16,758	27	21,919	36
TOTAL WATERSHED	16,787	6	87,568	29	134,831	45	59,348	20

Table 5.–Fish species found in the Rouge River in the last decade. Michigan Department of Natural Resources, Fisheries Division.

Common name	Scientific name
Lampreys	
American brook lamprey	*Lampetra appendix*
Gars	
Longnose gar	*Lepisosteus osseus*
Herrings	
Gizzard shad	*Dorosoma cepedianum*
Minnows	
Central stoneroller	*Campostoma anomalum*
Goldfish	*Carassius auratus*
Redside dace	*Clinostomus elongatus*
Spotfin shiner	*Cyprinella spiloptera*
Common carp	*Cyprinus carpio*
Common shiner	*Luxilus cornutus*
Redfin shiner	*Lythrurus umbratilis*
Hornyhead chub	*Nocomis biguttatus*
Golden shiner	*Notemigonus crysoleucas*
Emerald shiner	*Notropis atherinoides*
Blackchin shiner	*Notropis heterodon*
Spottail shiner	*Notropis hudsonius*
Northern redbelly dace	*Phoxinus eos*
Bluntnose minnow	*Pimephales notatus*
Fathead minnow	*Pimephales promelas*
Blacknose dace	*Rhinichthys atratulus*
Creek chub	*Semotilus atromaculatus*
Suckers	
Quillback	*Carpiodes cyprinus*
White sucker	*Catostomus commersoni*
Northern hog sucker	*Hypentelium nigricans*
Spotted sucker	*Minytrema melanops*
Golden redhorse	*Moxostoma erythrurum*
Catfishes	
Black bullhead	*Ameiurus melas*
Yellow bullhead	*Ameiurus natalis*
Brown bullhead	*Ameiurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Stonecat	*Noturus flavus*
Northern madtom	*Noturus stigmosus*
Pikes	
Grass pickerel	*Esox americanus vermiculatus*
Northern pike	*Esox lucius*
Muskellunge	*Esox masquinongy*

Table 5.–Continued.

Common name	Scientific name
Mudminnows	
Central mudminnow	*Umbra limi*
Trouts	
Rainbow trout	*Oncorhynchus mykiss*
Chinook salmon	*Oncorhynchus tshawytscha*
Brown trout	*Salmo trutta*
Killifishes	
Starhead topminnow	*Fundulus dispar*
Silversides	
Brook silverside	*Labidesthes sicculus*
Sticklebacks	
Brook stickleback	*Culaea inconstans*
Sculpins	
Mottled sculpin	*Cottus bairdi*
Temperate basses	
White perch	*Morone americana*
Sunfishes	
Rock bass	*Ambloplites rupestris*
Green sunfish	*Lepomis cyanellus*
Pumpkinseed	*Lepomis gibbosus*
Hybrid sunfish	*Lepomis x Lepomis spp.*
Bluegill	*Lepomis macrochirus*
Longear sunfish	*Lepomis megalotis*
Smallmouth bass	*Micropterus dolomieu*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Perches	
Rainbow darter	*Etheostoma caeruleum*
Johnny darter	*Etheostoma nigrum*
Yellow perch	*Perca flavescens*
Blackside darter	*Percina maculata*
Drums	
Freshwater drum	*Aplodinotus grunniens*

Table 6.–Species associations obtained from hierarchical cluster analysis of the 66 most common species at Michigan Rivers Inventory project sites. Species were clustered (based upon abundance at sites) using complete linkage method. Species in bold is representative of group. Data from: T. Zorn and P. Seelbach, Michigan Department of Natural Resources, Fisheries Division, preliminary data.

Group number	Species in group
1	**Creek chub**, redfin shiner, stoneroller, common shiner, bluntnose minnow, Johnny darter
2	**Blackside darter**, pirate perch
3	**White sucker,** brook stickleback, N. redbelly dace, hybrid sunfish
4	**Green sunfish**, pumpkinseed, bluegill, black bullhead, yellow bullhead, mudminnow
5	**Brook trout**, slimy sculpin
6	**Brown trout**, chinook salmon, rainbow trout
7	**Mottled sculpin**, blacknose dace
8	**Burbot**, longnose dace, rainbow darter
9	**Hornyhead chub**, grass pickerel, lake chubsucker
10	**Rock bass**, brown bullhead, longear sunfish, largemouth bass
11	**Flathead catfish**, white crappie, common carp, bowfin, black crappie, tadpole madtom, spotted sucker
12	**Gizzard shad**, freshwater drum, quillback
13	**Shorthead redhorse**, brook silverside, mimic shiner, logperch, sand shiner
14	**Walleye**, channel catfish, spotfin shiner
15	**Smallmouth bass**, black redhorse, striped shiner, river chub, northern hog sucker, stonecat, greenside darter
16	**Golden redhorse**, rosyface shiner, yellow perch, greater redhorse, silver redhorse, northern pike

Table 7.–Relative abundance of fish species (percent of total sample) identified in the Rouge River in 1986 and 1995. Data from: Michigan Department of Natural Resources, Fisheries Division.

Mainstem sites	MN-1 Beach Rd.		MN-2 Lahser Rd.		MN-3 Beech Rd.		MN-4 Spinoza Rd.		MN-5 Evans at Lahser	
Species	1986	1995	1986	1995	1986	1995	1986	1995	1986	1995
Black bullhead										
Black crappie				0.3						
Blackchin shiner										
Blacknose dace			4.2	4.2	3.4	30.7				
Blackside darter						0.4				
Bluegill	1.1	0.2		0.9				12.5		
Bluntnose minnow	3.4	25.6	1.2	0.9		2.9				
Brook lamprey										
Brook stickleback						0.4		12.5		
Brown bullhead										
Central mudminnow										
Central stoneroller	10.8	4.5	4.8	2.9		1.1				
Channel catfish										
Common carp	0.8	3.1			6.9			12.5	16.7	7.3
Common shiner	30.0	26.3	21.2	15.7	17.2	3.6				
Common white sucker	6.6	5.8	12.7	10.9	27.6	5.2				8.8
Creek chub	21.2	28.2	53.3	57.0	24.1	35.9	68.4	37.5	16.7	16.3
Fathead minnow	4.0					1.5		25.0	33.3	67.8
Gizzard shad										
Golden shiner										
Goldfish							31.6			
Hybrid carp/goldfish										
Grass pickerel										
Green sunfish	1.3	0.5	1.2	0.7	13.8	0.7			16.7	
Horneyhead chub	9.5									
Hybrid sunfish				0.9						
Johnny darter		0.3		1.3		17.5				
Largemouth bass	1.6	2.5		2.0						
Longear sunfish										
Mottled sculpin										
Northern hog sucker										
Northern pike										
N. redbelly dace										
N. starhead topminnow										
Pumpkinseed	1.1		0.6						16.7	
Rainbow darter										
Rainbow trout										
Redfin shiner		0.5								
Redside dace										
Rock bass	7.9	0.9	0.6	2.2	6.9					
Spotfin shiner		0.1								
Stonecat	1.1	1.4								
Yellow bullhead		0.1								
Yellow perch				0.3						
NUMBER FISH	378	6664	165	1078	29	719	19	24	36	400

Table 7.–Continued.

Upper Rouge River sites	U-1 Power St.		U-3 5 Mile Rd.		U-4 Bell Br at Sarasota	
Species	1986	1995	1986	1995	1986	1995
Black bullhead		0.2				
Black crappie						
Blackchin shiner						
Blacknose dace	13.6	11.4				
Blackside darter						
Bluegill	0.5		2.4			
Bluntnose minnow					3.3	11.3
Brook lamprey		0.4				
Brook stickleback				1.7	1.7	
Brown bullhead			2.4			
Central mudminnow	1.0	0.2	2.4		3.3	
Central stoneroller	1.0	0.4			1.7	
Channel catfish						
Common carp						0.4
Common shiner	2.8	6.3			3.3	1.7
Common white sucker	14.6	6.6	59.5	44.8	46.5	7.0
Creek chub	41.3	35.2	11.9	1.7	32.0	65.2
Fathead minnow		1.1	4.8	43.1	5.0	6.1
Gizzard shad						
Golden shiner						0.4
Goldfish			2.4			
Hybrid carp/goldfish						
Grass pickerel						
Green sunfish	3.8	5.7		5.2	3.3	1.7
Hornyhead chub						
Hybrid sunfish			7.1			
Johnny darter		0.2				
Largemouth bass	0.5	0.4	2.4	3.5		2.6
Longear sunfish						
Mottled sculpin	13.6	28.8				3.5
Northern hog sucker	6.1	1.3				
Northern pike						
N. redbelly dace						
N. starhead topminnow						
Pumpkinseed	0.5		4.8			
Rainbow darter						
Rainbow trout		0.2				
Redfin shiner						
Redside dace	0.5	1.5				
Rock bass						
Spotfin shiner						
Stonecat	0.5					
Yellow bullhead						
Yellow perch						
NUMBER FISH	2130	1695	168	290	241	920

Table 7.–Continued.

Middle Rouge R. sites	MD-1 Novi Rd.		MD-2 9 Mile Rd.		MD-3 Northville Rd.		MD-6 Wayne Rd.		MD-7 Inkster Rd.		MD-11 Tonquish Ck	
Species	1986	1995	1986	1995	1986	1995	1986	1995	1986	1995	1986	1995
Black bullhead												
Black crappie			2.0	0.1								
Blackchin shiner												
Blacknose dace				0.1	4.2	2.3					1.9	2.3
Blackside darter												
Bluegill				2.1		0.4	15.6	22.6				1.7
Bluntnose minnow			3.4	3.6	2.5	3.5		3.8			0.9	1.7
Brook lamprey												
Brook stickleback	4.0											
Brown bullhead				0.6								
Central mudminnow			0.7		0.6	0.4						
Central stoneroller			0.7	0.8	3.1	2.0						
Channel catfish			0.7									
Common carp			9.5		2.5	1.2	15.6	3.8	5.8	9.4		
Common shiner					1.2	1.6			2.9	9.4	0.9	11.2
Common white sucker	4.0		23.0	30.7	17.0	14.6	10.4	13.2	5.8	40.6	17.9	24.7
Creek chub	80.0	96.0	16.2	18.6	31.5	40.3			34.8	15.6	6.6	34.3
Fathead minnow	4.0		0.7						34.8	9.4	71.8	0.8
Gizzard shad												
Golden shiner				1.3								
Goldfish							31.2		15.9			
Hybrid carp/goldfish												
Grass pickerel				0.1								
Green sunfish	8.0	4.0	23.0	24.5	4.2	3.5		1.9				20.7
Hornyhead chub												
Hybrid sunfish			1.3	0.1								
Johnny darter			4.7	1.0		0.8						
Largemouth bass			2.0	4.6		1.2	2.1	1.9				1.7
Longear sunfish							2.1					
Mottled sculpin					30.3	22.9						
Northern hog sucker			0.7									
Northern pike			2.7									
N. redbelly dace												
N. starhead topminnow												
Pumpkinseed			5.4	5.5	1.2	5.1	7.3	13.2				0.8
Rainbow darter					0.6							
Rainbow trout												
Redfin shiner												
Redside dace												
Rock bass			2.0	5.9	1.2		15.6	37.7		15.6		
Spotfin shiner				0.1								
Stonecat												
Yellow bullhead			1.3									
Yellow perch				0.3				1.9				
NUMBER FISH	625	227	1644	2933	1178	903	96	53	69	32	882	598

Table 7.–Continued.

Lower Rouge R. sites	L-1 Sheldon Rd.		L-2 Newburgh Rd.		L-4 Ford Field Park	
Species	1986	1995	1986	1995	1986	1995
Black bullhead	0.3	2.7				
Black crappie						
Blackchin shiner						
Blacknose dace						
Blackside darter						
Bluegill	0.3					
Bluntnose minnow						
Brook lamprey						
Brook stickleback	3.1		0.7			0.4
Brown bullhead						
Central mudminnow	10.5	10.4	10.0	0.8	32.8	3.5
Central stoneroller	1.7					
Channel catfish						
Common carp	9.1	3.8	2.8	3.2	42.2	
Common shiner	19.6		2.8	2.4		
Common white sucker	5.2	3.8	51.8	17.1	9.4	
Creek chub	24.8	41.4	19.2	47.4		1.5
Fathead minnow	21.3		0.7	0.4	3.1	85.8
Gizzard shad			0.7			0.4
Golden shiner						
Goldfish	0.3				3.1	1.5
Hybrid carp/goldfish					9.4	
Grass pickerel						
Green sunfish	3.5	35.1	7.8	26.1		5.1
Horneyhead chub						
Hybrid sunfish						
Johnny darter			3.5	0.4		
Largemouth bass		2.7		0.4		1.0
Longear sunfish						
Mottled sculpin						
Northern hog sucker						
Northern pike						
N. redbelly dace	0.3					
N. starhead topminnow						0.4
Pumpkinseed				1.8		0.4
Rainbow darter						
Rainbow trout						
Redfin shiner						
Redside dace						
Rock bass						
Spotfin shiner						
Stonecat						
Yellow bullhead						
Yellow perch						
NUMBER FISH	925	367	542	778	128	688

Table 8.–Distribution of aquatic invertebrates in the Rouge River by river segments and major tributaries. Data from Jackson (1975), Evans (1987), Oemke & Stroh (1994), and Oemke (1994). "x" represents locations where invertebrate groups are found; "o" represents locations where groups are missing relative to other studies; blanks indicate group was not found in that segment in any of the studies; "(1)" indicates this group was found at only one sampling site in that segment. The first five invertebrate groups (**in bold**) are indicative of better water quality.

River segments	Rouge Mainstem				Upper Rouge River						Middle Rouge River			
	Upper		Lower		Upstream			Bell & Downstream			Above Johnson Creek			
Invertebrate groups	1973	1985-6	1973	1985-6	1973	1985-6	1994	1973	1985-6	1992	1973	1985-6	1992	1994
Ephemeroptera (mayflies)	x	x	x (1)	o	x	x	x	x (1)	o	x	x	x	x	o
Trichoptera (caddisflies)	x	x	o	x (1)	x	x	x	o	o	x	x	x	x	x
Amphipoda (scuds)	o	x	x	x	x	x	x	o	o	x	x	x	x	x
Diptera (flies, midges)														
Simuliidae (black flies)	x	x	o	o	x	x	o	o	o	o	x	x	x	o
Chironomidae (midges & flies)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Culicidae (mosquitoes, midges)											x (1)	o	o	o
Tipulidae (flies)	x	x	x	o	o	o	x				x	x	o	x
Athericidae (flies)											o	o	o	o
Porifera (sponges)	x	x	o	o							o	o	o	o
Turbellaria (flatworms)	x	x	o	o	o	o	x	o	o	x	o	x	o	o
Bryozoa (moss animals)	x	o	x	o	o	o	x	o	o	x	o	x	x	o
Oligocheata (aquatic worms)	x	x	x	x	x	x	o	x	x	o	x	x	o	o
Gastropoda (snails, limpets)	x	x	x	x	x	x	x	o	x	x	x	x	x	x
Hirudinea (leeches)	x	x	x	x	x	x	o	x	x	x	x	x	x	o
Odonata (dragonflies, damselflies)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Coleoptera (aquatic beetles)	x	x	x	o	x	x	x	x	x	x	x	x	x	o
Pelecypoda (clams)	x	x	x	x (1)	x	x	x	o	x	o	x	x	x	x
Isopoda (sowbugs)	x	x	x	x	x	x	o	o	x	x	x	x	o	o
Decapoda (crayfish)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hemiptera (true bugs)	x	x	x	x (1)	x	x	x	x	o	x	x	x	x	o
Megaloptera (alderflies)					o	x	o	o	o	o	o	o	o	o

Table 8.–Continued.

River segments	Middle Rouge River (continued)					Lower Rouge River					
	Johnson-Wayne Rd.		Tonquish Ck.	Below Wayne Rd.		Fellows Ck.	Above Merriman Rd.			Below Merriman	
Invertebrate groups	1973	1985-6	1992	1973	1985-6	1992	1973	1985-6	1994	1973	1985-6
Ephemeroptera (mayflies)	x	x	x	x (1)	x (1)	x	x	x	x	o	o
Trichoptera (caddisflies)	x	x	x	o	o	x	x	o	x	o	o
Amphipoda (scuds)	x	x	o	x	x	x	x	x	o	x	o
Diptera (flies, midges)											
Simuliidae (black flies)	x	x	x	o	o	o	o	x	x	o	x
Chironomidae (midges & flies)	x	x	x	x	x	x	x	x	x	x	x
Culicidae (mosquitoes, midges)	o	o	o	o	o						
Tipulidae (flies)	o	x	o	o	o						
Athericidae (flies)	o	x	o	o	o						
Porifera (sponges)	o	x (1)	x	o	o						
Turbellaria (flatworms)	x	x	x	x	o						
Bryozoa (moss animals)	o	x	o	o	x	o	o	x	o	o	o
Oligocheata (aquatic worms)	o	x	o	x	x	o	x	x	o	x	x
Gastropoda (snails, limpets)	x	x	x	x	x	x	x	x	x	x	x
Hirudinea (leeches)	x	x	x	x	x	x	o	o	x	x	x
Odonata (dragonflies, damselflies)	x	x	x	x	x	x	x	x	x	x	x
Coleoptera (aquatic beetles)	x	x	x	x	x	x	x	x	x	x	o
Pelecypoda (clams)	x	x	x	x	x	o	x	o	x	o	x
Isopoda (sowbugs)	x (1)	x	o	x	x	x	x	x	x	x	o
Decapoda (crayfish)	x	x	x	x	x	x	x	x	x	x	x
Hemiptera (true bugs)	x	x	x	x	x	x	x	x	x	x	x
Megaloptera (alderflies)	o	x	o	o	o						

Table 9.–Amphibians and reptiles in the Rouge River watershed that require an aquatic or wetland environment. Endangered, threatened, and special concern (defined as rare, may become endangered or threatened in the future) species are noted. Data from: J. Craves, University of Michigan-Dearborn, T. Payne, Michigan Department of Natural Resources, Wildlife Division, K. Gourlay, Michigan Department of Natural Resources, Parks and Recreation Division.
Sitings: confirmed = C; within range = R.

Common name	Scientific name	Sitings
Salamanders		
Blue-spotted salamander	*Ambystoma laterale*	C
Small-mouthed salamander	*Ambystoma texanum* (endangered)	R
Spotted salamander	*Ambystoma maculatum*	C
Eastern tiger salamander	*Ambystoma tigrinum tigrinum*	C
Mudpuppy	*Necturus maculosus*	R
Eastern newt	*Notophthalmus viridescens*	R
Red-spotted newt	*Notophthalmus viridescens viridescens*	R
Red-backed salamander	*Plethodon cinereus*	C
Four-toed salamander	*Hemidactylium scutatum*	R
Tiger salamander	*Ambystoma tigrinum*	R
Lizards		
Five-lined skink	*Eumeces fasciatus*	R
Frogs and Toads		
Blanchard's cricket frog	*Acris crepitans blanchardi* (special concern)	R
Eastern American toad	*Bufo americanus*	C
Northern spring peeper	*Pseudacris crucifer*	C
Eastern gray tree frog	*Hyla versicolor*	C
Cope's gray tree frog	*Hyla chrysoscelis*	R
Western chorus frog	*Pseudacris triseriata triseriata*	C
Bullfrog	*Rana catesbeiana*	C
Green frog	*Rana clamitans melanota*	C
Northern leopard frog	*Rana pipiens*	C
Pickerel frog	*Rana palustris*	C
Wood frog	*Rana sylvatica*	C
Turtles		
Spiny softshell	*Apalone spinifera*	C
Snapping turtle	*Chelydra serpentina*	C
Painted turtle	*Chrysemys picta*	C
Spotted turtle	*Clemmys guttata* (special concern)	R
Wood turtle	*Clemmys insculpta* (special concern)	C
Blanding's turtle	*Emydoidea blandingii* (special concern)	C
Common map turtle	*Graptemys geographica*	C
Red-eared slider	*Trachemys scripta elegans*	C
Common musk turtle	*Sternotherus odoratus*	R
Eastern box turtle	*Terrapene carolina carolina* (special concern)	C

Table 9.–Continued.

Common name	Scientific name	Sitings
Snakes		
Kirtland's water snake	*Clonophis kirtlandi* (endangered)	R
Northern water snake	*Nerodia sipedon*	C
Queen snake	*Regina septemvittata*	R
Eastern massasauga rattlesnake	*Sistrurus catenatus* (special concern)	C
Northern ribbon snake	*Thamnophis sauritus septentrionalis*	C
Eastern garter snake	*Thamnophis sirtalis*	C
Butler's garter snake	*Thamnophis butleri*	R
Eastern hognose snake	*Heterodon platyrhinos*	C
Black rat snake	*Elaphe obsoleta obsoleta* (special concern)	R
Brown snake	*Storeria dekayi*	C
Blue racer	*Coluber constrictor foxi*	C
Northern red-bellied snake	*Storeria occipitomaculata*	C
Eastern milk snake	*Lampropeltis triangulum*	C
Eastern fox snake	*Elaphe vulpina gloydi* (threatened)	R
Northern ringneck snake	*Diadophis punctatus edwardsi*	R
Eastern smooth green snake	*Liochlorophis vernalis vernalis*	R

Table 10.–Birds regularly occurring in the Rouge River watershed. Data from: J. Craves, University of Michigan-Dearborn, T. Payne, Michigan Department of Natural Resources, Wildlife Division. B = Breeding species in the watershed.

Common name	Scientific name	Breeding Status
Common loon	*Gavia immer*	
Pied-billed grebe	*Podilymbus podiceps*	
Double-crested cormorant	*Phalacrocorax auritus*	
Great blue heron	*Ardea herodias*	
Great egret (American egret)	*Ardea alba*	B
Green heron	*Butorides virescens*	B
Black-crowned night heron	*Nycticorax nycticorax*	
Yellow-crowned night heron	*Nyctanassa violacea*	B
Tundra swan (Whistling swan)	*Cygnus columbianus*	
Mute swan	*Cygnus olor*	B
Canada goose	*Branta canadensis*	B
Wood duck	*Aix sponsa*	B
American black duck	*Anas rubripes*	
Mallard	*Anas platyrhynchos*	B
Turkey vulture	*Cathartes aura*	B
Sharp-shinned hawk	*Accipiter striatus*	
Cooper’s hawk	*Accipiter cooperii*	B
Broad-winged hawk	*Buteo platypterus*	B
Red-tailed hawk	*Buteo jamaicensis*	B
American kestrel	*Falco sparverius*	B
Peregrine falcon	*Falco peregrinus*	B
Ring-necked pheasant	*Phasianus colchicus*	B
Killdeer	*Charadrius vociferus*	B
Greater yellowlegs	*Tringa melanoleuca*	
Lesser yellowlegs	*Tringa flavipes*	
Spotted sandpiper	*Actitis macularia*	B
Upland sandpiper	*Bartramia longicauda*	B
Common snipe	*Gallinago gallinago*	
American woodcock	*Sclopax minor*	B
Ring-billed gull	*Larus delawarensis*	
Herring gull	*Larus argentatus*	
Caspian tern	*Sterna caspia*	
Common tern	*Sterna hirundo*	
Rock dove	*Columba livia*	B
Mourning dove	*Zenaida macroura*	B
Black-billed cuckoo	*Coccyzus erythropthalmus*	B
Yellow-billed cuckoo	*Coccyzus americanus*	B
Eastern screech-owl	*Otus asio*	B
Great horned owl	*Bubo virginianus*	B
Northern saw-whet owl	*Aegolius acadicus*	
Common nighthawk	*Chordeiles minor*	B
Chimney swift	*Chaetura pelagica*	B
Ruby-throated hummingbird	*Archilochus colubris*	B
Belted kingfisher	*Ceryle alcyon*	B

Table 10.–Continued.

Common name	Scientific name	Breeding Status
Red-headed woodpecker	*Melanerpes erythrocephalus*	B
Red-bellied woodpecker	*Melanerpes carolinus*	B
Yellow-bellied sapsucker	*Sphyrapicus varius*	
Downy woodpecker	*Picoides pubescens*	B
Hairy woodpecker	*Picoides villosus*	B
Northern flicker	*Colaptes auratus*	B
Eastern wood-pewee	*Contopus virens*	B
Yellow-bellied flycatcher	*Empidonax flaviventris*	
Alder flycatcher	*Empidonax alnorum*	
Willow flycatcher	*Empidonax traillii*	B
Least flycatcher	*Empidonax minimus*	B
Eastern phoebe	*Sayornis phoebe*	B
Great-crested flycatcher	*Myiarchus crinitus*	B
Eastern kingbird	*Tyrannus tyrannus*	B
Tree swallow	*Tachycineta bicolor*	B
Northern rough-winged swallow	*Stelgidopteryx serripennis*	B
Bank swallow	*Riparia riparia*	B
Cliff swallow	*Hirundo pyrrhonota*	B
Barn swallow	*Hirundo rustica*	B
Blue jay	*Cyanocitta cristata*	B
American crow	*Corvus brachyrhynchos*	B
Black-capped chickadee	*Parus atricapillus*	B
Tufted titmouse	*Parus bicolor*	B
Red-breasted nuthatch	*Sitta canadensis*	
White-breasted nuthatch	*Sitta carolinensis*	B
Brown creeper	*Certhia americana*	B
Carolina wren	*Thryothorus lucovicianus*	B
House wren	*Troglodytes aedon*	B
Winter wren	*Troglodytes troglodytes*	
Golden-crowned kinglet	*Regulus satrapa*	
Ruby-crowned kinglet	*Regulus calendula*	
Blue-gray gnatcatcher	*Polioptila caerulea*	B
Eastern bluebird	*Sialia sialia*	B
Veery	*Catharus fuscescens*	B
Gray-cheeked thrush	*Catharus minimus*	
Swainson’s thrush	*Catharus ustulatus*	
Hermit thrush	*Catharus guttatus*	
Wood thrush	*Hylocichla mustelina*	B
American robin	*Turdus migratorius*	B
Gray catbird	*Dumetella carolinensis*	B
Northern mockingbird	*Mimus polyglottos*	B
Brown thrasher	*Toxostoma rufum*	B
Cedar waxwing	*Bombycilla cedrorum*	B
European starling	*Sturnus vulgaris*	B
Solitary vireo	*Vireo solitarius*	
Yellow-throated vireo	*Vireo flavifrons*	
Warbling vireo	*Vireo gilvus*	B

Table 10.–Continued.

Common name	Scientific name	Breeding Status
Philadelphia vireo	*Vireo philadelphicus*	
Red-eyed vireo	*Vireo olivaceus*	B
White-eyed vireo	*Vireo griseus*	B
Blue-winged warbler	*Vermivora pinus*	
Golden-winged warbler	*Vermivora chrysoptera*	
Tennessee warbler	*Vermivora peregrina*	
Orange-crowned warbler	*Vermivora celata*	
Nashville warbler	*Vermivora ruficapilla*	B
Northern parula	*Parula americana*	
Yellow warbler	*Dendroica petechia*	B
Chestnut-sided warbler	*Dendoica pensylvanica*	B
Magnolia warbler	*Dendroica magnolia*	
Cape may warbler	*Dendroica tigrina*	
Black-throated blue warbler	*Dendroica caerulescens*	
Yellow-rumped warbler	*Dendroica coronata*	
Black-throated green warbler	*Dendroica virens*	
Blackburnian warbler	*Dendroica fusca*	
Pine warbler	*Dendroica pinus*	
Palm warbler	*Dendroica palmarum*	
Bay-breasted warbler	*Dendroica castanea*	
Blackpoll warbler	*Dendroica striata*	
Black-and-white warbler	*Mniotilta varia*	
American redstart	*Setophaga ruticilla*	
Ovenbird	*Seiurus aurocapillus*	B
Northern waterthrush	*Seiurus noveboracensis*	B
Louisiana waterthrush	*Seiurus motacilla*	
Connecticut warbler	*Oporornis agilis*	
Mourning warbler	*Oporornis philadelphia*	
Common yellowthroat	*Geothlypis trichas*	B
Wilson’s warbler	*Wilsonia pusilla*	
Canada warbler	*Wilsonia canadensis*	
Scarlet tanager	*Piranga olivacea*	B
Northern cardinal	*Cardinalis cardinalis*	B
Rose-breasted grosbeak	*Pheucticus ludovicianus*	B
Indigo bunting	*Passerina cyanea*	B
Eastern (rufous-sided) towhee	*Pipilo erythrophthalmus*	B
American tree sparrow	*Spizella arborea*	
Chipping sparrow	*Spizella passerina*	B
Field sparrow	*Spizella pusilla*	B
Savannah sparrow	*Passerculus sandwichensis*	B
Fox sparrow	*Passerella iliaca*	
Song sparrow	*Melospiza melodia*	B
Lincoln’s sparrow	*Melospiza lincolnii*	
Swamp sparrow	*Melospiza georgiana*	
White-throated sparrow	*Zonotrichia albicollis*	
White-crowned sparrow	*Zonotrichia leucophrys*	
Dark-eyed junco	*Junco hyemalis*	

Table 10.–Continued.

Common name	Scientific name	Breeding Status
Bobolink	*Dolichonyx oryzivorus*	B
Red-winged blackbird	*Agelaius phoeniceus*	B
Eastern meadowlark	*Sturnella magna*	B
Common grackle	*Quiscalus quiscula*	B
Brown-headed cowbird	*Molothrus ater*	B
Baltimore oriole	*Icterus galbula*	
Orchard oriole	*Icterus spurius*	B
House finch	*Carpodacus mexicanus*	B
American goldfinch	*Carduelis tristis*	B
House sparrow	*Passer domesticus*	B

Table 11.–Mammals in the Rouge River watershed that use aquatic, wetland, or riparian habitats. Data from: O. Gelderloos, University of Michigan-Dearborn, T. Payne, Michigan Department of Natural Resources, Wildlife Division. Sitings: confirmed = C.

Common name	Scientific name	Sitings
Red fox	*Vulpes vulpes*	C
Gray fox	*Urocyon cinereoargenteus*	C
Raccoon	*Procyon lotor*	C
Muskrat	*Ondantra zibethicus*	C
Eastern mole	*Scalopus aquaticus*	C
Fox squirrel	*Sciurus niger*	C
Eastern cottontail rabbit	*Sylvilagus floridanus*	C
Eastern chipmunk	*Tamias striatus*	C
White-footed mouse	*Peromyscus leucopus*	C
Deer mouse	*Peromyscus maniculatis*	C
Meadow vole	*Microtus pennsylvanicus*	C
Mink	*Mustela vison*	C
Opossum	*Didelphis virginiana*	C
Red bat	*Lasarius borealis*	C
Big brown bat	*Eptesicus fuscus*	C
Southern flying squirrel	*Glaucomys volans*	C
White-tailed deer	*Odocoileus virginianus*	C
Ground hog	*Marmota monax*	C

Table 12.–Natural features of Rouge River watershed. Data from: Michigan Department of Natural Resources, Wildlife Division, Natural Features Inventory, November 7, 1995. Status Codes: E=endangered, T=threatened, SC=special concern (rare, may become E or T in the future). No species are federally listed. Blanks indicate that none of the categories are applicable.

Common name	Scientific name or feature	State status
Oakland County		
Novi Township		
Redside dace	*Clinostomus elongatus*	T
Showy orchis	*Galearis spectabilis*	SC
Great blue heron rookery		
Green violet	*Hybanthus concolor*	SC
Twinleaf	*Jeffersonia dyphylla*	SC
Sullivant's milkweed	*Asclepias sullivantii*	T
Prairie rose	*Rosa setegera*	SC
Dry-mesic southern forest		
Seedbox	*Ludwigia alternivolia*	T
Three-awned grass	*Aristida longespica*	T
Farmington Hills		
Redside dace	*Clinostomus elongatus*	T
West Bloomfield Township		
Pugnose shiner (Walnut Lk., 1906)	*Notropis anogenus*	SC
Dry-mesic southern forest		
Vasey's pondweed	*Potamogeton vaseyi*	T
Bloomfield Township		
American chestnut	*Castanea dentata*	E
Least shrew	*Cryptotis parva*	T
Washtenaw County		
Superior Township		
Champion tree, blue ash	*Fraxinus quadrangulata*	
Wayne County		
Plymouth & Northville Townships		
Redside dace	*Clinostomus elongatus*	T
Champion tree, wild crab apple	*Malus coronaria*	
Mesic southern forest		
Goldenseal	*Hydrastis canadensis*	T
Livonia		
Shellbark or kingnut hickory	*Carya laciniosa*	SC
Canton Township		
Compass-plant	*Silphium laciniatum*	T

Table 12. Continued.

Common name	Scientific name or feature	State status
Wayne County continued		
Detroit		
False pimpernel	*Lindernia anagallidea*	SC
Prairie trillium	*Trulluim recurvatum*	T
Northern madtom	*Noturus stigmosus*	E
T02S, R09E		
American chestnut	*Castanea dentata*	E
Champion tree, cottonwood	*Populus deltoides*	
T02S, R10E		
Cup-plant	*Silphium perfoliatum*	T
Prairie rose	*Rosa setigera*	SC
Champion tree, pin oak	*Quercus palustris*	
Compass-plant	*Silphium laciniatum*	T
T02S, R11E		
Northern madtom (mouth of river)	*Noturus stigmosus*	E
Showy orchis	*Galearis spectabilis*	SC
Cup-plant	*Silphium perfoliatum*	T

Table 13.–Composition of surface geology in Rouge River sub-watersheds. Calculated from the Quaternary Geology of Michigan (Michigan Rivers Inventory).

Sub-watershed	Percent by type						
	Lacustrine clay & silt	Lacustrine sand & gravel	Glacial outwash sand & gravel, and postglacial alluvium	Fine-textured glacial till	End moraines of fine-textured till	Medium -textured glacial till	End moraines of medium-textured till
Mainstem (above branches and Evans Ditch)	21	10	7	0	23	11	28
Mainstem @ mouth	34	35	4	1	12	3	11
Upper Rouge River	20	18	4	0	13	4	41
Middle Rouge River	21	17	12	3	19	5	23
Lower Rouge River	53	34	1	3	9	0	0

Table 14.–July 1994, temperature data from Rouge River and species specific temperature tolerances for selected fish species. Temperature data from Rouge Program Office. Temperature tolerances data from P. Seelbach, Michigan Department of Natural Resources, Fisheries Division.

Rouge River - July 1994, weekly temperature data				
Site name	Weekly average minimum	Weekly average maximum	Weekly average mean	Weekly flux (max-min)
Mainstem				
Adams Rd	20.3	26.5	23.3	6.2
Lahser Rd	21.0	27.3	24.1	4.7
Seven Mile Rd	18.2	21.7	19.9	2.6
Plymouth Rd	18.5	23.5	20.7	3.8
U of M Dearborn	20.0	23.8	21.8	3.8
Greenfield Rd	20.5	28.6	24.0	8.1
Upper Branch				
Powers Rd	16.8	22.5	20.1	5.8
Telegraph Rd	17.9	23.1	20.5	5.2
Bell Branch	18.2	23.0	20.8	4.8
Middle Branch				
Nine Mile Rd	20.8		23.3	3.0
Johnson Drain	15.0	20.5	17.6	5.6
Hines @ Merriman	19.9	25.9	22.7	6.0
Hines @ Ford Rd	20.9	24.3	22.5	3.4
Lower Branch				
Beck Rd	18.1	23.1	20.5	4.9
Fellows Ck	17.9	23.0	20.2	3.9
Wayne Rd	19.3	23.6	21.1	4.3
Military Rd	18.6	23.6	21.0	5.1

Species specific temperature tolerances		
Species	July mean temperature (C)	Weekly flux (max - min)
Brown trout	<18-19	<6
Smallmouth bass	>21-22	<10-11
Rockbass	>20-21	<12
Mottled sculpin	<22	<8

Table 15.–Rouge River mainstem, branches, and tributaries cross-section data summary. Expected width was calculated using Rouge Program Office (RPO) data. Hydraulic diversity index was calculated using the Shannon-Weiner diversity index. *Denotes RPO station. RPO mean daily discharge is actually mean hourly discharge for April-November, 1994. Data at M1003501 was analyzed to determine if mean hourly flow (from Rouge Program Office) differed from mean daily flow (from USGS data). Difference of 0.4 cfs was determined not to be significant, therefore, RPO data will be considered mean daily discharge for all stations.

River	Location	Actual width (ft)	Mean daily discharge (cfs)	Expected width (ft)	Hydraulic diversity index
Mainstem	Adams Rd. in Troy*	31.0	12.4	19.34	0.64
Mainstem	Maple Rd. in Birmingham	32.0	26.2	28.08	0.57
Mainstem	Lahser Rd. in Beverly Hills*	42.5	33.8	31.88	0.82
Mainstem	Plymouth Rd. in Detroit	69.0	139.0	64.52	0.79
Mainstem	Ford Estate in Dearborn*	100.0	251.6	86.72	1.00
Upper Rouge	Shiawassee Rd. in Farmington	32.0	14.4	20.84	0.80
Upper Rouge	Telegraph Rd. in Redford*	42.5	55.6	40.86	0.71
Middle Rouge	Nine Mile Rd. in Novi*	55.0	19.8	24.42	0.75
Middle Rouge	Newburgh Lk. Outlet*	49.0	43.0	35.95	0.56
Middle Rouge	Hines Drive near Merriman*	55.0	71.4	46.29	0.73
Middle Rouge	Inkster Rd. in Dearborn Hts.	45.5	76.5	47.91	0.83
Middle Rouge	Hines Drive near Ford Rd.*	73.0	89.2	51.72	0.45
Lower Rouge	Beck Rd. in Canton*	31.0	13.2	19.95	0.79
Lower Rouge	John Daly Rd. in Inkster	56.5	42.2	35.61	0.81
Lower Rouge	Military Rd. in Dearborn*	52.5	45.9	37.14	0.90
Johnson Drain	Seven Mile Rd. near Sheldon Rd.*	28.0	12.5	19.42	0.56
Bell Branch	Beech Daly Rd. in Redford*	45.0	34.9	32.40	0.86

Table 16. Information on Rouge River dams and impoundments, from upstream to downstream within each branch. Data from: Michigan Department of Environmental Quality, Land and Water Management Division, 1995. Blanks indicate data was unavailable. Date = construction year.

Dam	River	Date	Head (ft)	Owner	Surface acres	Storage (acre-ft)
Mainstem						
Lake Charnwood	Sprague Br. Rouge R.		3	Private	5	0
Northfield Hills	Rouge River		5	Private	6	norm=12
Oak River Sub #2	Rouge River	1981	2	Private	5	max=20
Vhay Lake	Amy Drain	1966	11	Private	14	max=140
Lovett	Rouge River		7	Private	2	0
River Rouge #1	Rouge River		3	Private	1	0
Cranbrook Lk. Upper #2	Rouge River		8	Private	9	norm=29
Cranbrook Lk. Upper #1	Rouge River		5	Private	9	norm=18
Cranbrook Lk. Lower	Rouge River		3	Private	9	norm=11
Cranbrook Foundation	Rouge River		3	Private	1	0
Endicott Lake	Tr. - Rouge River	1913	11	Private	9	max=200
River Rouge #2	Rouge River		3	Private	1	0
Quarton	Rouge River	1921	15	Local Govt.	25	max=100
R. Rouge USGS Control	Rouge River	1962	1	Private	1	0
Erity Mill Pond	Rouge River	1913	11	Private	27	max=200
Franklin Drain	Franklin Drain		1	Private	1	0
Franklin Drain #2	Franklin Drain		2	Private	2	0
Waldon Pond	Inlet Wing Lake		0	Private	2	max=22
Franklin Drain	Franklin Drain		2	Private	2	0
Meadow Lake	Franklin Drain		9	Private	10	0
Woodcreek Hills	Pebble Creek		6	Private	1	0
Lake Genesareth	Tr. - Pebble Creek		11	Private	4	norm=18
Outwood Sub	Tr. - Rouge River		0	Private	5	0
Sisters of Mercy	Tr. - Rouge River		9	Private	2	max=12
Ray Dam	Tr. - Rouge River		0	Private	3	0
Ford Estate	Rouge River	1909	12	Private	13	max=75
Upper						
Applebrook Detention #1	Tr. - Seeley Drain	1981	7	Private	2	max=10
Farmington Venture Pd.	Tr. - Seeley Drain	1979	7	Private	7	max=28
San Marino Golf Club	Seely Ditch	1967	2	Private	1	0
Old Hamestead	Seely Ditch		1	Private	1	0
Northbrook Gardeners	Seely Ditch		1	Private	1	0
Upper R. Rouge USGS	Upper Rouge River	1959	0	Private	1	0
Dunn-Rovin Golf Course	Bell Br. Rouge R.		3	Private	2	0
Meadowbrook Retention	Tr. - Bell Creek	1979	8	Private	1	max=5
Glen Eden Cemetery	Bell Br.Rouge R.		4	Private	2	0
Meadowhills Pd N.	Tr. - Tarabusi Creek	1978	5	Private	2	
Meadowhills Pd S.	Tr. - Tarabusi Creek	1978	6	Private	2	
Meadowglen Storm Ret.	Tr. - Tarabusi Creek	1977	7	Private	6	max=21

Table 16.–Continued.

Dam	River	Date	Head (ft)	Owner	Surface acres	Storage (acre-ft)
Middle						
Twelve Oaks Mall	Basset Drain	1976	4	Private	36	max=245
Crestwood Mannor Det.	Tr. - Johnson Drain	1990	0	Private	1	
Heather Lake	Tr. - Walled Lake	1978	10	Private	7	norm=26
Northville Yerkes Pond	Walled Lake Branch		7	Private	6	norm=3
Silver Spring Lake	Silver Spr. Lk. Outlet	1978	4	Private	15	max=112
Northville Imp. Basin	Walled Lake Branch		2	Private	2	
Maybury State Park	Tr. - Johnson Drain	1979	11	State	9	max=106
N. Beacon Hill Storm Ret.	Tr. - Johnson Drain		12	Private	1	max=6
Waterford	Middle Br. Rouge R.	1925	18	Private	35	max=250
Meads Mill	Middle Br. Rouge R.		3	County	1	0
Phoenix	Middle Br. Rouge R.	1920	35	County	35	max=450
Wilcox	Middle Br.Rouge R.	1933	19	County	12	max=120
Newburgh	Middle Br. Rouge R.	1933	18	County	114	max=125
Nankin Mill	Middle Br. Rouge R.	1921	14	County	25	max=140
Willow Creek	Willow Creek		2	Private	4	0
Ridgewood Hills Ret.	Tr.-S Br Tonquish Ck		8	Private	2	max=9
Plymouth Twp. Pond	S. Br. Tonquish Creek	1978	15	Local Govt.	2	max=35
Walkers Dam	Tr. - Tonquish Creek		7	Private	3	
Lower						
Trib. to Lower Rouge R.	Trib. to Lower Rouge		0	Private	2	0
Superior Dev. Co.	Trib. to Lower Rouge		0	Private	2	0
Jones	Trib. to Lower Rouge		0	Private	2	0
Fellows Creek	North Br. Fellows Ck.		0	Private	40	0
North Branch Fellows Ck.	North Br. Fellows Ck.		0	Private	2	0
Wayne Road	Lower Rouge River		3	County		

Table 17.–Estimated number of channel crossings of the Rouge River. Data from: S. Perry, Southeast Michigan Council of Governments, 1995.

Water body	Residential	County	Highway	Railway
Mainstem and major branches	130	209	52	51
Tributaries	789	525	138	56
TOTAL	919	734	190	107

Table 18.–State and federal statutes administered by Michigan Department of Environmental Quality that protect the aquatic resource. N.R.P. Act=Natural Resources and Environmental Protection Act.

State of Michigan Acts	Previous statute
Land and Water Management Division	
Public Health Code (1978 PA 386, as amended)	Amendments to Aquatic Nuisance Control Act (PA 86, 1977)
Part 13 N.R.P. Act (1994 PA 451)	Floodplain Regulatory Authority (PA 167, 1968)
Part 91 N.R.P. Act (1994 PA 451)	Soil Erosion and Sedimentation Control Act (PA 347, 1972)
Part 301 N.R.P. Act (1994 PA 451)	Inland Lakes and Streams Act (PA 346, 1972)
Part 303 N.R.P. Act (1994 PA 451)	Wetland Protection Act (PA 203, 1979)
Part 307 N.R.P. Act (1994 PA 451)	Inland Lake Level Act (PA 146, 1961)
Part 309 N.R.P. Act (1994 PA 451)	Inland Lake Improvement Act (PA 345, 1966)
Part 315 N.R.P. Act (1994 PA 451)	Dam Safety Act (PA 300, 1989)
Part 323 N.R.P. Act (1994 PA 451)	Shoreland Protection and Management Act (PA 245, 1970)
Part 325 N.R.P. Act (1994 PA 451)	Great Lakes Submerged Lands Act (PA 247, 1955)
Part 341 N.R.P. Act (1994 PA 451)	Irrigation District Act (PA 205, 1967
Surface Water Quality Division	
Part 31 N.R.P. Act (1994 PA 451)	Water Resources Commission Act (PA 245)
Waste Management Division	
Part 41 N.R.P. Act (1994 PA 451)	Sewage Disposal and Waterworks System Act (PA 98)

US Federal Acts
Federal Water Pollution Control Act, Section 314 (PL 92-55)
Coastal Zone Management Act (PL 92-583, 1972)
Clean Water Act, Section 404 (PL 95-217)
River and Harbor Act, Section 10 (1899)
Coastal Energy Impact Program (PL 92-538)

Table 19.–Designated drains in Rouge River, by county and township. Information provided by each county drain office. Drains located in more than one community are listed in headwater community.

Oakland County

Avon Township., T3N,R11E
- Borden
- Chester
- Gabler
- Jensen
- Lueders
- Robert J. Evans
- Sprague Branch & Extension
- Sprague No. 2
- Taylor

Bloomfield Township, T2N,R10E
- Acacia Park
- Amy
- Bloomfield Village No. 2
- Bloomfield-Highlands
- Case
- Daly
- Devonshire
- Earlmoore
- Fisher
- Hamlin
- Hayward
- Law
- Levinson
- Luz Relief
- Lynn D. Allen
- Murphy
- Nichols
- Oak Knob
- Sunken Bridge
- Triple
- Twin Oaks
- Waldron

Novi, T1N,R8E
- Davis
- Francis
- Randolph Street (Inter-county)
- Seeley
- Townline

Southfield, T1N,R10E
- Austin
- Brennan
- Carr-Killian (Inter-county)
- Claire
- Duns Scotus
- Eight Mile Rd.
- Emily
- Evans
- Evergreen Road Storm
- Fracassi
- Franklin
- Griffin
- Gronkowski
- Hollander
- Jilbert
- Lathrup Townsite
- Martha Washington
- McClung
- McDonnell
- McKinley
- Morgan
- Murray
- Northwestern
- O'Donoghue
- Owens
- Perinoff
- Peterson
- Rummell Relief
- Santa Ann
- Sherman
- Snyder
- Southfield No. 1
- Southfield Road
- Stewart Relief
- Wagner
- Wilcox

Table 19.–Continued.

Oakland County continued

West Bloomfield Township, T2N,R9E
- Aspen Ridge Condominiums
- Autumn Ridge
- Bloomfield Glens Health Center
- Chimney Hill Apartments
- Chimney Hill Apartments Branch No. 1
- Crown Center
- Deconick Branch No. 1
- Deconick Branch No. 2
- Deconick
- Dorothy Webb
- Drakeshire Condominium
- Edwards Relief
- Edwards Relief Branch No. 1
- Edwards Relief Branch No. 2
- German
- Graves
- Greenpointe Condominium
- Greenpointe Condominium Br. No. 1
- Kemp
- Kollar
- Maple Park Office Center
- Maple Place Condominium
- Maple Place Villas
- Maple Place Woods
- Maple West Retail Center
- Mapleridge Condominium
- Maplewoods North Sub'n Branch No. 1
- Maplewoods North Sub'n Branch No. 2
- Maplewoods North Subdivision
- McIntosh
- Mullen
- Oakbrooke Condominium
- Perrytown Estates
- Powers
- Professional Village of West Bloomfield
- Ravines of West Bloomfield
- Royal Pointe
- Royal Pointe Branch No. 1

West Bloomfield Twp., T2N,R9E continued
- Royal Pointe Branch No. 2
- Royal Pointe Branch No. 3
- Sherwood Creek Cluster Homes
- Silverbrook Villa Apartments
- Silverbrook Villa Apartments Br. No. 1
- Simsbury Condominium
- Simsbury Plaza
- Stonebridge
- The Arbors of West Bloomfield
- Thornberry
- Thornberry Branch No.1
- Walnut Hills of West Bloomfield
- Walnut Woods Apartments
- Ward
- Westbrooke
- Westwood Park
- Woodcliff on the Lake

Troy, T2N,R11E
- Sprague

Farmington, T1N,R9E
- Caddell
- Clarenceville Ext.
- Courter
- Coy
- Hazel
- Minnow Pond
- Oakland Hills Orchard
- Oxford Ave.
- Pearl Street
- Ten Mile - Rouge Sanitary
- Tulane
- U.S. 16

Table 19.–Continued.

Washtenaw County

Salem Township, T1S,R7E
- Atchison
- Beacon Farms Subdivision
- Ingalls
- Johnson (Inter-county)
- North Branch Salem Village #2
- Salem #1
- Salem and Plymouth (Inter-county)
- Salem Village Tile
- Salem Village Tile #2

Superior Township, T2S,R7E
- Bazely Foster
- Clark Lane
- Crippen
- Furlong
- Geddes Ridge
- Kimmel
- Meinzinger
- Murray and Geer
- North Branch Kimmel #2
- North Branch Kimmel #3
- Sines & Arnold (Inter-county)
- Ypsilanti Township Drain #6

Wayne County

Allen Park
- Allen
- Tyre

Canton
- Barker
- Bradner Improvements
- Deer Creek Improvements
- Elliott
- Fellows Creek, North Branch
- Fellows Creek, South Branch
- Goodell
- Green & Branches
- Hannan & Ext.
- Holley
- Hunter
- Hunter Leng & Branches
- Huston
- Huston, N. Branch
- McKinney Tile
- Monroe
- Mott
- Newton
- Oakview
- Pattengill
- Rich
- Schuart
- Stevens
- Travis
- Truesdell
- Wiles

Dearborn
- Dudley
- Kirk Lateral of Red Run

Dearborn Heights
- Annis Hawthorne Sub. Tile
- Bonaparte Tile
- Conley Tile
- Dearborn Hts. Retention Basin
- Ecorse Creek Pool Abate Dr. #3
- Kennedy
- Kinmore Storm
- Lefler Ready Sanitary
- Lefler Storm Water
- Lehigh Storm Water
- Lenore Storm & Sanitary
- Lukaszewicz Tile
- Mayburn Tile
- Military Hills
- Pennie Storm Tile
- Presley
- Watsonia Heights
- Watsonia Park

Detroit
- Detroit #1 & Branches
- Fox Creek
- Fox Creek Enclosure
- No. 1 Shaft

Table 19.–Continued.

Garden City
- Bills
- Garden City Moeller
- Lathers & South Branch
- Mid-town
- Red Run, S. Branch of
- Red Run, N. Branch of
- Bills Tile
- Stewart

Highland Park
- Conner Creek Improvements
- Ford-Victor Relief
- Monterey-California Relief

Inkster
- Bayhan & Extension
- Inkster Retention Basin
- Lucas Storm
- Phipps Interceptor
- Phipps, Branch of
- Ready Storm Water
- Westwood Tile

Livonia
- Barlow
- Beitz
- Bell & Branch
- Bell & N. Branch
- Blue
- Blue Ex. & Br.
- Clarenceville Tile (IC)
- Cransen
- Dawson Tile
- Farmington Relief Ext. #1
- Farmington Road Storm Relief
- Five Elms
- Gates
- Gunn Br. of Patter
- Hale Tile
- Hanley
- Hawkins
- Hawkins, Br. of
- Lindsay
- Livonia
- Livonia Basin
- Livonia #1
- Livonia #1 Ext. & Branches

Livonia continued
- Livonia #2
- Livonia #2 Branches
- Livonia #5 Branches
- Livonia #6 Ext. & Branches
- Livonia #10 Ext. & Branches
- Livonia #11
- Livonia No. 11 Extensions
- Livonia No. 12
- Livonia No. 12 Branches
- Livonia No. 13
- Livonia No. 13 Ext. & Branches
- Livonia No. 16
- Livonia No. 16 Ext. & Branches
- Livonia No. 17
- Livonia No. 19
- Livonia No. 19 Extension
- Livonia No. 20
- Livonia No. 21
- Livonia No. 22
- Livonia No. 22 Ext. & Branches
- Livonia No. 25
- Livonia No. 26
- Livonia No. 27 & Branches
- Livonia No. 28 & Branches (Pickford)
- Livonia No. 29 & Branches
- Livonia No. 30
- Livonia No. 31
- Livonia No. 33
- Livonia No. 35 Branches
- Livonia No. 36
- Livonia No. 37
- Livonia No. 38
- Livonia No. 39 & Branches
- Livonia No. 41
- Livonia No. 42
- Livonia No. 43 & Extensions
- Livonia No. 44
- Livonia No. 45
- Livonia No. 46
- Livonia No. 47
- Livonia No. 48
- Livonia No. 49
- Mahoney Br. of Patter
- Middlewood Tile
- Neumann
- Newburg Tile
- Patterson

Table 19.–Continued.

Wayne County continued

Livonia continued
- Pickford
- Ryder
- Tarabusi Tile, Lateral to
- Wolfram

Nankin
- Corey

Northville
- Bakewell
- Bell Cr. Middle of Rouge
- Sump (Inter-county)

Northville Township
- Huff
- Sly

Plymouth
- Bassett
- Bradner
- Deer Creek
- Fellows Creek
- Green Meadows Tile
- Koss
- Tonquish Creek
- Willow Creek
- Wnuk Tile

Plymouth Township
- Butternut Tile
- Eastlawn Tile
- Eaton
- Gasper
- Palmer Acres
- Plymouth #1 Ext. of Br# 1
- Plymouth Gardens
- Plymouth Twp. #1
- Plymouth Twp. #2
- Tonquish Creek #1

Redford Township
- Redford Retention Basin

Redford
- Bigelow
- Campbell
- Centralia
- Kingsboro San. & Storm
- MacArthur Storm & Sand
- Negaunee Storm
- Norborn Redford Lateral
- Prindell & Branch
- Probst
- Redford Consolidated
- Rone
- Shaw & Branch
- Thomas
- Tuttle #1
- Tuttle #2
- Wolf Tile

River Rouge
- River Rouge CSO Basin

Romulus
- Austin & Corey
- Barton
- Boice Extension
- Brower
- Corey, Branch of McClaugherty
- Crocker
- Delaney & Branch
- Edmonds Creek
- Evans
- Freeman
- Gamong Br. McConologue
- Gordionier
- Karen
- Martin
- McConologue
- McBride and Branches
- McGee
- Moore Branch of Barlow
- Post
- Rawson
- Trouton
- Wilbur

Table 19.–Continued.

VanBuren
- Apple Run
- Austin
- Ayers
- Begole,Br. of Quirk, West
- Bell Creek
- Bingel
- Cooper & Dean & Br.
- Cooper & Fey
- Crawford
- Denton & Branch
- Durham
- Fisher & Lenge
- French & Post
- Hanshaw
- Horner
- Leonard
- McClaugherty
- McConnell
- McKinstry S. Branch
- McKinstry
- Post & Branch
- Post - Robson
- Robinson
- Rowe
- Smith
- Smock & Spear Br. Cooper
- Strong
- Sugar
- Wallace
- Winslow
- Yost Branch of McKinstry

Wayne County
- Bradshaw (Inter-county)
- Rouge R. (Inter-county) N. of Michigan
- Washtenaw/Wayne (Inter-County)

Westland
- Alexander
- Bailey
- Barnes
- Budlong
- Butler
- Carver
- Christine
- Cummings
- Erdman
- Flynn
- Garling
- Leng & Branches (E & W Branch)
- McFee
- Meldrum
- Meldrum N. Branch
- Milo
- Moore
- Morgan
- Murdock
- Osband
- Perrin
- Perrin No. Br & Ext
- Perrin So. Br. of So. Br.
- Perrin So. Br.
- Rice
- Schumann & Branches
- Slatton
- Straight N. Br. & Venoy Br.
- Straight S. Br.
- Venoy
- Westland Cons. #1
- Westland Cons. #2
- Wilson
- Wright

Table 20.–National Pollution Discharge Elimination System permits issued in the Rouge River watershed by Michigan Department of Environmental Quality, Surface Water Quality Division. Additionally, there are 472 stormwater discharge permits.

Facility	NPDES permit no.	Location	Comments
Amoco Oil Co-Livonia	MI0048771	Livonia	
Amoco Oil Co-River Rouge	MI0002283	River Rouge	
Amoco Oil Co-Southfield	MI0049883	Southfield	
Amoco-Plymouth-W Ann Arbor Tr	MI0051632	Plymouth	Tonquish Creek
Beverly Hills CSO	MI0037427	Beverly Hills	1 CSO w/retention basin
BFI-Northville	MI0045713	Northville	Johnson Creek
Birmingham CSO	MI0025534	Birmingham	33 CSOs & 1 retention basin
Bloomfield Hills CSO	MI0025461	Bloomfield Hills	2 CSOs
Bloomfield Village CSO	MI0048046	Bloomfield	2 CSOs & 1 retention basin
BMC Manufacturing Inc	MI0005789	Plymouth	Middle Rouge River
BP Oil Company	MI0046264	Taylor	
Browning Ferris Industry	MI0045713	Northville	Middle Rouge River
Buckeye Pipeline-Plymouth	MI0049255	Plymouth	Middle Rouge River
Buckeye Pipeline-Wayne	MI0046205	Wayne	
Commerce Twp WWTP	MI0025071	Walled Lake	3 outfalls
Dearborn CSO	MI0025542	Dearborn	20 CSOs & 1 retention basin
Dearborn Heights CSO	MI0051811	Dearborn Hts	
Detroit Diesel Corp	MI0001759	Detroit	
Detroit WWTP	MI0022802	Detroit	32 CSOs
Dow Corning Corp-Auto Dev Ctr	MI0050245	Plymouth	
Eppert Oil Company	MI0054658	Detroit	
Evans Assets Holding Co	MI0047210	Plymouth	
Ford-Mich Truck Plt	MI0003387	Wayne	Lower Rouge River
Ford-Rouge Mfg Complex	MI0003361	Dearborn	Rouge River
Ford-Wayne Assembly Plt	MI0046183	Wayne	
GM-CPC-Romulus Engine	MI0039039	Romulus	
GM-Delco Prod Div-Livonia	MI0000965	Livonia	Middle Rouge River
GM-Inland Div-Livonia Trim Plt	MI0000973	Livonia	Middle Rouge River
Hayes Wheels Intl Inc-Romulus	MI0035602	Romulus	
Hygrade Food Products	MI0038610	Livonia	
Inkster CSO	MI0047601	Inkster	10 CSOs, 1 retention basin
Inkster/Dearborn Heights CSO	MI0051837	Inkster	
IPMC Inc	MI0000949	Detroit	
Johnson Controls-Whitmore Lake	MI0003212	Dearborn	
Livonia CSO	MI0051802	Livonia	
Livonia/Redford Twp CSO	MI0051586	Livonia	
Marblehead Lime Co	MI0003344	River Rouge	
Michcon-River Rouge Sta	MI0003336	Melvindale	
Mobil Oil Corp-Farmington Hill	MI0050521	F. Hills	Rouge River

Table 20.–Continued.

Facility	NPDES permit no.	Location	Comments
Norfolk & Western RR	MI0027626	Melvindale	
Oakland Co DPW-Farm Evergr CSO	MI0037621	Pontiac	3 CSOs
Oakland Co-Walled Lk/Novi WWTP	MI0024287	Novi	Finley Drain
Polymeric Protective Linings	MI0043117	Livonia	
Power & Utility Op-Rouge Cplx	MI0050903	Dearborn	Rouge River
Redford Twp CSO	MI0051829	Redford	2 CSOs
River Rouge CSO	MI0028819	River Rouge	
Robert Bosch Corp	MI0046426	F. Hills	
Rouge-Power & Utility Oper.	MI0050903	Dearborn	
Rouge Steel Co	MI0043524	Dearborn	
Rouge-USX Corp-Double Eagle	MI0044415	Dearborn	Rouge River
Shell Oil Co-Detroit	MI0000469	Detroit	Rouge River
Shell-Orchard Lk-Orchard Lk Rd	MI0051934	Orchard Lake	
Solder Craft Inc	MI0036081	Plymouth	
Steel Technologies Inc	MI0053775	Canton	
Sun-Westland-N Wayne Road	MI0051926	Westland	
Unisys Corp-Plymouth Plt	MI0002275	Plymouth	Rouge River
VIP Car Wash	MI0049140	Dearborn Hts	
Wayne Co-Rouge Valley CSO	MI0026123	River Rouge	2 CSOs
Wayne Co/Garden Cty/Westld CSO	MI0051543	Garden City	2 CSOs
Wayne Co/Inkster CSO	MI0051471	Inkster	9 CSOs, 1 retention basin
Wayne Co/Inkster/Drbrn Hts CSO	MI0051462	Dearborn Hts	2 CSOs
Wayne Co/Livonia CSO	MI0051551	Livonia	3 CSOs
Wayne Co/Livonia/Westland CSO	MI0051560	Westland	
Wayne Co/Plymouth Twp CSO	MI0051578	Plymouth	2 CSOs
Wayne Co/Rdfrd/Livonia CSO	MI0051535	Livonia	1 CSO, 1 retention basin
Wayne Co/Redford Township CSO	MI0051527	Redford	9 CSOs, 1 retention basin
Wayne Co/Wayne CSO	MI0051519	Wayne	3 CSOs, 1 equalization basin
Wayne Co/Westland CSO	MI0051497	Westland	
Wayne Co/Westland/Wayne CSO	MI0051501	Wayne	1 CSO
Wayne Co/WTUA/Plymouth Twp CSO	MI0051594	Plymouth	4 CSOs
Ypsilanti Community Utilities Auth.	MI0042676	Ypsilanti	Lower Rouge, 1 retent. basin
Treated Groundwater Discharges			
Amoco Oil Co-Farmington Hills	MIG990229	F. Hills	Rouge River
Amoco Oil Co-Walled Lake	MIG990151	Walled Lake	
Amoco Oil Co-West Bloomfield	MIG990166	W. Bloomfield	Franklin Drain
Amoco Oil Co-Westland	MIG990005	Westland	Middle Rouge River
GM-Parts-Belleville	MIG990246	Belleville	Ayres Drain

Table 21.–Combined sewer overflows in the Rouge River watershed, by subwatershed, as of 1995.

City or township	NPDES permit number	Location
Mainstem (MAIN-1)		
Beverly Hills	MI0037427	Evergreen 400' N of Beverly
Birmingham	MI0025534	N of Big Beaver E of Woodward-E Bank
		Henley extended E of Woodward-E Bank
		Henley extended E of Woodward-E Bank
		E of Hunter-S Bank
		E of Woodward S of Harmon-S Bank
		Under Woodward-S Bank
		Under Woodward-N Bank
		Bonnie Brier extended-N Bank
		across & downstream of 008
		Tooting Ln extended-N Bank
		Under Willits-E Bank
		Under Willits-W Bank
		W of Southfield N of Maple-S Bank
		Under Baldwin-N Bank
		Willow Ln extended S of Raynale-N Bank
		Pine extended
		Harmon extended
		Under Maple-W Bank
		Hawthorn NE Hawthorne-Aspen Int-W Bank
		Hawthorne at Aspen-W Bank
		Wallace extended-E Bank
		N of Lincoln E of Shirley-W Bank
		Under Lincoln-E Bank
		Under Lincoln-W Bank
		N of Northlawn Dr-W Bank
		S of Northlawn-E Bank
		Northlawn south of 026-E Bank
		Larchlea extended S of Northlawn-N Bank
		Tooting Ln extended-N Bank W of 010
		N of Willits E of Greenwood-W bank
		N of Maple SE of Millrace ext-S Bank
		Under Maple-E Bank
		Hawthorne E of 019-W Bank
Birmingham	MI0048046	Lincoln and Lahser
		Cranbrook N of 14 Mile
Bloomfield Hills	MI0025461	Cranbrook & Lone Pine
		330 ft S of Outfall 001

Table 21.–Continued.

City or township	NPDES permit number	Location
Mainstem (MAIN-1) continued		
Detroit	MI0022802	Ray & R River
		Lyndon & R River
		Fenkell & R River
		Puritan & W Shore R River
		Puritan & Rouge River (E Shore)
		Florence & R River
		W McNichols & R River
		Glenhurst & R River
		W 7 Mile & R River (W Shore)
		W 7 Mile & R River (E Shore)
		Frisbee & W Shore R River
		Frisbee & E Shore R River
Mainstem (MAIN-2)		
Dearborn Heights	MI0051489	Bonaparte Tile-Joy & Hazelton W Parkway
Detroit	MI0022802	Jeffries Fwy, I-96 & R River
		W Warren & R River
		Tireman & R River
		W Chicago & Middle Rouge (E Shore)
		W Chicago & Middle Rouge (W Shore)
		Plymouth & R River
		Rouge Park Golf Course
		Lahser & R River
		Jeffries Fwy, I-96 & R River
Redford Township	MI0051527	W Chicago & Grayfield-E Bank
Redford Township	MI0051829	Orange Lawn at Woodbine
Mainstem (MAIN-3)		
Dearborn	MI0025542	500' NE of Cherry Hill-W Bank
Mainstem (MAIN-4)		
Detroit	MI0022802	S Fort St & R River (W Shore)
		S Fort St & R River (W Shore)
		Sothfld Fwy & Middle Rouge
		Miller Rd & W Fort St
		Cary & R. River
		Dearborn St & R River
		Pulaski & R River
		Carbon & R River
		Flora & R River
		W Fort St & R River (E Shore)
		Sanders & Liddesdale

Table 21.–Continued.

City or township	NPDES permit number	Location
Mainstem (MAIN-4) continued		
Detroit	MI0025542	Greenfield Village-W Bank
E. Dearborn Dists.	MI0025542	Miller Pump Station 1000' S of Dix
Dearborn	MI0025542	1625' N of Rotunda-W Bank
		S of Rotunda-E Bank
		Michigan at Greenfield
		Ford Motor Co. Turning Basin
Rouge Valley	MI0026123	Wayne County Connection to Detroit Sewer Syst
River Rouge	MI0028819	100' W of Jefferson-S Bank
Upper Rouge River		
Redford	MI0051829	Lola Dr at Beech Daly Rd
Redford Township	MI0051527	Puritan W of Beech Daly-N Bank
		Beech Daly & Lola-N Bank
Redford/Livonia	MI0051535	Wakenden & Lola S of 6 Mile-N Bankl
Bell Branch		
Redford Township	MI0051527	Inkster, Denby & Keeler extended-E Bank
		Ross & Sarasota extended-S Bank
		Graham & Sarasota extended-S Bank
		Ross 800' W of Beech Daly-S Bank
		Meadowbrook E of Inkster
		S of 5 Mile E of Meadowbrook
Dearborn Heights	MI0051489	Ford E of Belmont extended-S Bank
		Edward Hines and Parkland extended-N Bank
		Bonaparte Tile-Edward Hines & E of Warrendale
		Mayburn Tile-W of Telegraph N of Warren
		Edward Hines & Wormer extended-N Bank
		Conley Tile-Rouge River Dr & Fenton extended
		Rouge River & Silvery Ln extended-S Bank
		E of Beech Daly-E Bank
Middle Rouge River		
Dearborn Heights	MI0051811	Rouge River Dr & Gulley ave
Garden City	MI0051543	W of Middlebelt & Hines-S Bank
		E of Merriman Warren extended
Livonia	MI0051551	S of Ann Arbor W of Edward Hines
		Newburgh Tile-Ann Arbor & Levan extended
Livonia	MI0051560	W of Merriman-N Bank Old Parkway Plant
Livonia	MI0051802	Middle Belt Rd & Elmira Dr
NW Wayne Co.	MI0026123	W of Edward Hines N of Ford Rd-N Bank
Plymouth Twp.	MI0051578	Butternut extended-S Bank Robinson I
		Edward Hines & Brownell-S Bank Robinson II

Table 21.–Continued.

City or township	NPDES permit number	Location
Middle Rouge River continued		
Plymouth Twp.	MI0051594	Northville Road at Phoenix Lake, Schoolcraft & 5 Mile Road
		Edward Hines E of Riverside-S bank
		E of Northville S of Edward Hines
		Northville Rd at Phoenix Lk
Westland	MI0051497	E of Merriman Road, N Bank-across Parkway Regulator
Westland	MI0051551	Edward Hines 1400' W of Inkster Wilson Drain
Lower Rouge River		
Dearborn	MI0025542	E of Telegraph-S Bank
		E of Telegraph-N Bank
		Silvery Ln W of Telegraph-N Bank
		Silvery Ln W of Telegraph-S Bank
		Michigan Ave 625' W of Telegraph-S Bank
		1000' W of Outer Dr Trenton-Terrace Ext-N Bank
		E of Outer Dr-N Bank
		W of Outer Dr-S Bank
		Alexandriene at Reginald extended-N Bank
		E of Military-S bank
		E of Morley-W Bank
		E of Garrison-S Bank
		Brentwood extended-N Bank
Dearborn Heights	MI0051489	E of Beech Daly and Michigan
Inkster	MI0047601	Arlington extended
		400' W of John Daly
		Meadowbrook extended
		E of Middlebelt-N Bank
		W of Beech Daly Meadowdale Storm Sewer
Inkster	MI0051462	Beech Daly and Avondale
		W of Beech Daly at Michigan
Inkster	MI0051471	Franklin extended-S Bank
		E of John Daly-S Bank S River Park
		Michigan Ave and Sylvia
		E of Middlebelt-N Bank Buckingham
		Phipps Interceptor-600' E of Inkster W Rd extended
		E of River Park at Crescent-W Bank Inkster Park
		W of Inkster Magnolia extended-N Bank

Table 21.–Continued

City or township	NPDES permit number	Location
Lower Rouge River continued		
Inkster continued		E of John Daly-S Bank Hills Dr
		Andover & Burton
Inkster	MI0051837	W of Beech Daily N of Princeton
Wayne	MI0051501	SE of 4 St-N Bank Glenwood
Wayne	MI0051519	Michigan Ave & Venoy-S Bank
		Michigan Ave at Sims-S Bank Wayne Chamber
		Adele,Winfred extended S Bank

Table 22.–Act 307 sites in the watershed, by county, 1995. Data from: Michigan Department of Environmental Quality, Environmental Response Division. Acronyms: BTEX=benzene, toluene, ethylbenzene, and xylene; DCA=Dichloroethane; 1,1-DCA=isomer of previous; DCE=dichloroethylene; 1,2-DCE=isomer of DCE; DDE=Dichlorodiphenyldichloroethylene; DDT=Dechlorodiphenyltrichloroethane; MTBE=Methyl tertiary butyl ether; PCB=Polychlorinated biphenyl; PCE or PERC=Perchloroethylene; PNAs=Polynuclear Aromatic Hydrocarbons; TCA=Trichloroethane; TCE=Trichloroethylene; TPH=Total Petroleum Hydrocarbons. Blanks indicate that data were not listed. See last page of table for score and status key.

Name	Site Number	SAM score/status	Major pollutants
Oakland County			
11 Mile & Orchard Lake	630001	24/B-3	BTEX
AB Dick Company, former	630161	24/B-3	TCE, Methylene Chloride
Allied Signal M.E.L.	630854	33/B-3	1,2 DCE, TCE
American Screw Products, former	630088	20/B-3	TCE, DCE, Vinyl Chloride
American Heating Spill	630144	18/A	Heating Oil
Amoco-Hunter & Oak	630076	24/B-3	Petroleum Products
Amoco-Maple & Orchard Lake	630002	29/B-3	Petroleum Products
Anderson Heat Treat	630004	40/B-3	Lead, Copper, Nickel, Zinc
By Rite Oil Company	630012	22/B-3	Petroleum Product
Clark-9 Mile & Farmington	630120	24/B-3	Petroleum Products
GM Truck & Bus Pontiac Central	630048	24/A	Cyanide
Leemon Oil	630100	27/B-3	Petroleum Products
Munn Landfill Section 23	630040	26/B-2	Lead, Fluoranthene
Selastomer, former	630857	35/B-3	TCE, DCE, DCA, TCA
United Paint & Chemical	630086	22/B-3	Petroleum Products
Washtenaw County			
Arbor Hills - East	810004	24/B-3	Benzene, Toluene, Xylene, Chloroform
Old Ypsi. Twp Sludge Disposal	810030	35/A	PCBs, Mercury, Toluene, Xylene
Salem Landfill	810033	38/B-3	Lead, Benzene, Chromium, PCBs
Willow Run Creek Area	810048	39/A	Chromium, Cadmium, Lead, PCBs, Mercury
Wayne County			
ABC Drum Barrel	820143	27/B-3	Toluene, Xylene, 1,1DCA, PCE
Accu Park	820148	17/A	Waste Oil, Liquid Waste
Accurate Machine Services	821493	30/A	Lead, Copper, Cadmium, Chromium
Adistra Corporation	820219	31/B-3	Barium, Chromium, Lead
American Tube&Wire Fabricators	820161	29/A	Nickel, Lead, Chromium, Oils
Amoco River Rouge Terminal	820122	23/B-3	Gasoline, Lead, Fuel Oil
Amoco Service Station 7217	820106	23/B-5	
Amsted Industries	820147	33/B-3	PERC, TCE
Bietz Creek Fill (Marshal Elem.)	820227	23/B-3	
Beta Chemical - Detroit	820058	25/B-3	Ethyl Ether, Ethyl Acetate
Bra Con Industries	820167	27/B-5	1,1,1 TCA
Buckeye Pipeline Company	821422	33/B-3	BTEX, MTBE
By Rite Station - Westland	820064	32/A	Benzene, Toluene, Ethylbenzene
Chesapeake Properties	820151	24/A	Cyanide, Lead, PCE
Chevy Livonia Plant	820008	34/B-3	Chromium, Nickel
Commercial Auto Wrecking	820155	20/A	Solid Waste, Industrial Waste
Cooper School Site	820010	37/B-2	Lead, PCBs, Cadmium, 4,4DDT, Mercury

Table 22.–Continued.

Name	Site Number	SAM score/status	Major pollutants
Cyanokem	820035	32/B-3	Copper, Chromium, Cyanide, Cadmium
Dearborn Refining Company	820011	39/A	Lead, Oil
Detroit River Paper	820197	36/B-3	DDT, DDE, BTEX, PCBs, PNAs, Metals
Detroit Strip Cyclops Steel	820173	20/A	Petroleum Products, PCBs, Sulfuric Acid
Detroit Diesel	820222	35/B-3	TCE, DCE, DCA, TCA
Dexco Corporation	820201	38/B-3	Chromium
Dexter Chevrolet	821418	24/B-3	PNAs, Dichlorobenzene
Dial Trucking	820013	23/A	Domestic Comm
Enterprise Oil	820200	22/B-3	Waste Oil
Eumet Recycling	820184	28/B-3	Lead, PCBs, PNAs
Feister Oil Company	821427	31/B-3	PNAs
Freedland Industries	820176	21/A	Chromium, BTEX, Methylene Chloride
General Oil - Northville	820208	43/B-3	PCBs, Lead, Cadmium, BTEX, DCE, TCE, TCA
GTE Products - Ford Rd. Facility	820225	30/B-3	BTEX, Arsenic
Heavy T's	821499	16/A	Solid Waste
Henry's Service Center	820085	23/B-3	Benzene, Toluene, Ethylbenzene
Inkster & Schoolcraft Contam.	820160	21/B-3	Transmission Fluid
Inkster Rd. Oil Contamination	820021	33/B-3	
Intervale Lyndon LC	820022	18/B-3	Heavy metals
K and J Landfill	820023	22/A	Chromium, Lead, Cadmium
Marathon Refinery Tank Farm	820149	23/A	Crude Oil
Marathon Pipeline Crystal Mine	820076	33/B-3	Chlorides, Fuel Oil
Marathon Refinery Weathering Pl.	820154	16/B-3	Lead, BTEX, Ethylene Dibromide
Marquette & Hanlon Road	821430	16/B-3	Lead
Maybury State Park	820230	16/B-2	
MDES Dix Avenue	820163	37/A	PCBs, BTEX, Lead, Chromium
Means Industries Corporation	821423	25/B-3	PNAs
Mich Con Gas Co. - Melvindale	820028	40/B-3	Benzene, Xylene, Toluene, Arsenic
Michigan Recovery Systems	820182	31/B-3	Phenol, TCE, Toluene, Xylene
Michigan Bell Telephone Co.	820126	24/B-3	TPH
Middlebelt Hill	820207	28/B-3	Lead, Mercury, Cadmium
Mobil Oil Terminal	820226	30/B-3	BTEX, MTBE
Mobil Station - Livonia	820063	32/B-3	BTEX
Munoz Machine Shop - Livonia	820070	27/B-3	Oils & Grease
Nagel Asphalt	820079	18/A	
National Airport Site	820034	16/B-2	Domestic Comm
Newburgh Industrial Subdivision	820220	20/B-3	
Norfolk & Western Railroad	820036	21/A	Domestic Comm
Payless Service Station	820071	26/B-3	Petroleum
Peerless District	820206	20/B-3	Solid Waste
Penn Central Melville	820171	19/A	Oils, Solid Waste
PIC Holding Company	820044	14/B-3	Light Industrial
Prospect Street - Dearborn	820072	30/A	Lead, Silver, PNA, Chromium
R E Leggette Company	820211	27/B-3	Metals, BTEX
Republic Tool & Die Company	820046	20/B-3	Oils
Rouge River	820047	43/B-2	Lead, Cyanide, PCB
S and Mini Mart	820081	19/B-3	Gasoline

Table 22.–Continued.

Name	Site Number	SAM score/status	Major pollutants
SERVCO	820217	26/B-3	TPHs, BTEX
Southland Corporation	821488	35/B-3	BTEX
Total Gas Station	820078	19/B-3	
Total Service Station 2513	820187	31/B-3	BTEX
Trilex	820050	25/A	Heavy Metals
Tronex Chemical corporation	820051	21/B-3	Chemical Products Mfg.
Unistrut Corporation	820053	19/B-3	Oil, Xylene
Unisys Burroughs Landfill	820172	31/B-3	Toluene, Vinyl Chloride
United 6208	820193	32/B-3	
Vacant Property - Ann Arbor Trail	820110	25/B-3	Fluoranthene, Pyrene
Van Dresser Corporation	821425	25/B-2	BTEX, PNAs
VanBorn & Lilley Rd. Site	820054	28/B-3	PCB, Chrysene, Benzo[a]anthracene
Western Wayne Correctional Fac.	821486	33/B-2	Lead, TCE, Benzene
Wick Elementary School Dump	820014	34/B-2	
Willow Run Airport East	820125	23/B-3	Toluene, Ethylbenzene
Wolverine Gasket Company	820215	36/B-5	Toluene, Xylenes
Zug Island Great Lakes Steel	820057	22/A	Organic Wastes, Oil Acids

Table Key:

Site Assessment Model (SAM) Score

Act 307 sites are scored on a scale from 0 (lowest priority) to 48 (highest priority) based on risk factors including potential hazard to public health, safety, and welfare, or environment. Scores listed are total points out of a possible 48. Environmental Response Division of the Michigan Department of Environmental Quality is responsible for investigating and scoring.

Status

A) Inactive: Either cleanup plan has not been approved by MDEQ or there have been no actions taken.

B) Cleanup actions taken or in progress

2) Evaluation/Interim Response -Fund
Cleanup plan not approved by MDEQ and interim response activity has been, or is being provided, by state funds.

3) Evaluation/Interim Response - PRP/Other
Cleanup plan approved by MDEQ and interim response activity is being provided by potentially responsible party or other funds.

4) Final Cleanup - Fund
Cleanup plan approved by MDEQ and remedial actions have been or are being provided by the state.

5) Final Cleanup - PRP/Other
Cleanup plan approved by DEQ and remedial actions have been or are being provided by potentially responsible party or other funds.

Table 23.–Fish contaminant sampling results from Rouge River watershed (1985-95). Data from: Michigan Department of Environmental Quality, Surface Water Quality Division. Department of Public Health consumption advisory trigger levels indicated in ( ). Contaminant values are averages of all fish sampled. *Total chlordane is the sum of five isomers: oxychlordane, trans-nonachlor, cis-nonachlor, g-chlordane, and a-chlordane. **Total PCBs include Aroclor 1242, 1248, 1254, and 1260. ***Total DDT = the sum of DDT, DDD, and DDE.

Location sampled	Fish species (sample size)	Date	Total PCBs ** (2.0 ppm)	Total DDT*** (5.0 ppm)	Mercury (0.5 ppm)	Total Chlordane* (0.3 ppm)	Heptachlor (0.3 ppm)	Dieldrin (0.3 ppm)	Toxaphene (5.0 ppm)
Mainstem									
Oakland Co., Lahser Road	White Sucker (9), Carp (2), Rockbass (1)	6/17/87	0.107	0.494	0.31	0.091	0.004	0.002	
Wayne Co., Eliza Howell Park	White Sucker (8)	9/13/94	0.099	0.070	0.07	0.052	0.004	0.005	
Wayne Co., Elisa Howell Park	White Sucker (1)	6/17/87	0.128	0.208	0.23	0.066	0.004	0.009	0.050
Wayne Co., above turning basin	Carp (10)	6/19/85	**3.766**	0.614	0.11	0.183	0.015	0.023	
Wayne Co., below Jefferson Ave	Carp 10)	6/19/85	**4.366**	0.415	0.22	0.095	0.007	0.015	0.001
Wayne Co., river mouth	Carp (5)	6/24/86	**13.000**		0.11				
Upper Rouge River									
Oakland Co., Powers Road	White Sucker (10)	6/17/87	0.060	0.039	0.19	0.020	0.001	0.002	
Wayne Co., 7 Mile Road	White Sucker (5)	6/17/87	0.147	0.057	0.19	0.029	0.001	0.003	
Middle Rouge River									
Oakland Co., 9 Mile Road	Rockbass (4), Carp (10), White Sucker (2), Brown Bullhead (2), Channel Catfish (2)	6/16/87	0.167	0.049	0.18	0.015	0.001	0.001	
Wayne Co., Pheonix Lake	Bluegill (1), Carp (1)	5/30/95 & 6/13/95	0.394	0.466	0.17	0.018			
Wayne Co., Pheonix Lake	Northern Pike (7), White Sucker (5), Carp (8)	7/19/88	0.227	0.487		0.023	0.003		
Wayne Co., Haggerty/Hines Dr.	Smallmouth Bass (1), Rockbass (4), White Sucker(10)	6/16/87	**2.020**	0.317	0.18	0.012			
Wayne Co., Newburgh Lake	Largemouth Bass (1), Bluegill (1)	5/30/95 & 6/13/95	**2.973**	0.224	0.40	0.009			
Wayne Co., Newburgh Lake	White Sucker (5), Northern Pike (9)	11/17/93	**2.931**	0.537	0.29	0.012			
Wayne Co., Newburgh Lake	Largemouth Bass (1), Northern Pike (8), White Sucker (10)	7/19/88	**8.922**	0.374		0.014			
Wayne Co., Inkster Road	Goldfish (1)	6/16/87	0.520	0.417	0.10	0.113	0.008	0.001	0.050
Lower Rouge River									
Wayne Co., Gulley Road	Carp (10)	6/16/87	**2.504**	0.538	0.14	0.327	0.016	0.016	

Table 24.–Fish stocking in Rouge River from 1900-96. Data from: Michigan Department of Natural Resources, Fisheries Division.

Common name	Stocking location	Years (1900s)	Numbers	Comments
Oakland County				
Largemouth bass	Quarton Lake-Birmingham	74	2,000	reclamation after rotenone
" "	Walled Lake	34-45, 52	over 15,000	to augment the fishery
Bluegills	Quarton Lake	74	10,000	reclamation after rotenone
"	Walled Lake	34-45, 52	over 20,000	to augment the fishery
Smallmouth bass	Rouge River - Southfield	81, 89, 91	384	in conjunction with habitat work
" "	Walled Lake	34-45	thousands	to augment the fishery
Northern pike	Walled Lake	34-45, 52	over 70,000	to augment the fishery
Walleye	Walled Lake	34-45	thousands	to create a fishery
Perch	Walled Lake	34-45	thousands	to augment the fishery
Wayne County				
Rainbow trout	Upper Rouge Creek - Redford	82-83	600	fishing derby
" "	Middle Rouge- Hines Park	96	400	fishing derby
" "	Johnson Drain	50's	1,600/year	fishery did not develop
" "	Phoenix Lake	67-69	7,000	fishery did not develop
Brown trout	Johnson Drain	50's	400/year	fishery did not develop
" "	Johnson Drain	92-96	19,393	to create a fishery
" "	Phoenix Lake	67-69	7,000	fishery did not develop
Largemouth bass	Newburgh Lake	68-75	16,212	reclamation after rotenone
" "	Walnut Lake	34-45	3,850	reclamation after rotenone
" "	Wilcox Lake	68-69	1,008	reclamation after rotenone
Smallmouth bass	Walnut Lake	34-45	2,520	reclamation after rotenone
Bluegills	Newburgh Lake	69-75	1,035	reclamation after rotenone
" "	Walnut Lake	34-45	79,000	to augment the fishery
" "	Wilcox Lake	68-69	70	reclamation after rotenone
Black crappie	Newburgh Lake	70	300	reclamation after rotenone
Channel catfish	Newburgh Lake	69	152	reclamation after rotenone
Perch	Walnut Lake	34-45	14,500	to augment the fishery
Walleye	Walnut Lake	34-45	524,000	to create a fishery

Table 25.–Groups currently involved in promoting or restoring the Rouge River. Data from: 1994 Rouge River Remedial Action Plan update, with additions by citizens.

Organization	Project/Involvement
Army Corps of Engineers	Developed database of sediment data for rivers in Southeast Michigan.
Village of Beverly Hills	Working to disconnect residential sump pumps from sanitary sewer system.
City of Birmingham	Requires a permit for any construction within 500 feet of a river.
	Developing a stream bank stabilization program.
Canton Township	Sump pump program separates footing drains from sanitary sewer system.
	Developing a stormwater management program including regional sediment/detention basins, BMPs, and construction details.
Commerce Township.	Seeley Drain Fishery Management Plan under development.
City of Dearborn	Separating street stormsewer from the combined sewer system, where feasible.
	Stabilized the riverbank west of the new Brady St. bridge in Ford Field.
City of Dearborn Heights	Requires on-site stormwater retention for new development.
	Cleans all sewers every six years.
City of Detroit	Bat nesting boxes placed in Riverdale Park, and insecticide spraying reduced.
	Leaf burning ordinance to reduce airborne sources of contaminants.
Detroit Water & Sewerage Department	Constructed new pump station to greatly increase plant's treatment capacity.
	North Huron Valley/Rouge Valley Sewerage Project.
	Industrial Pretreatment Program limits pollutants being discharged through CSOs.
	PCB and mercury minimization program, working with Michigan Dental Association to minimize mercury use.
	Strict enforcement of septage hauling and dump site regulations.
City of Farmington	Eliminated all known CSOs in the Farmington Sewage District by separation.
	Built a 3 million gallon sewage pump station and retention basin.
City of Farmington Hills	Completed a home inspection and downspout extension program.
	Erosion control project on Caddell Drain.
	Regional stormwater retention basin built to lessen flooding in Minnow Pond Drain. Smaller basins were constructed for Pebble Creek.
Village of Franklin	Adopted ordinance requiring setbacks from wetlands and watercourses.
	Installed a pressure sanitary sewer, available to all residents by fall 1995.

Table 25.–Continued.

Organization	Project/Involvement
The Friends of the Rouge (FOTR)	RiverWatch program organizes groups to sponsor sections of river and perform annual clean-ups of debris and logjams.
	Tree planting in City of Detroit's Rouge Park.
	Build and place nesting boxes for wood ducks, bluebirds, tree swallows and brown bats.
Holliday Nature Preserve Association	Supports the FOTR RiverWatch program, adopting 4.2 miles of Tonquish Creek. Cleaning creek of man-made materials and clearing logjams.
	Conducts storm drain stenciling, wood duck nest box program, floodplain cleanups, trail maintenance and nature walk program.
	Has sponsored 9 Rouge Rescues.
City of Inkster	Construction of artificial wetland in floodplain to treat stormwater.
City of Livonia	Constructed 2.2 million gallon equalization basin.
City of Melvindale	Plans to construct a sanitary sewerage pump station to eliminate raw sewage bypasses.
Michigan Department of Agriculture, Natural Resources Conservation Service and Districts	Implemented a project to reduce phosphorous pollution entering Lake Erie from the Lower Rouge River.
Monroe Elementary - Wayne	Placed wood duck nesting boxes in the City of Wayne's natural area.
City of Northville	Friends of the Mill Pond non-profit organization formed.
	Enforcing stormwater discharge limits through construction of detention basins.
City of Novi	Along with MDOT are building wetlands to mitigate M-5 construction.
	Planted trees and shrubs for stabilization in headwaters of Upper Rouge.
	Stabilized 700 ft of Munro Creek.
Oakland County Health Div.	Inspect septic systems to identify failures.
	Conducted a dye test program and in-stream water quality and macroinvertebrate sampling to assess on-site septic failure rate in Farmington Hills and Southfield.
Oakland County	Completed Evergreen/Farmington sewerage project.
Plymouth Township.	Constructed a detention facility with sediment trap at the twp. park.
Redford Township	Conducting a seven-year cleaning and inspection program of combined sewer system. Sealed 138 sewer covers in 1993, eliminating stormwater input.
	Requires all new commercial developments to retain their stormwater on site.
City of Rochester Hills	Purchased land with Michigan Land Trust Fund money to preserve wetlands.
	Stabilized eroding streambank of Borden Drain and constructed weirs and steps to reduce flow rates.
	Building a Chapter 20 drain (Chester Drain) to flow into existing retention basin.

Table 25.–Continued.

Organization	Project/Involvement
City of Southfield	Habitat rehabilitation project of 1.3 km of Rouge River.
Southeast Michigan Council of Governments (SEMCOG)	Development and distirbution of a video to educate the public, teachers, students, and planning comissions about headwaters preservation issues.
City of Troy	Downspout inspection program to ensure that home downspouts drain away from foundations.
U of M - Dearborn	Wood duck nesting boxes installed at outdoor education center.
City of Walled Lake	Completed $6 million in improvements to their sanitary sewer system.
Washtenaw County	Revised stormwater mgt. regulations to include water quality requirements.
City of Wayne	Separated all combined sewers in Areas 19, 20, 23, and 25.
	Will separate remaining combined sewers at Fourth Street south of Glenwood in 1997.
	Will build a 2.3 million gallon equalization basin by the summer of 1998.
Wayne County in cooperation with Rouge River National Wet Weather Demonstration Project	Sediment sampling throughout the watershed, with emphasis on Newburgh Lake.
Wayne County Parks	Renovated access sites on Newburgh Lake and stabilized banks.
Wayne County Health Dept.	Inspect septic systems to identify failures and require repairs.
West Bloomfield Township.	Strict floodplain and wetlands ordinances backed by GIS map of township.
	Collected water quality data in township lakes and recommended measures to slow eutrophication.
	Fertilizer and pesticide ordinance to regulate use of these chemicals.
	Leaf burning ordinance to limit airborne sources of contamination.
Western Townships Utility Authority (Canton, Northville, Plymouth Twps)	Completed $94 million sanitary sewer correction project.
Western Wayne County Conservation Association	Bank stabilization and habitat placement in Johnson Drain.
City of Westland	Restricts stormwater runoff to agricultural rates for new construction.
	Construction of detention basins with soil erosion controls along the Middle Rouge River.

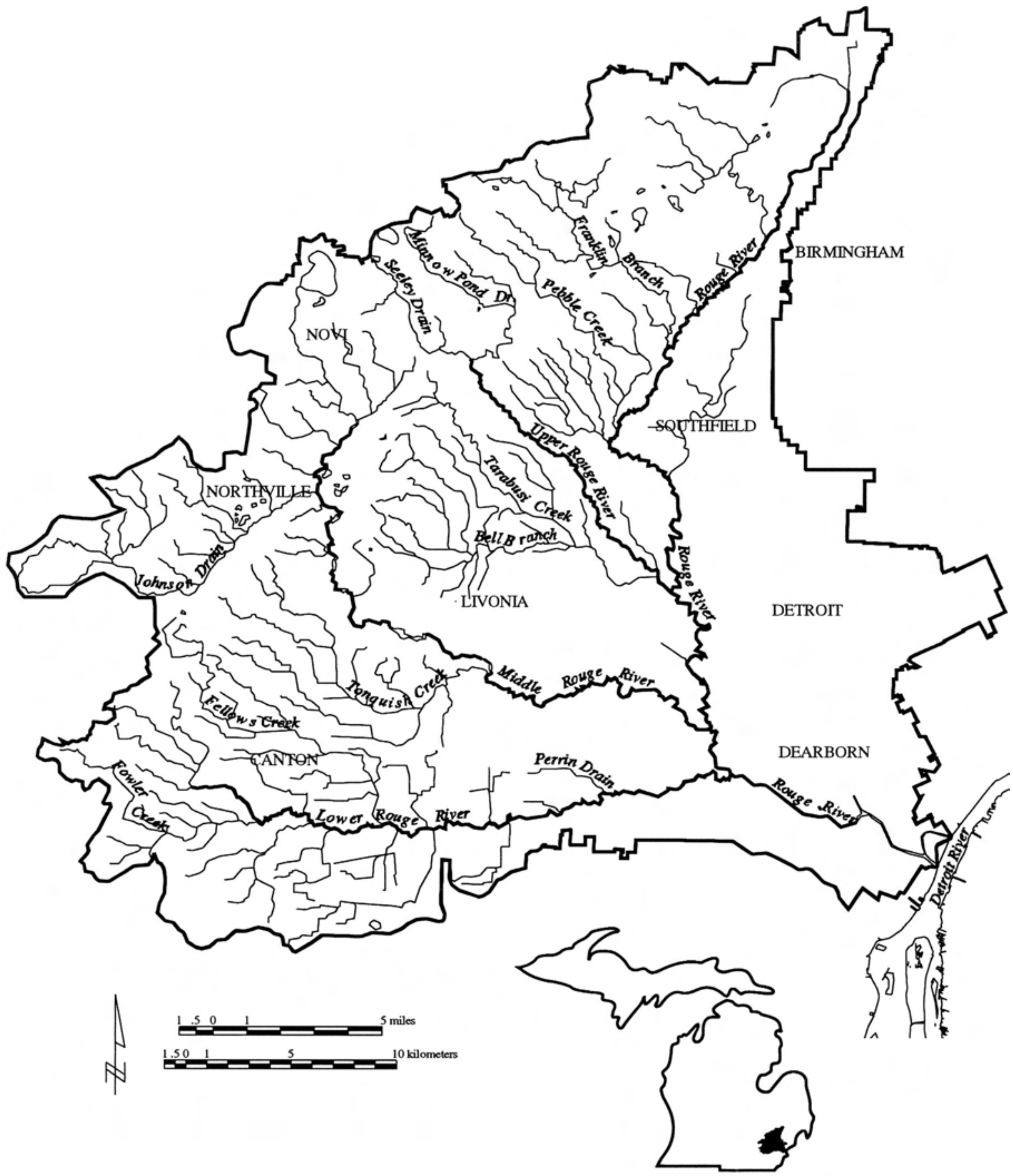

Figure 1.–The Rouge River watershed in Southeastern Michigan. Major reaches include the mainstem and Upper, Middle, and Lower branches. Map from Rouge Program Office.

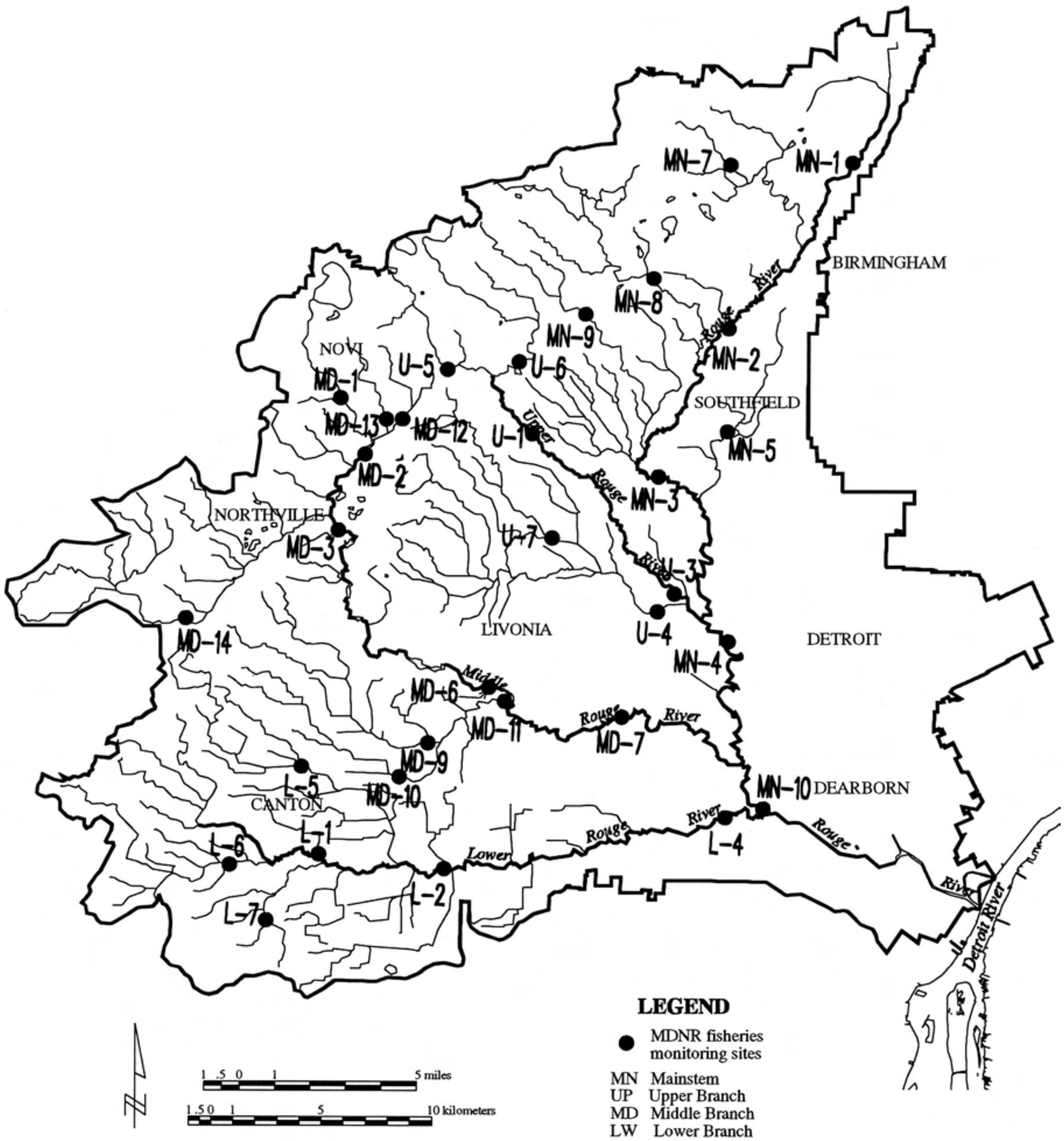

Figure 2.–Fish sampling locations surveyed in 1995. (Michigan Department of Natural Resources, Fisheries Division). Map from Rouge Program Office.

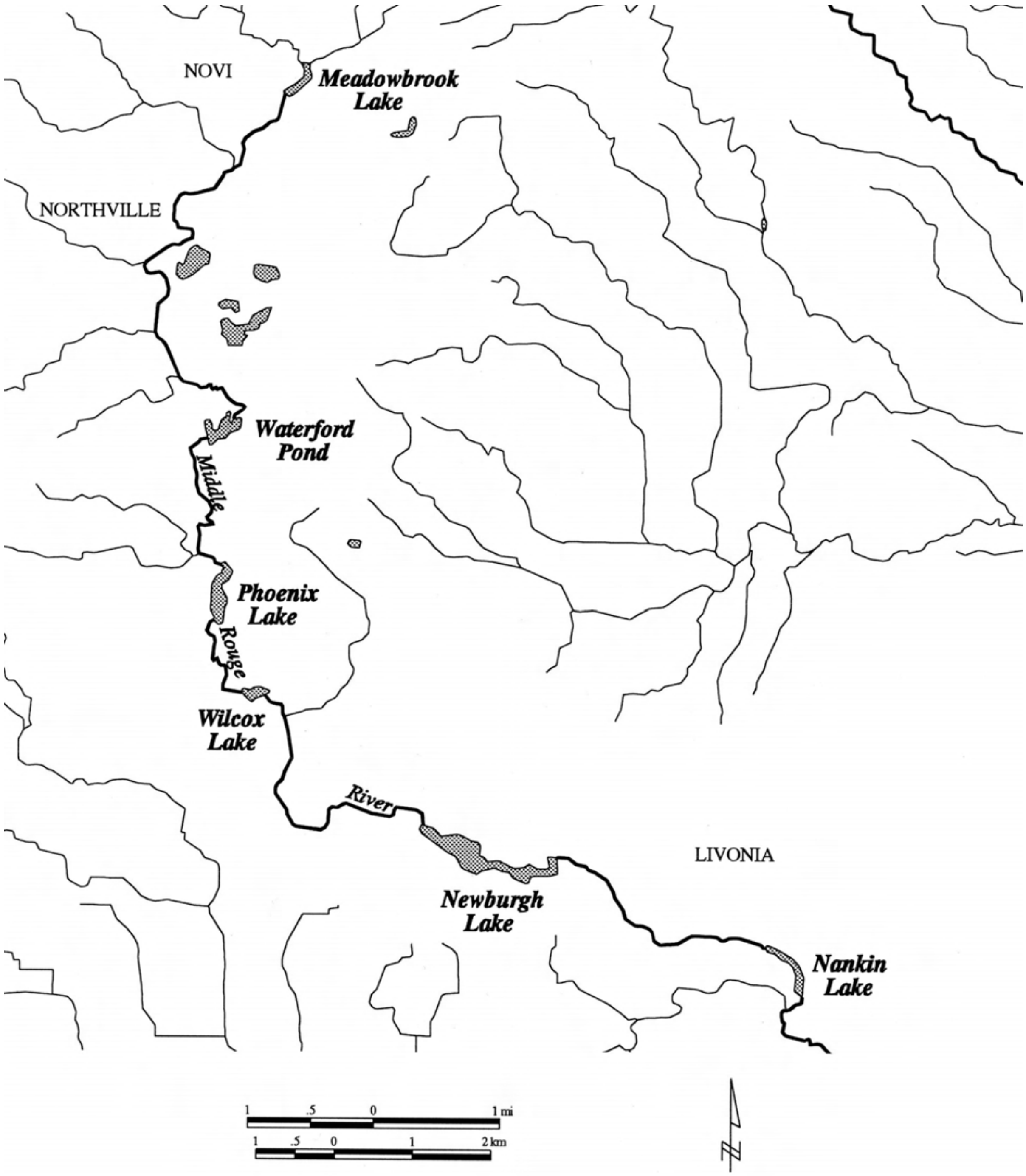

Figure 3.–Major impoundments located on the Middle Rouge River. Map from Rouge Program Office.

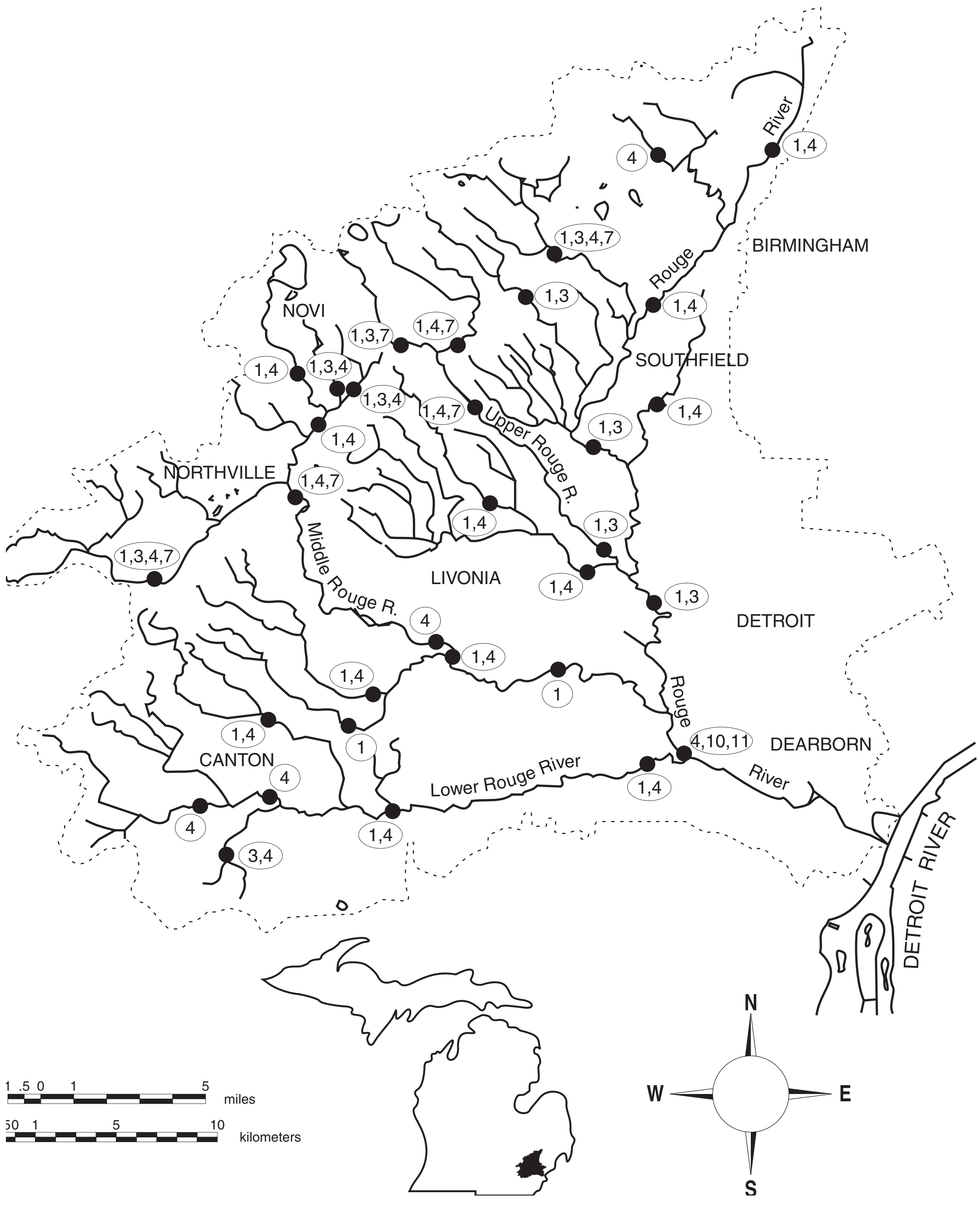

Figure 4.–Fish communities within the Rouge River as defined by Michigan Rivers Inventory Project (T. Zorn and P. Seelbach, Michigan Department of Natural Resources, Fisheries Division, preliminary data.). See Table 6 for group definitions.

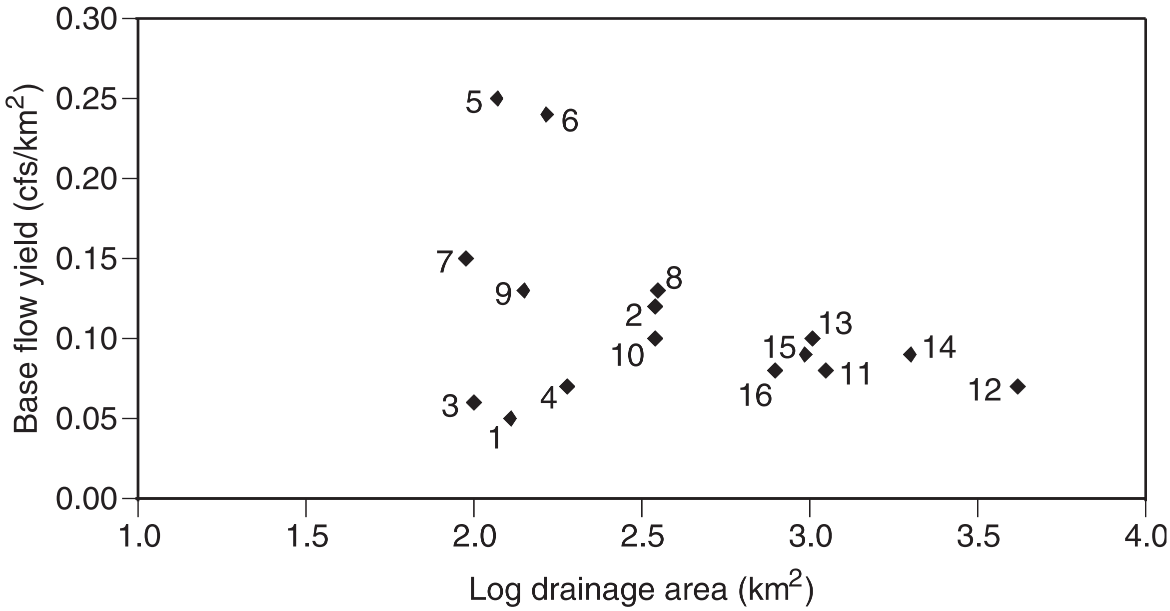

Figure 5a.–Statewide fish species associations plotted against primary watershed characteristics.

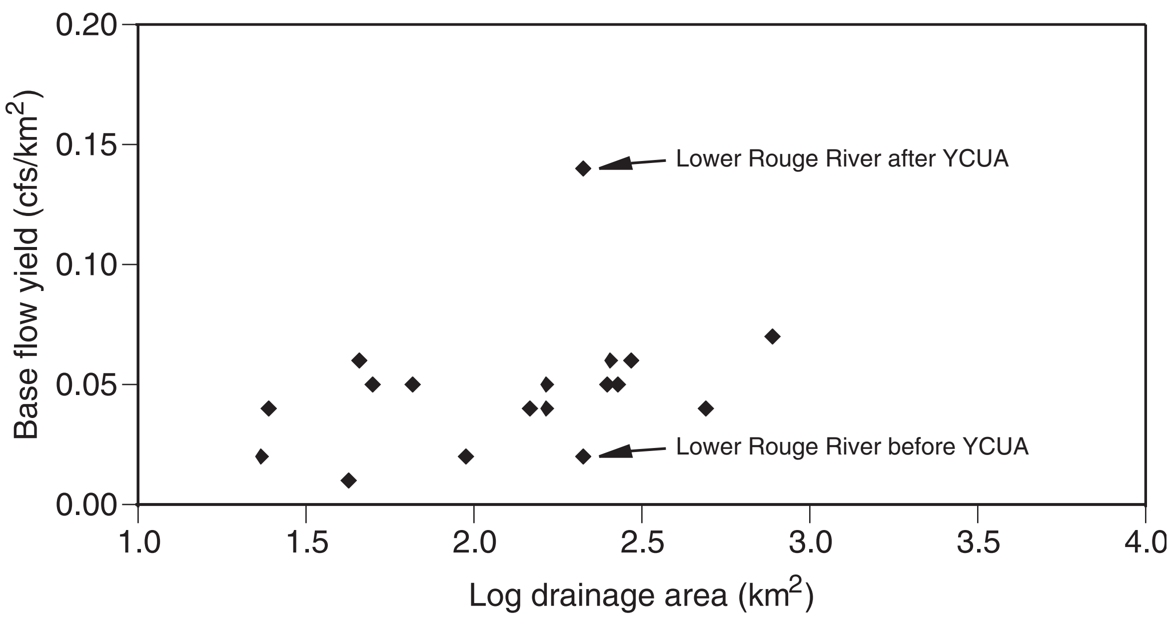

Figure 5b.–Primary watershed characteristics of sites in the Rouge River.

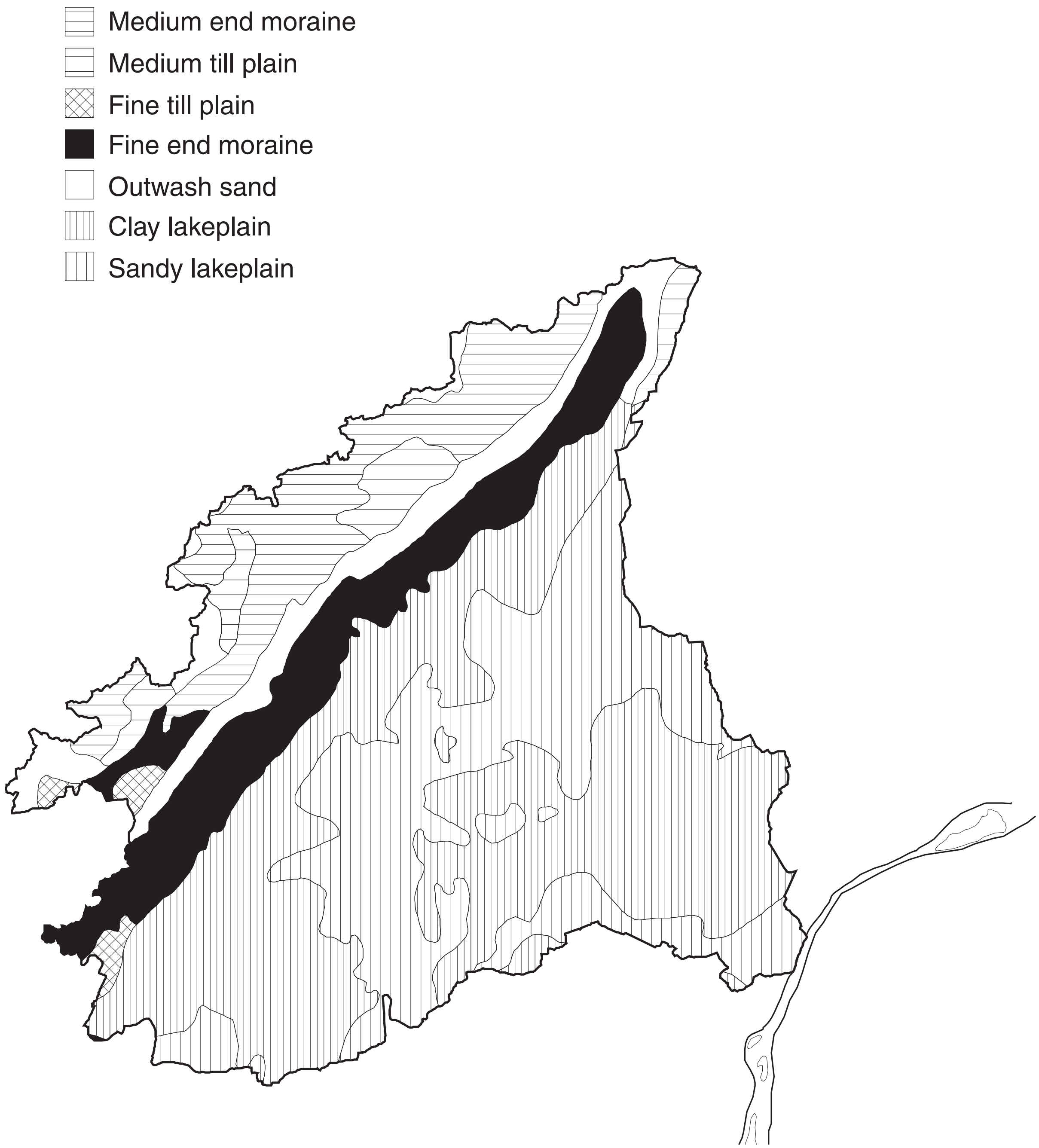

Figure 6.–Surficial geology map of the Rouge River watershed.

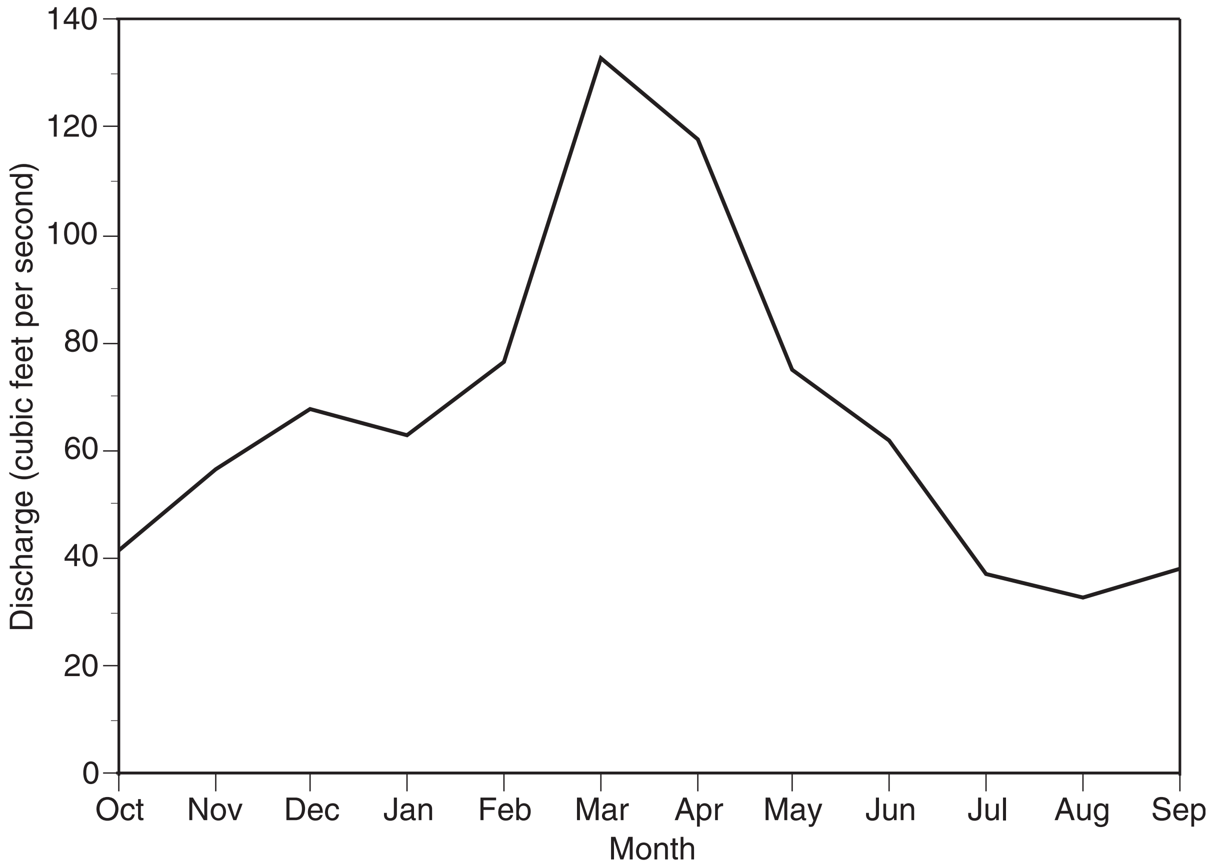

Figure 7.–Mean monthly discharge (cfs) for Rouge River in Southfield for period of record (1958-94). Data from: United States Geological Survey.

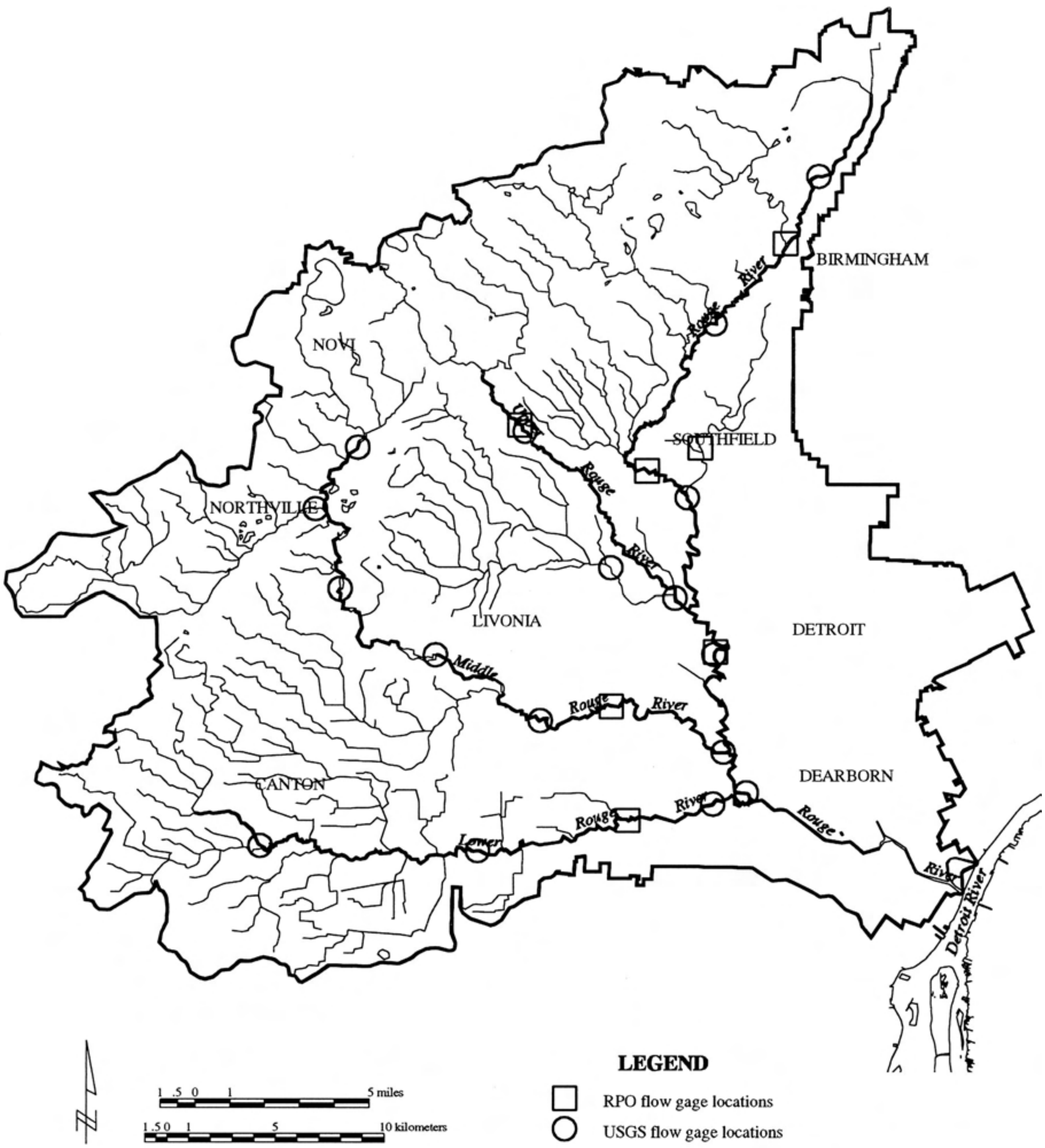

Figure 8.–Location of Rouge Program Office and United States Geological Survey flow gauge stations in the Rouge River. Map from Rouge Program Office.

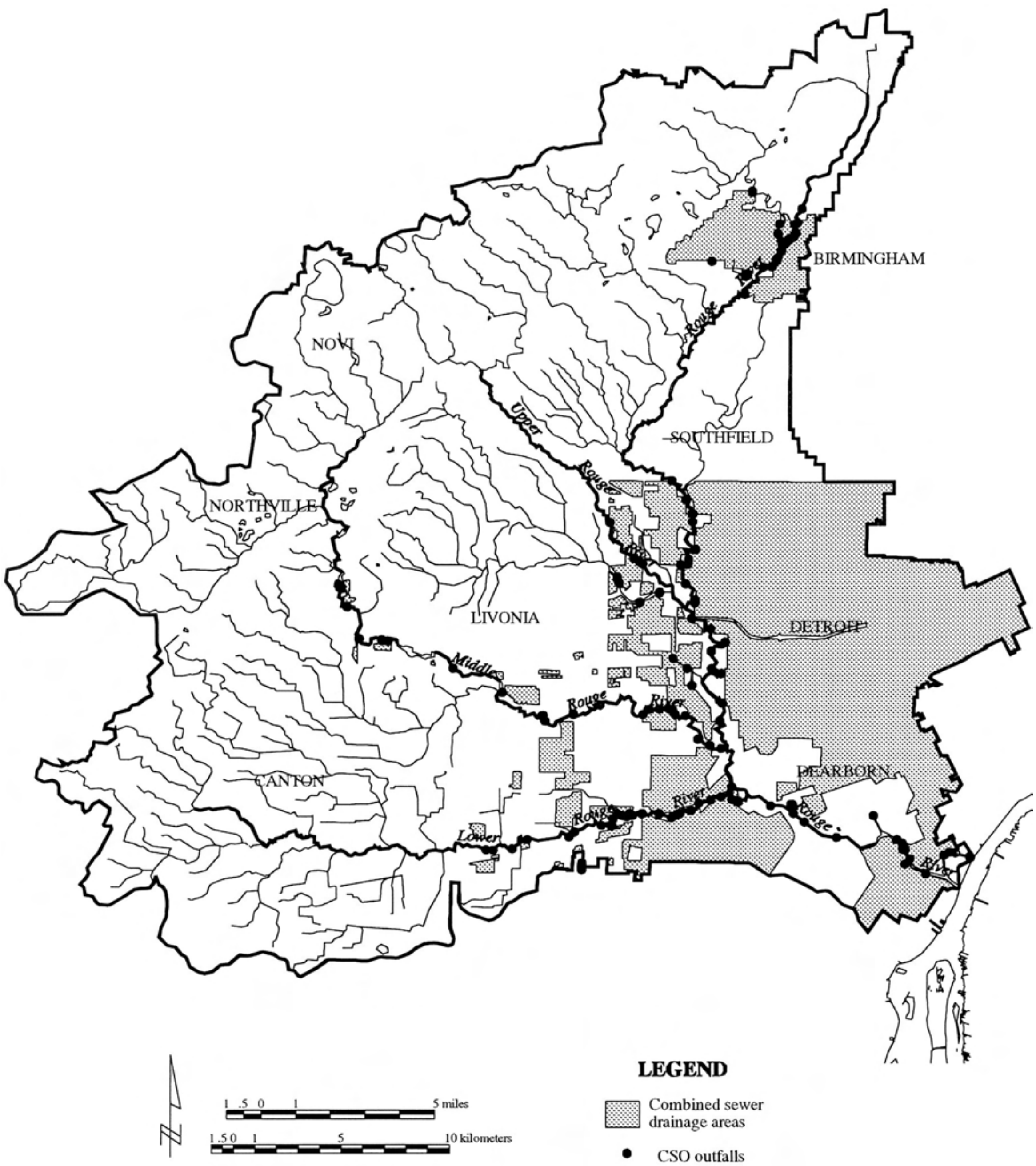

Figure 9.–Location of Combined Sewer Overflows (CSOs) in the Rouge River watershed and their service areas. Map and data from Rouge Program Office.

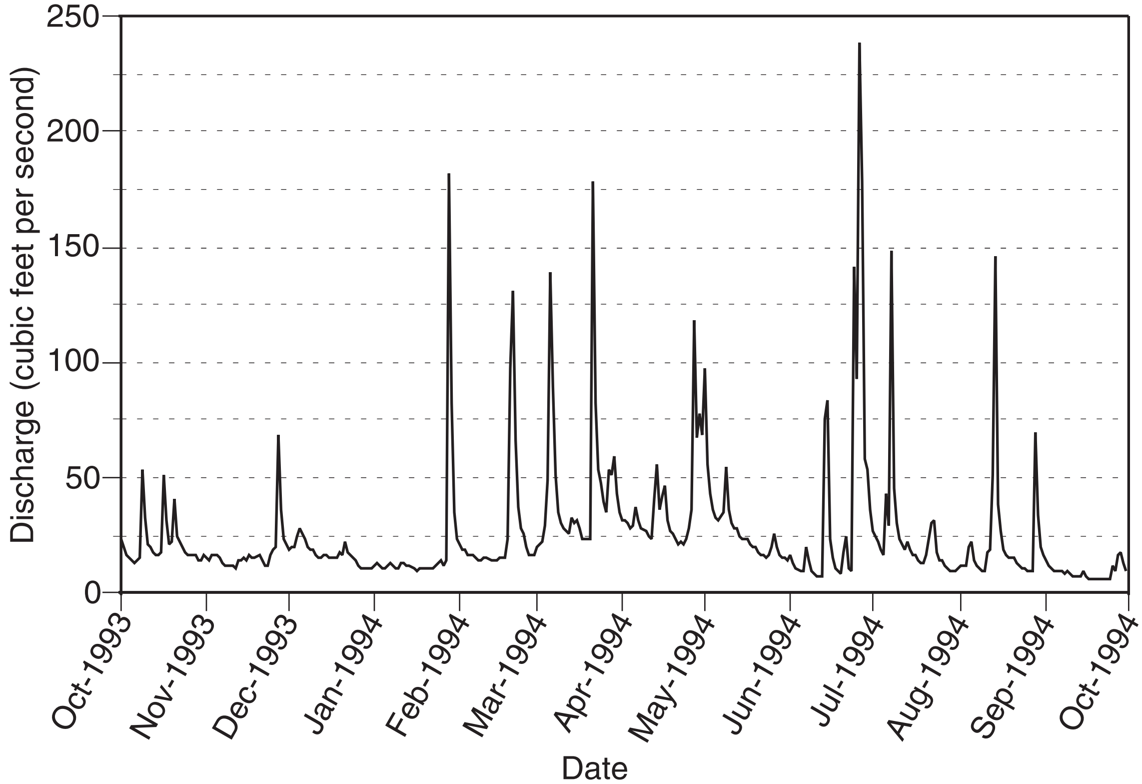

Figure 10.–Mean daily discharge of Rouge River in Birmingham for water year 1994. Data from: United States Geological Survey.

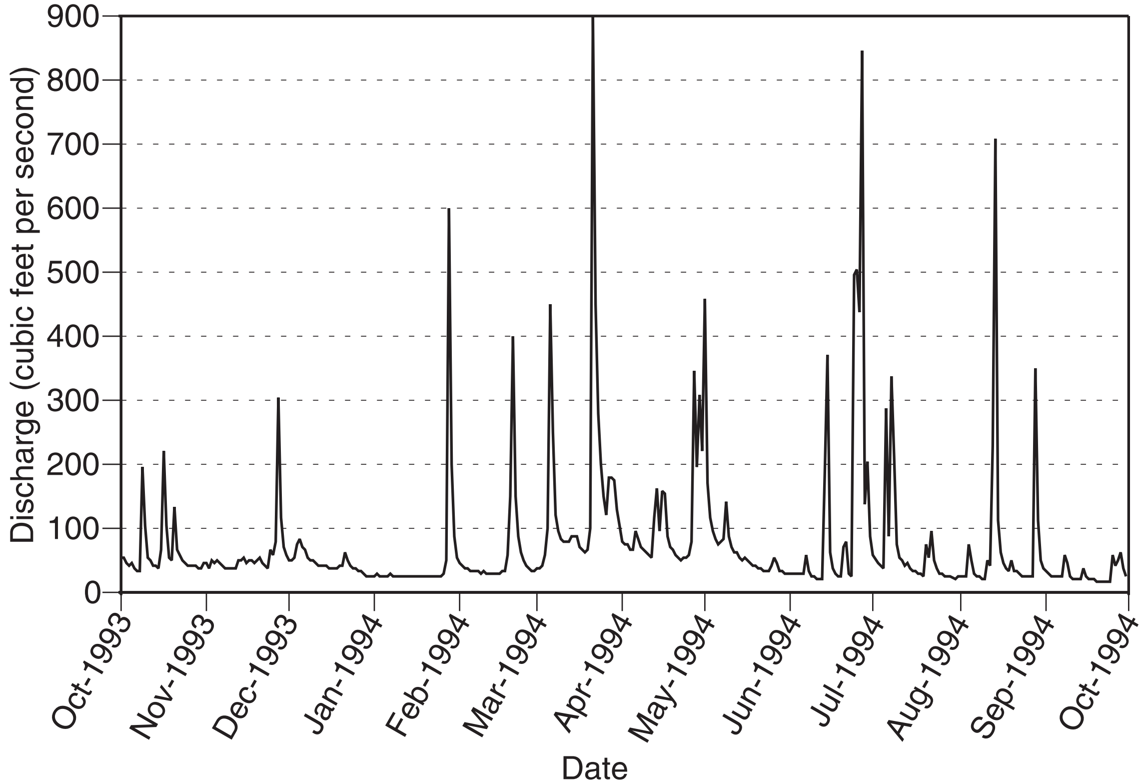

Figure 11.–Mean daily discharge of Rouge River in Southfield for water year 1994. Data from: United States Geological Survey.

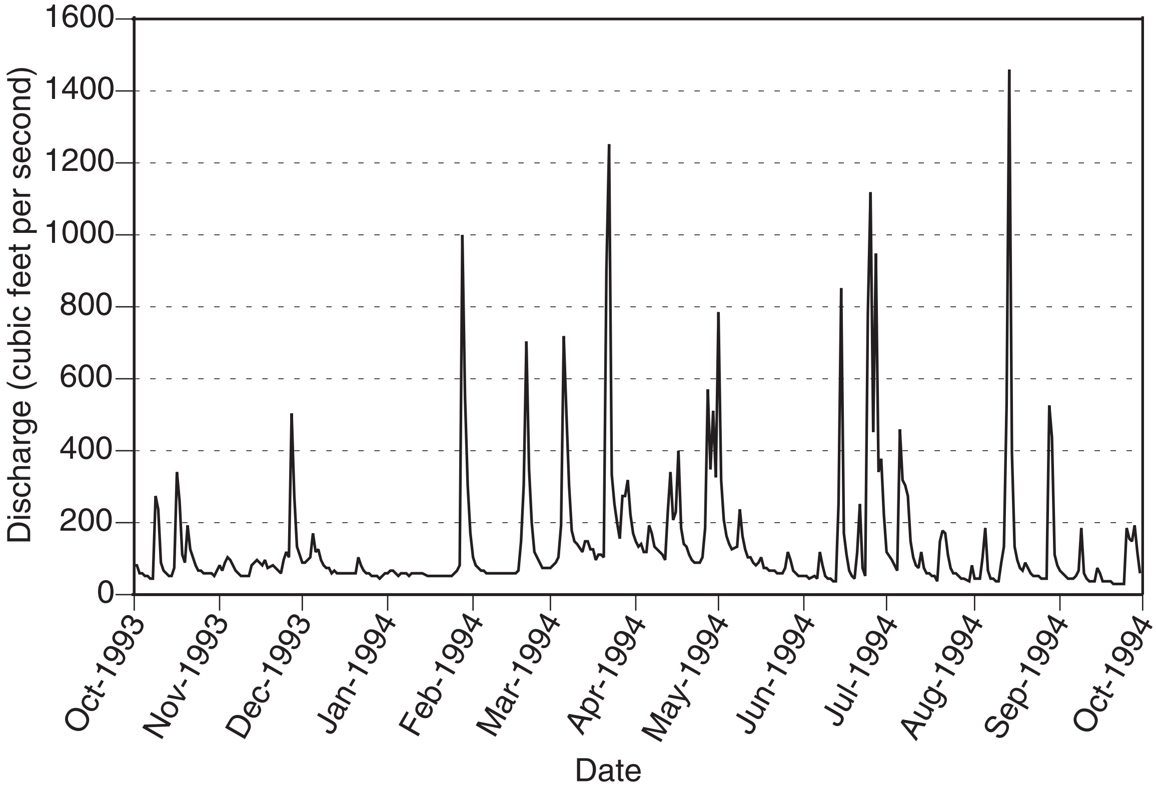

Figure 12.–Mean daily discharge of Rouge River in Detroit for water year 1994. Data from: United States Geological Survey.

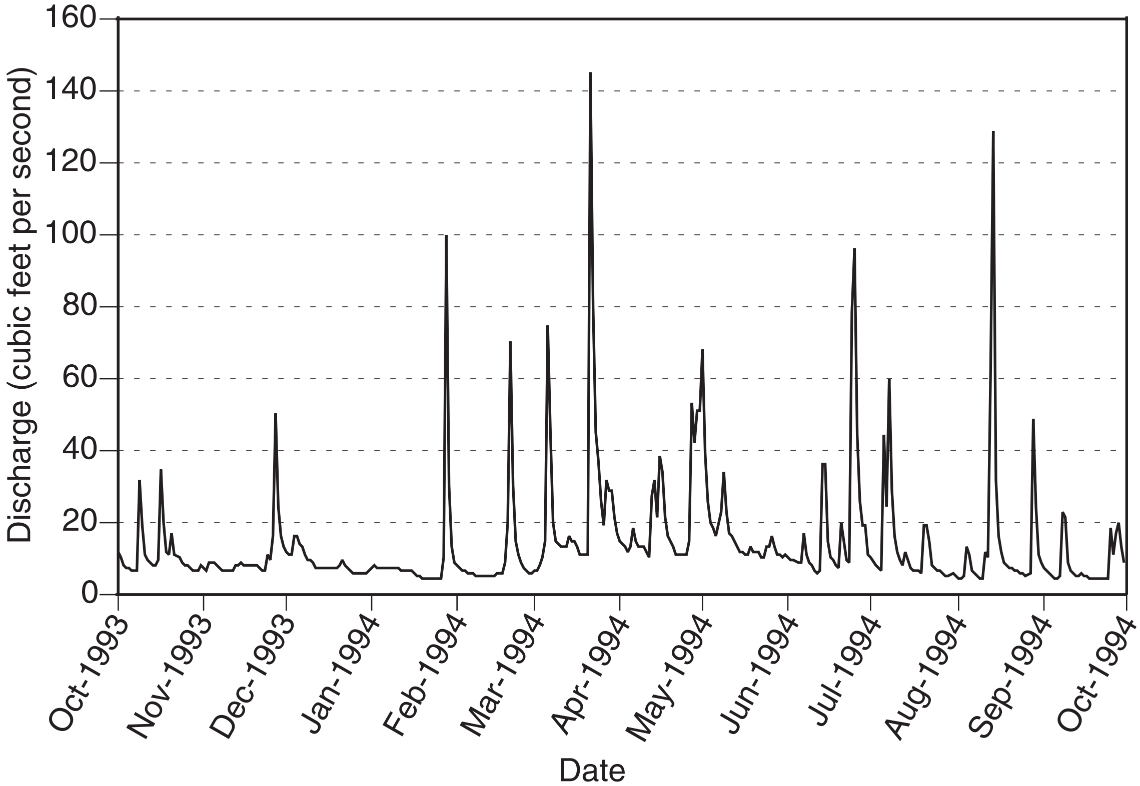

Figure 13.–Mean daily discharge of Upper Rouge River in Farmington for water year 1994. Data from: United States Geological Survey.

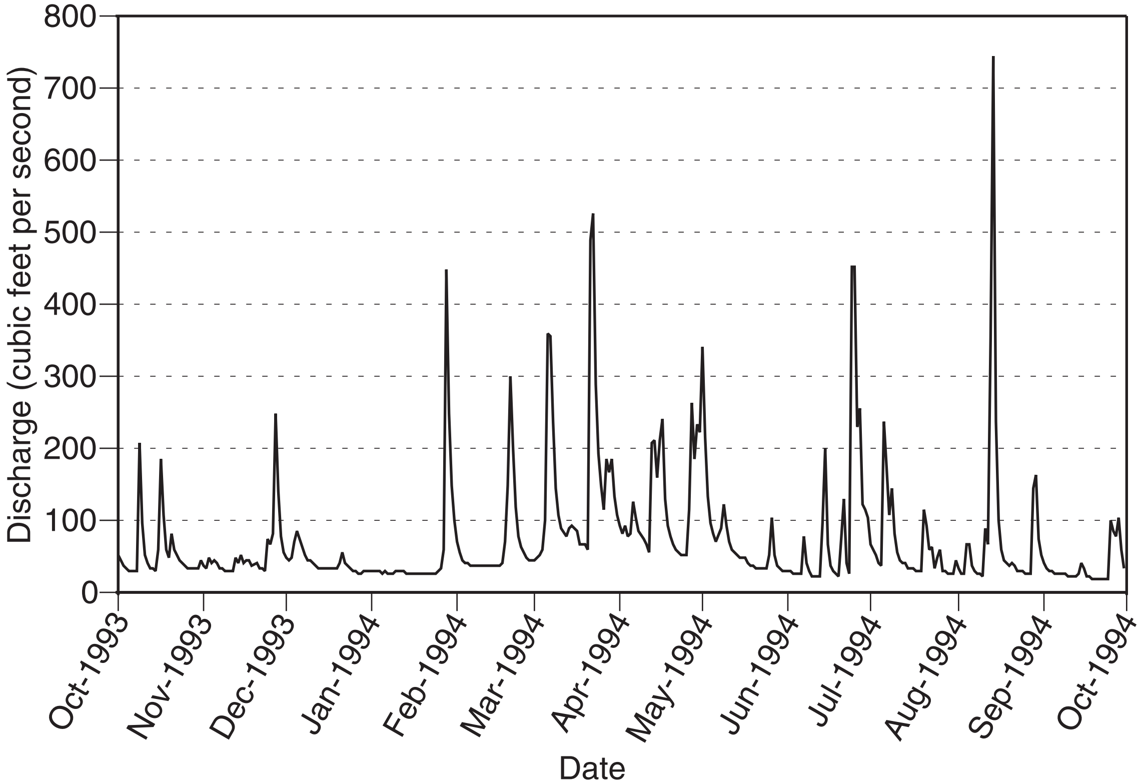

Figure 14.–Mean daily discharge of Middle Rouge River near Garden City for water year 1994. Data from: United States Geological Survey.

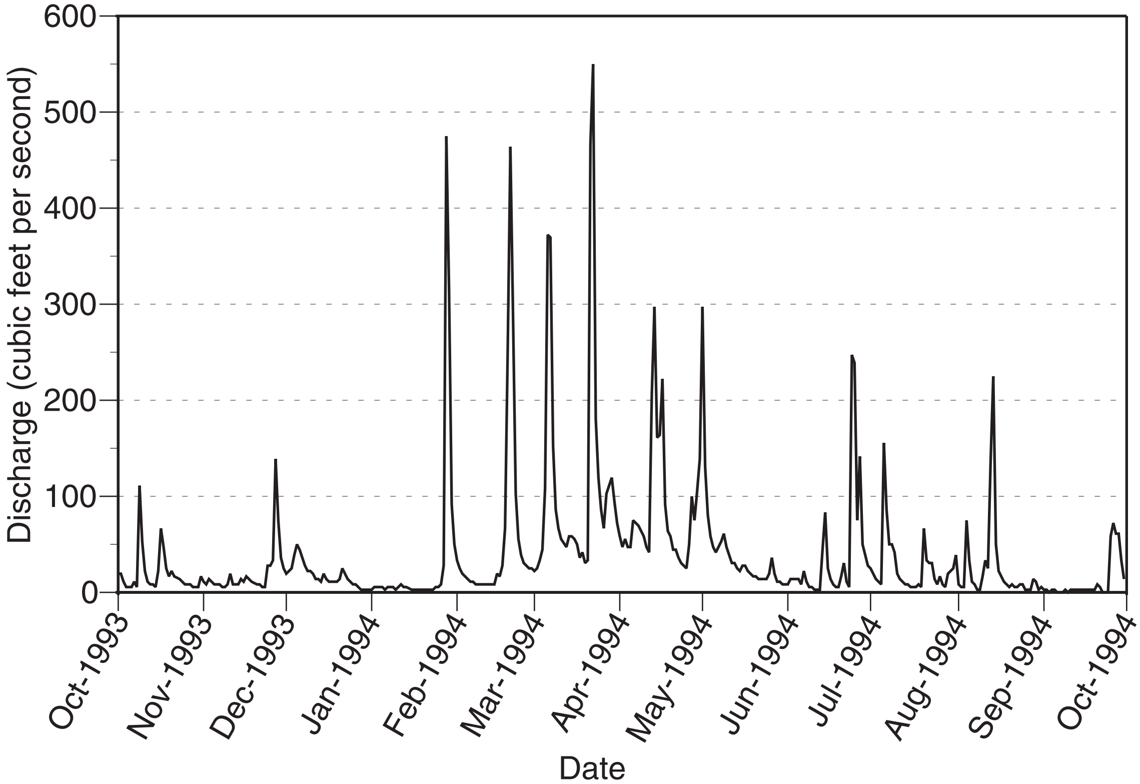

Figure 15.–Mean daily discharge of Lower River in Inkster for water year 1994. Data from: United States Geological Survey.

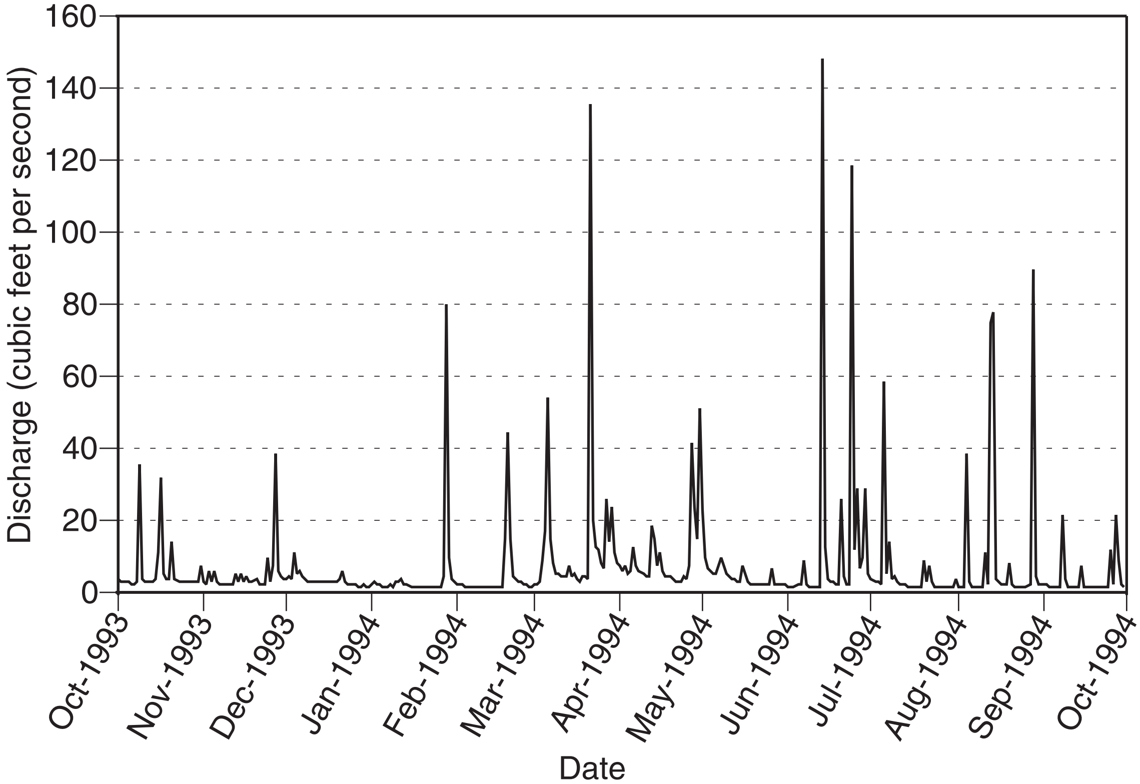

Figure 16.–Mean daily discharge of Evans Ditch in Southfield for water year 1994. Data from: United States Geological Survey.

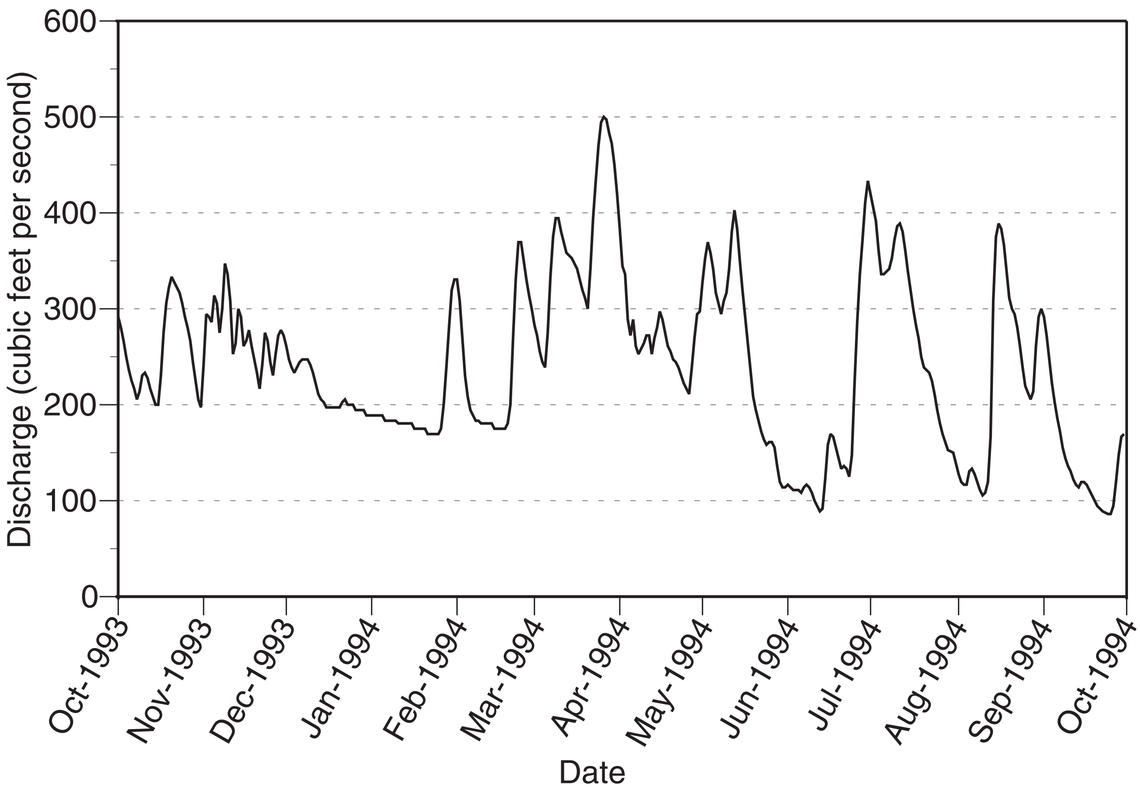

Figure 17.–Mean daily discharge of Huron River near Hamburg for water year 1994. Data from: United States Geological Survey.

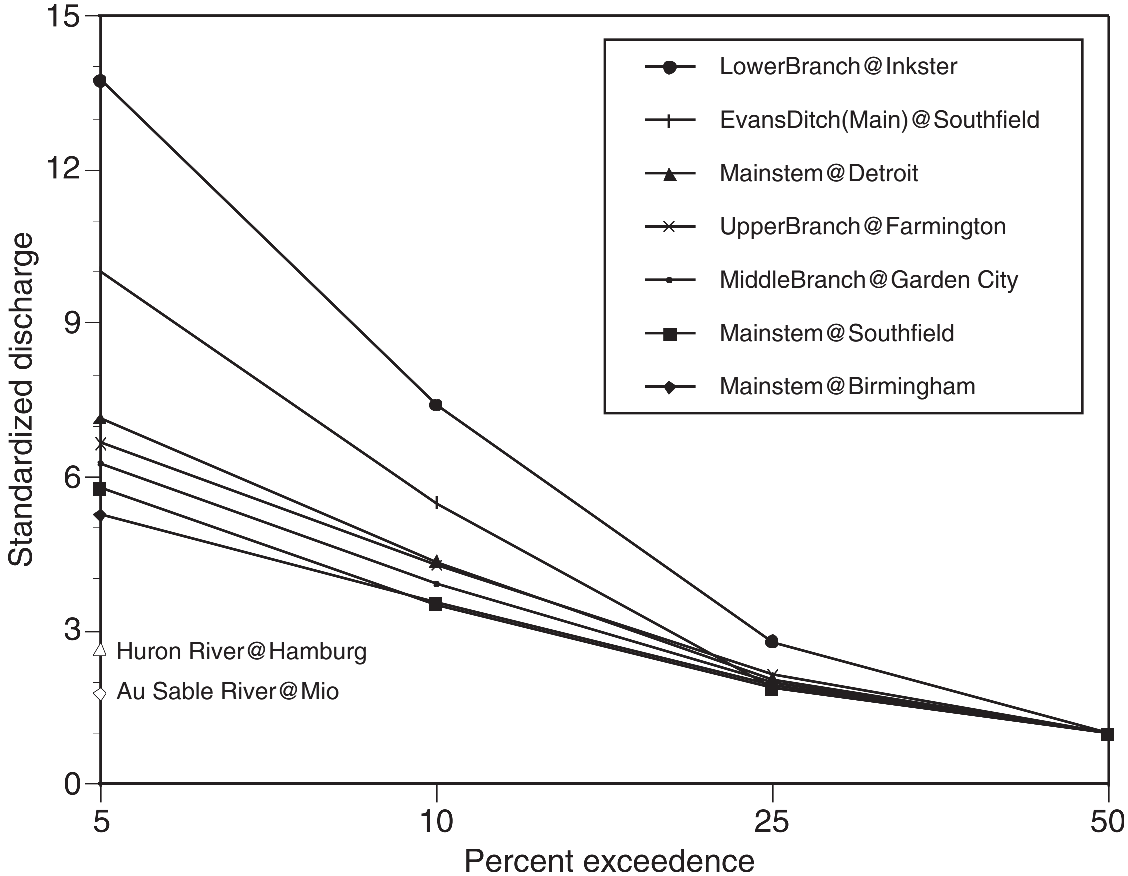

Figure 18.–Standardized high flow exceedence curves for three main branches and mainstem of Rouge River and Evans Ditch. Information from United States Geological Survey gauge stations for period of record. Standardized discharge is discharge/median (50%) discharge. Shown for comparison are neighboring Huron River and extremely stable, groundwater fed Au Sable River.

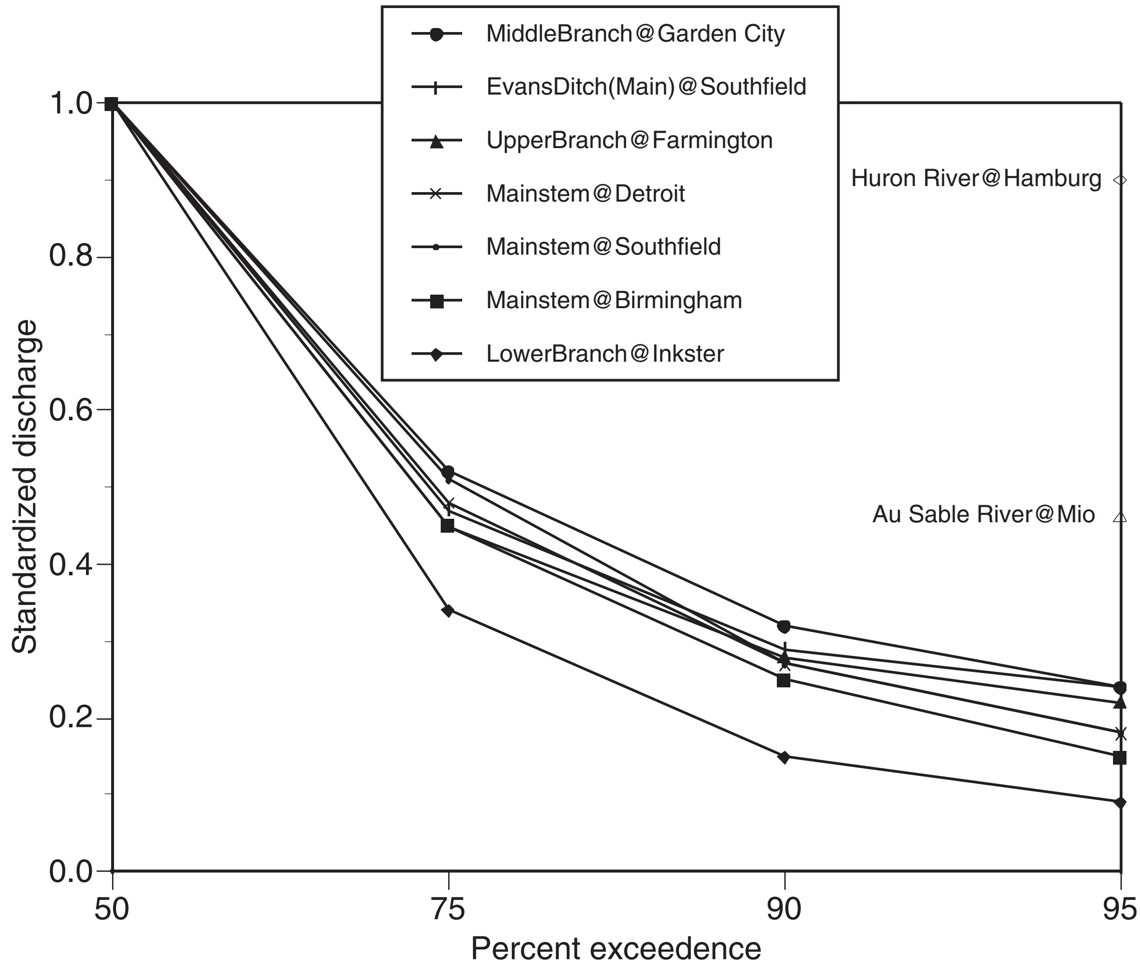

Figure 19.–Standardized low flow exceedence curves for three main branches and mainstem of Rouge River and Evans Ditch. Information from United States Geological Survey gauge stations for period of record. Standardized discharge is discharge/median (50%) discharge. Shown for comparison are neighboring Huron River and extremely stable, groundwater fed Au Sable River.

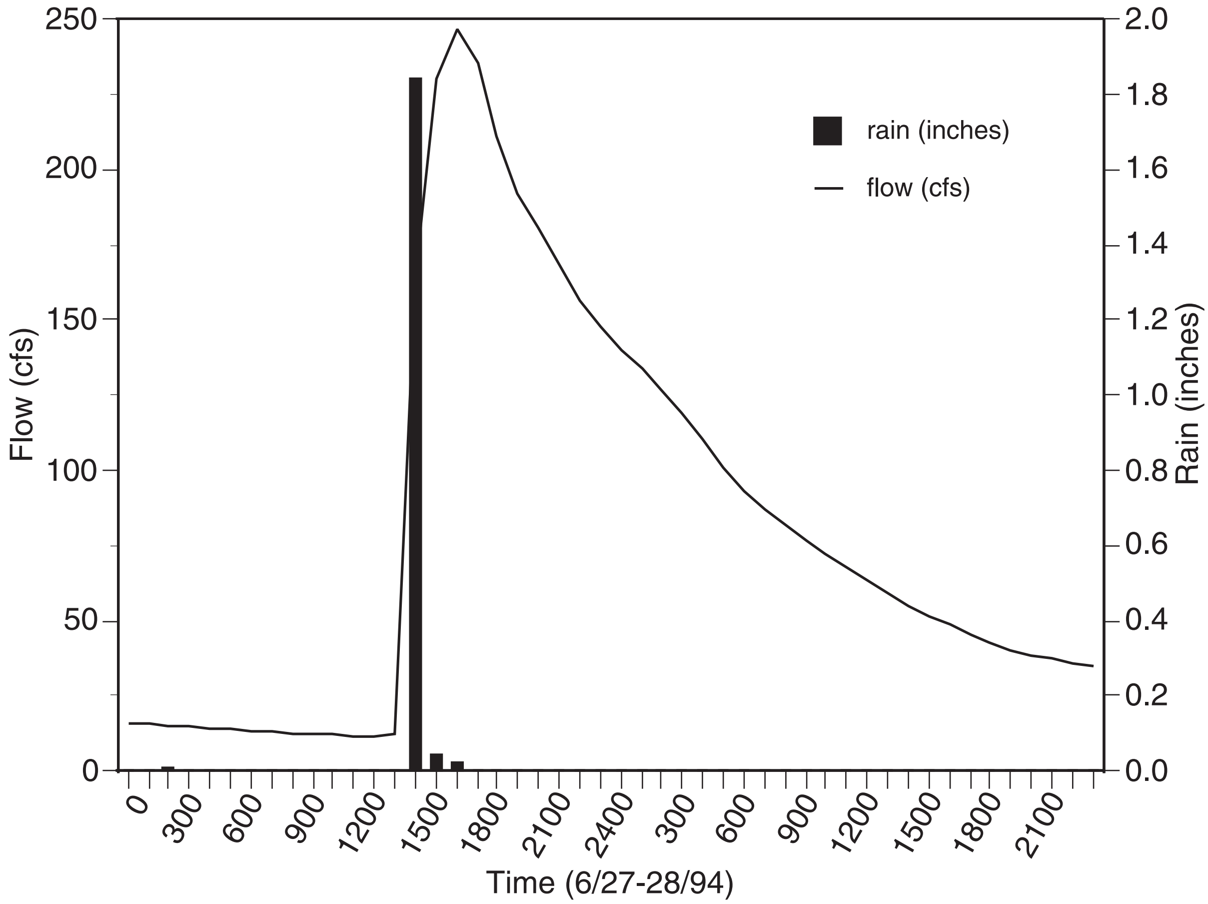

Figure 20.–Mainstem (in Bloomfield Hills) flow in response to 6/27/94 rain event. Data from: Rouge Program Office. Depicts almost immediate response to rain event with rapid recovery. Indicates presence of impervious surfaces, combined sewer overflows, and storm sewers. Rain is expressed as an hourly average.

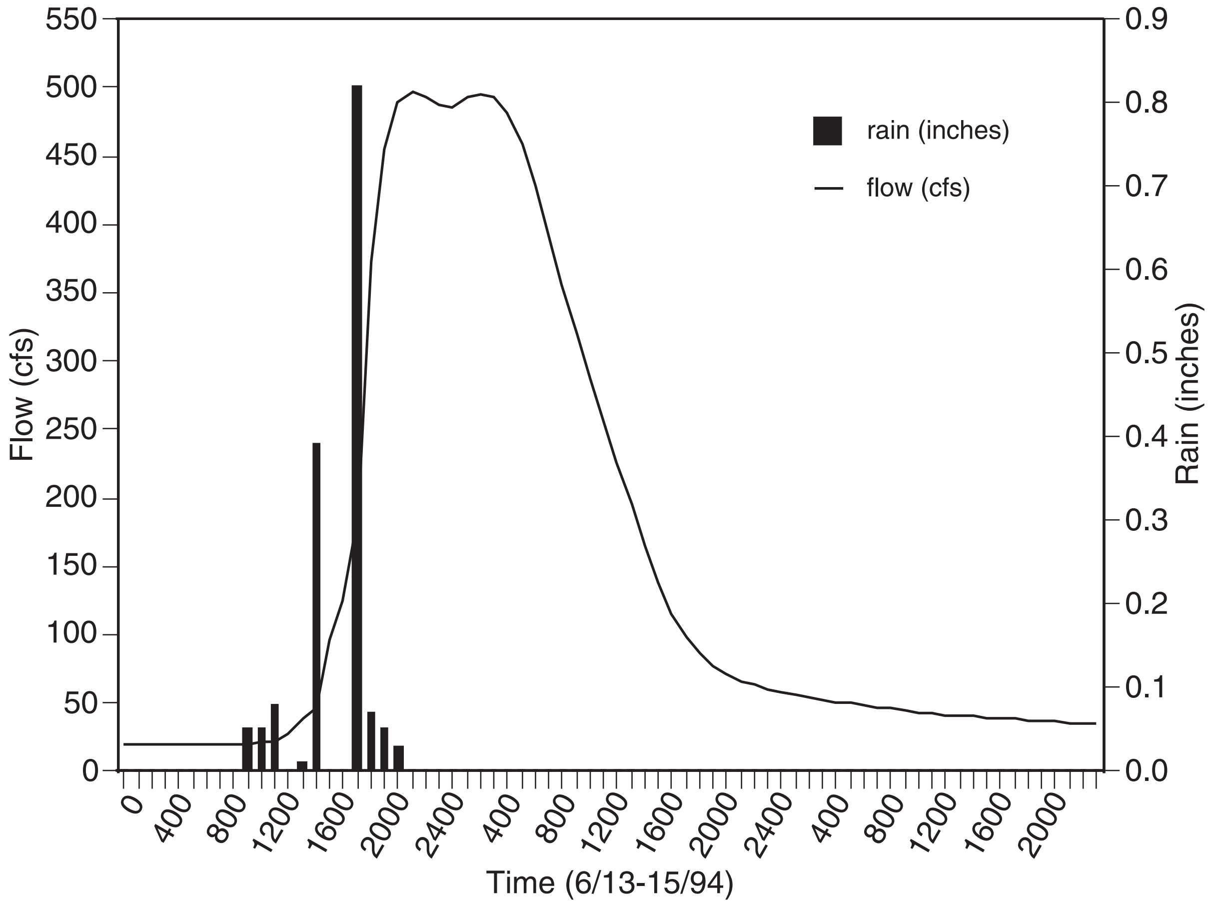

Figure 21.–Upper Rouge River (in Redford) flow in response to 6/13/94 rain event. Data from: Rouge Program Office. Depicts almost immediate response to rain event with rapid recovery. Indicates presence of impervious surfaces, combined sewer overflows, and storm sewers. Rain is expressed as an hourly average.

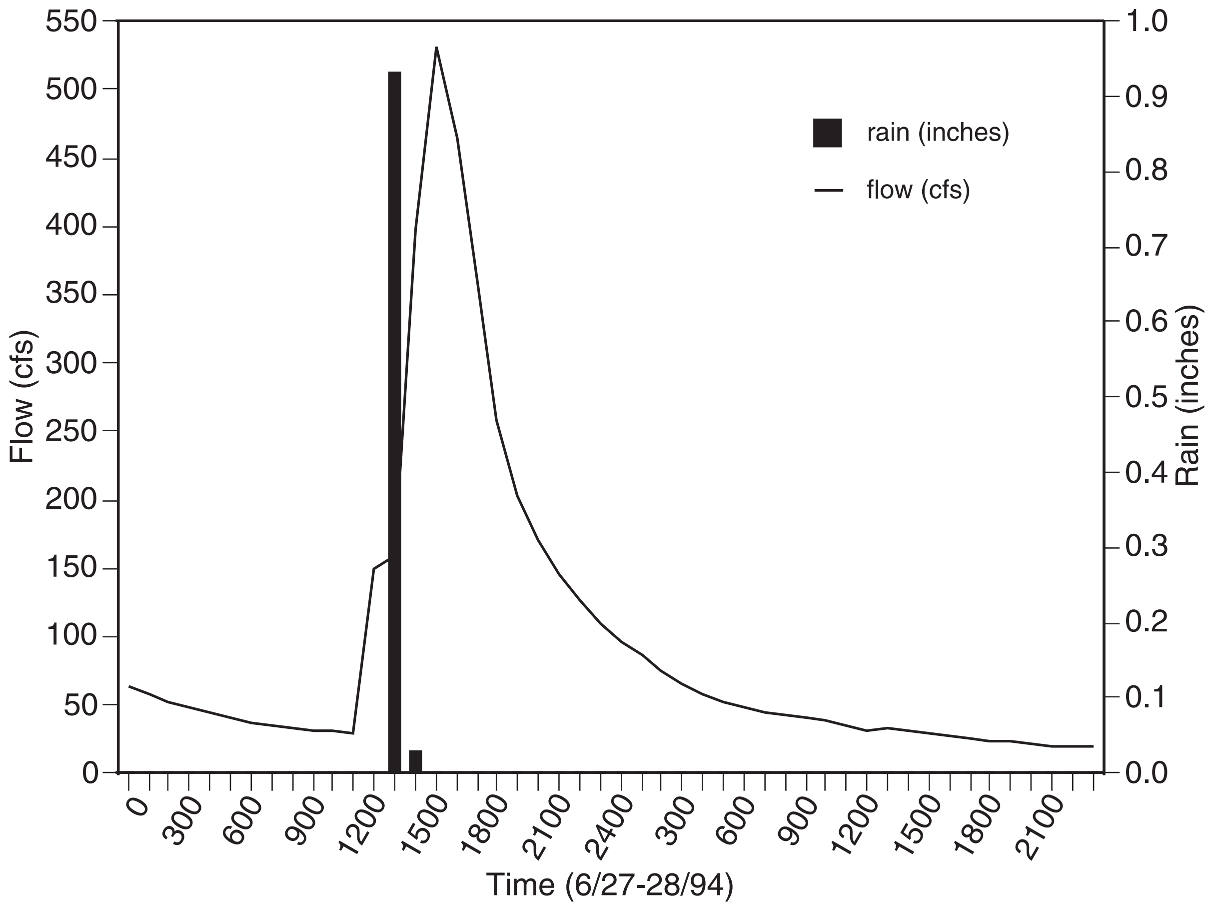

Figure 22.–Middle Rouge River (in Novi) flow in response to 6/26/94 rain event. Data from: Rouge Program Office. Depicts almost immediate response to rain event with rapid recovery. Indicates presence of impervious surfaces and storm sewers. Rain is expressed as an hourly average.

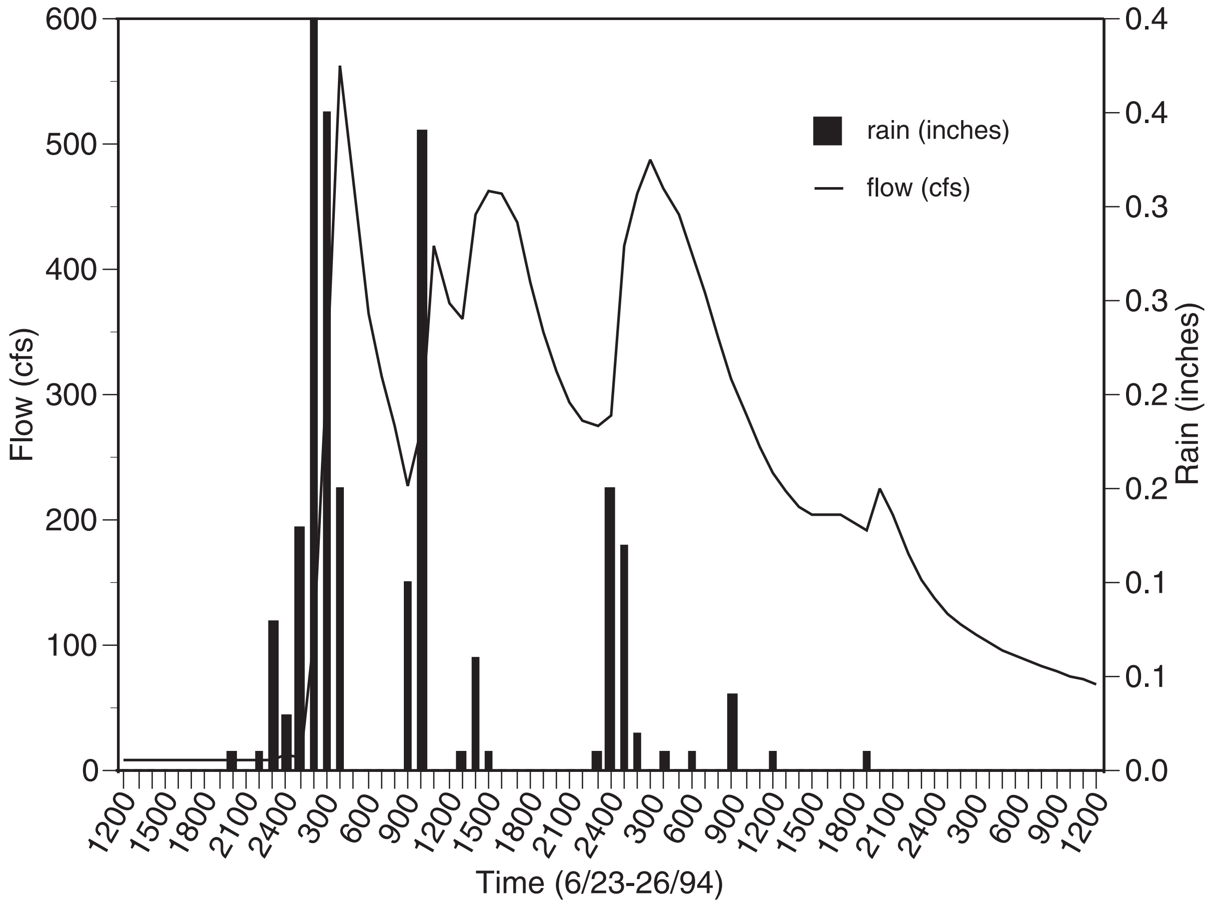

Figure 23.–Lower Rouge River (in Dearborn) flow in response to 6/23-26/94 rain events. Data from: Rouge Program Office. Depicts almost immediate response to rain event with rapid recovery. Indicates presence of impervious surfaces, combined sewer overflows, and storm sewers. Rain is expressed as an hourly average.

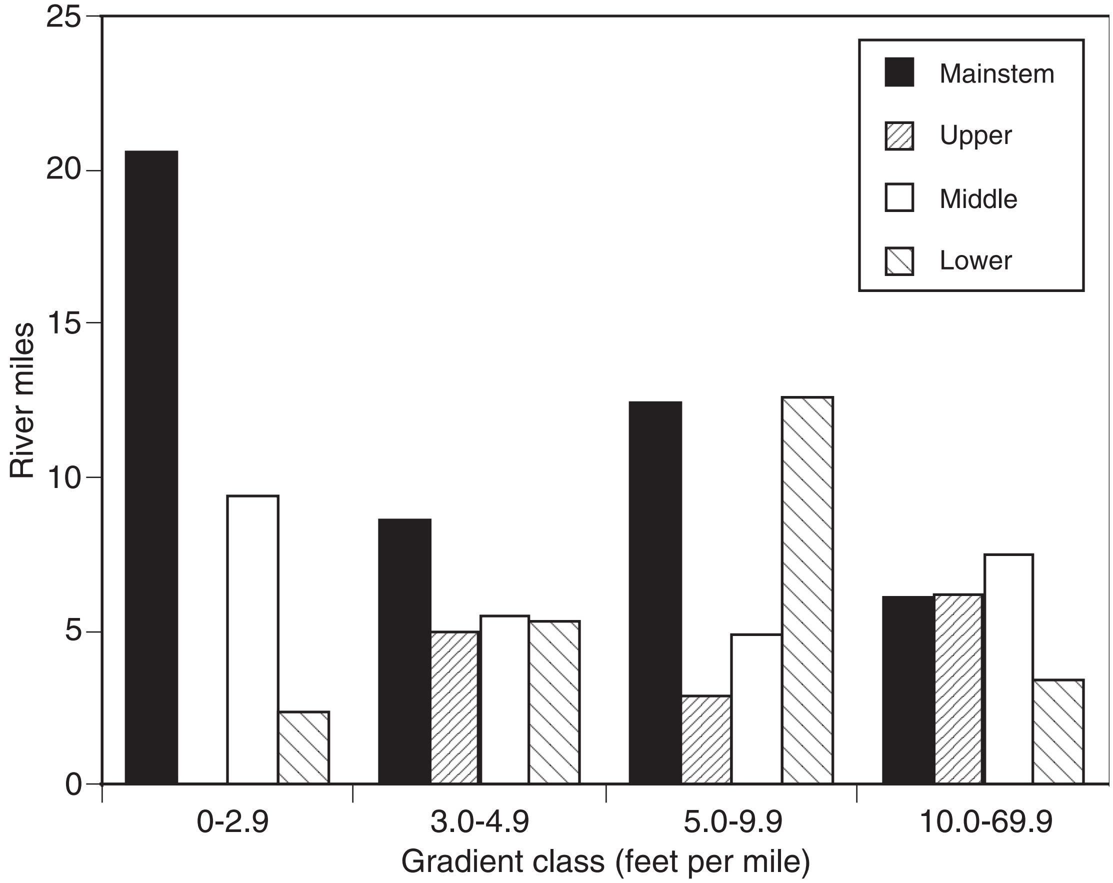

Figure 24.–Gradient classes and length of river in each for the mainstem and three branches.

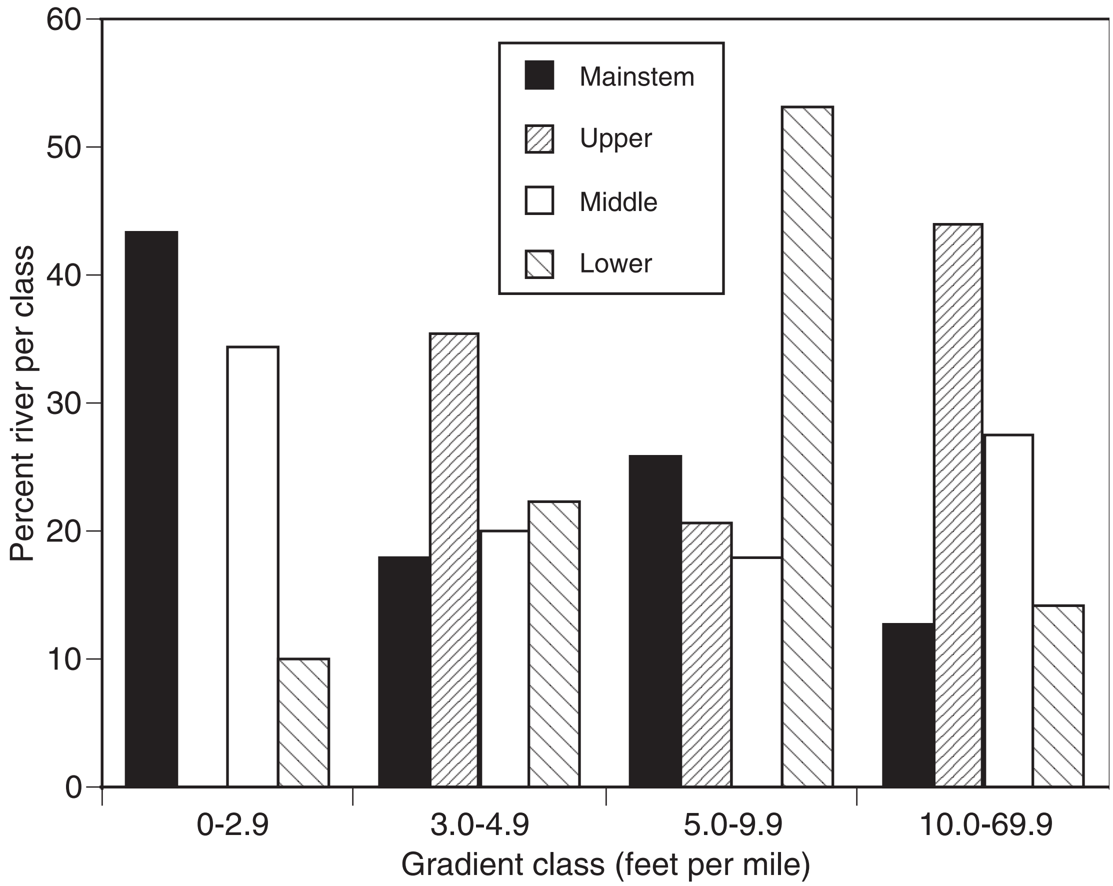

Figure 25.–Gradient classes and percent of river in each for the mainstem and three branches.

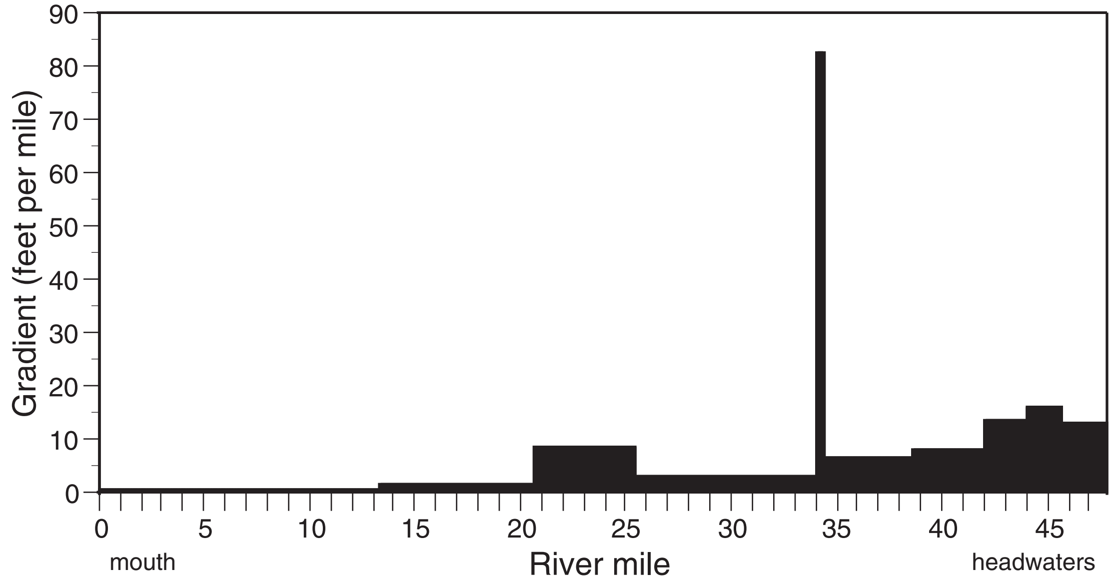

Figure 26a.–Gradient (elevation change in feet per mile) of the mainstem. Values are of stream bottom in tenths of river mile. Gradient is shown without existing dams or lake-level control structures. Data from: United States Geological Survey topographic maps.

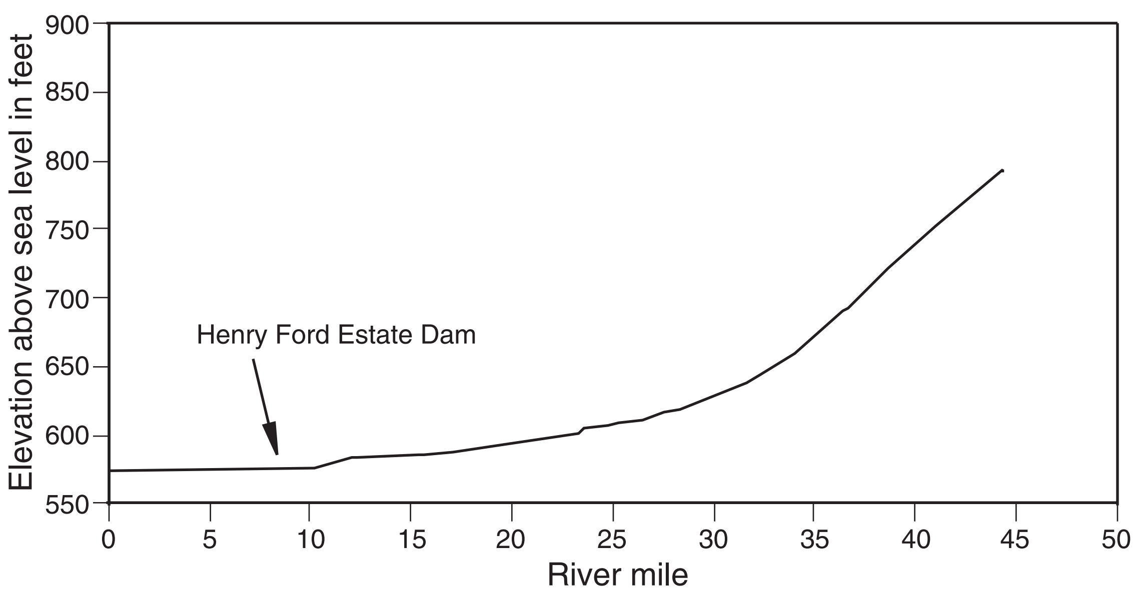

Figure 26b.–Elevation changes, by river mile, from the headwaters to the mouth, of the mainstem. Major mainstem dam locations are shown. Data from: Knutilla, 1970.

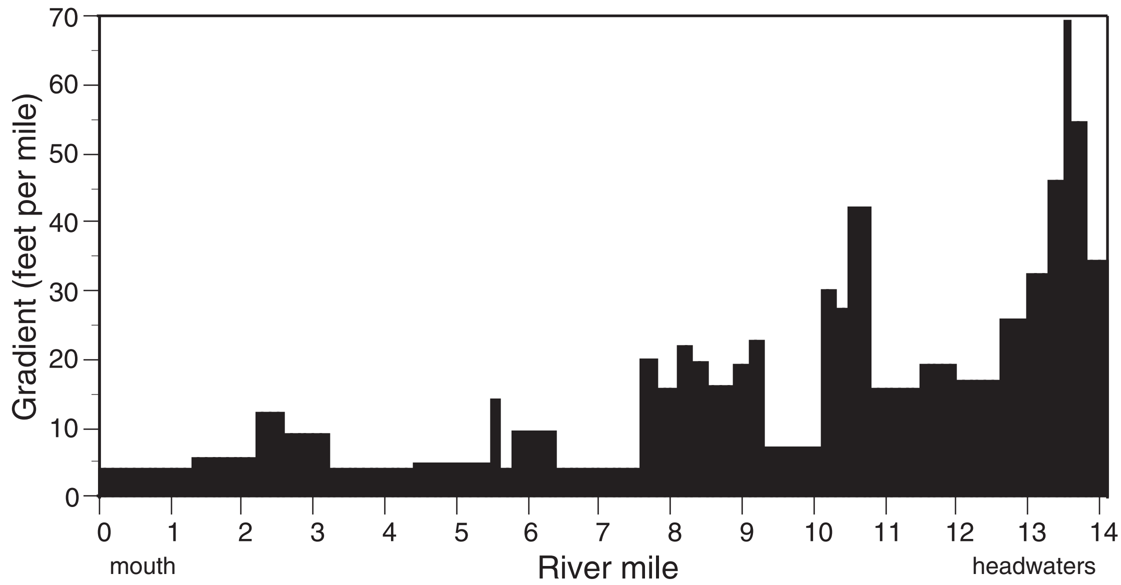

Figure 27a.–Gradient (elevation change in feet per mile) of the Upper Rouge River. Values are of stream bottom in tenths of river mile. Gradient is shown without existing dams or lake-level control structures. Data from: United States Geological Survey topographic maps.

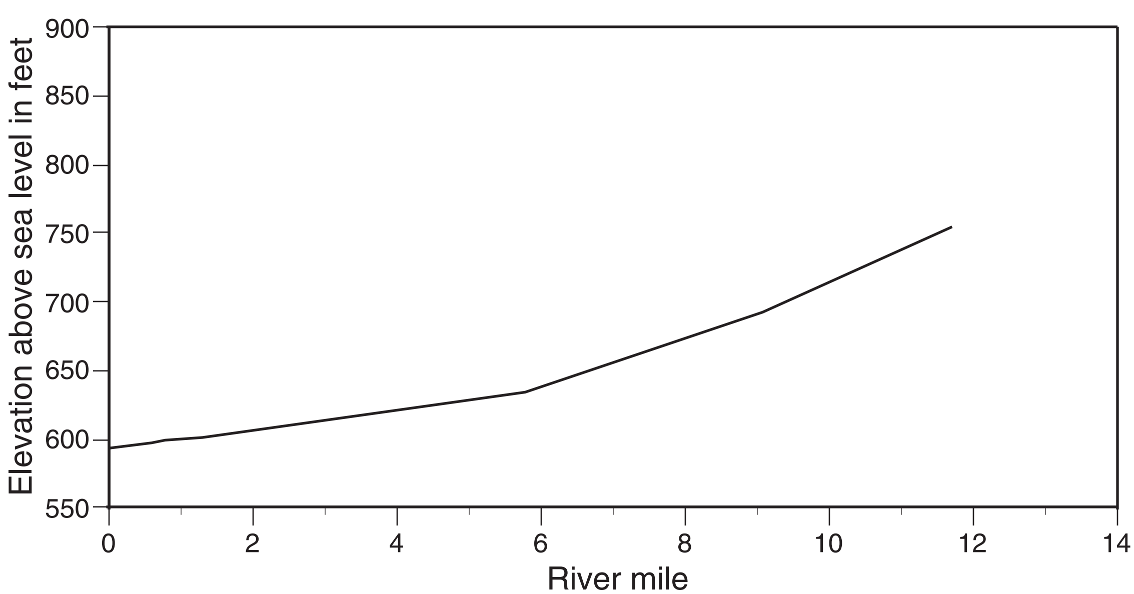

Figure 27b.–Elevation changes, by river mile, from the headwaters to the mouth, of the Upper Rouge River. Data from: Knutilla, 1970.

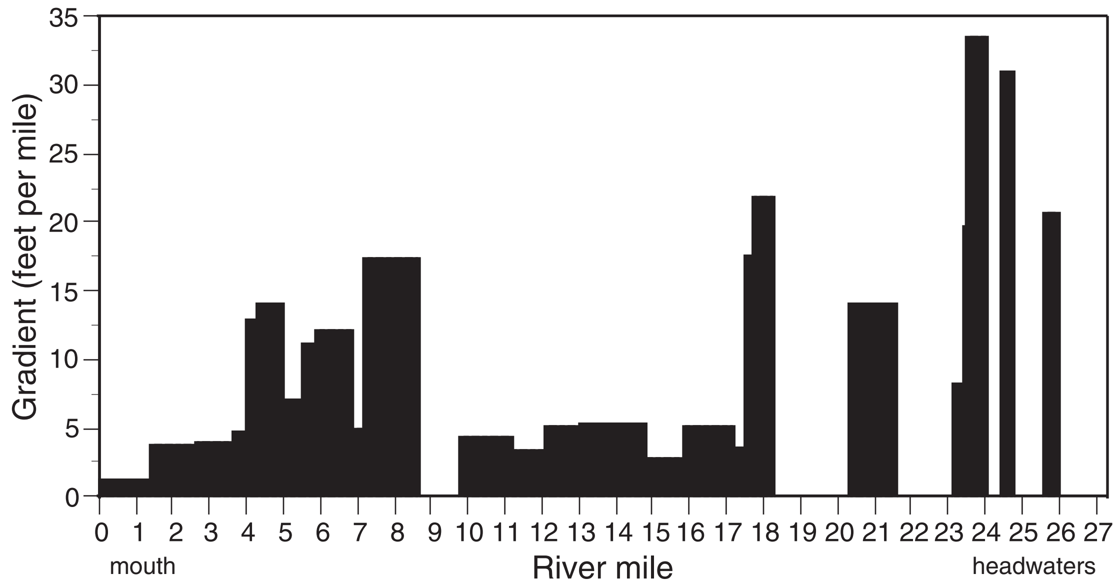

Figure 28a.–Gradient (elevation change in feet per mile) of the Middle Rouge River. Values are of stream bottom in tenths of river mile. Gradient is shown without existing dams or lake-level control structures. Data from: United States Geological Survey topographic maps.

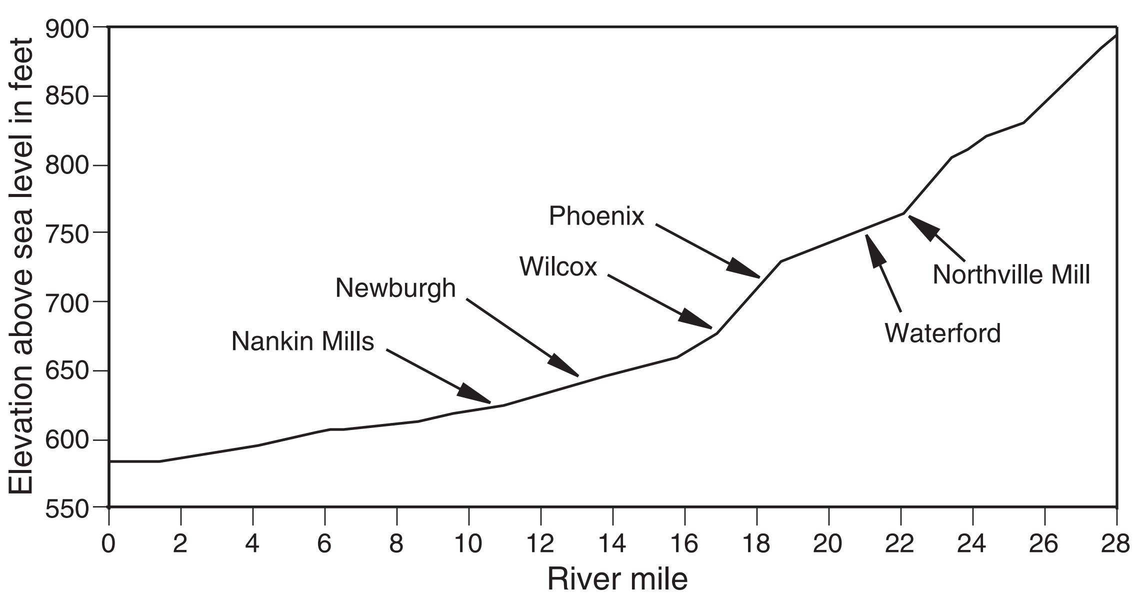

Figure 28b.–Elevation changes, by river mile, from the headwaters to the mouth, of the Middle Rouge River. Major mainstem dam locations are shown. Data from: Knutilla, 1970.

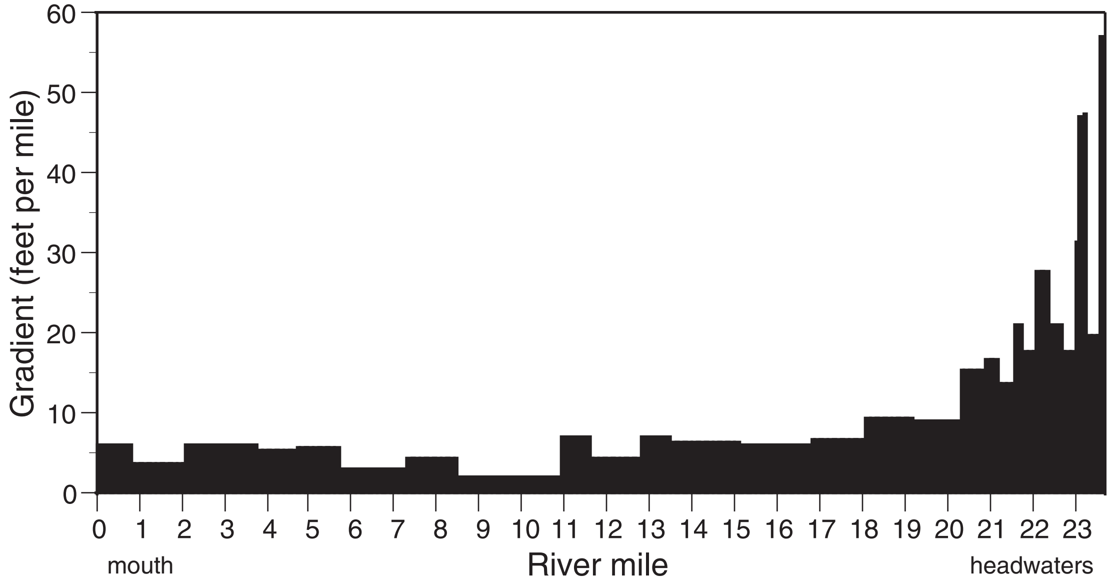

Figure 29a.–Gradient (elevation change in feet per mile) of the Lower Rouge River. Values are of stream bottom in tenths of river mile. Gradient is shown without existing dams or lake-level control structures. Data from: United States Geological Survey topographic maps.

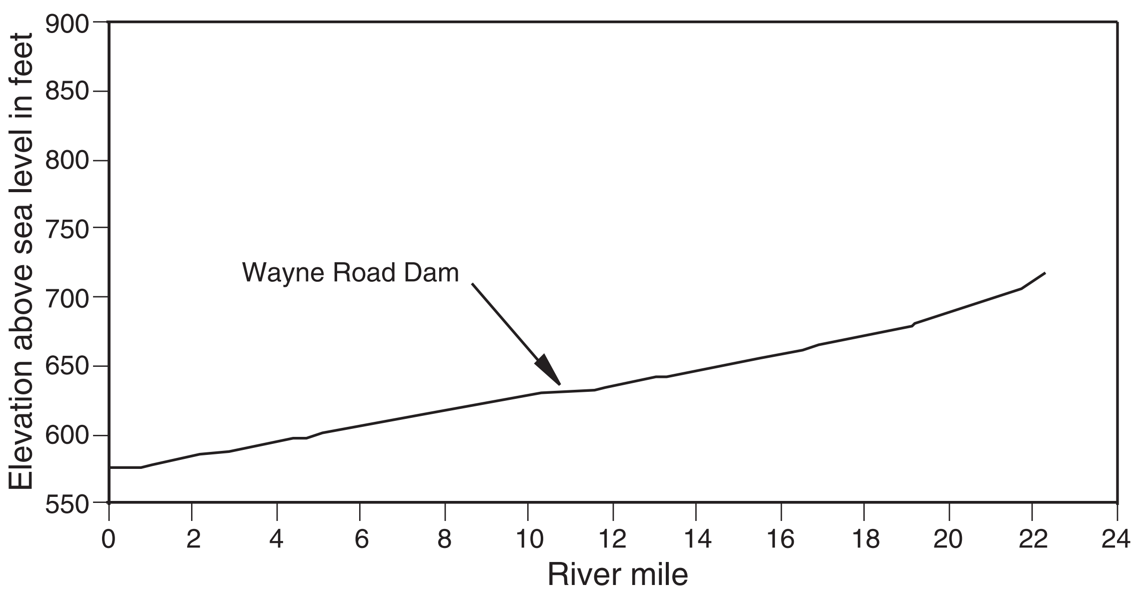

Figure 29b.–Elevation changes, by river mile, from the headwaters to the mouth, of the Lower Rouge River. Major mainstem dam locations are shown. Data from: Knutilla, 1970.

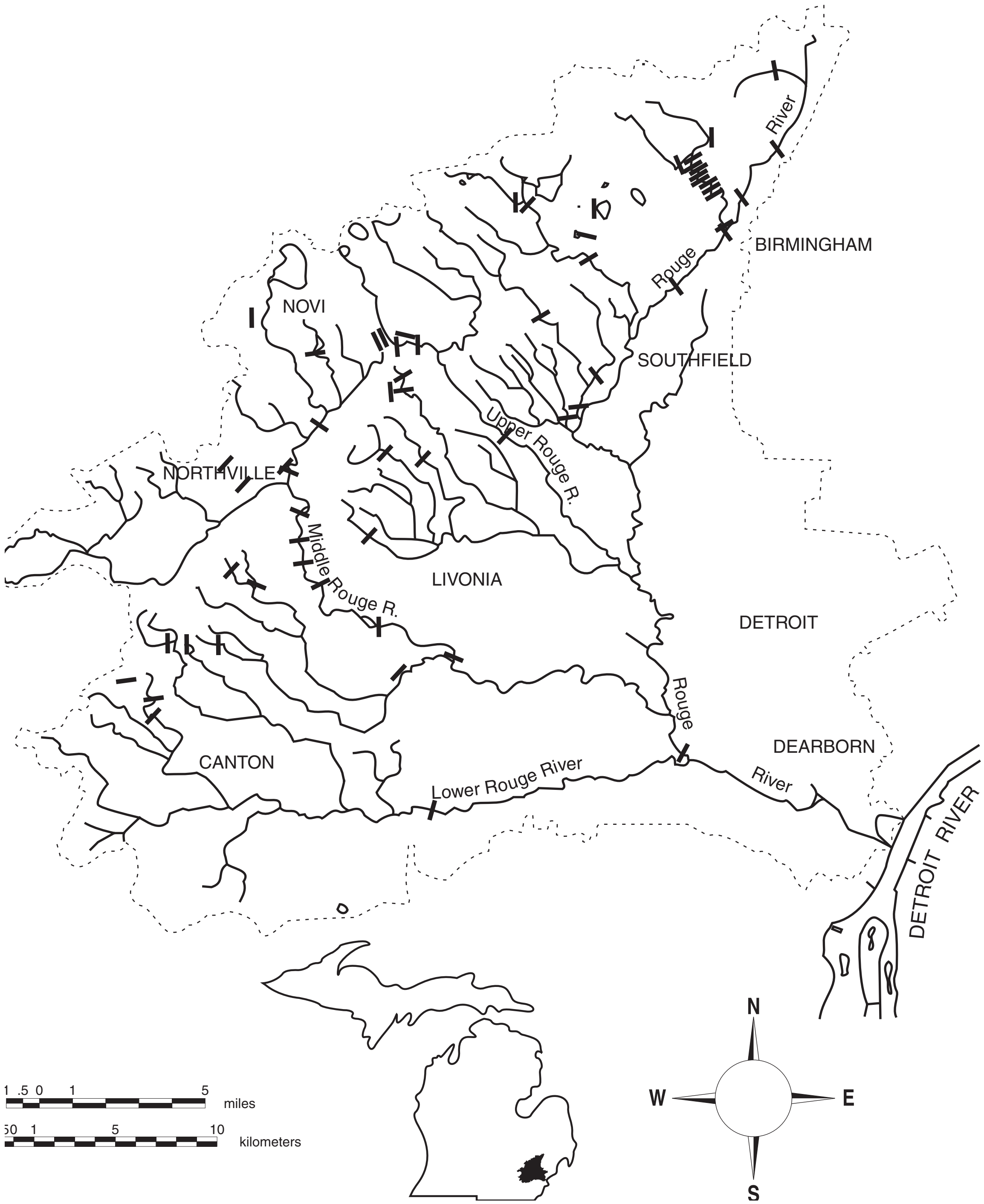

Figure 30.–Locations of dams in the Rouge River watershed. Data from Rouge Program Office.

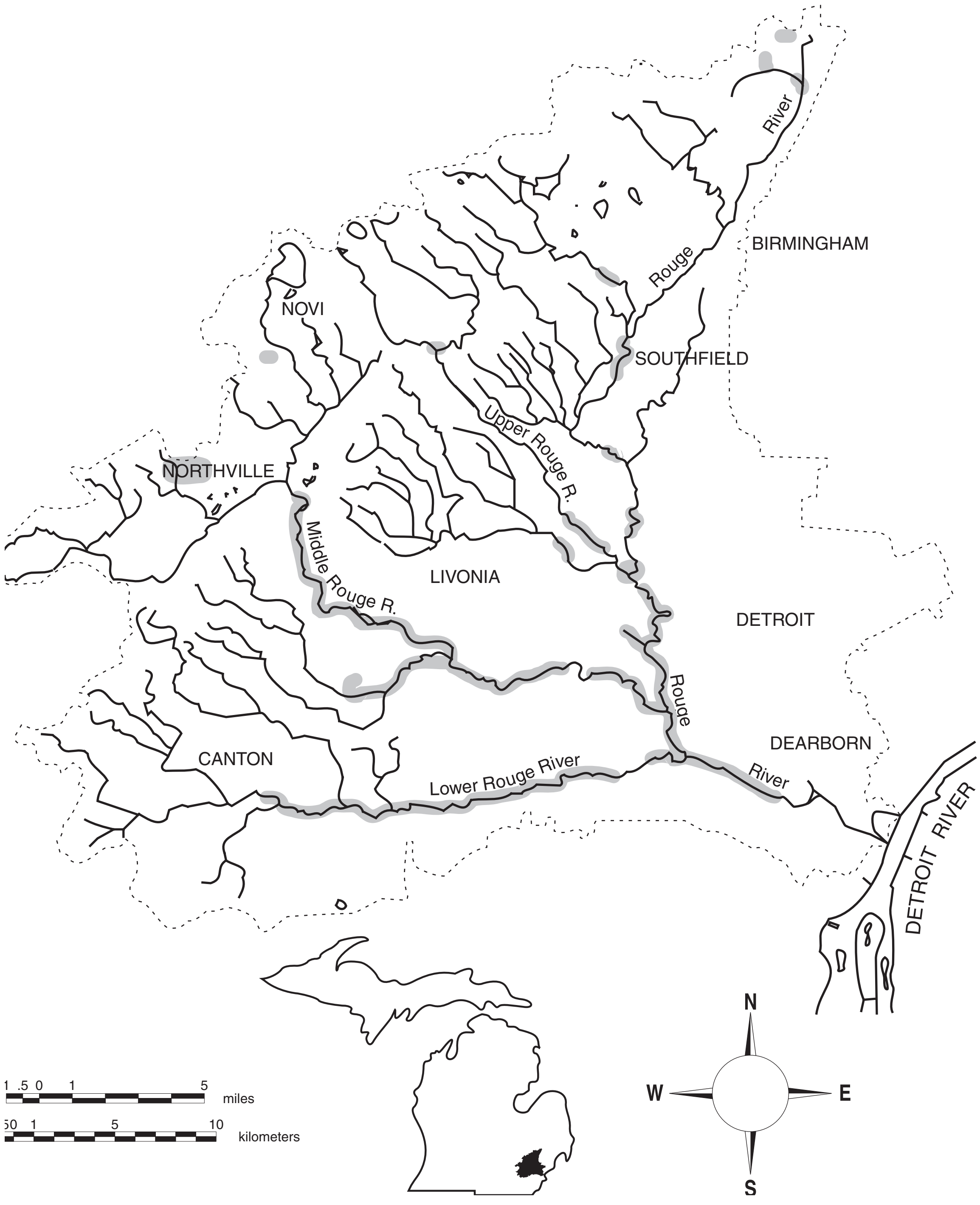

Figure 31.–Major public parkland in the Rouge River watershed.

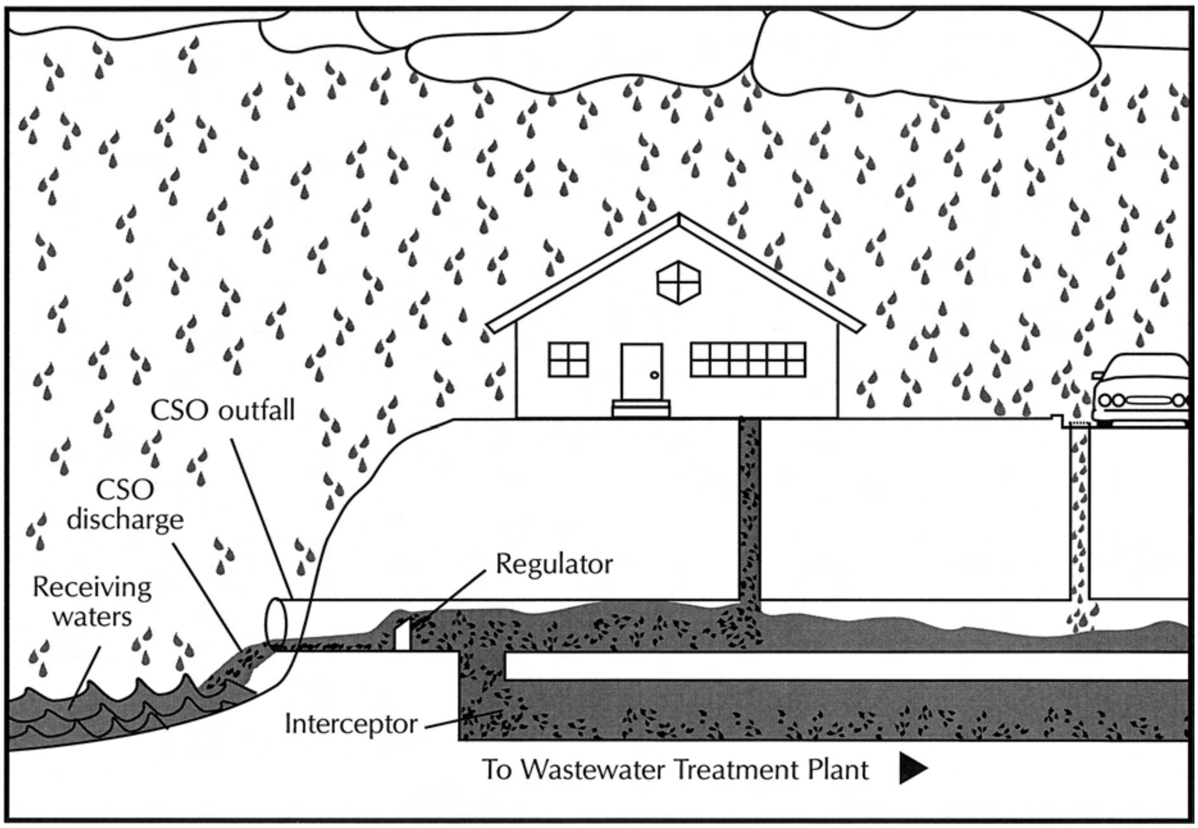

Figure 32.–Illustration of a typical combined sewer system. CSO = combined sewer overflow. Prepared by: Southeast Michigan Council of Governments.

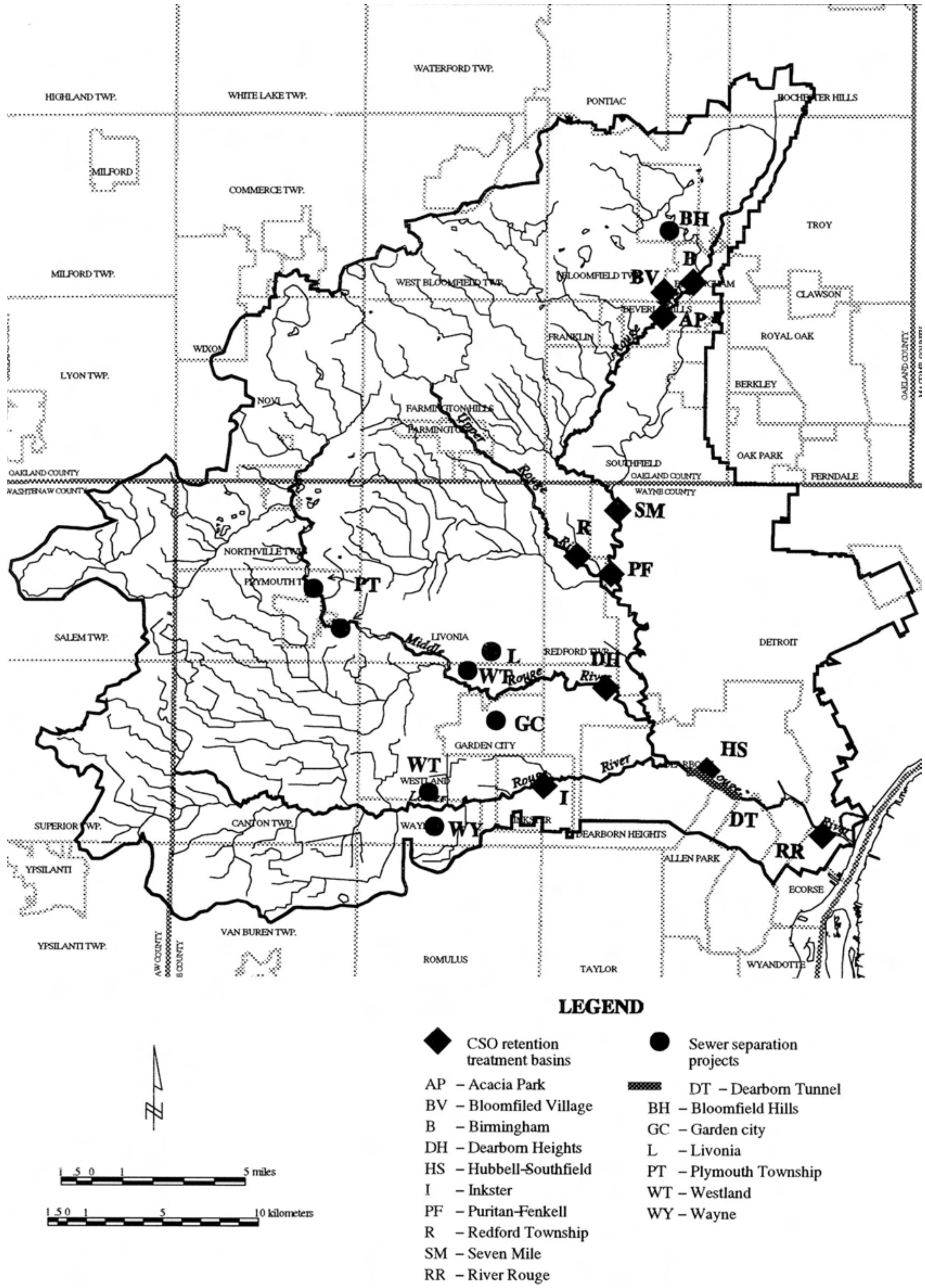

Figure 33.–Location of combined sewer overflow (CSO) abatement projects in the Rouge River watershed. Map and data from Rouge Program Office.

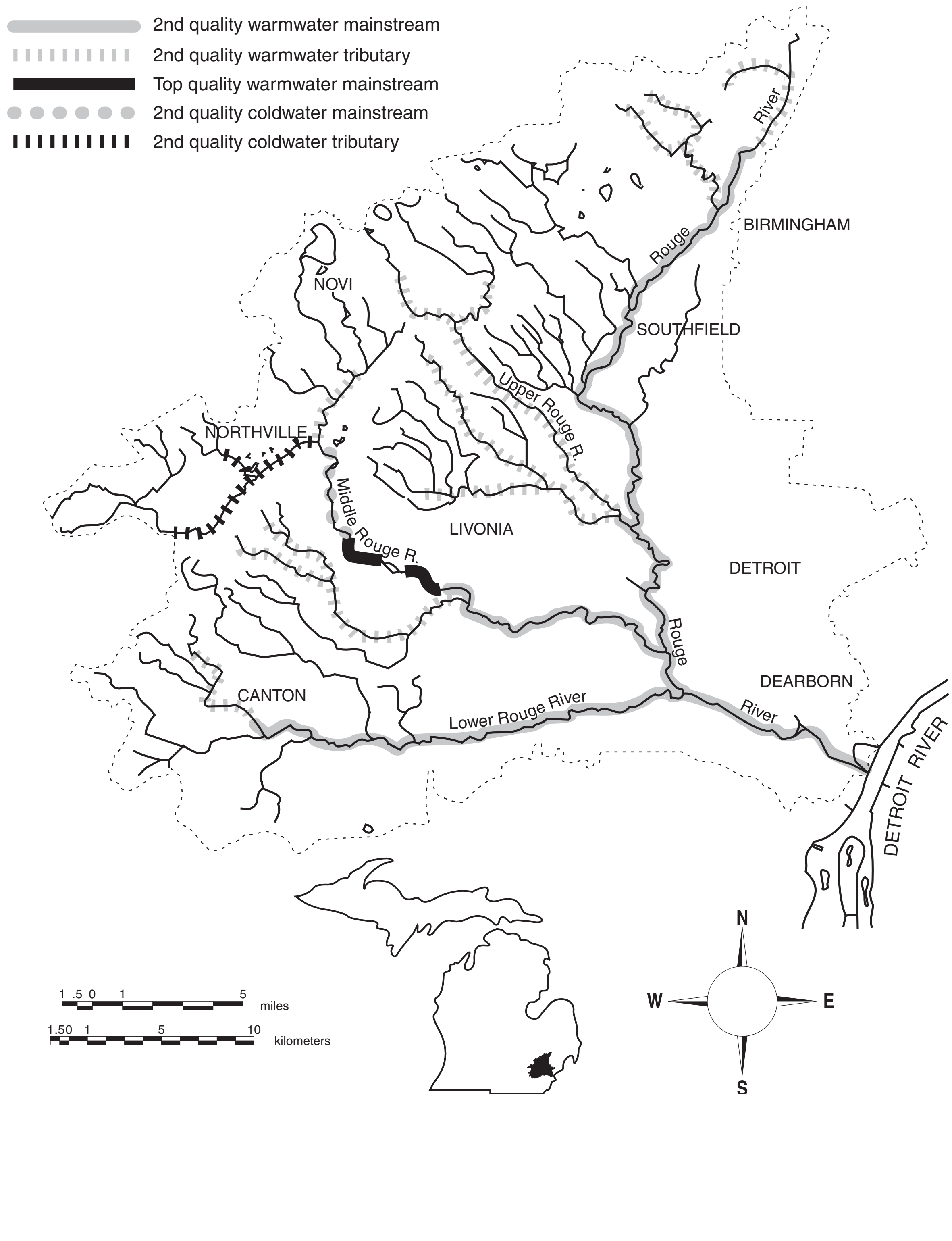

Figure 34.–Fisheries stream classification map. (Michigan Department of Natural Resources, Fisheries Division, 1964.)

DNR
STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

Number 22 September 1998

Rouge River Assessment
Appendix

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FISHERIES DIVISION
SPECIAL REPORT

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

Fisheries Special Report 22
September 1998

Rouge River Assessment
Appendix

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APPENDIX

Fish Species Distribution Maps

Known present fish distributions within the Rouge River. The distributions of fish species were compiled from records located at Michigan Department of Natural Resources, Southeast Michigan District Office, Livonia. Scientific names and phylogenic order follow Robins et al. 1991. Species that are listed under Michigan's Endangered Species Act (Part 365, Endangered Species Protection, of the Natural Resource and Environmental Protection Act, Act 451 of the Public Acts of 1994), their status follows their scientific name. Categories are declining, rare, threatened, endangered, extinct, and locally extinct.

The habitat descriptions were compiled from Fisheries of the Great Lakes Region (Hubbs and Lagler 1947), Freshwater Fishes of Canada (Scott and Crossman 1973), Fishes of Missouri (Pflieger 1975), The Fishes of Ohio (Trautman 1982), and Fishes of Wisconsin (Becker 1983).

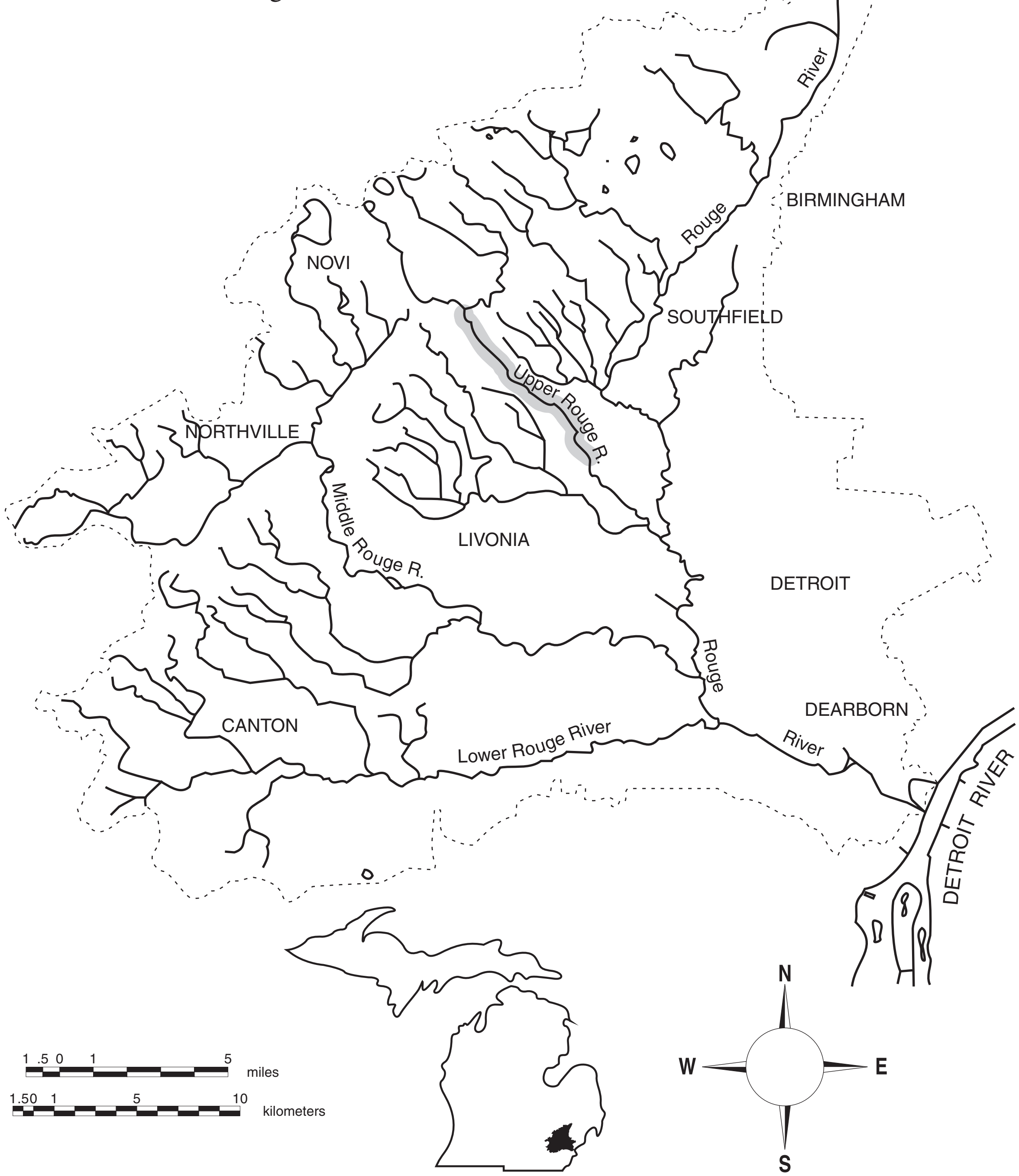
American brook lamprey (*Lampetra appendix*)

Habitat:

feeding - young: low gradient, substrate with bars and beds of mixed sand and organic debris
- clear cool stream water, sensitive to turbidity

spawning - clear, high gradient streams (>15 feet wide)
- cold water
- gravel substrate

winter refuge - sand or silt substrate for amnocoetes

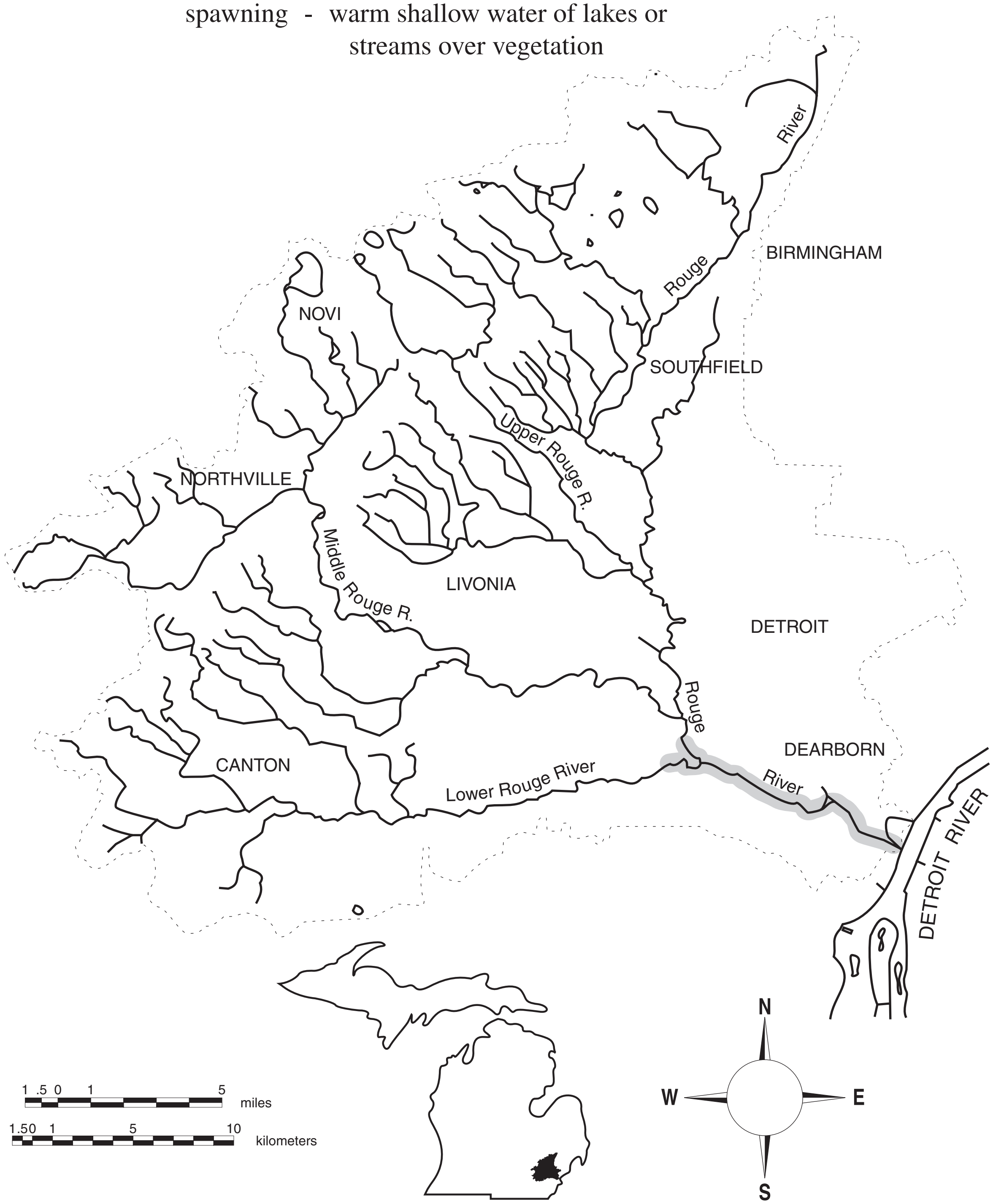


Longnose gar (*Lepisosteus osseus*)

Habitat:

feeding
- adults: in deeper water
- young: in shallows
- clear water, low-gradient streams, lakes, and impoundments
- will feed in moderate current
- aquatic vegetation preferred, but not necessary
- open water fish

spawning
- warm shallow water of lakes or streams over vegetation

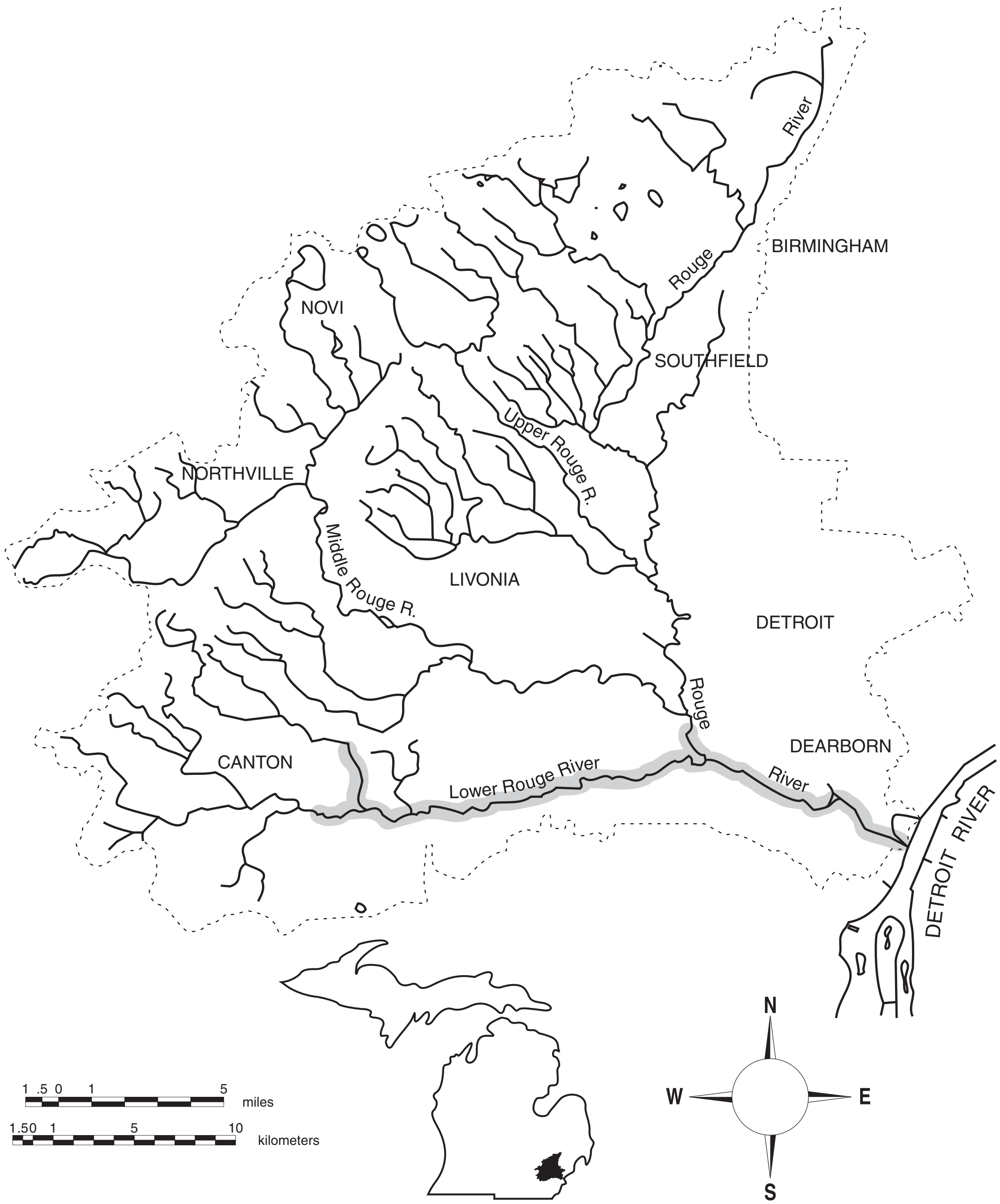


Gizzard shad (*Dorosoma cepedianum*)

Habitat:

feeding - large streams with low gradient, impoundments, and Detroit River
- tolerant of clear and turbid water

spawning - shallow areas of ponds, lakes, and large rivers
- low gradient

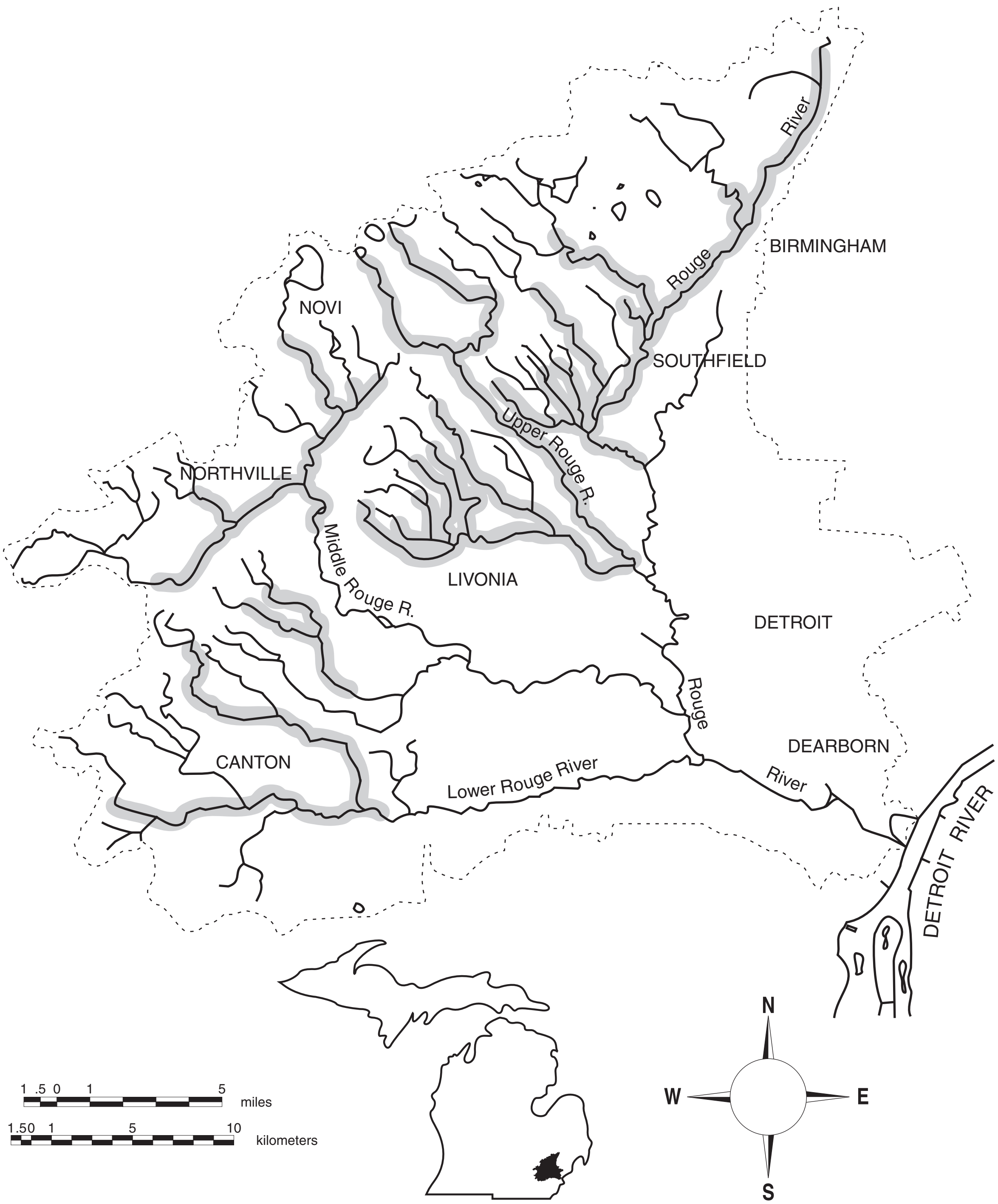


Central stoneroller (*Campostoma anomalum*)

Habitat:

feeding
- moderate to high gradients
- rocky riffles
- somewhat tolerant of turbidity
- riffles and adjacent pools of warm, clear, shallow streams
- gravel or cobble substrate

spawning
- riffles

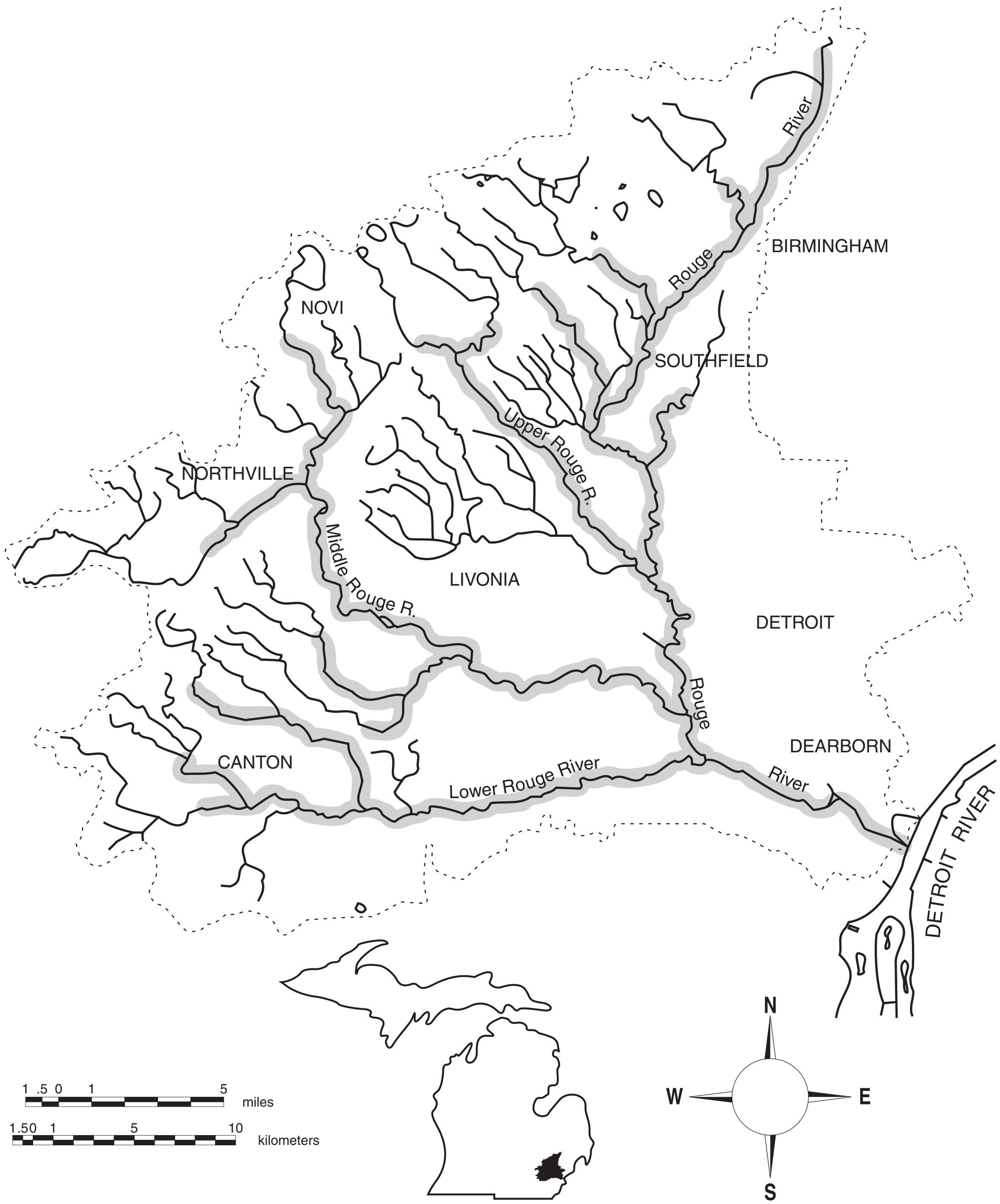


Goldfish (*Carassius auratus*)

Habitat:

feeding - vegetation
- low gradient, shallow, warm water streams, rivers, lakes, and impoundments
- tolerates some turbidity and siltation

spawning - warm, weedy shallows

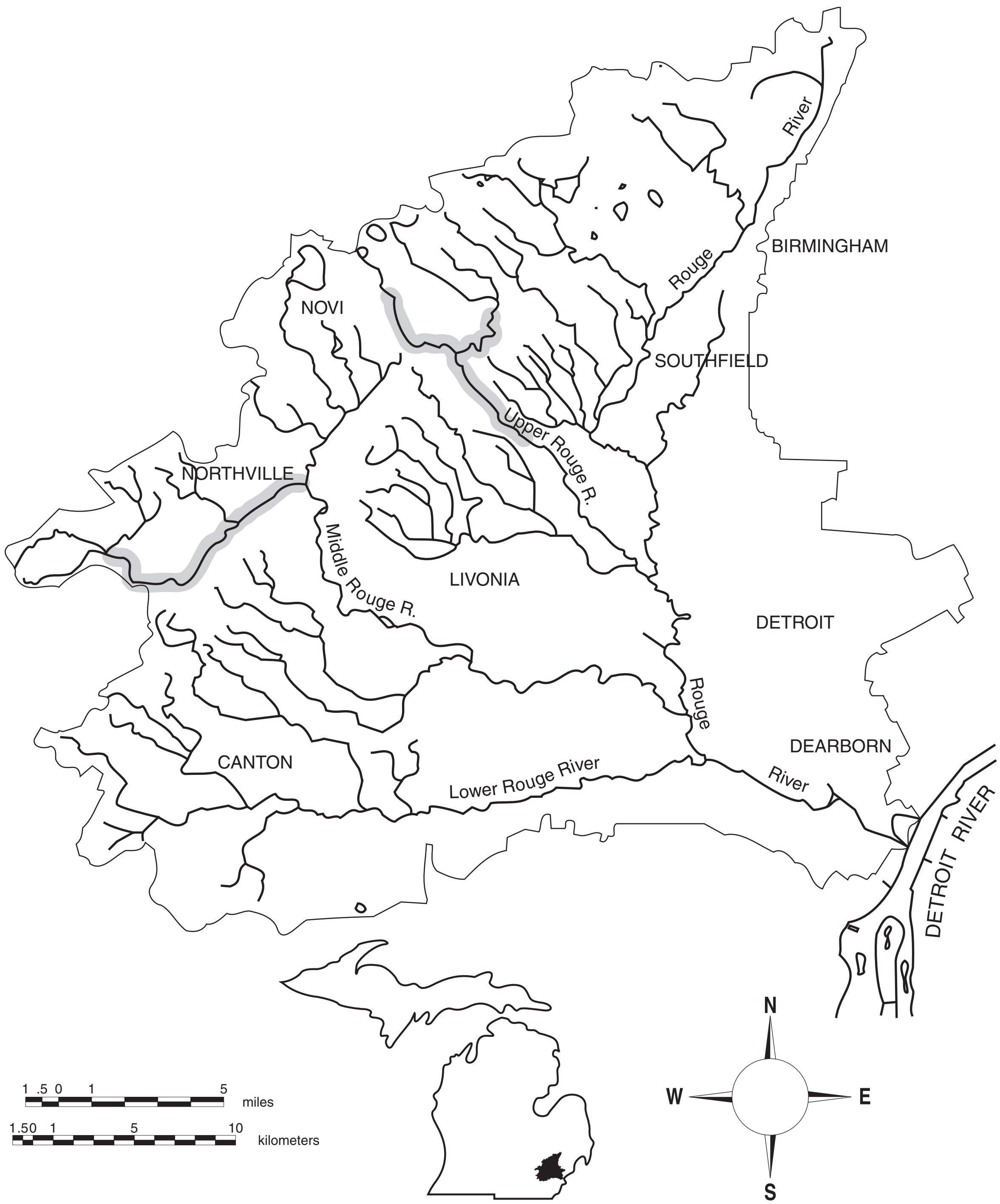


Redside dace (*Clinostomus elongatus*) - rare

Habitat:

feeding - small clear, cooler headwater streams with moderate to high gradient
- overhanging grassy vegetation
- clean sand, gravel, or bedrock substrate
- does not tolerate clayey silt

spawning - uses gravelly nests of creek chub

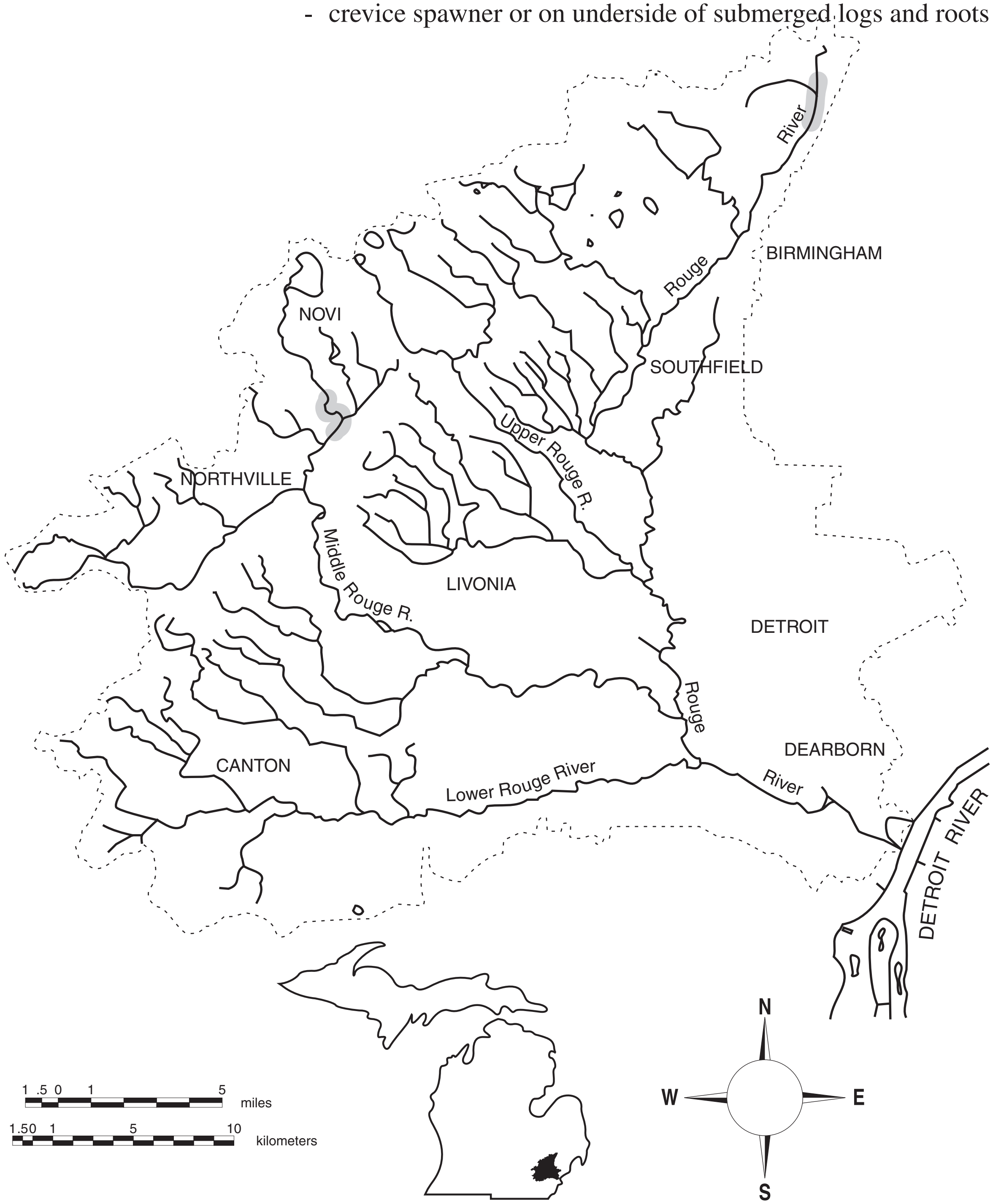


Spotfin shiner (*Cyprinella spiloptera*)

Habitat:

feeding
- clear water tolerant of turbidity and siltation
- some current
- shallow depths
- medium sized streams, lakes, and impoundments
- clear sand or gravel substrate

spawning
- swift current
- crevice spawner or on underside of submerged logs and roots

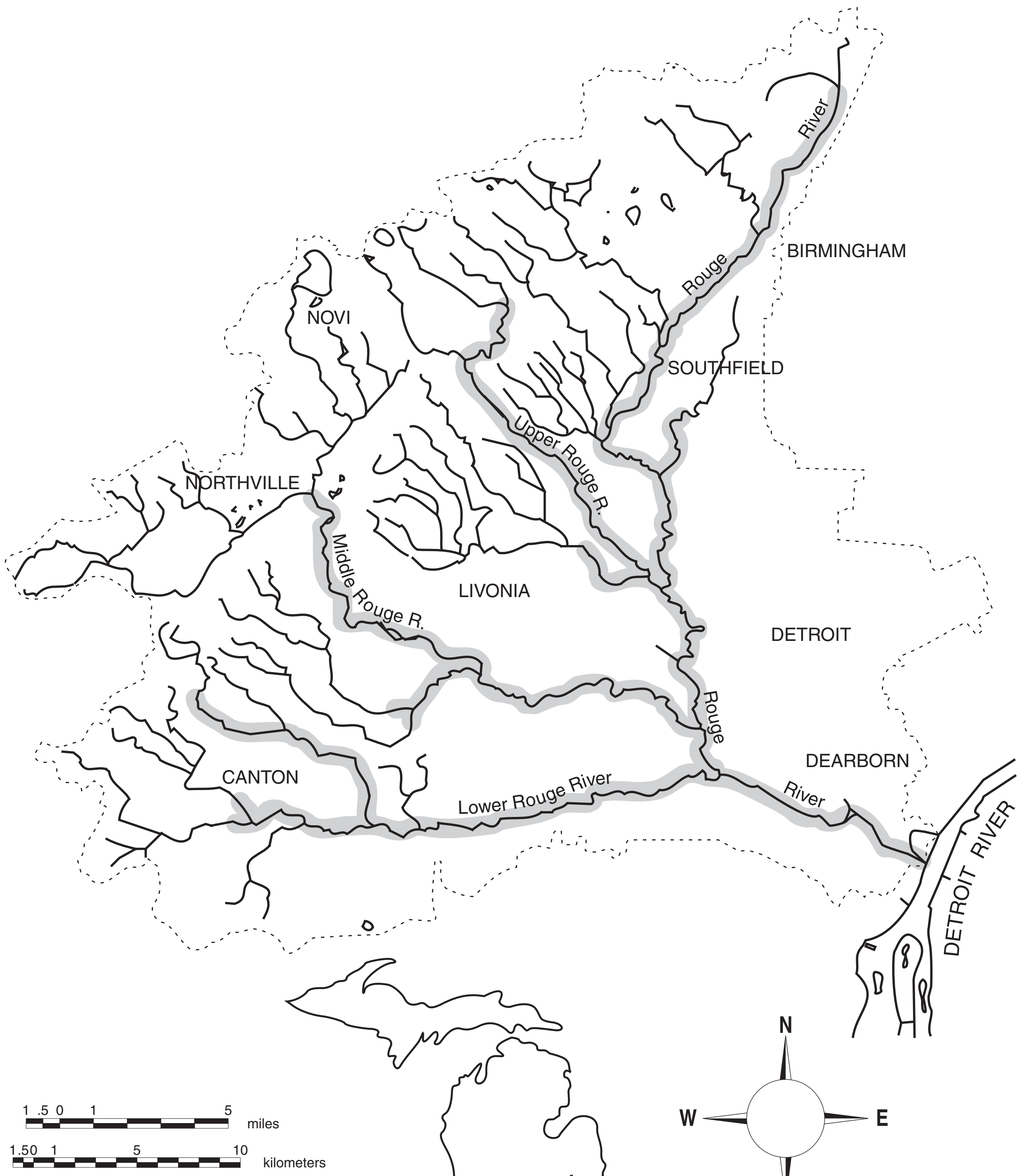


Common carp (*Cyprinus carpio*)

Habitat:

feeding - low gradient fertile streams, rivers, lakes, and impoundments
- abundance of aquatic vegetation or organic matter
- tolerant of all substrates and clear to turbid water

spawning - weedy or grassy shallows

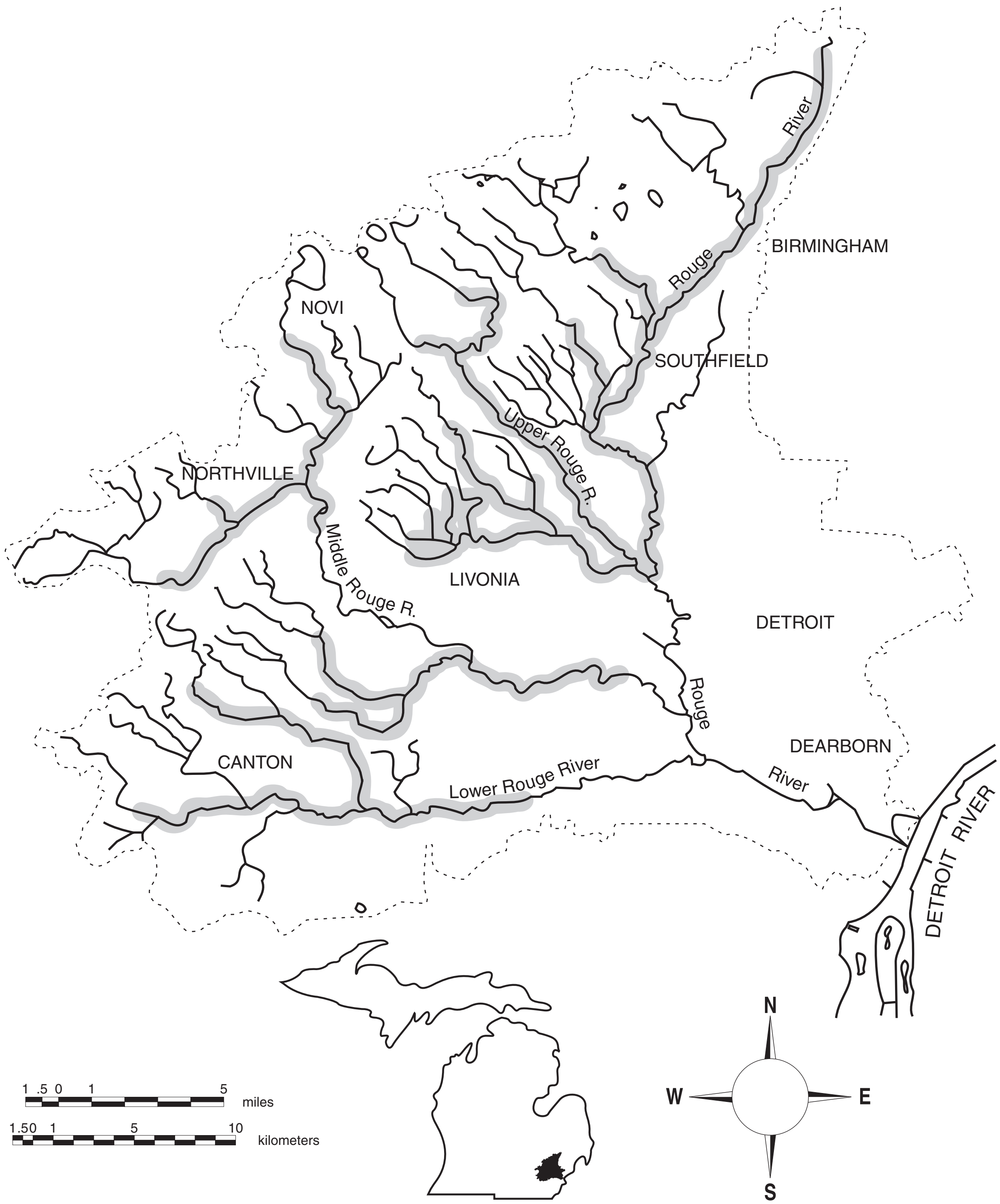


Common shiner (*Luxilus cornutus*)

Habitat:

feeding
- small, clear, high-gradient streams and rivers, or shores of clear water lakes and impoundments
- gravel substrate
- can tolerate some submerged aquatic vegetation
- not very tolerant of turbidity or silted waters

spawning
- gravel nests of other fish, especially those at the head of a riffle

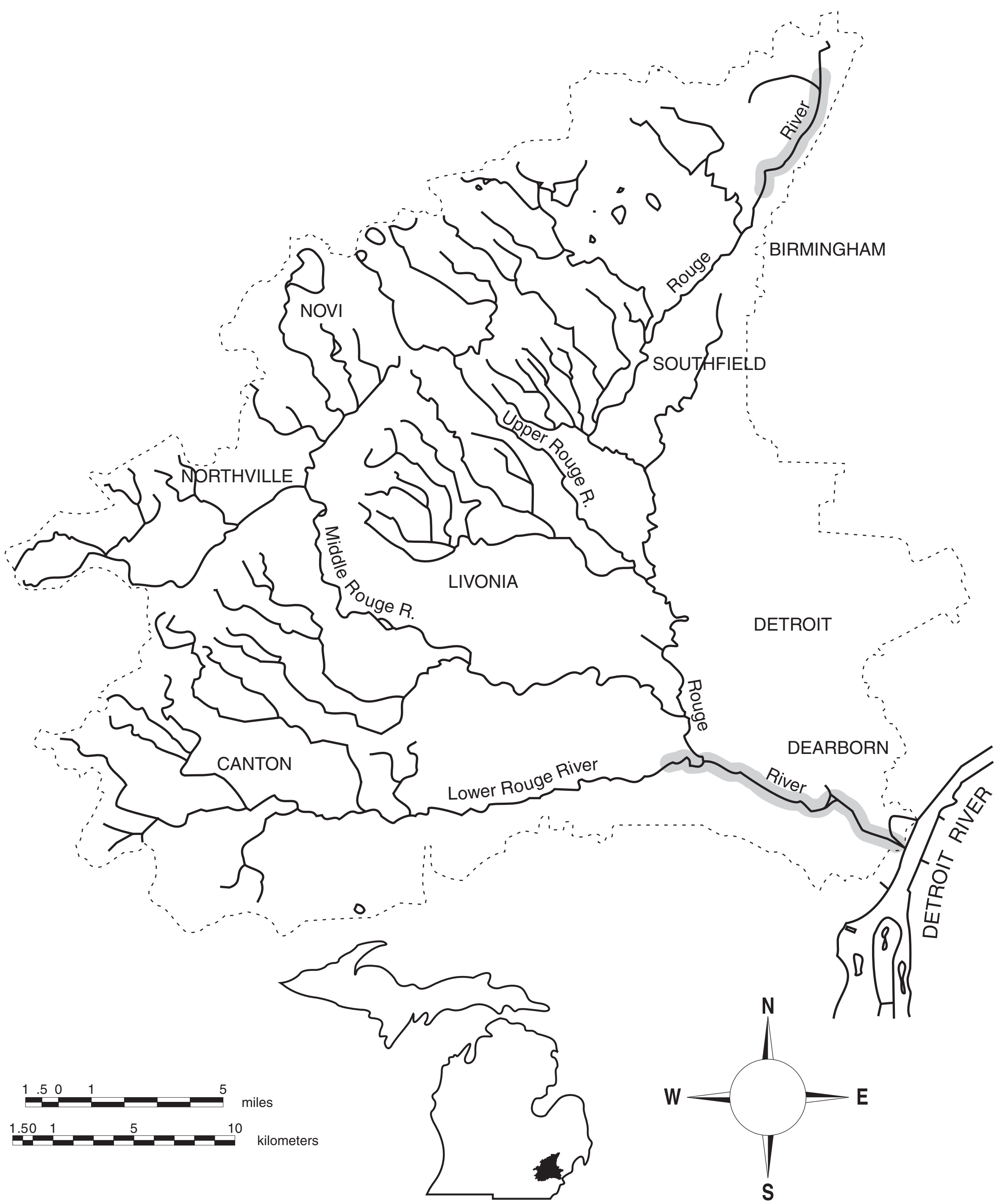


Redfin shiner (*Lythrurus umbratilis*)

Habitat:

feeding - clear, quiet warm rivers in weedy pools
- little to no current
- abundant submerged and emergent vegetation

spawning - over sand and gravel substrate in slow moving sections of streams

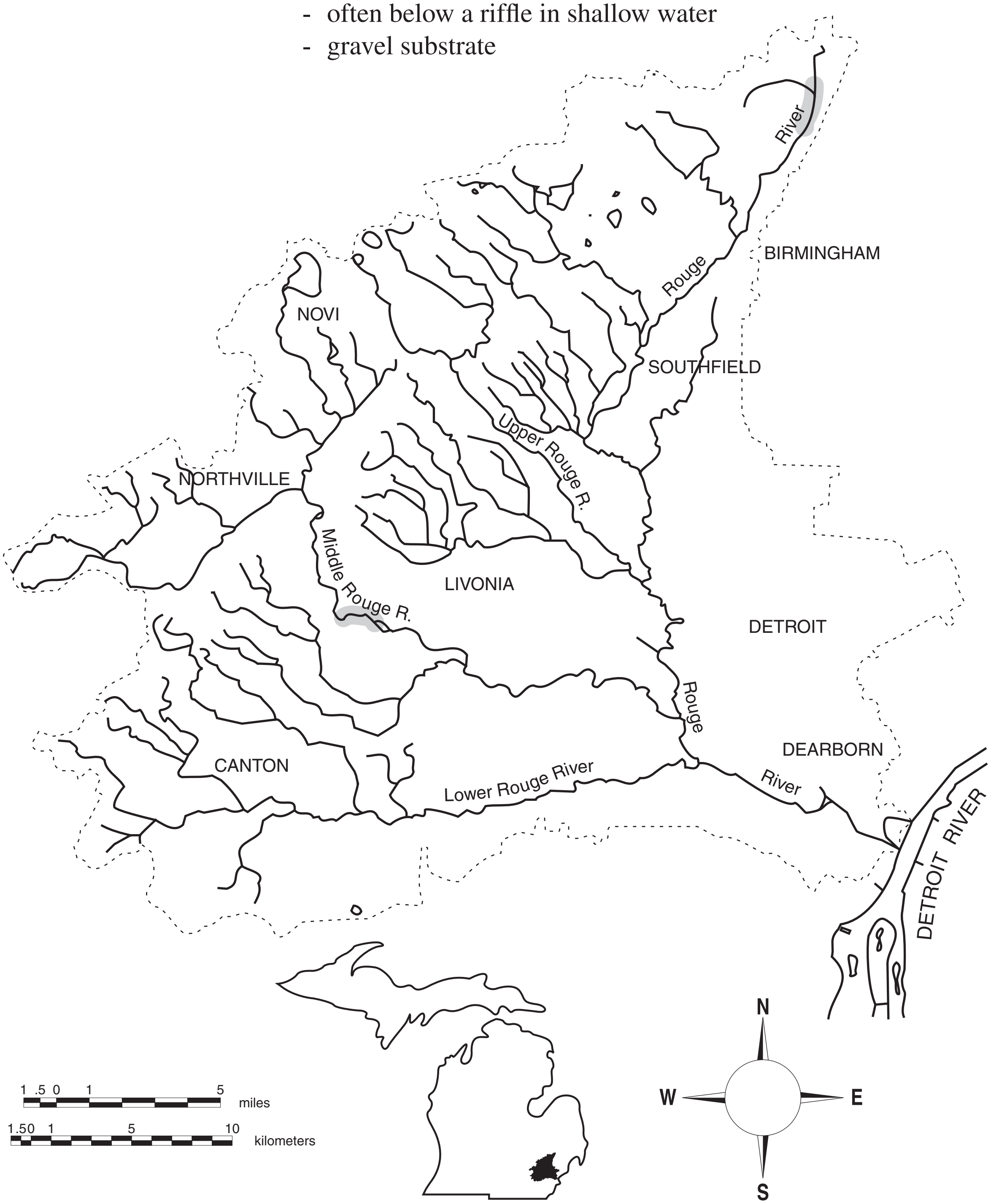


Hornyhead chub (*Nocomis biguttatus*)

Habitat:

feeding
- adults: near riffles
- young: near vegetation
- clear water, does not tolerate turbidity
- gravel substrate
- low gradient streams that are tributaries to large streams

spawning
- large stones and pebbles present
- often below a riffle in shallow water
- gravel substrate

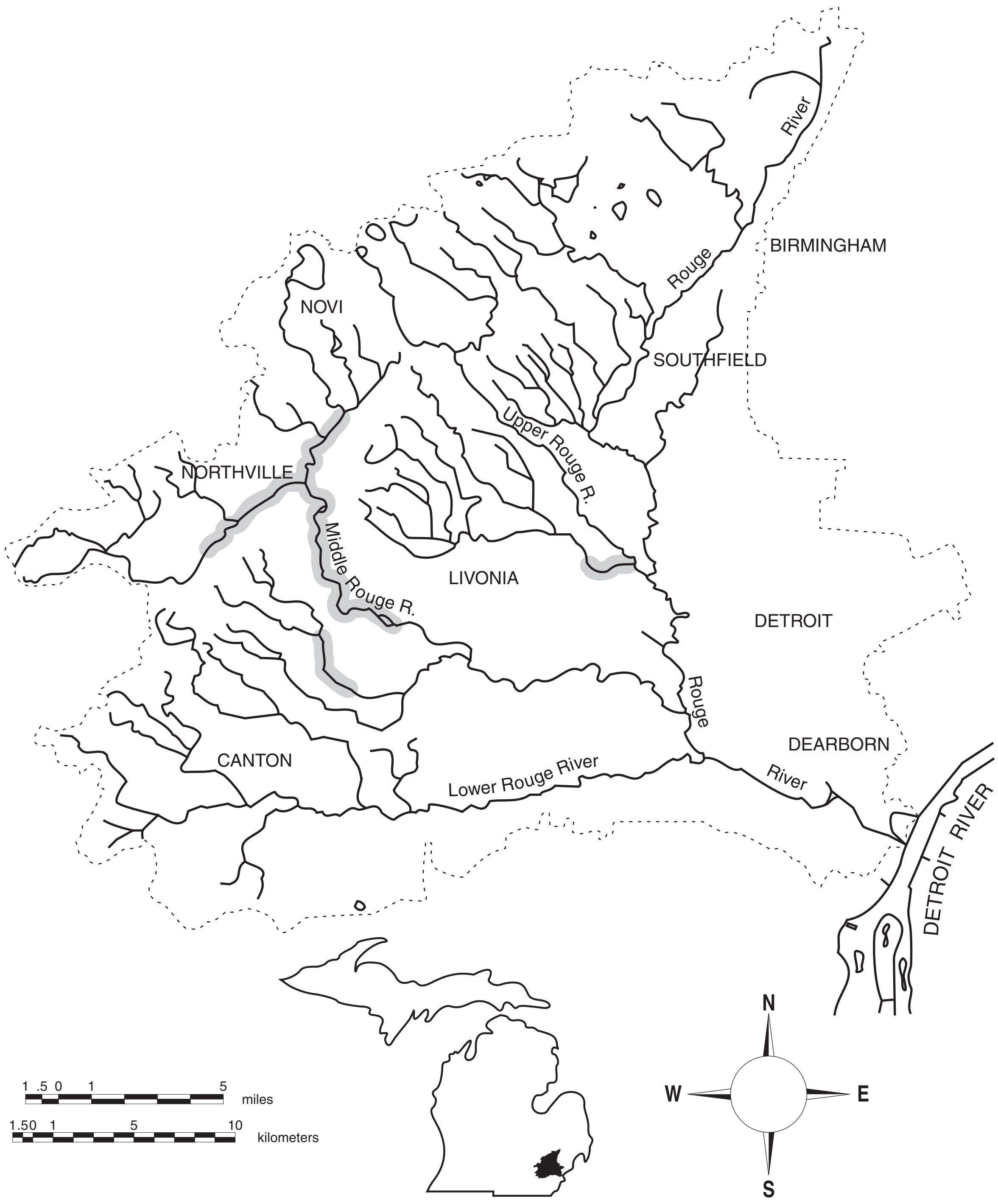


Golden shiner (*Notemigonus crysoleucas*)

Habitat:

feeding - lakes and impoundments and quiet pools of low gradient streams
- clear shallow water
- heavy vegetation

spawning - vegetation

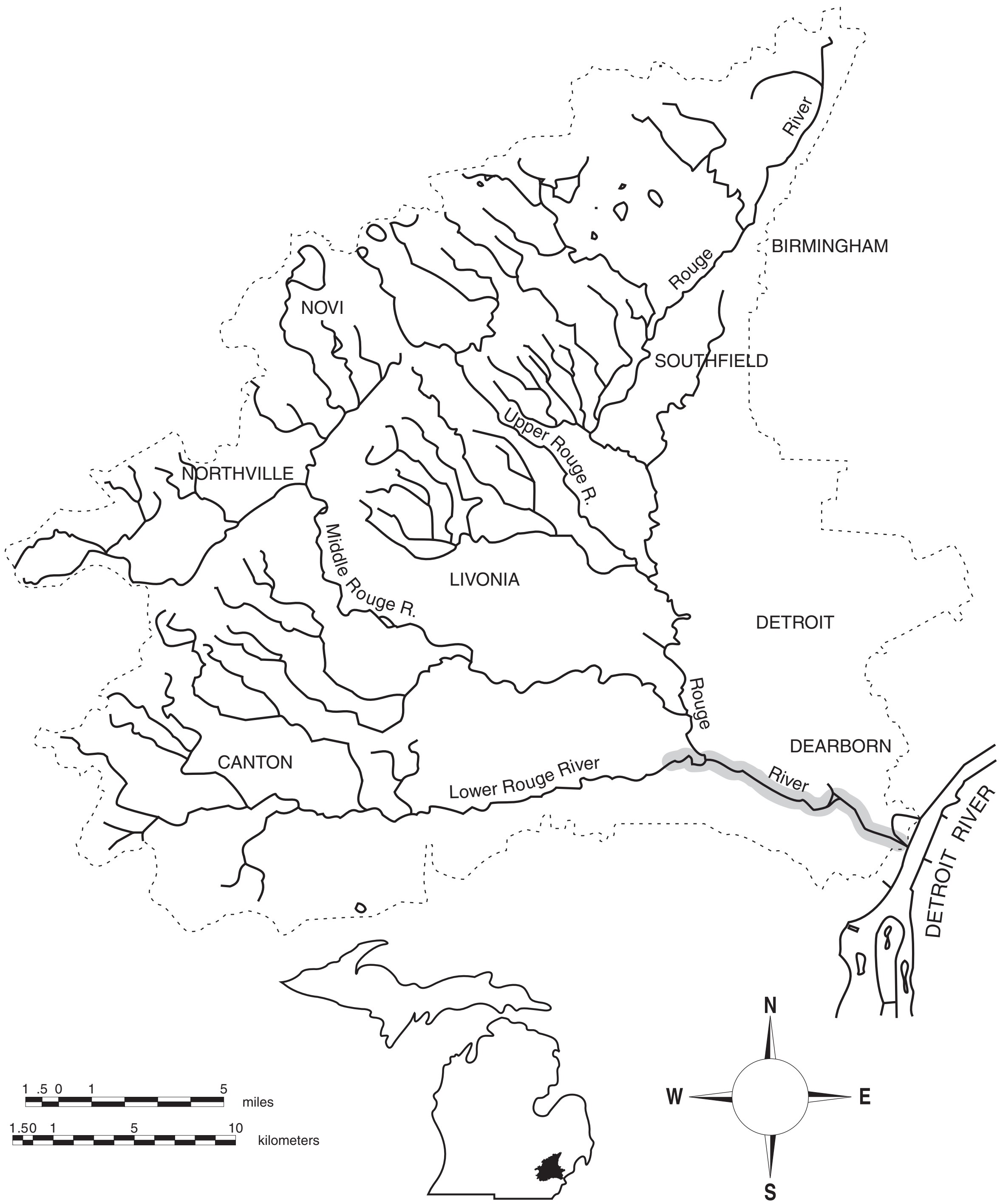


Emerald shiner (*Notropis atherinoides*)

Habitat:

feeding - open-large stream channels and Detroit River
- low to moderate gradient
- range of turbidites and bottom types
- midwater or surface preferred, substrate of little importance
- avoids rooted vegetation

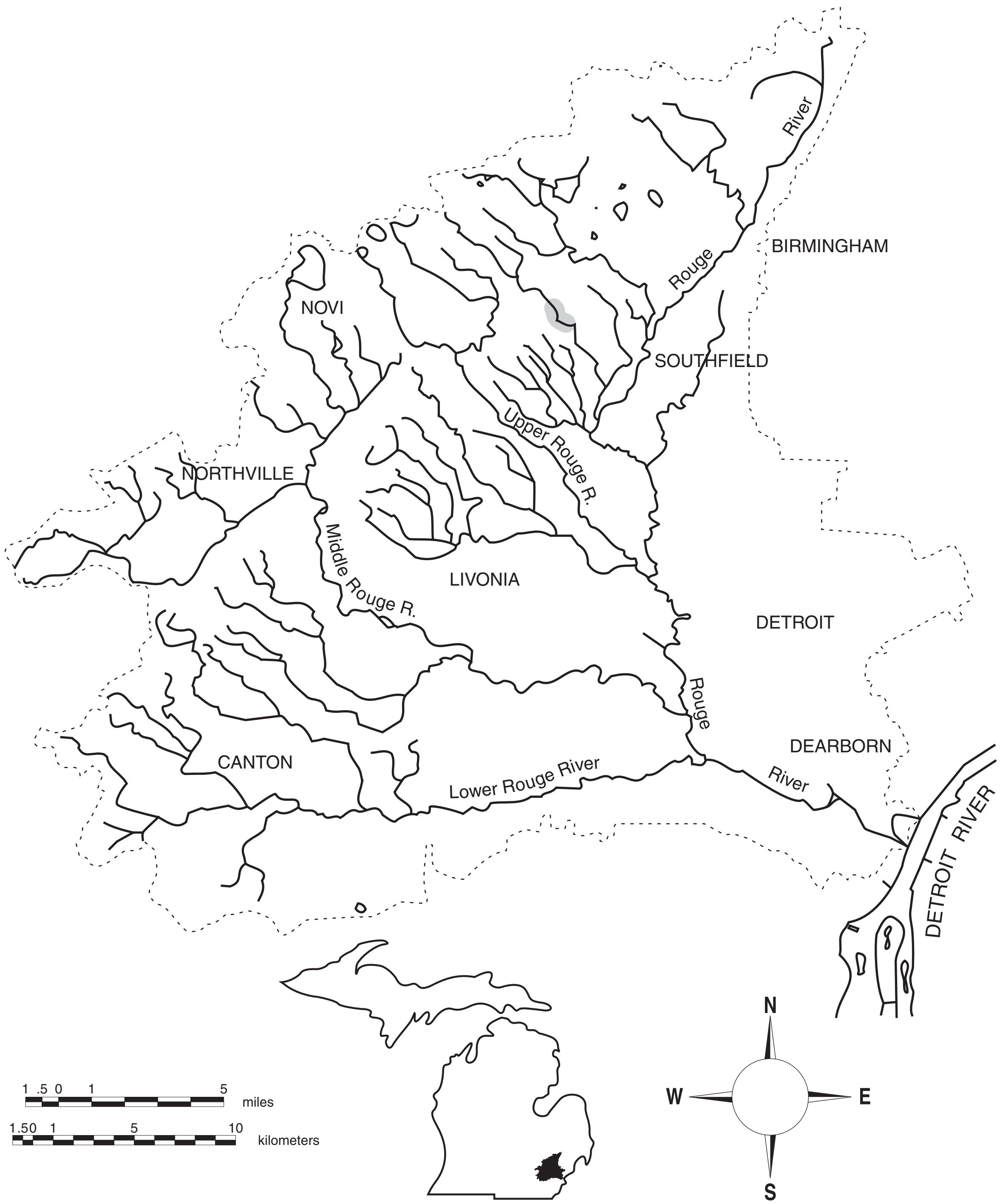
spawning - sand or firm mud substrate or gravel shoals



Blackchin shiner (*Notropis heterodon*)

Habitat:

feeding
- lakes, impoundments, and quiet pools in streams and rivers
- clear water
- clean sand, gravel, or organic debris substrate
- dense beds of submerged aquatic vegetation
- cannot tolerate turbidity, silt, or loss of aquatic vegetation

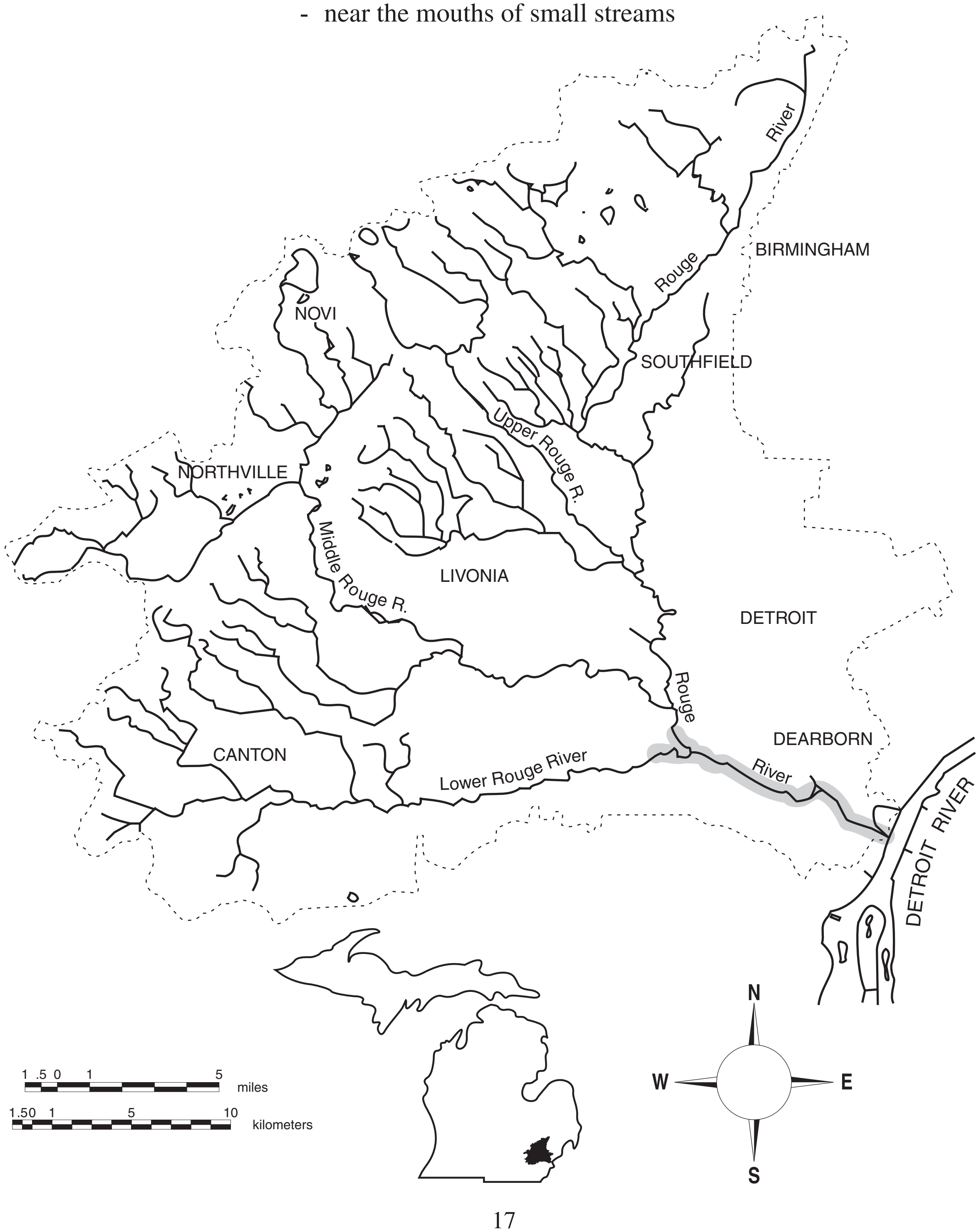


Spottail shiner (*Notropis hudsonius*)

Habitat:

feeding
- large rivers, lakes, and impoundments
- firm sand and gravel substrate
- low current
- sparse to moderate vegetation
- avoids turbidity

spawning
- over sandy shoals or gravelly riffles
- near the mouths of small streams

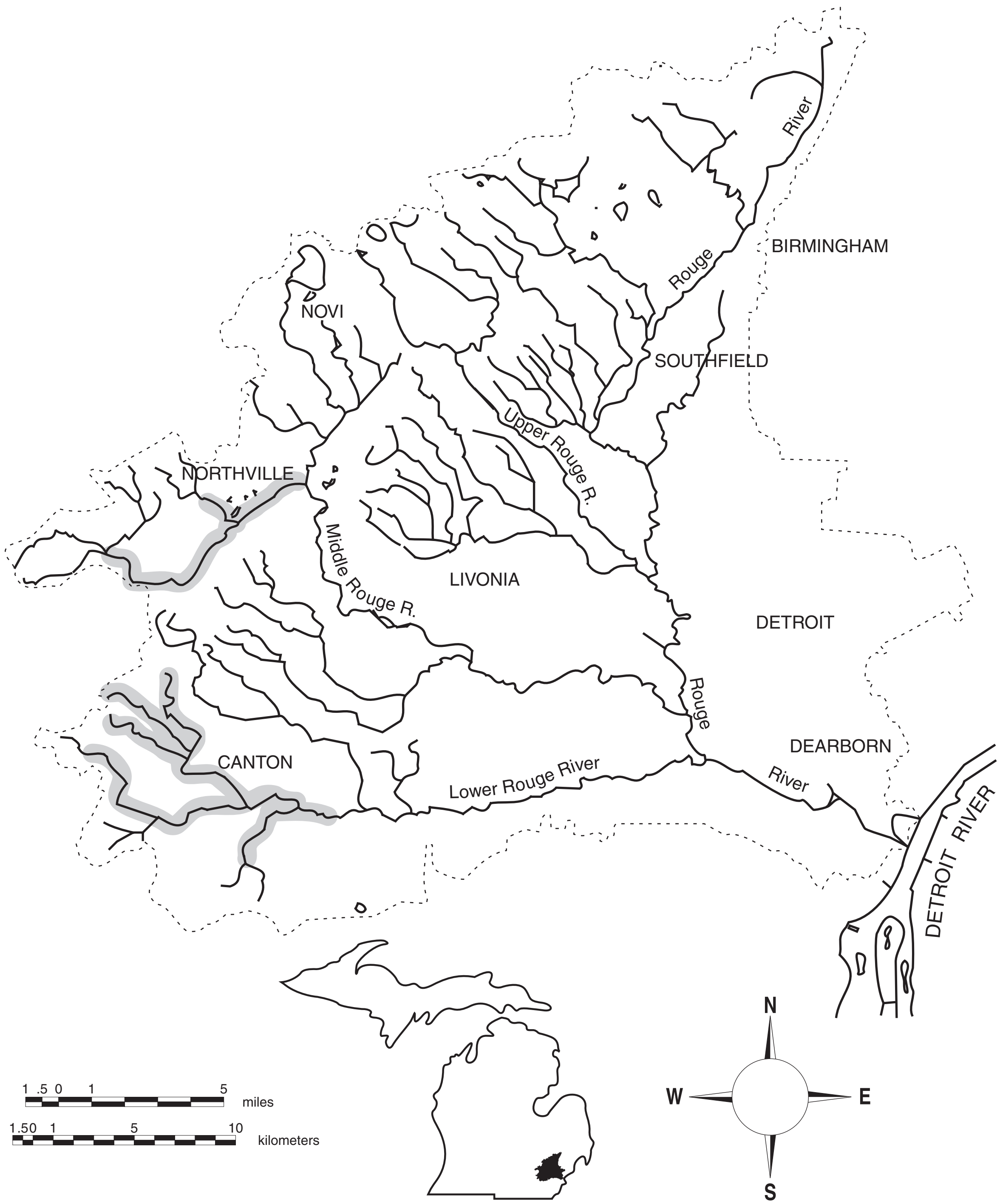


Northern redbelly dace (*Phoxinus eos*)

Habitat:

feeding
- slow current
- in boggy lakes and streams
- detritus or silt substrate
- clear to slightly turbid water

spawning
- filamentous algae needed for egg deposition

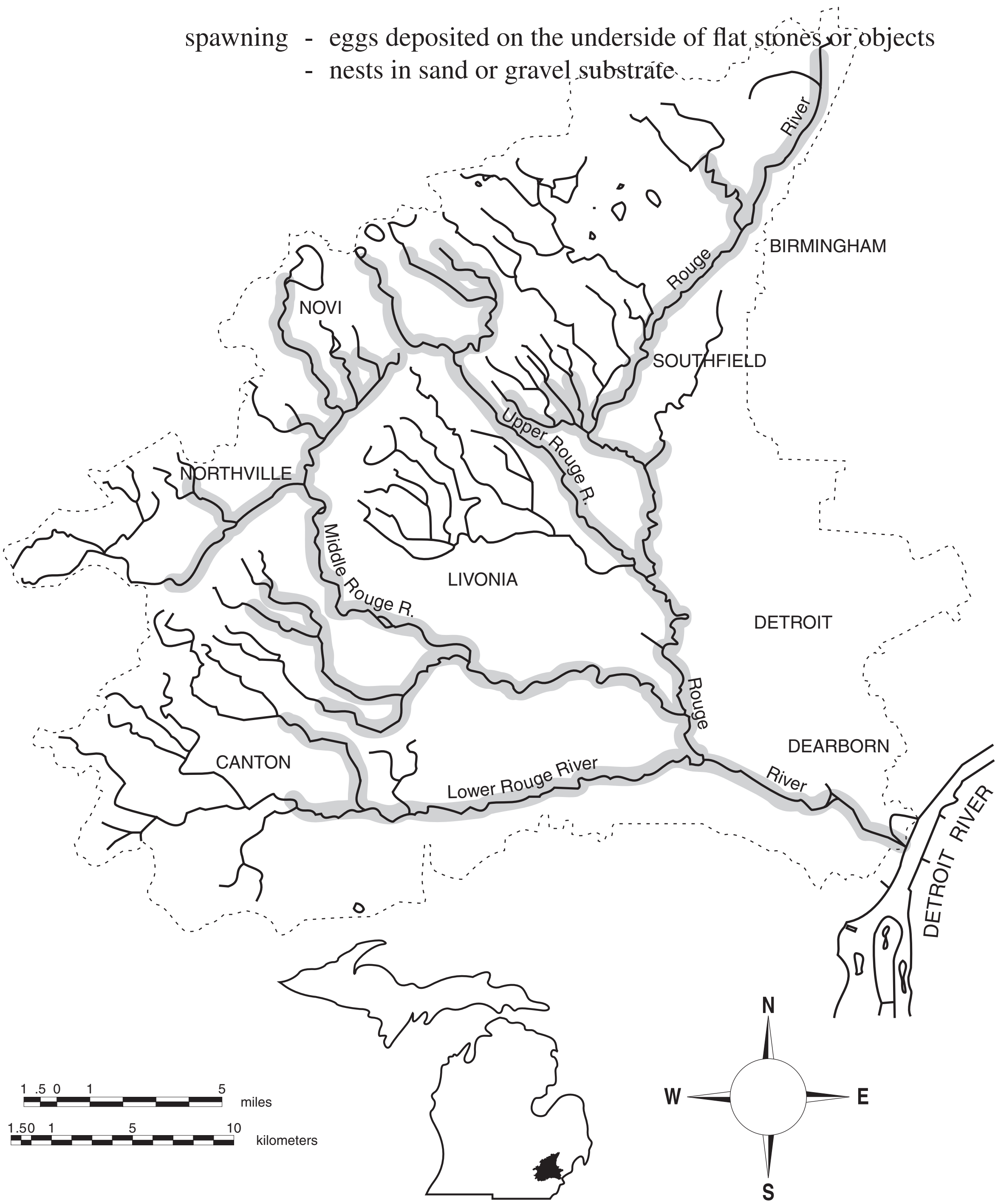


Bluntnose minnow (*Pimephales notatus*)

Habitat:

feeding
- quiet pools and backwaters of medium to large streams, lakes, and impoundments
- clear warm water
- some aquatic vegetation
- firm substrates
- tolerates all gradients, turbidity, organic and inorganic pollutants

spawning
- eggs deposited on the underside of flat stones or objects
- nests in sand or gravel substrate

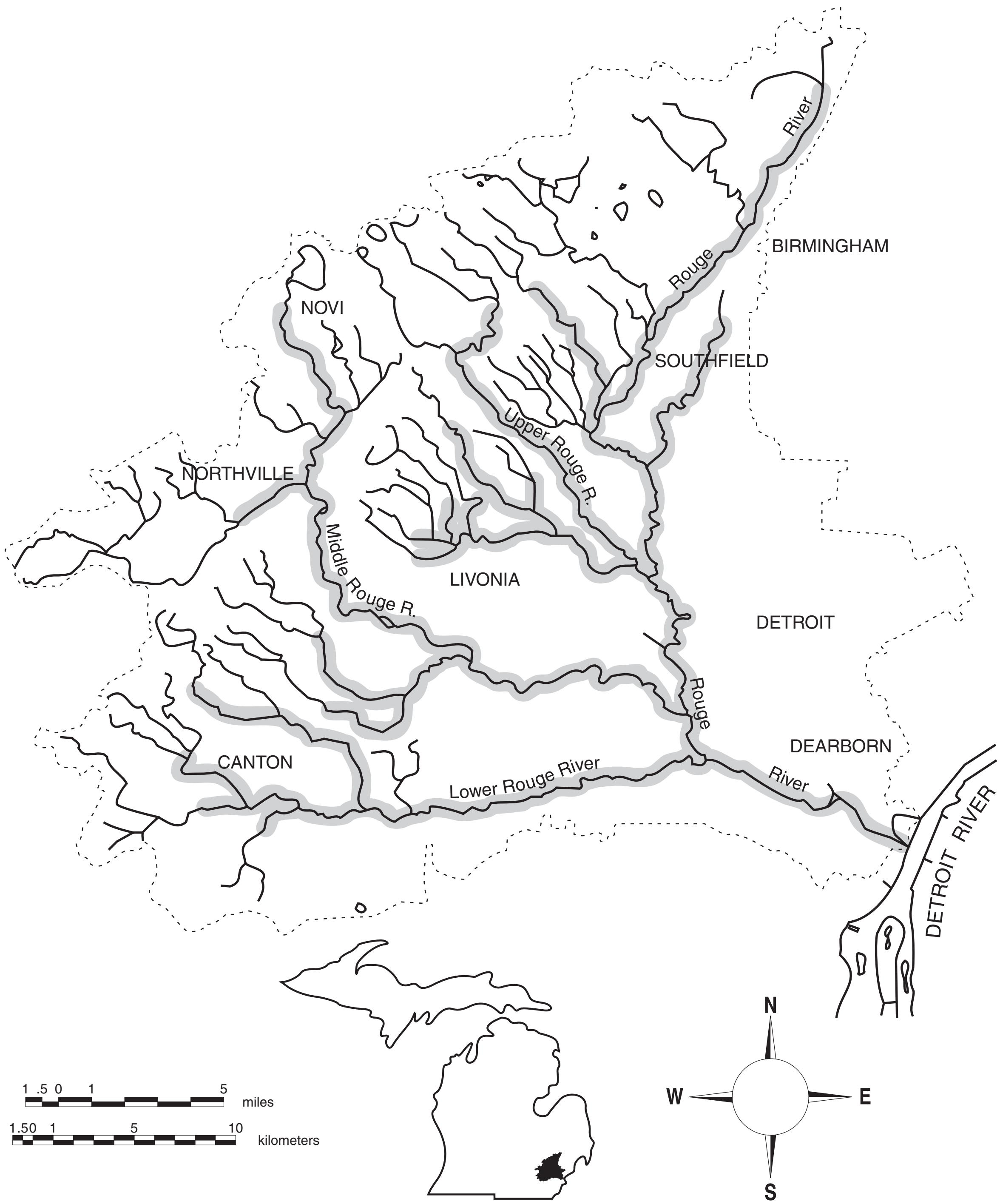


Fathead minnow (*Pimephales promelas*)

Habitat:

feeding - pools of small streams, lakes, and impoundments
- tolerant of turbidity, high temperatures, and low oxygen

spawning - on underside of objects in water 2 to 3 feet deep
- prefer sand, marl, or gravel substrate



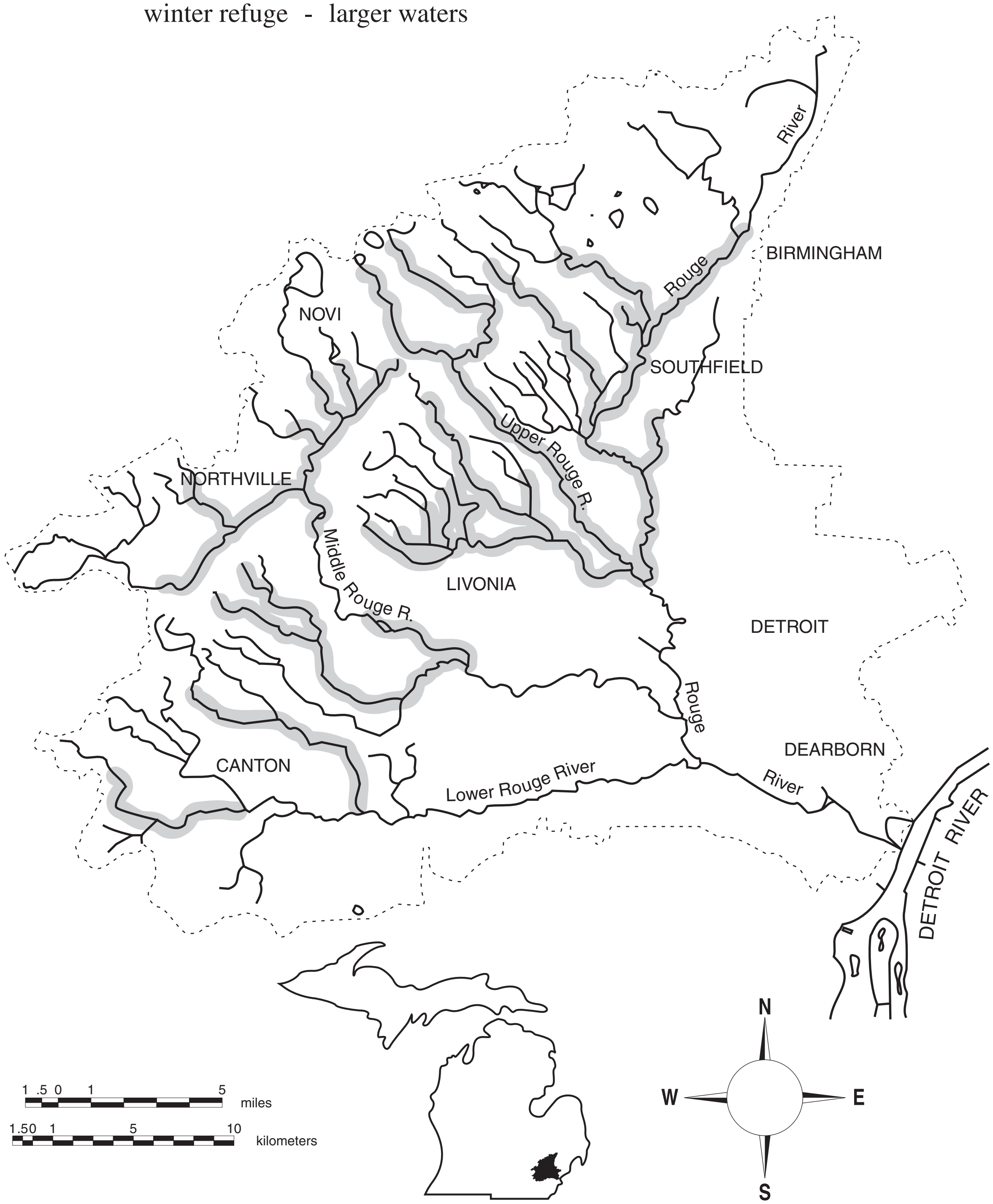
Blacknose dace (*Rhinichthys atratulus*)

Habitat:

feeding - moderate to high gradient streams
- sand and gravel substrate
- clear cool water in pools with deep holes and undercut banks
- does not tolerate turbidity and silt well

spawning - riffles with gravel substrate and fast current

winter refuge - larger waters



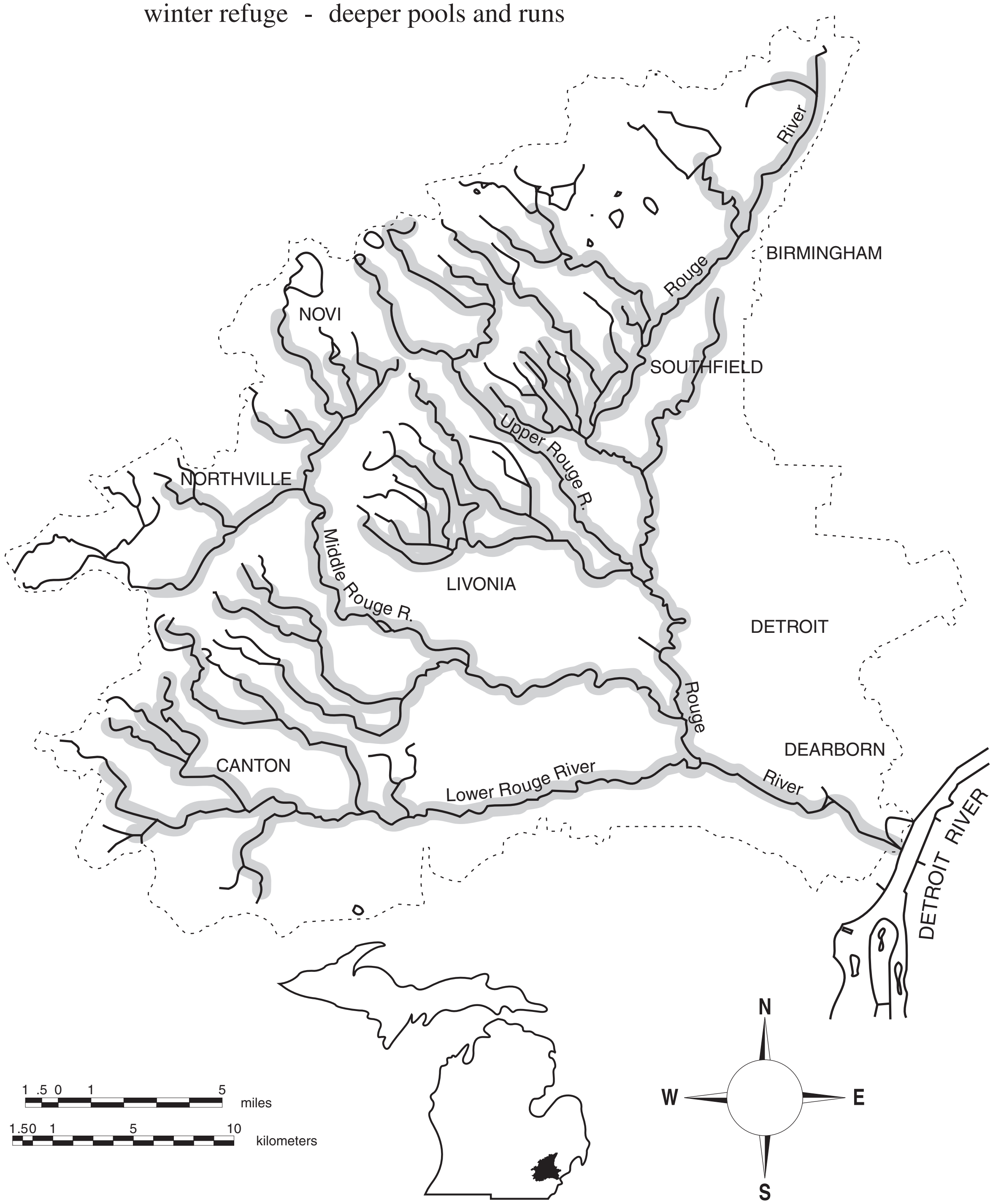
Creek chub (*Semotilus atromaculatus*)

Habitat:

feeding - streams, rivers, or shore waters of lakes and impoundments
- can tolerate intermittent flows
- tolerates moderate turbidity

spawning - gravel nests
- low current

winter refuge - deeper pools and runs

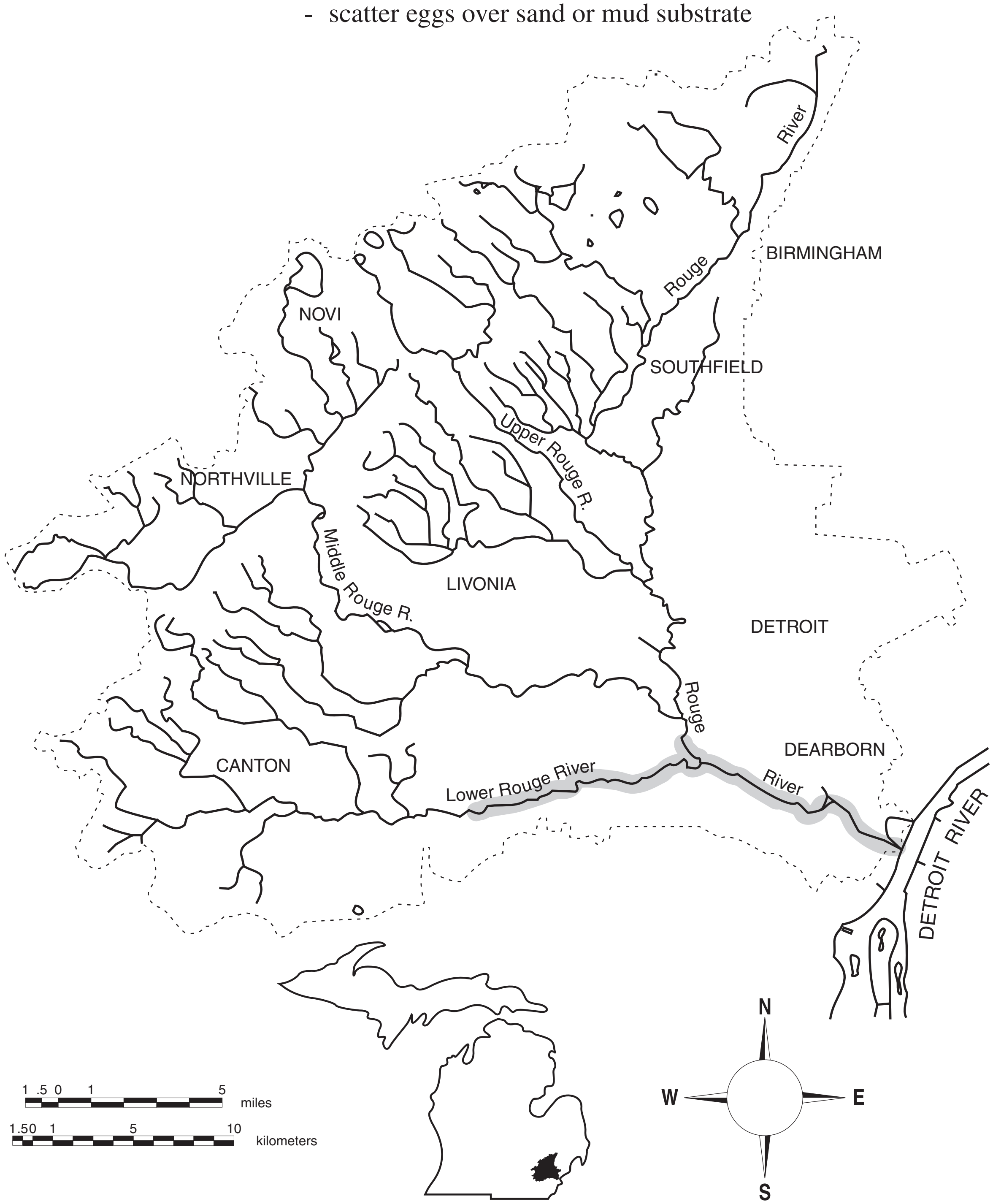


Quillback (*Carpoides cyprinus*)

Habitat:

feeding
- clear to turbid water
- Detroit River
- sand, sandy gravel, sandy silt, or clay-silt substrate
- medium- to low-gradient rivers and streams; also lakes and sloughs

spawning
- streams or overflow areas of bends of rivers or bays of lakes
- scatter eggs over sand or mud substrate

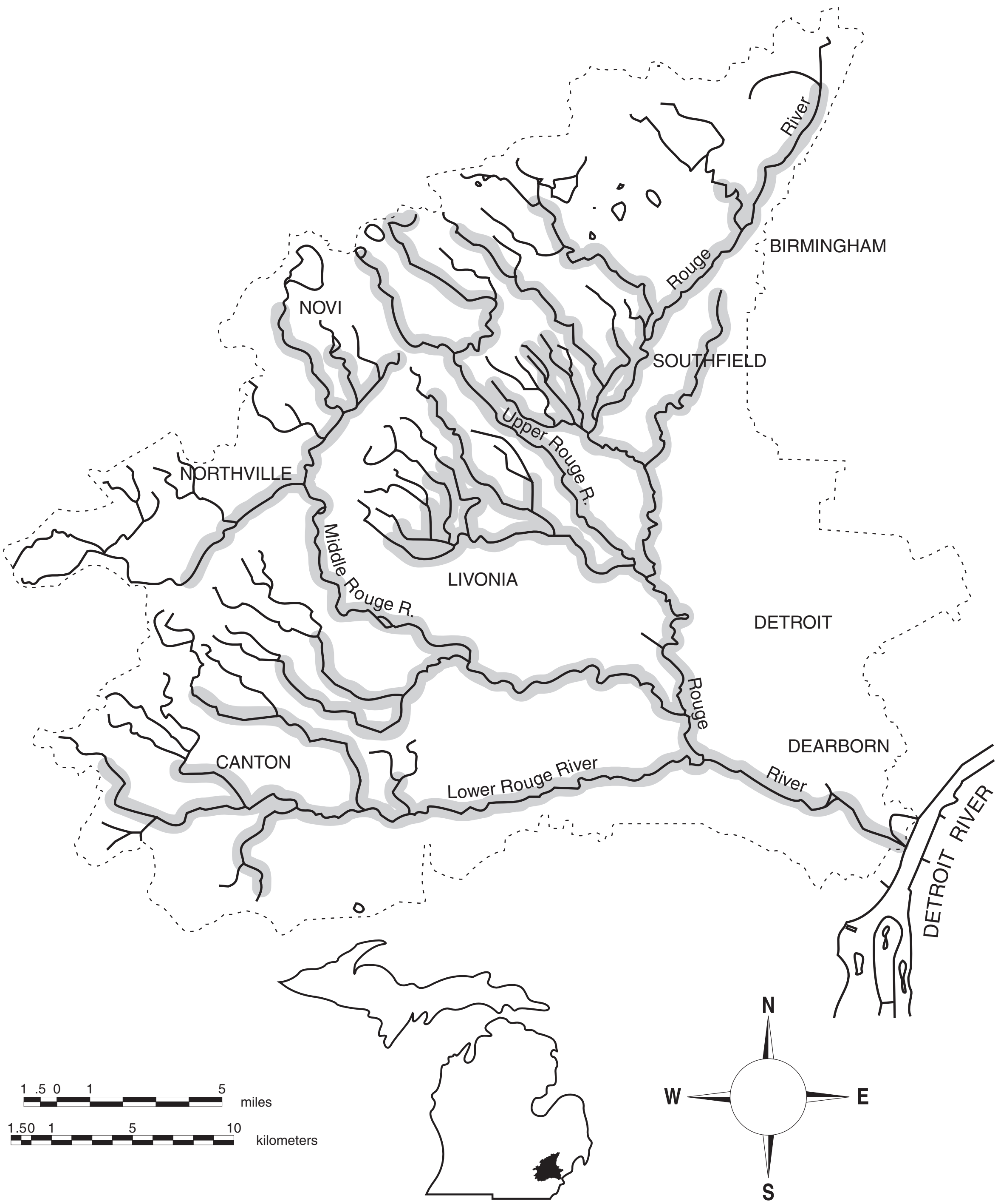


White sucker (*Catostomus commersoni*)

Habitat:

feeding - streams, rivers, lakes, and impoundments
- can inhabit highly turbid and polluted waters

spawning - quiet gravelly shallow areas of streams



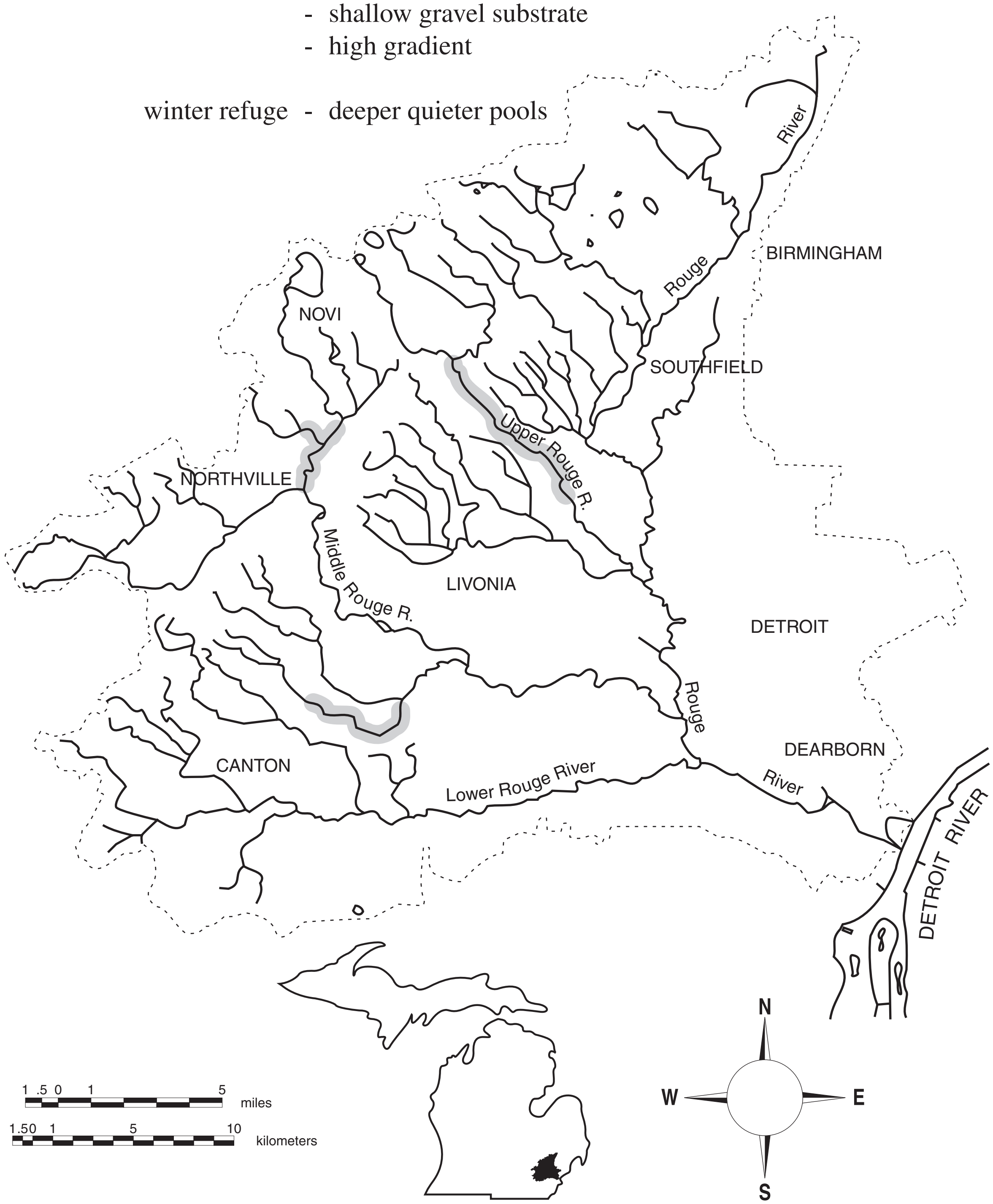
Northern hog sucker (*Hypentelium nigricans*)

Habitat:

feeding
- gravel or rubble substrate
- riffles and adjacent pools of warm shallow streams
- clear water
- doesn't like turbidity or siltation
- avoids profuse amounts of aquatic vegetation

spawning
- riffles
- shallow gravel substrate
- high gradient

winter refuge
- deeper quieter pools

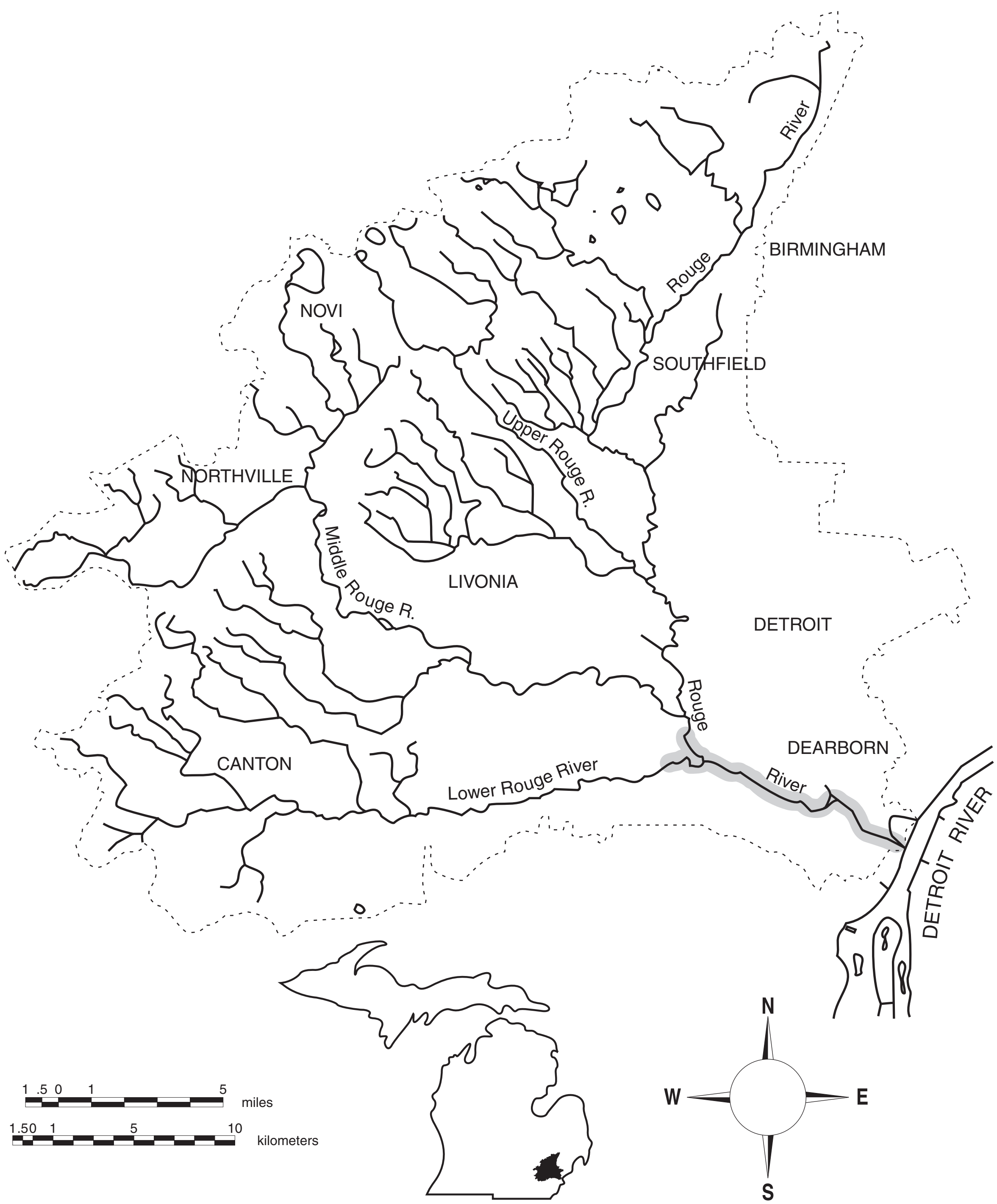


Spotted sucker (*Minytrema melanops*)

Habitat:

feeding - clear warm rivers (pools, backwaters) with little current
- abundant vegetation
- soft substrate with organic debris
- intolerant of turbidity

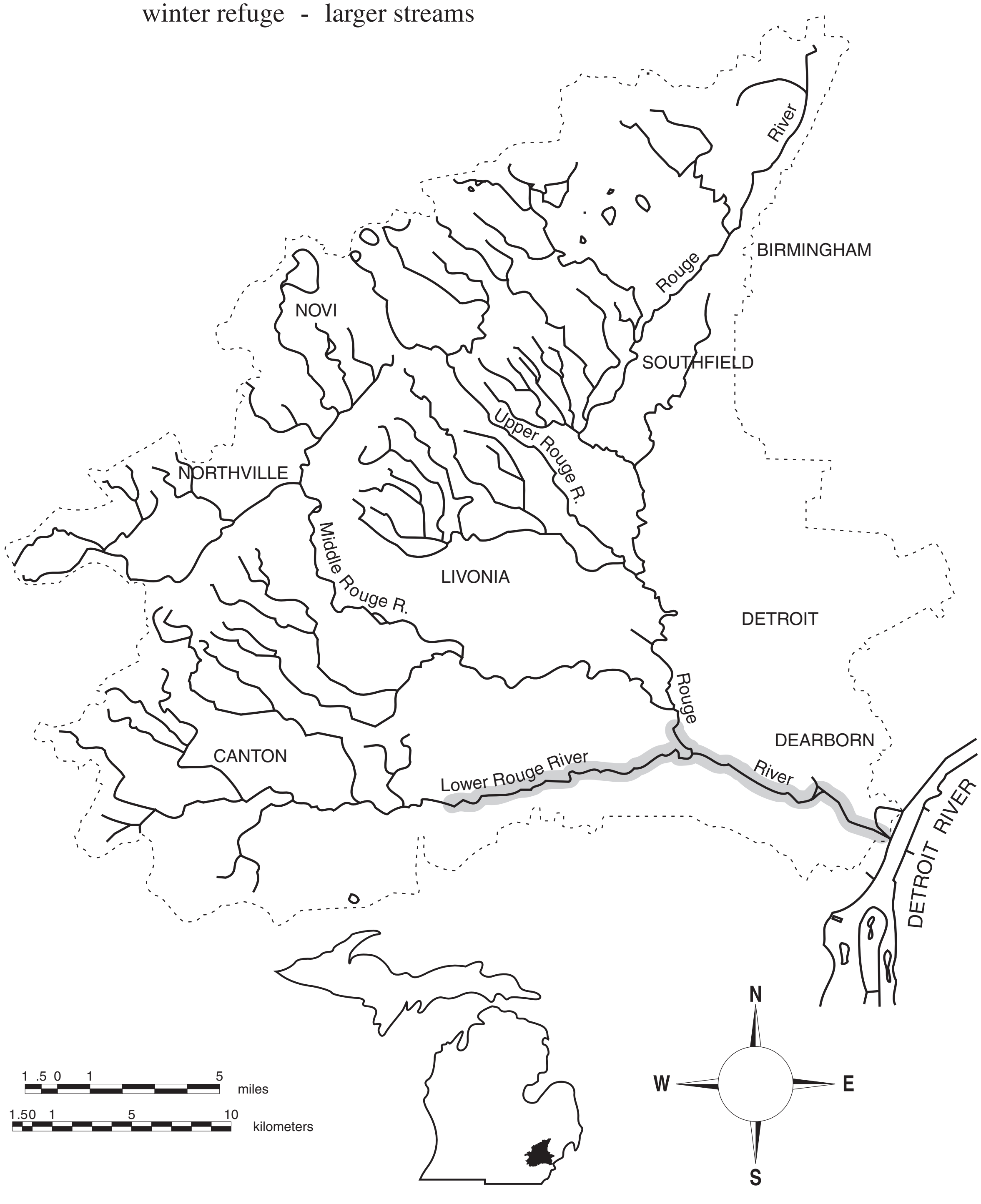
spawning - riffles



Golden redhorse (*Moxostoma erythrurum*)

Habitat:

feeding	-	warm medium gradient streams and rivers
	-	clear riffly streams
	-	medium size streams and rivers
	-	tolerates some turbidity and silt
spawning	-	shallow gravelly riffles
winter refuge	-	larger streams

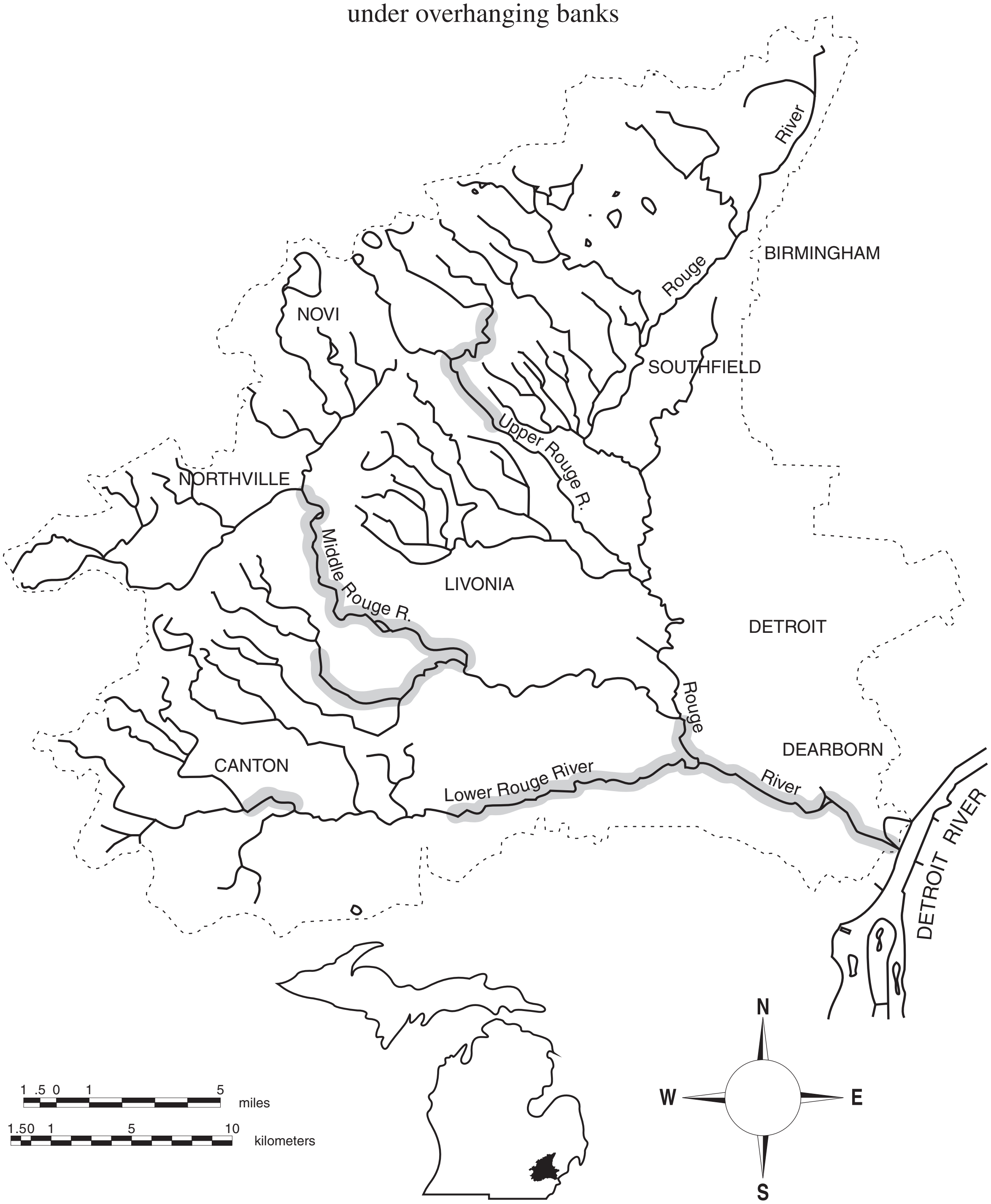


Black bullhead (*Ameiurus melas*)

Habitat:

feeding
- turbid water
- silt bottom
- low gradient small to medium streams, pools, and headwaters of large rivers; also in lakes and impoundments
- can tolerate very warm water and very low dissolved oxygen

spawning
- nest in moderate to heavy vegetation or woody debris and under overhanging banks

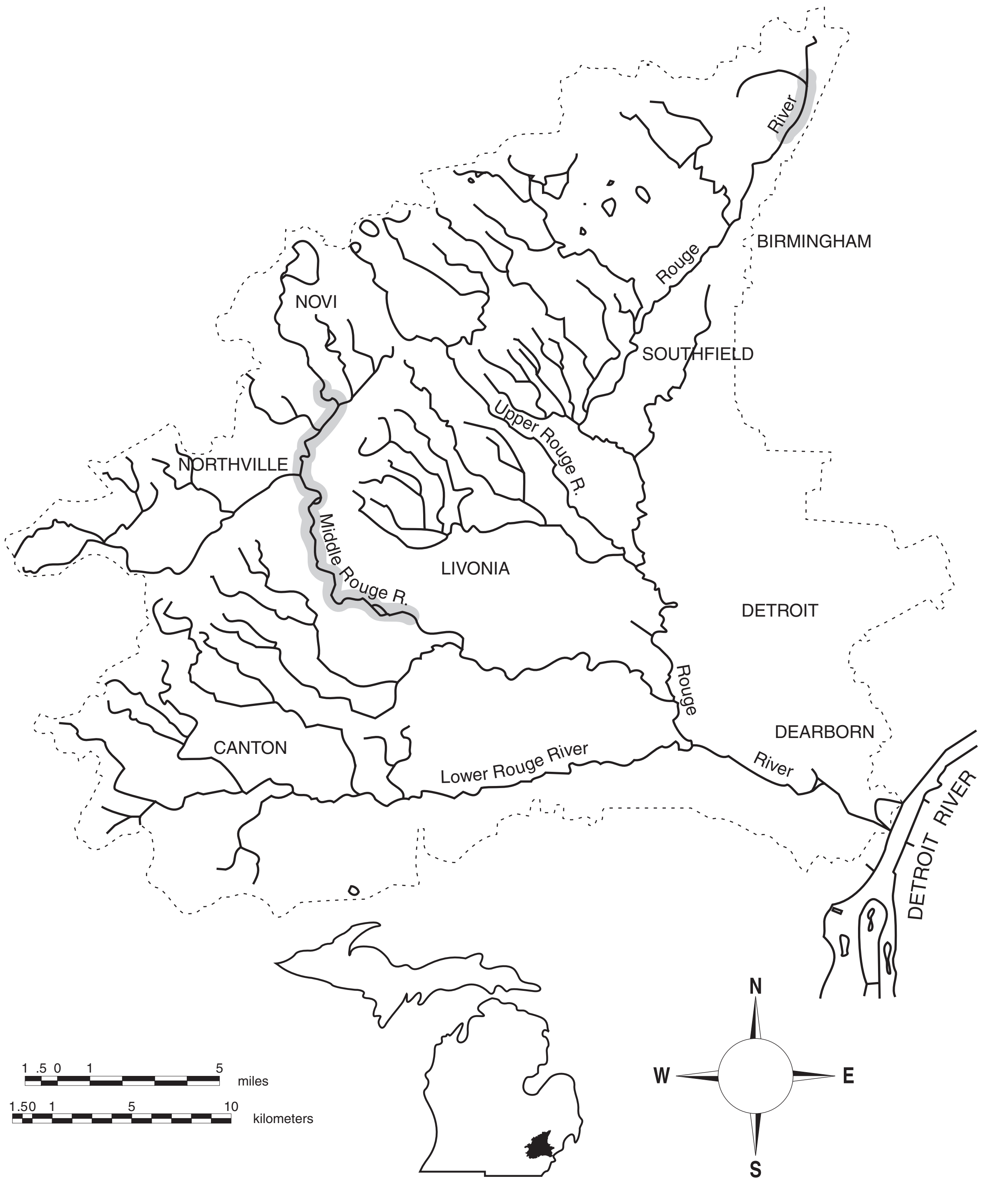


Yellow bullhead (*Ameiurus natalis*)

Habitat:

feeding - clear flowing water
- heavy vegetation
- low gradient streams, lakes, and impoundments
- tolerant of low oxygen

spawning - nest under a stream bank or near stones or stumps



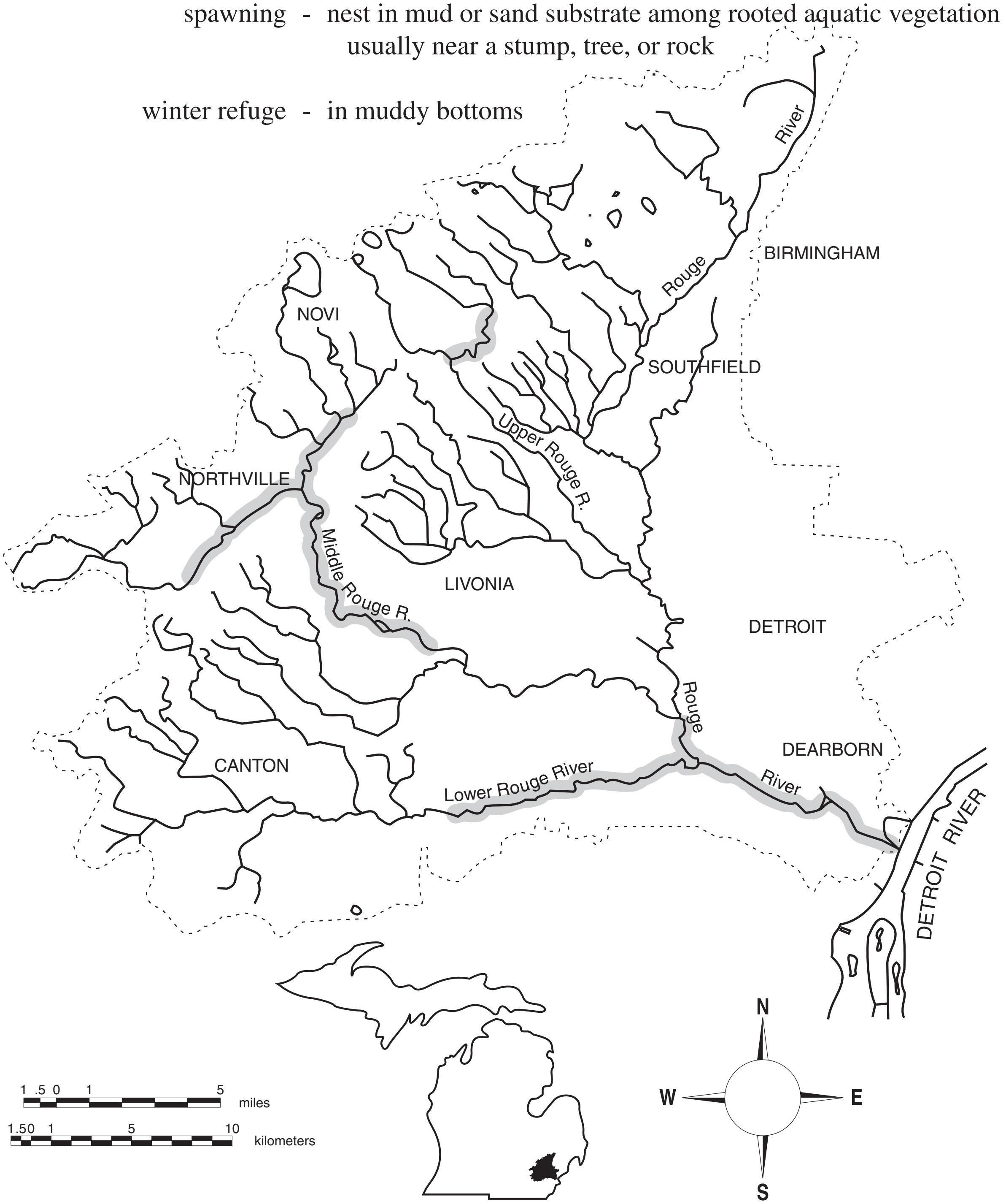
Brown bullhead (*Ameiurus nebulosus*)

Habitat:

feeding
- larger streams and rivers, lakes and impoundments
- clear cool water with little clayey silt
- moderate amounts of aquatic vegetation
- sand, gravel, or muck substrate
- not tolerant of turbid water
- tolerant of warm water and low oxygen

spawning
- nest in mud or sand substrate among rooted aquatic vegetation usually near a stump, tree, or rock

winter refuge
- in muddy bottoms

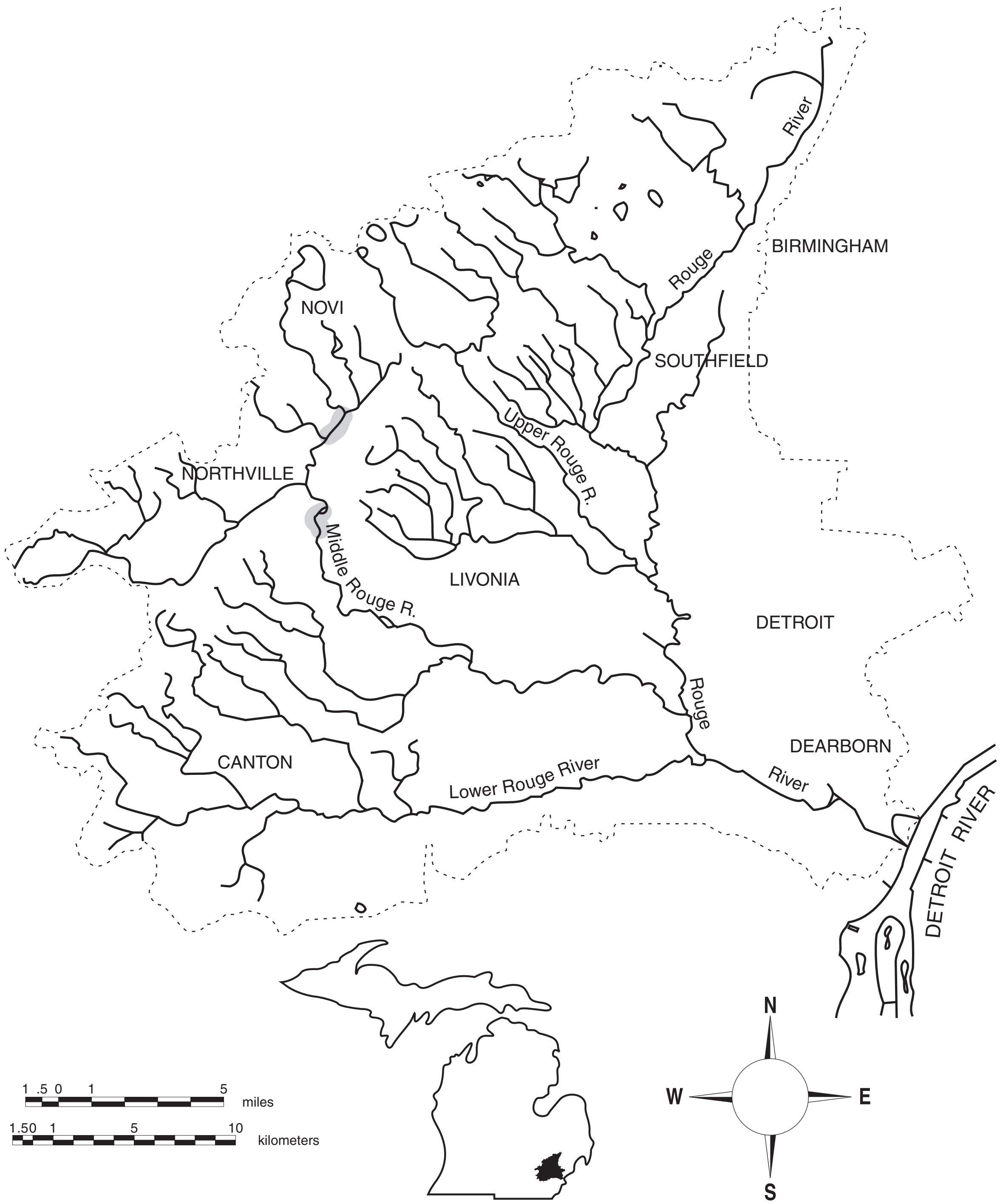


Channel catfish (*Ictalurus punctatus*)

Habitat:

feeding - moderately-clear, deeper waters of rivers, lakes, and impoundments
- sand, gravel, or rubble substrate
- low to moderate gradient

spawning - secluded semi-dark areas such as holes, under banks, log jams, or rocks

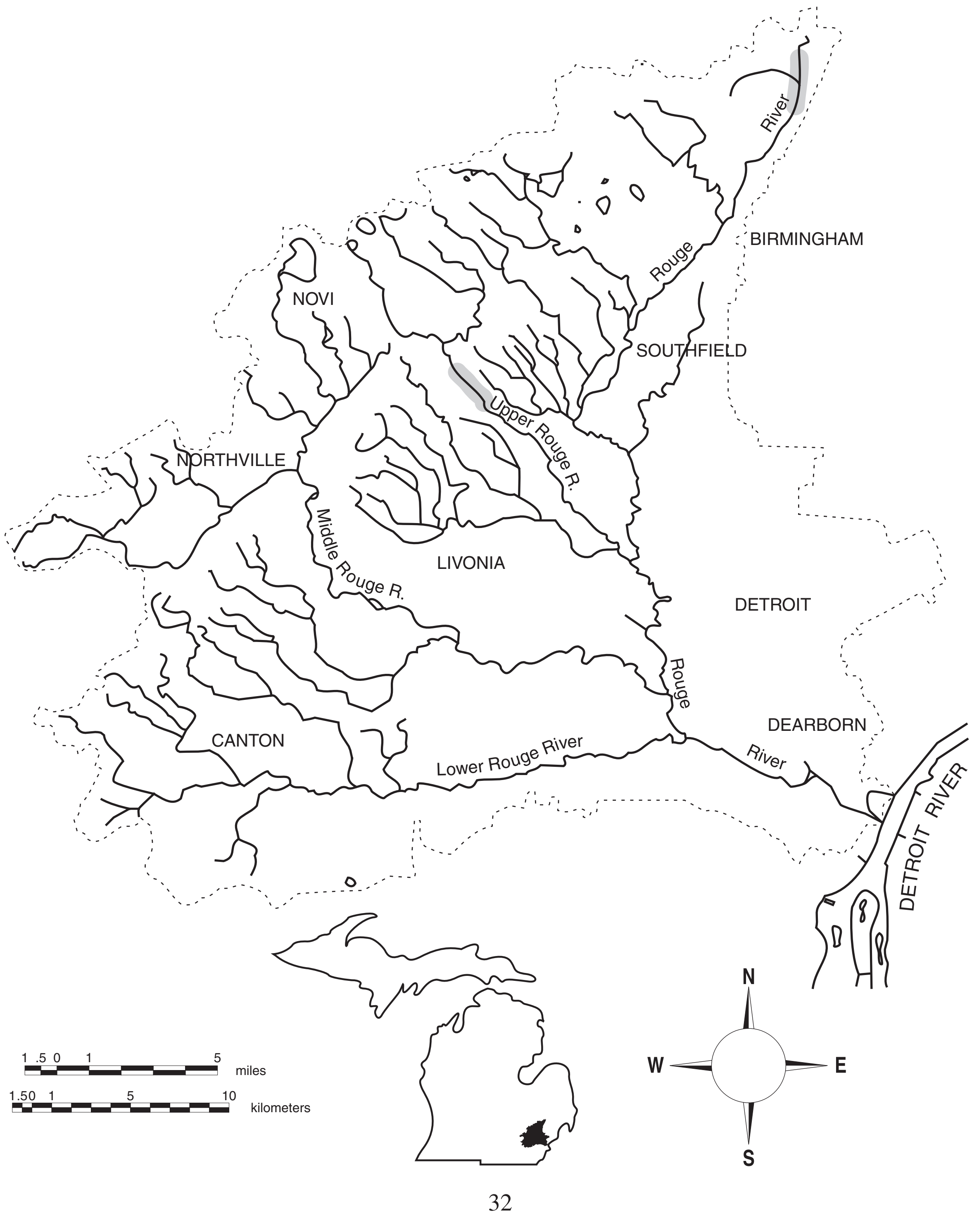


Stonecat (*Noturus flavus*)

Habitat:

feeding
- consistent low to moderate gradient flowing water
- rocky riffles of larger streams and smaller rivers
- not tolerant of silt
- tolerant of low oxygen and pollution

spawning
- eggs deposited beneath stones
- shallow rocky areas of streams or lakes

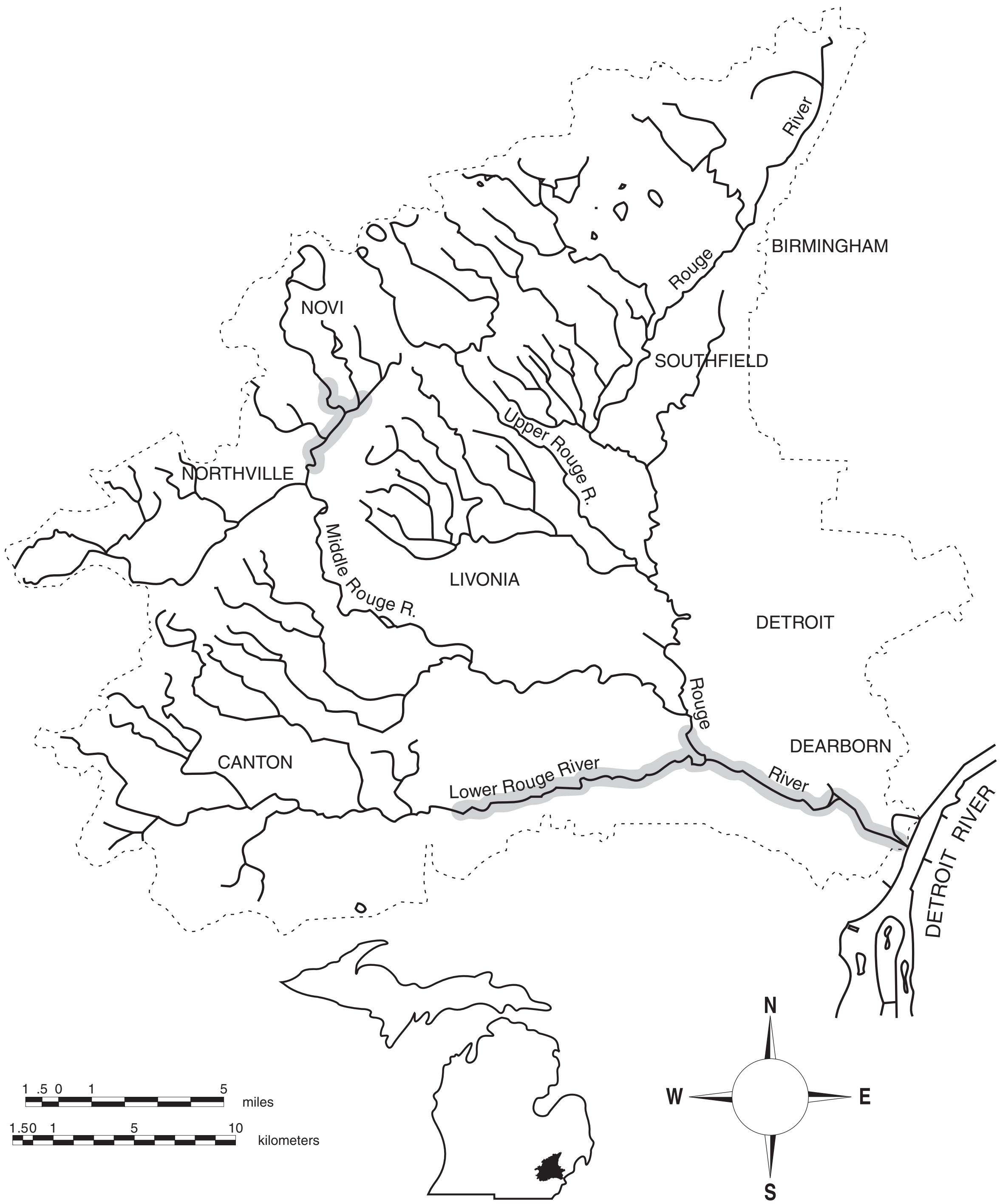


Grass pickerel (*Esox americanus vermiculatus*)

Habitat:

feeding
- juveniles: along shore
- adults: in deeper portions of streams, rivers, lakes, and impoundments
- clear water, little current, dense vegetation
- tolerates low oxygen concentrations

spawning
- broadcast spawner over submerged vegetation

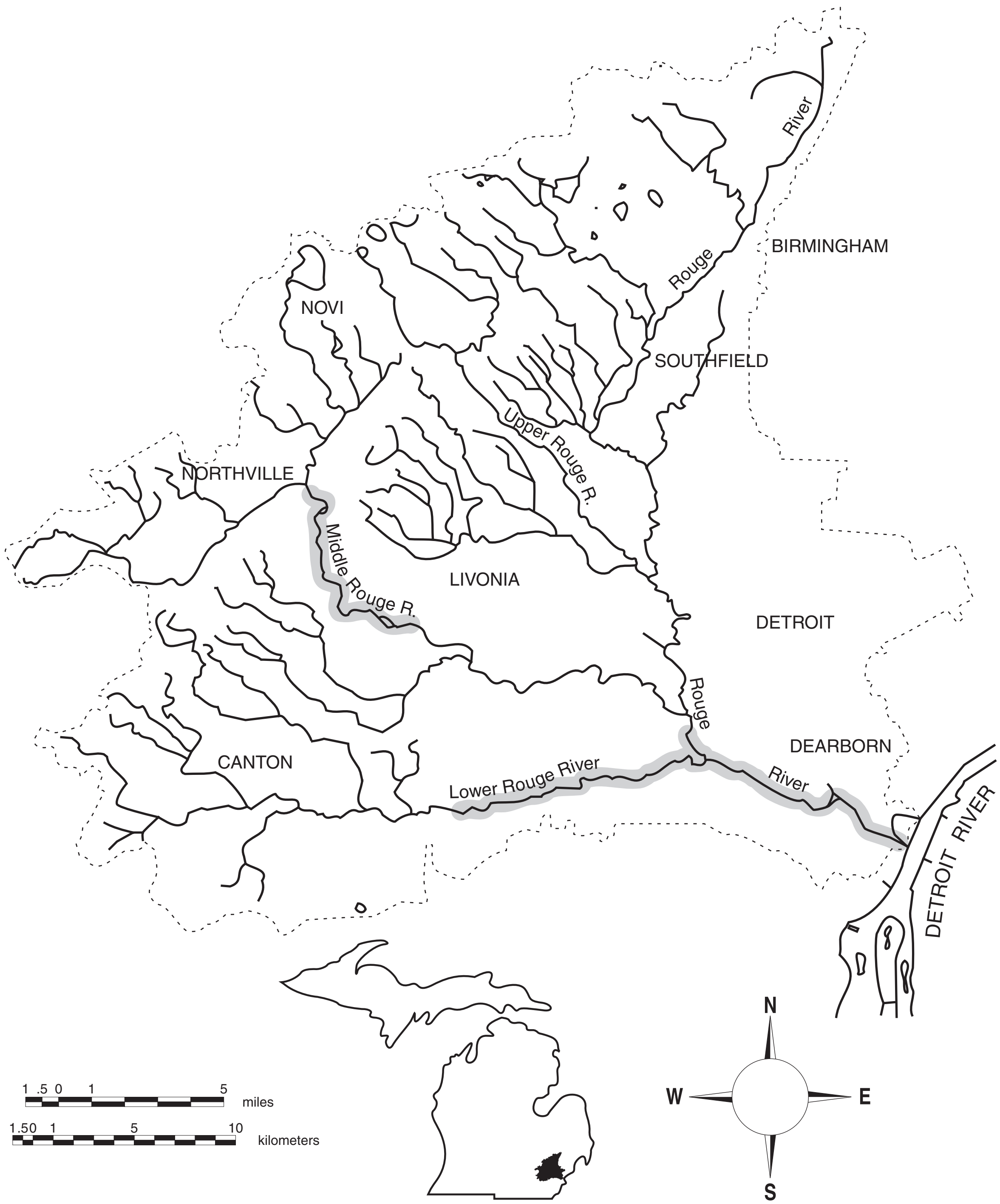


Northern pike (*Esox lucius*)

Habitat:

feeding - cool to moderately warm streams, rivers, lakes, and impoundments
- vegetation in slow to moderate current

spawning - submerged vegetation with slow current in shallow water

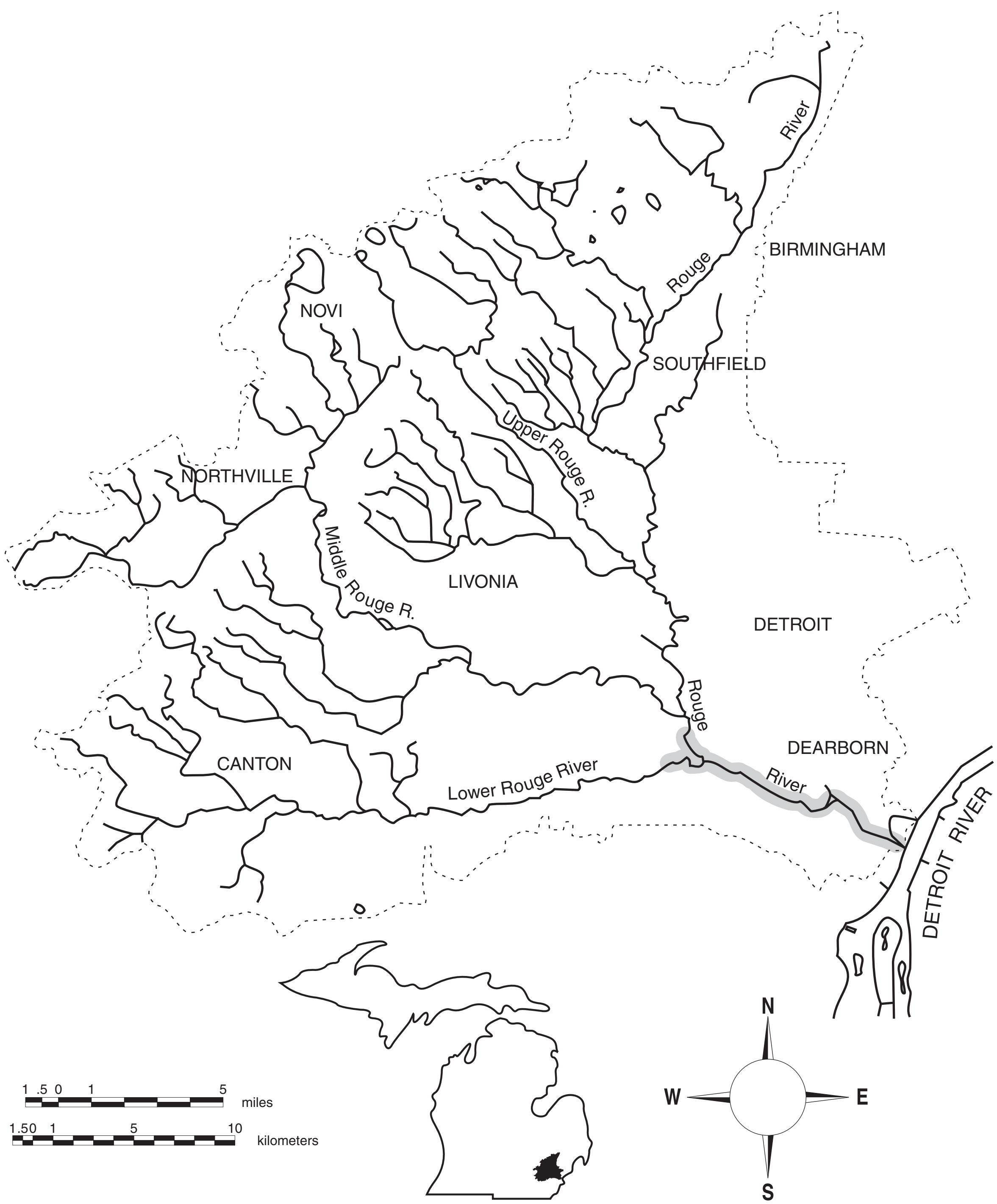


Muskellunge (*Esox masquinongy*)

Habitat:

feeding - warm, heavily vegetated lakes, stumpy weedy bays, and slow heavily vegetated medium to large rivers
- shallow cool water
- tolerant of low oxygen

spawning - clear shallow waters (15-20”) in heavily vegetated areas

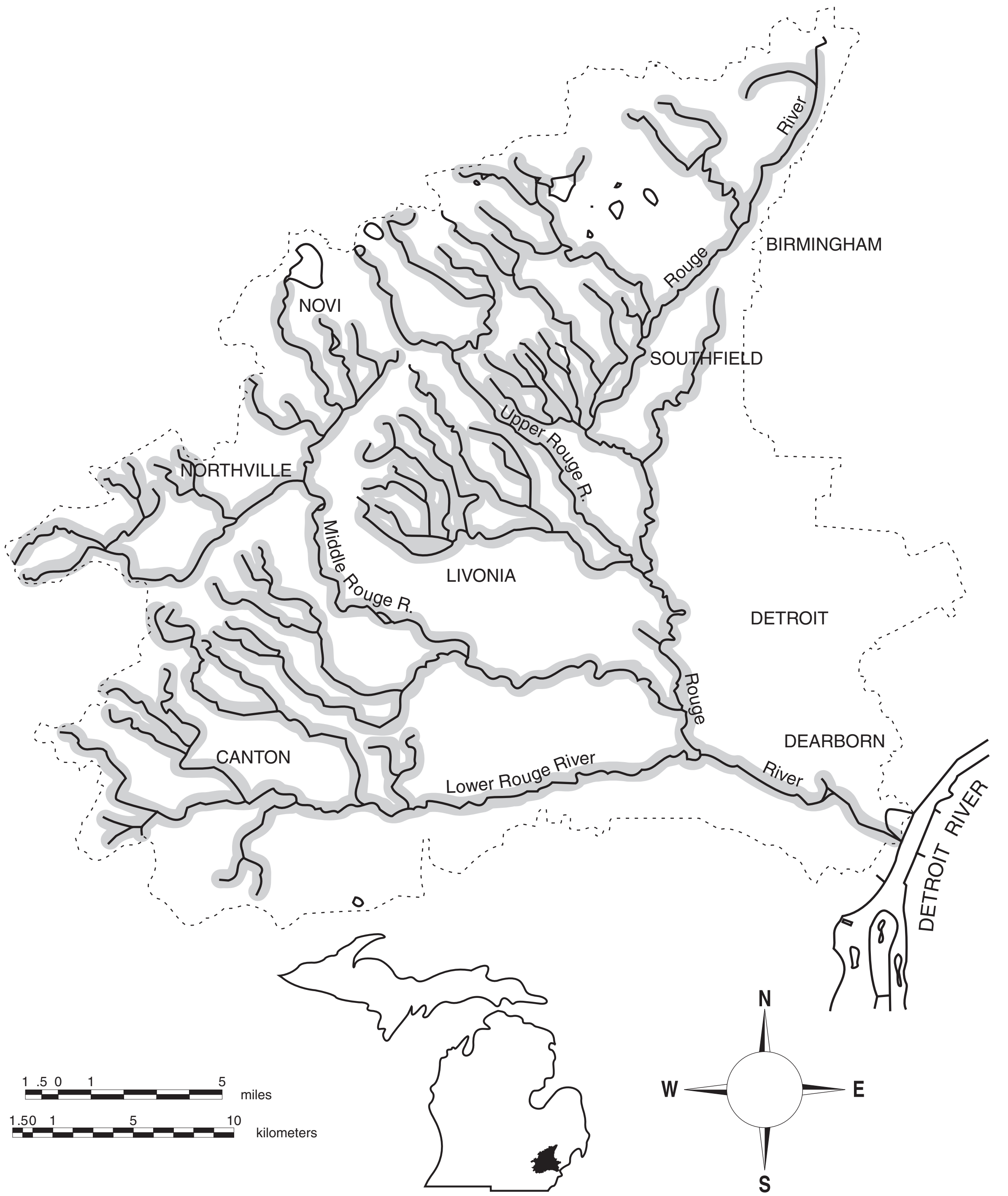


Central mudminnow (*Umbra limi*)

Habitat:

feeding - undisturbed clear, low-gradient streams or rivers and lakes and impoundments
- organic debris, muck, or peat substrates
- aquatic vegetation

spawning - floodplain areas, on vegetation

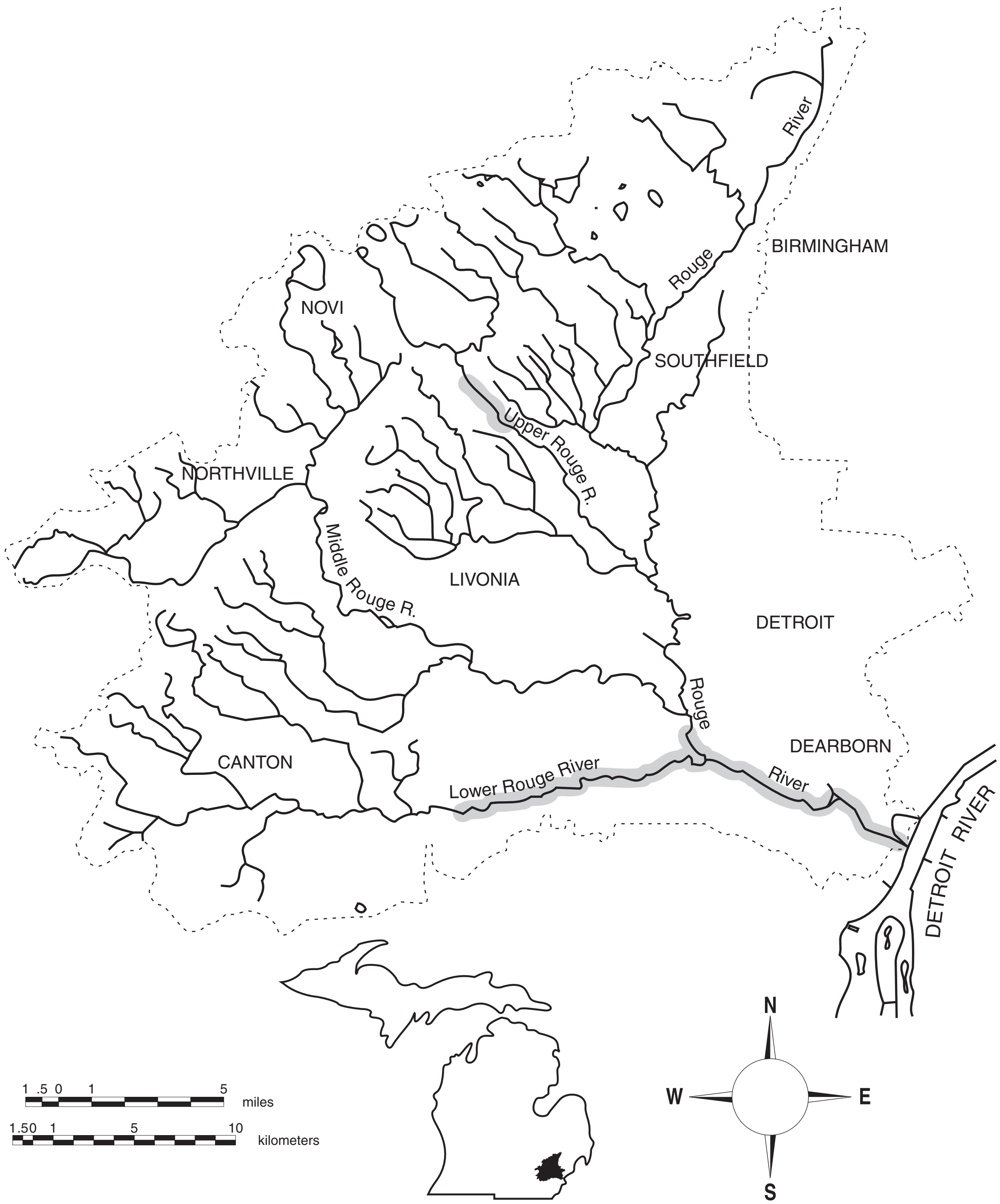


Rainbow trout (*Oncorhynchus mykiss*)

Habitat:

feeding - cold clear water of rivers and Lake Erie
- moderate current

spawning - gravelly riffles above a pool
- smaller tributaries

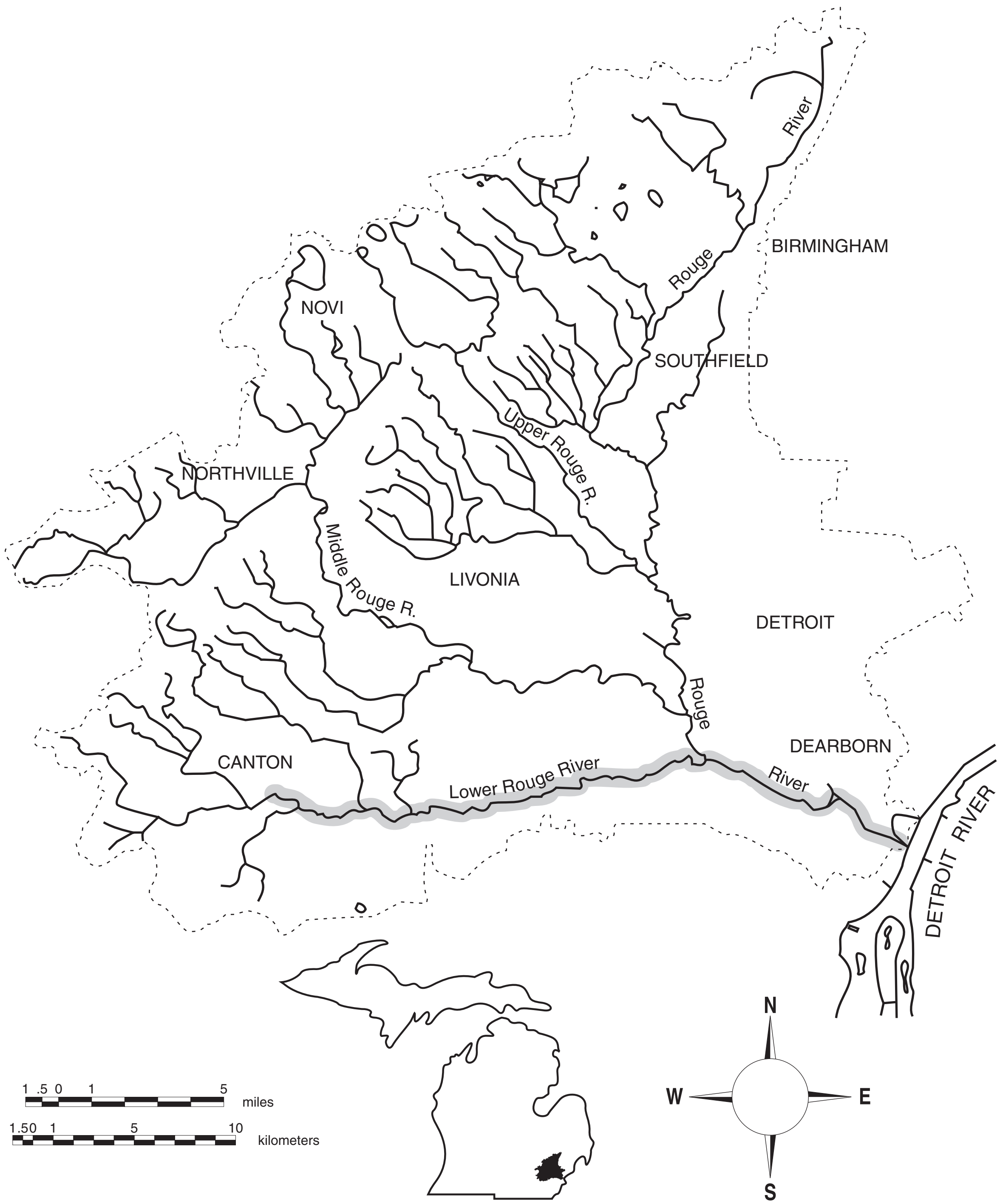


Chinook salmon (*Oncorhynchus tshawyscha*)

Habitat:

feeding - adults: Lake Erie
- young: shallow gravel substrate in cool streams, later into pools

spawning - gravelly substrate in cool streams

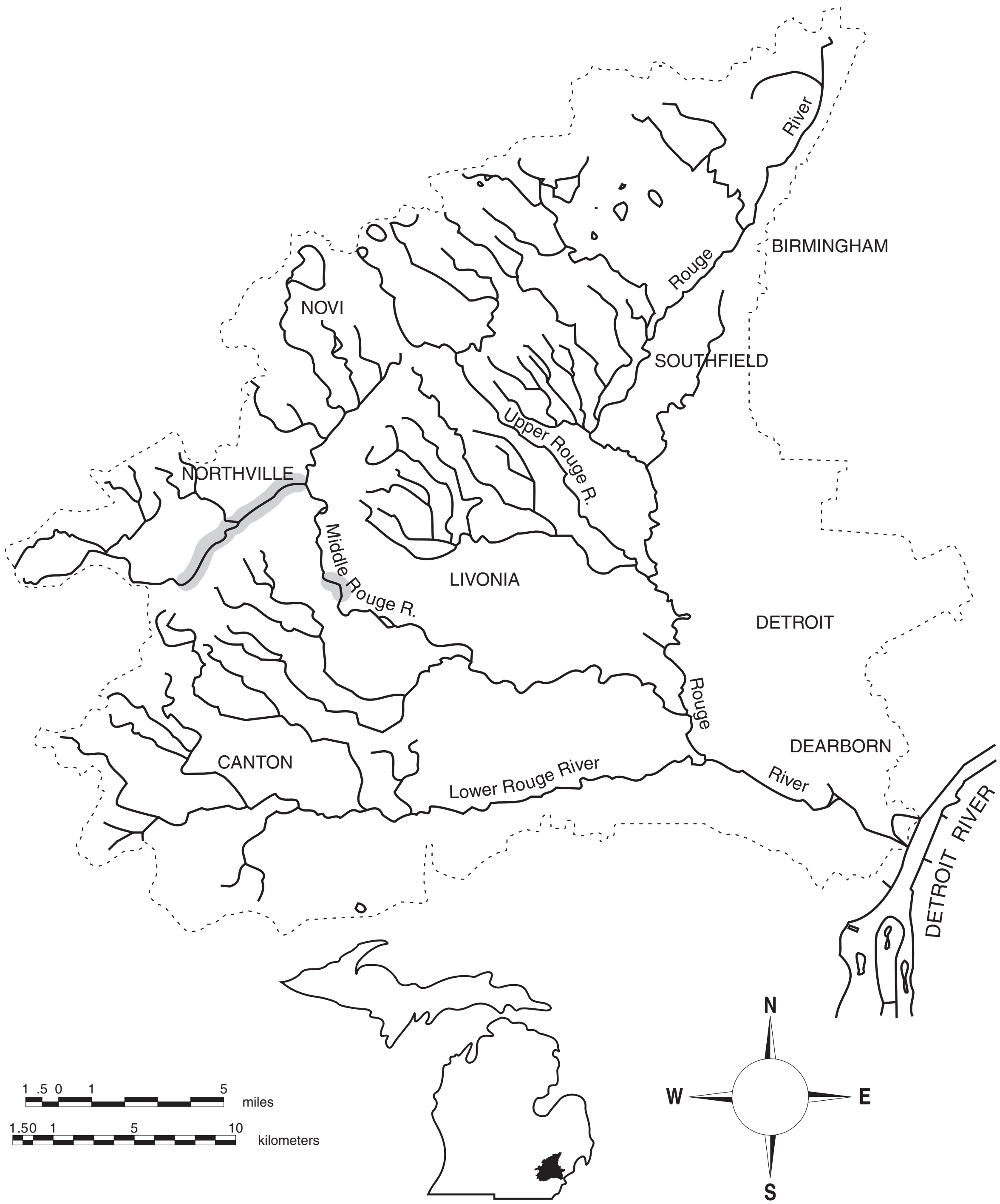


Brown trout (*Salmo trutta*)

Habitat:

feeding - cold, clear streams, rivers, and lakes (not >70˚F)
- medium to swift current in streams
- does not tolerate silt well
- prefers few individuals and species around
- abundance of aquatic and land insects

spawning - gravelly riffles; shallow headwater areas

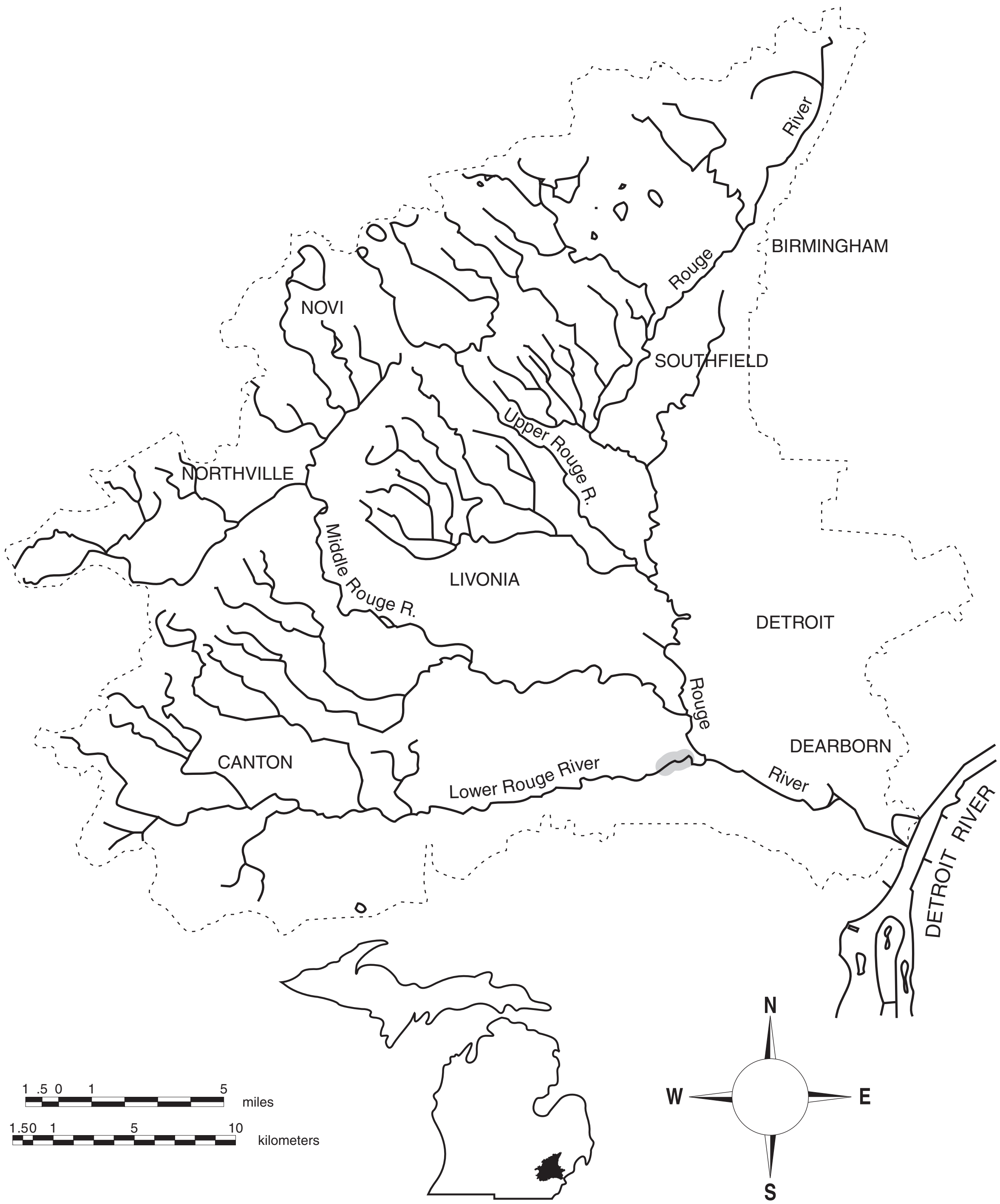


Starhead topminnow (*Fundulus dispar*)

Habitat:

feeding - clear, warm pools in streams and rivers; also lakes
- does not tolerate turbidity
- most frequently at surface

spawning - in and around aquatic vegetation or over gravel substrate with a moderate current

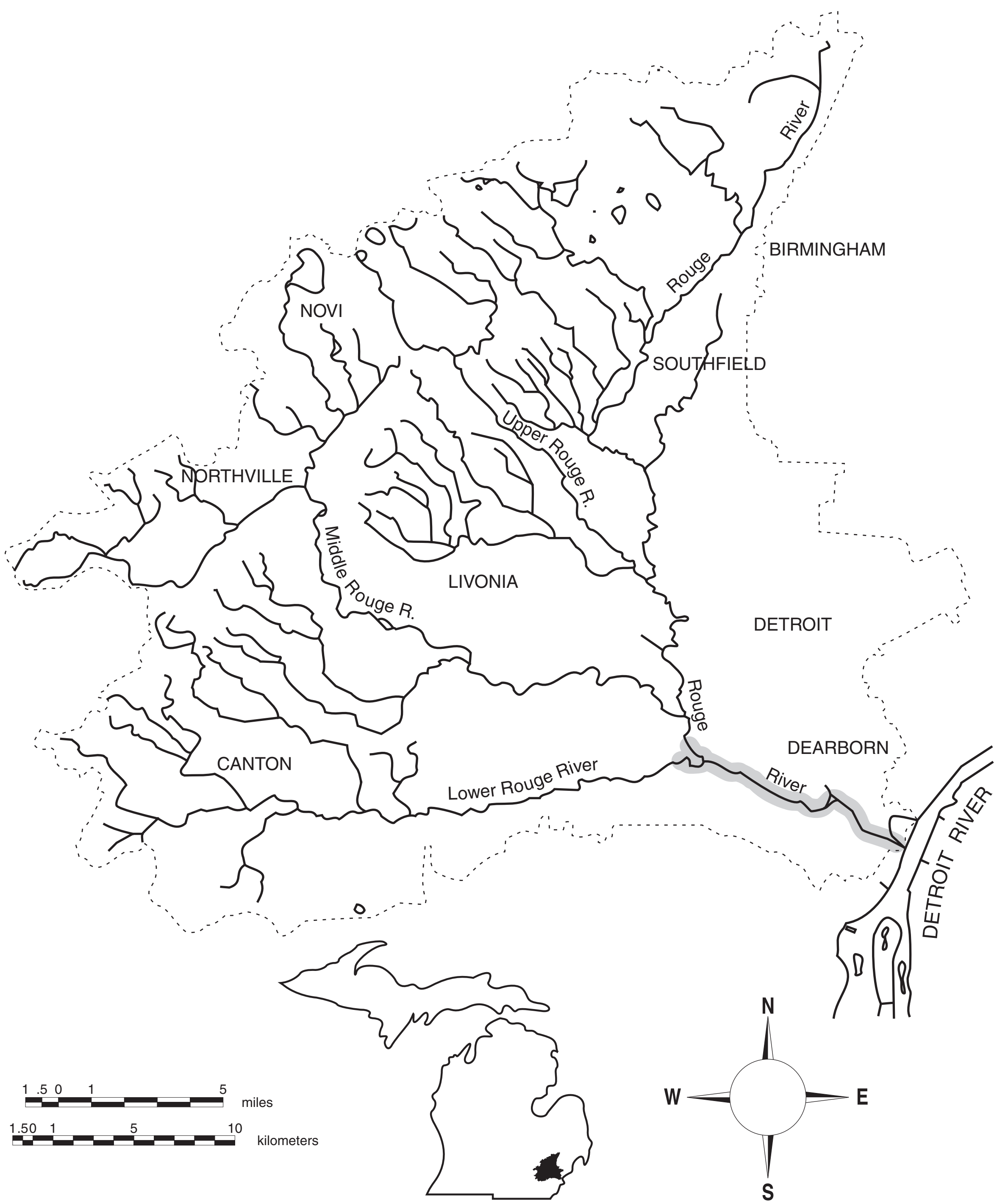


Brook silverside (*Labidesthes sicculus*)

Habitat:

feeding - clear, warm pools in streams and rivers; also lakes
- does not tolerate turbidity
- most frequently at surface

spawning - in and around aquatic vegetation or over gravel substrate with a moderate current

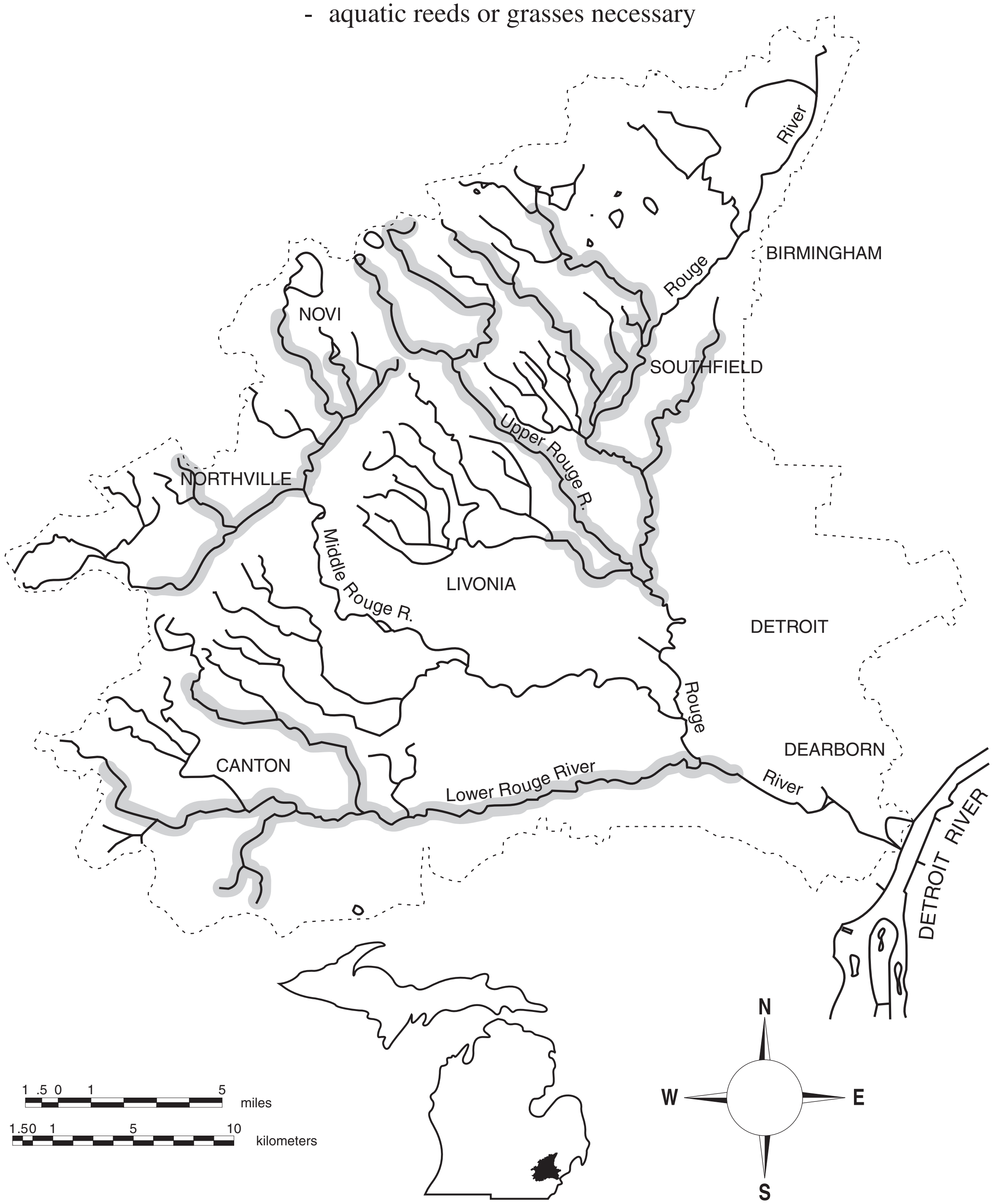


Brook stickleback (*Cluaea inconstans*)

Habitat:

feeding
- clear, cold, densely vegetated streams, and swampy margins of lakes
- low gradient
- muck, peat, or marl substrate
- not tolerant of turbidity

spawning
- shallow cool (<66˚F) water
- aquatic reeds or grasses necessary

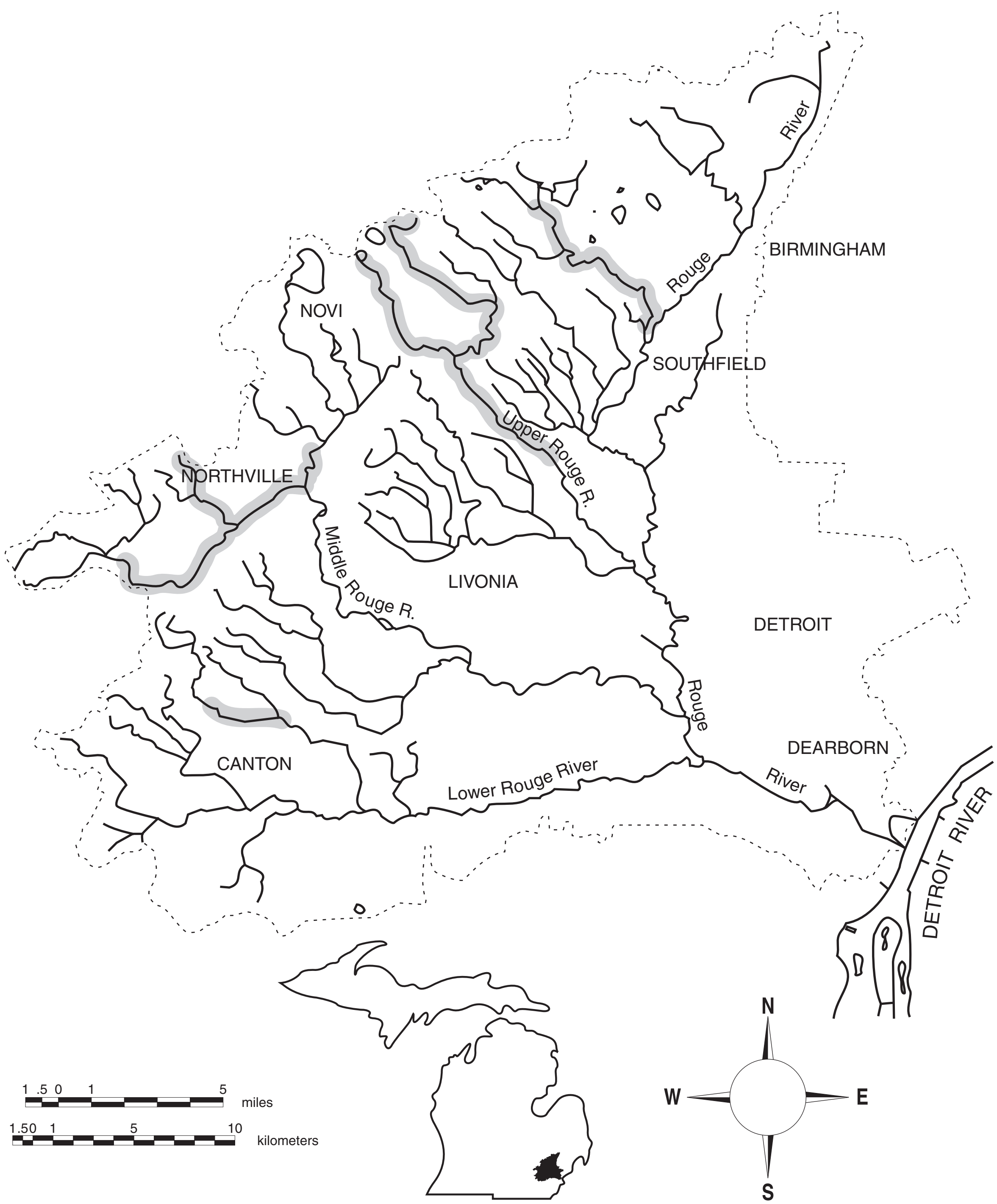


Mottled sculpin (*Cottus bairdi*)

Habitat:

feeding - cool to cold streams
- riffle and rock substrates preferred
- clear to slightly turbid shallow water

spawning - nests under logs or rock

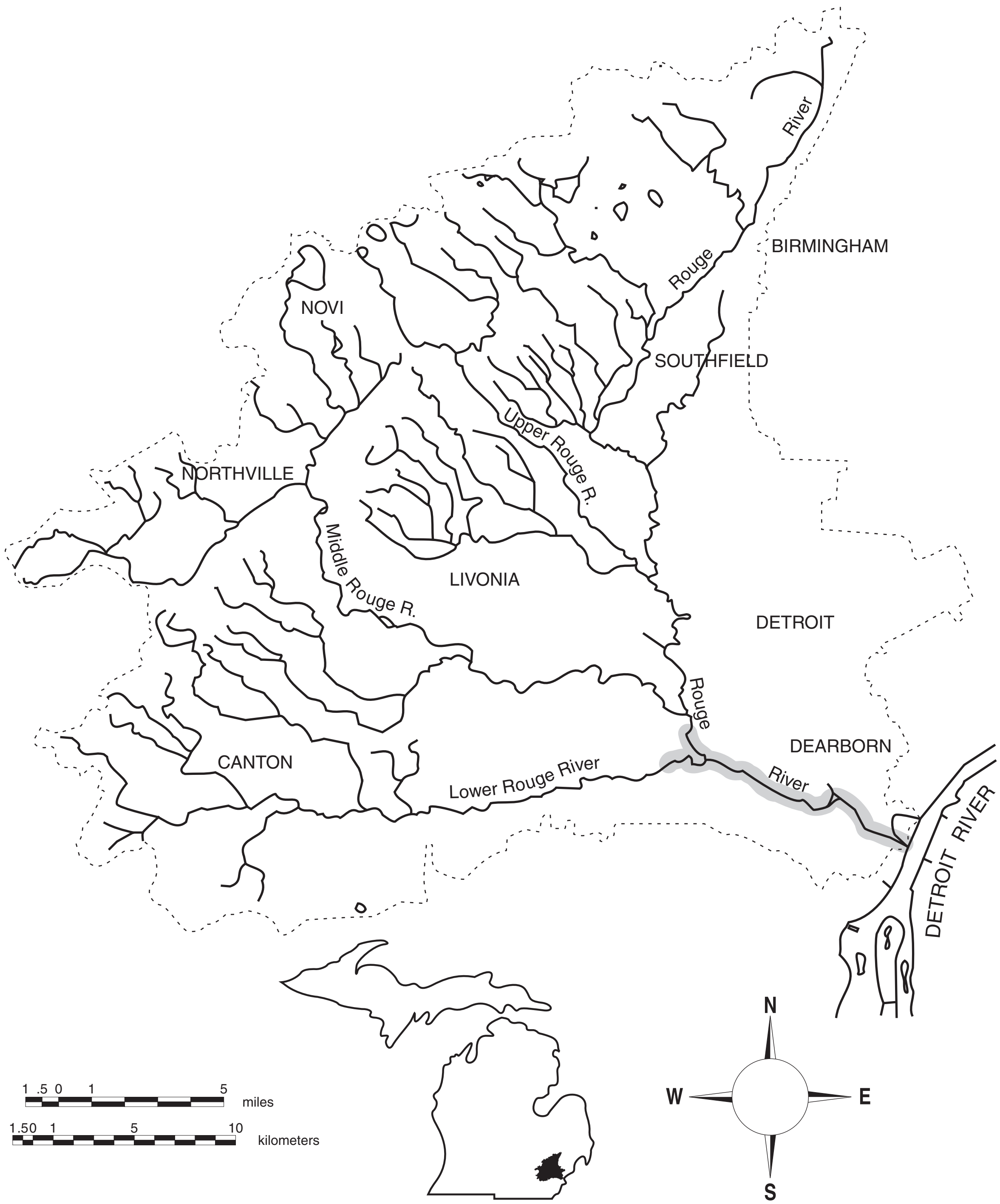


White perch (*Morone americana*)

Habitat:

feeding - clear, warm water of low-gradient streams, lakes, impoundments, and Detroit River

spawning - shallow water over firm substrate



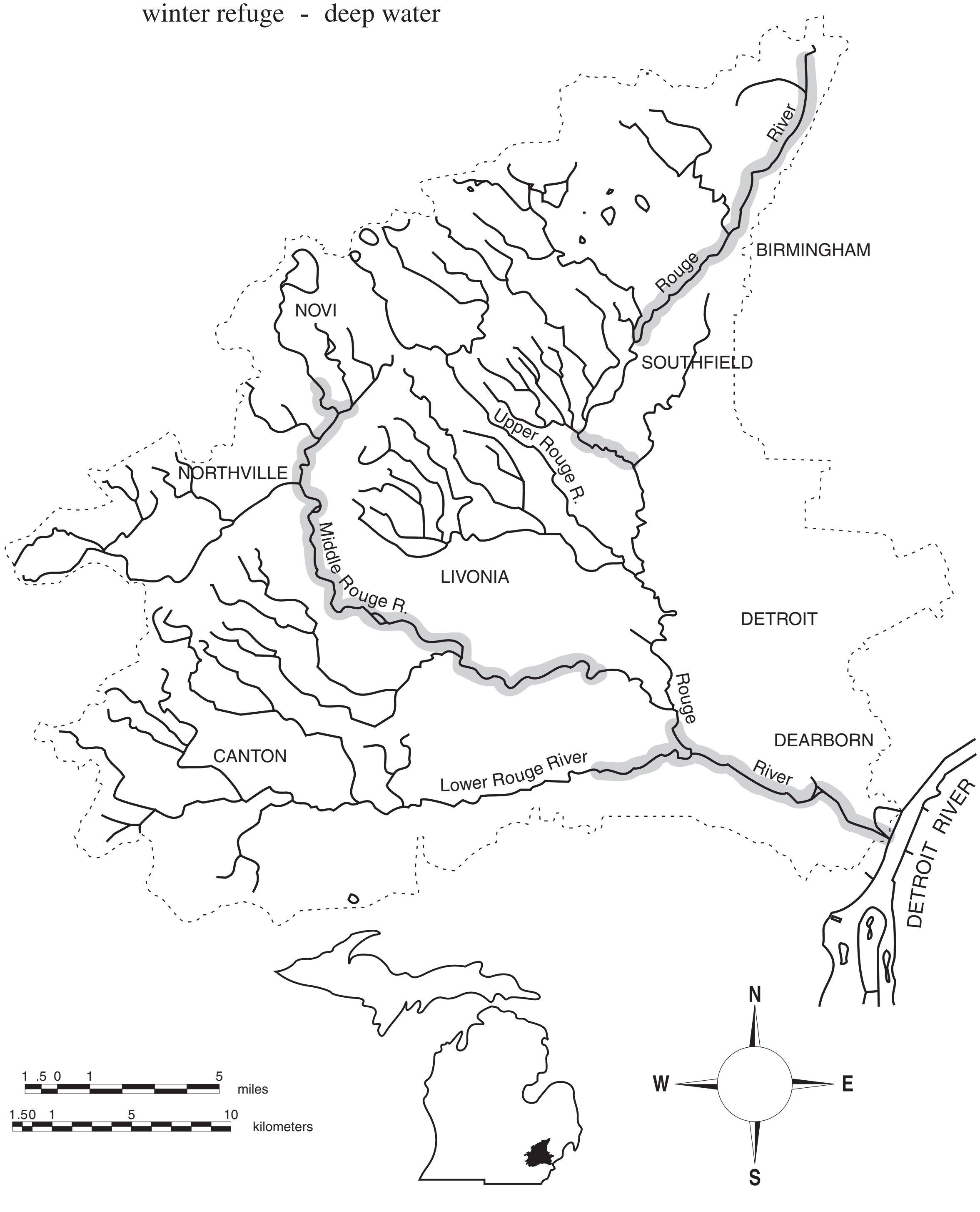
Rock bass (*Ambloplites rupestris*)

Habitat:

feeding - clear, cool streams, rivers, and lakes
- rocky to sand substrate
- woody or vegetative cover

spawning - sand or gravel nests
- shallow water

winter refuge - deep water

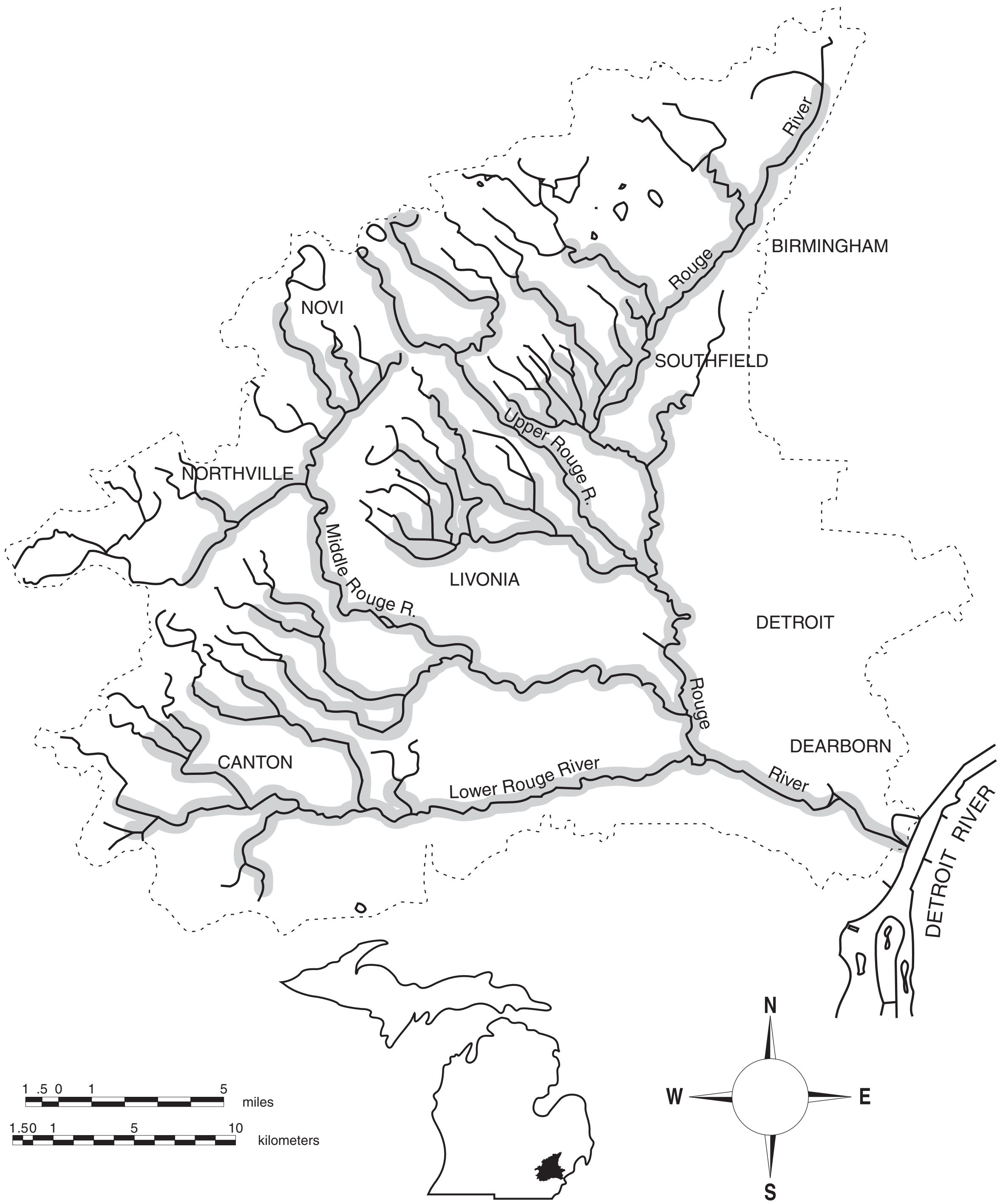


Green sunfish (*Lepomis cyanellus*)

Habitat:

feeding - impoundments and lakes, and low-current streams and rivers
- no substrate preference

spawning - nests in shallow areas sheltered by rocks, logs, or aquatic vegetation

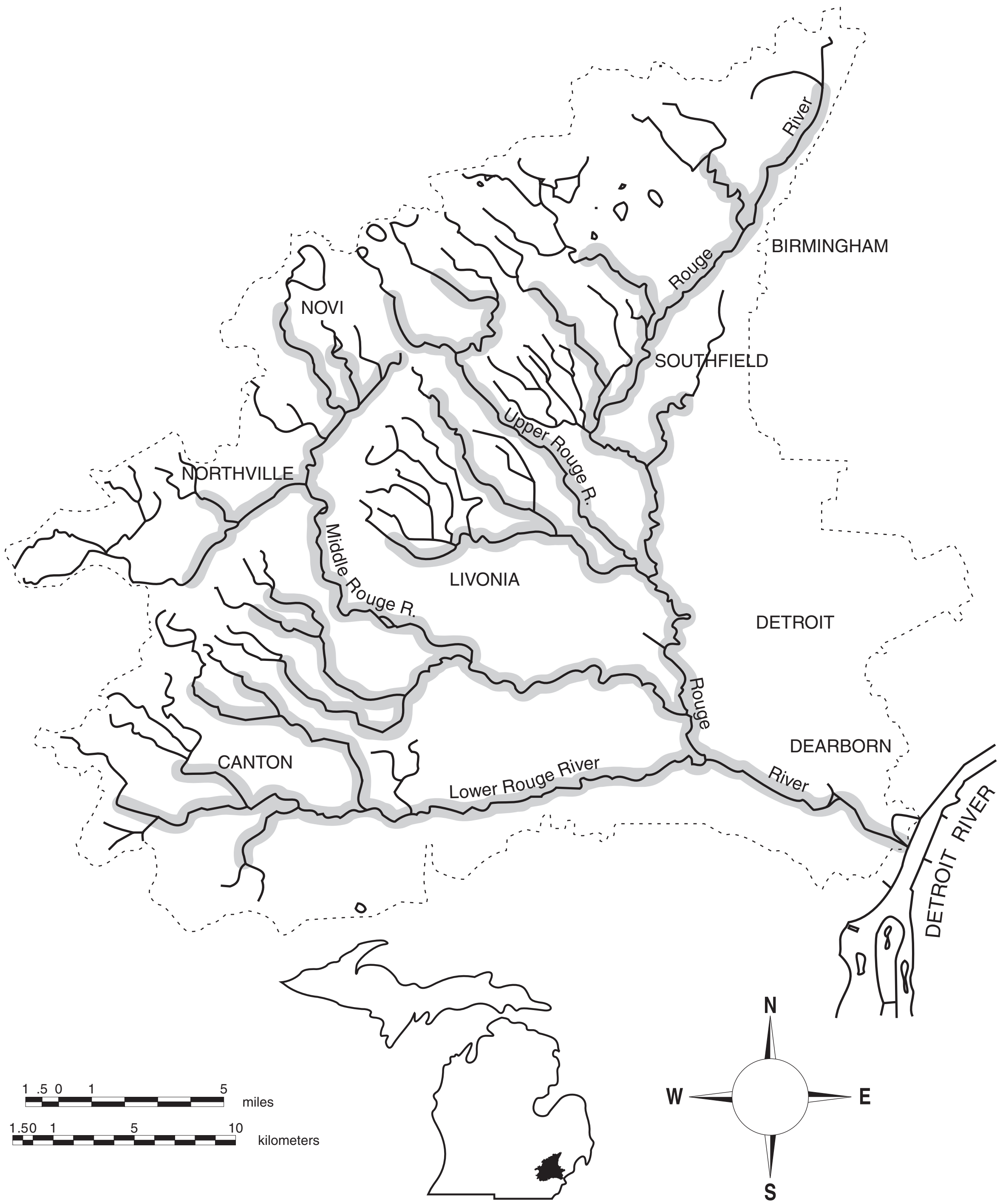


Pumpkinseed sunfish (*Lepomis gibbosus*)

Habitat:

feeding - non-flowing clear water in streams and rivers; also lakes and impoundments
- muck or sand partly covered with organic debris substrate
- dense beds of submerged aquatic vegetation

spawning - nest in sand, gravel, or rock substrate
- in shallow water near submerged vegetation



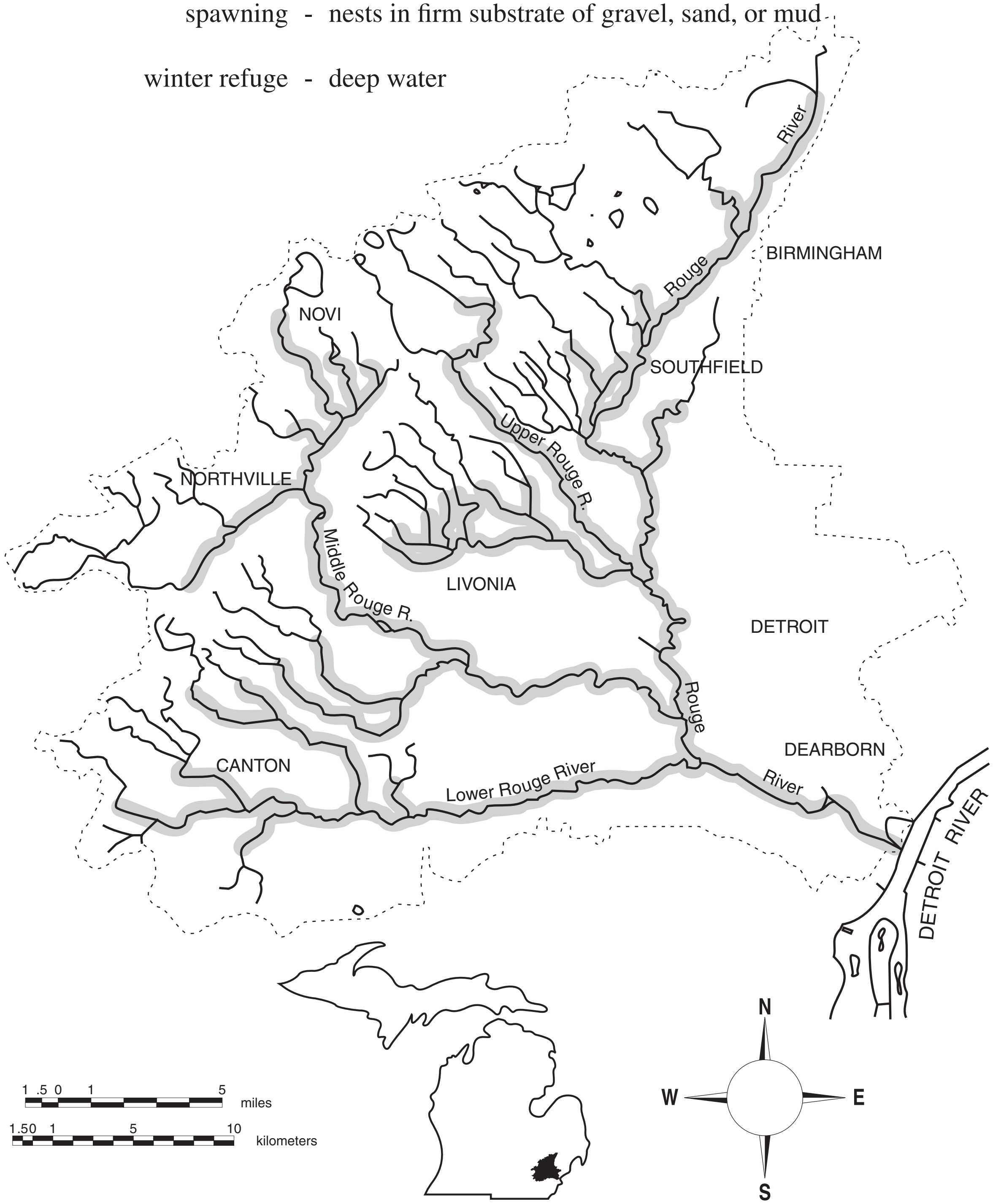
Bluegill (*Lepomis macochrius*)

Habitat:

feeding - non-flowing clear streams and rivers; also lakes and impoundments
- sand, gravel, or muck containing organic debris substrate
- scattered beds of aquatic vegetation
- cannot tolerate low oxygen or continuous high turbidity and siltation

spawning - nests in firm substrate of gravel, sand, or mud

winter refuge - deep water

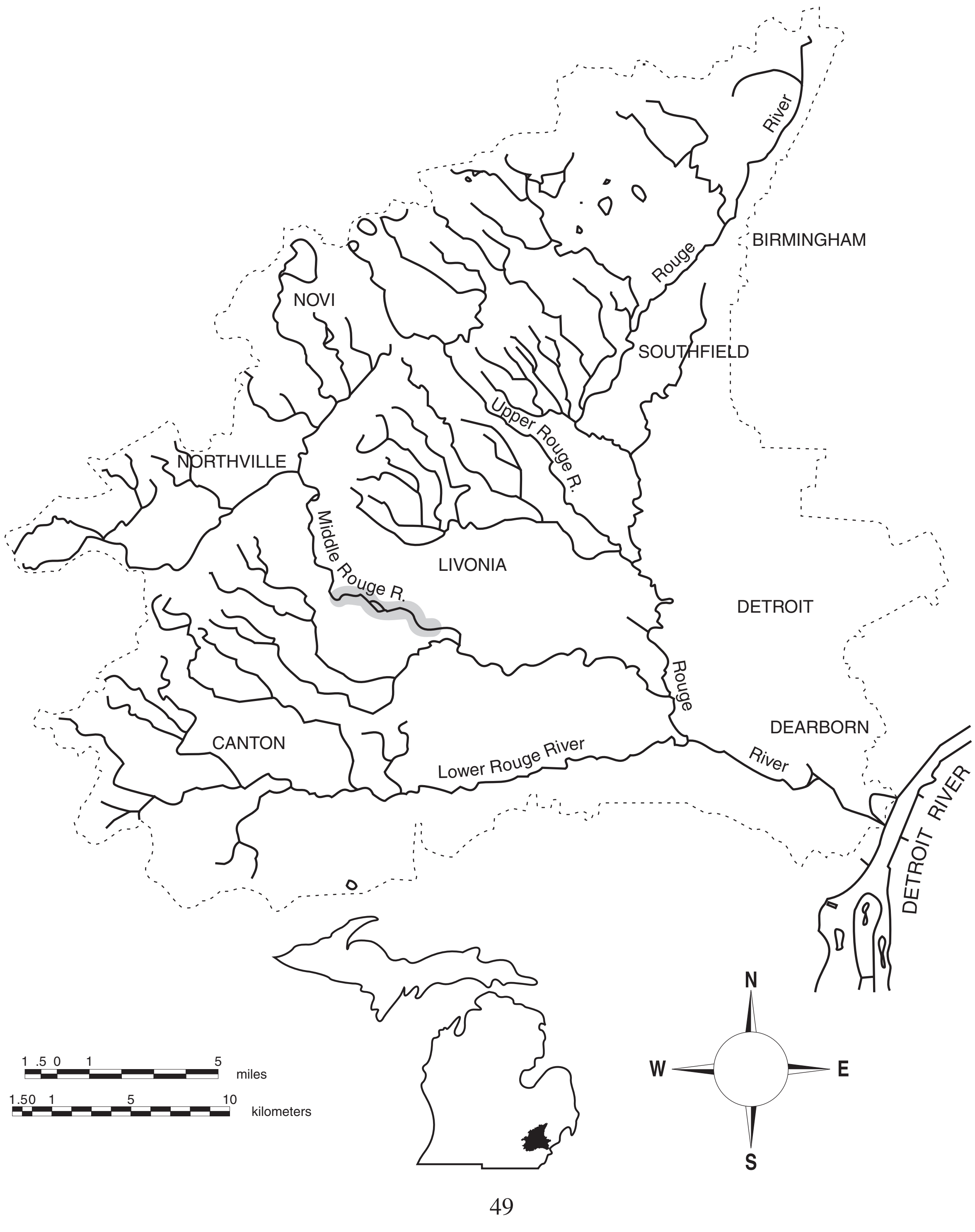


Longear sunfish (*Lepomis megalotis*)

Habitat:

feeding - clear moderate-sized shallow streams with moderate vegetation
- rocky substrates
- little to no current

spawning - nests in gravel, sand, or hard rock substrate



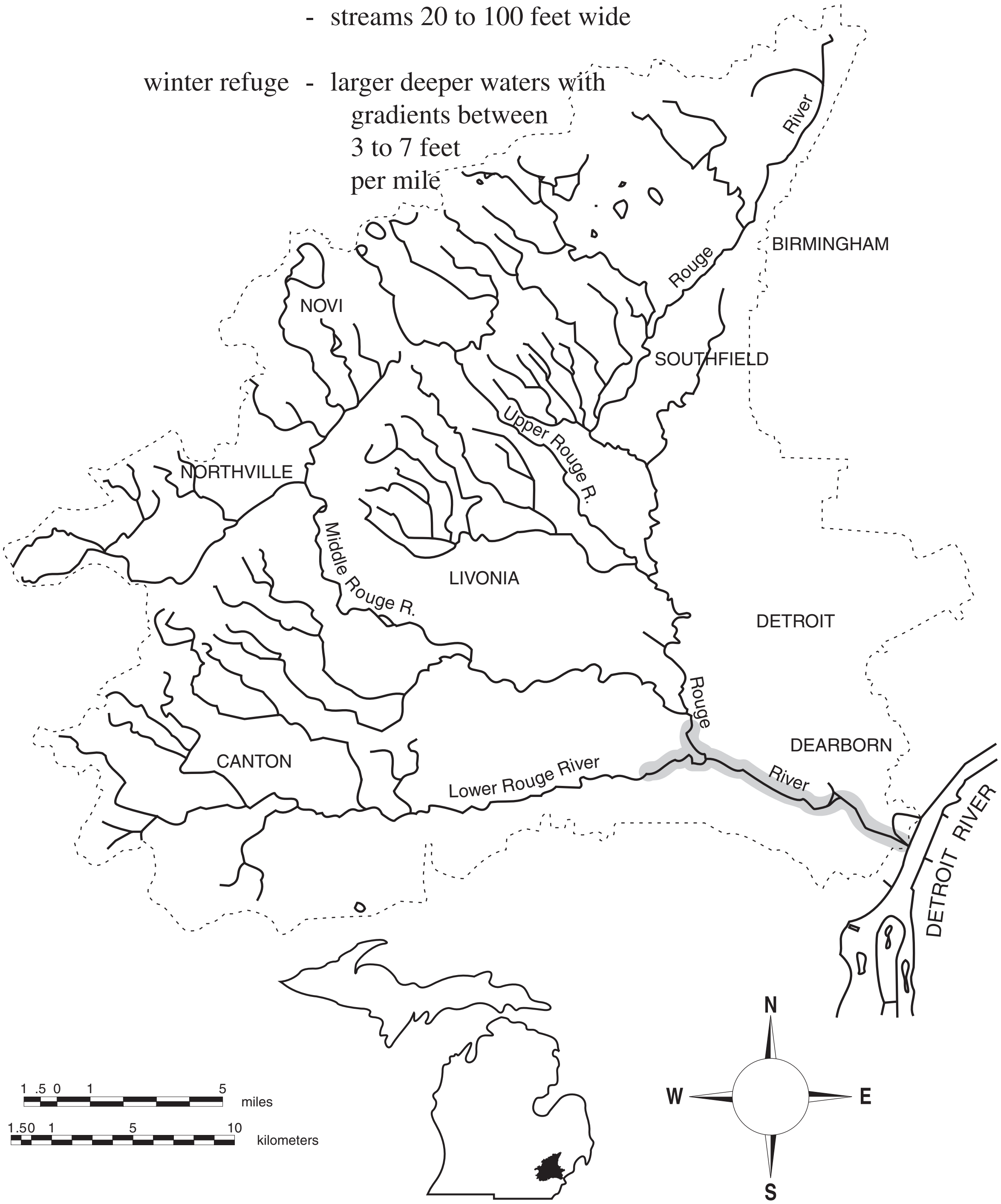
Smallmouth bass (*Micropterus dolomieu*)

Habitat:

feeding
- clear, cool, deep lakes and rivers
- streams where 40% consists of riffles over clean gravel, boulder, or bedrock substrate
- in pools with a current and >4 feet of depth
- gradients between 4 and 25 feet per mile

spawning
- nest in sandy, gravel, or rocky substrate
- gradients 7 to 25 feet per mile
- streams 20 to 100 feet wide

winter refuge
- larger deeper waters with gradients between 3 to 7 feet per mile

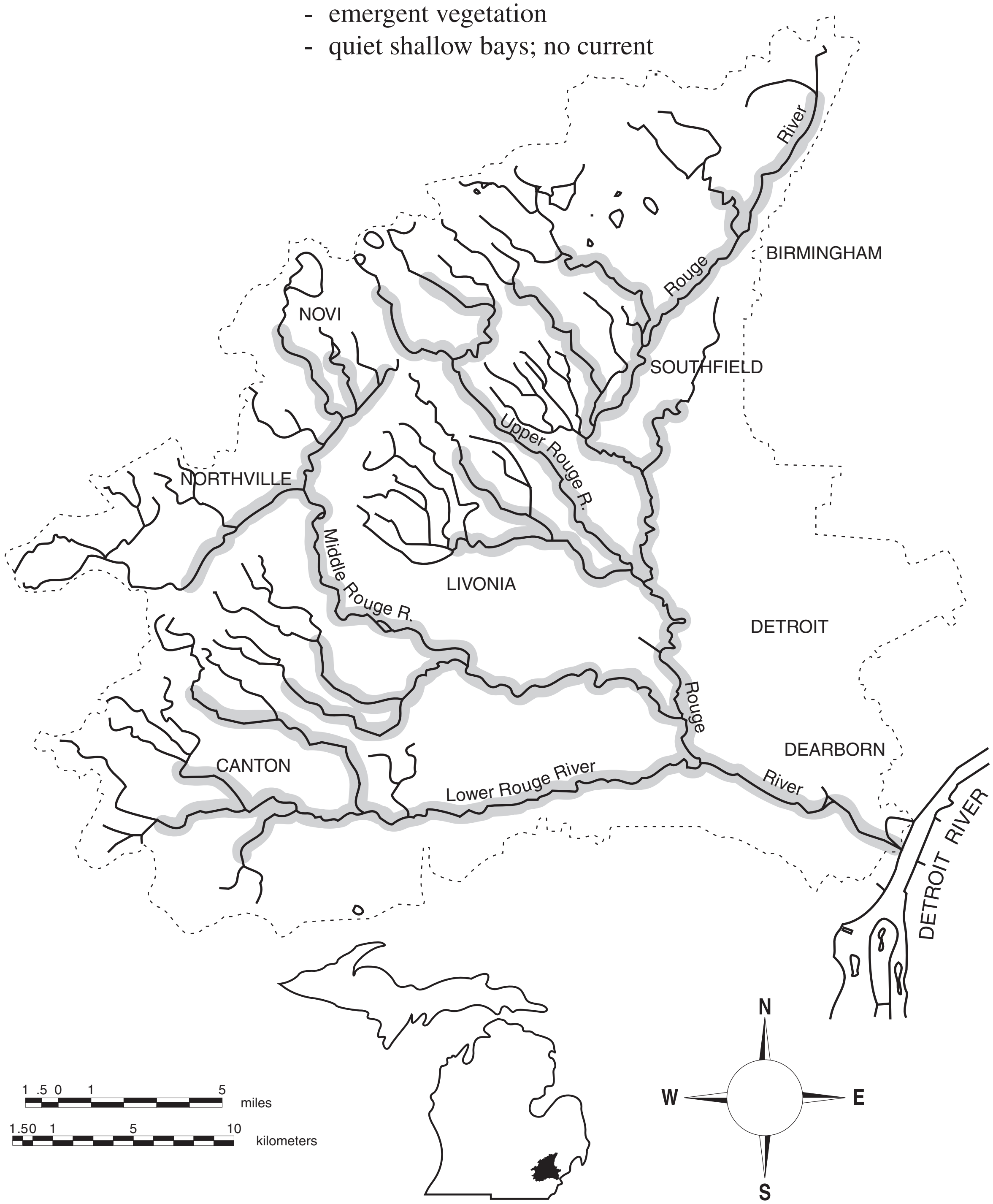


Largemouth bass (*Micropterus salmoides*)

Habitat:

feeding
- non-flowing clear waters - lakes, impoundments, and pools of streams
- abundant aquatic vegetation
- soft muck, organic debris, gravel, sand, and hard non-flocculent clay substrates

spawning
- nest in gravelly sand to marl and soft mud substrates
- emergent vegetation
- quiet shallow bays; no current

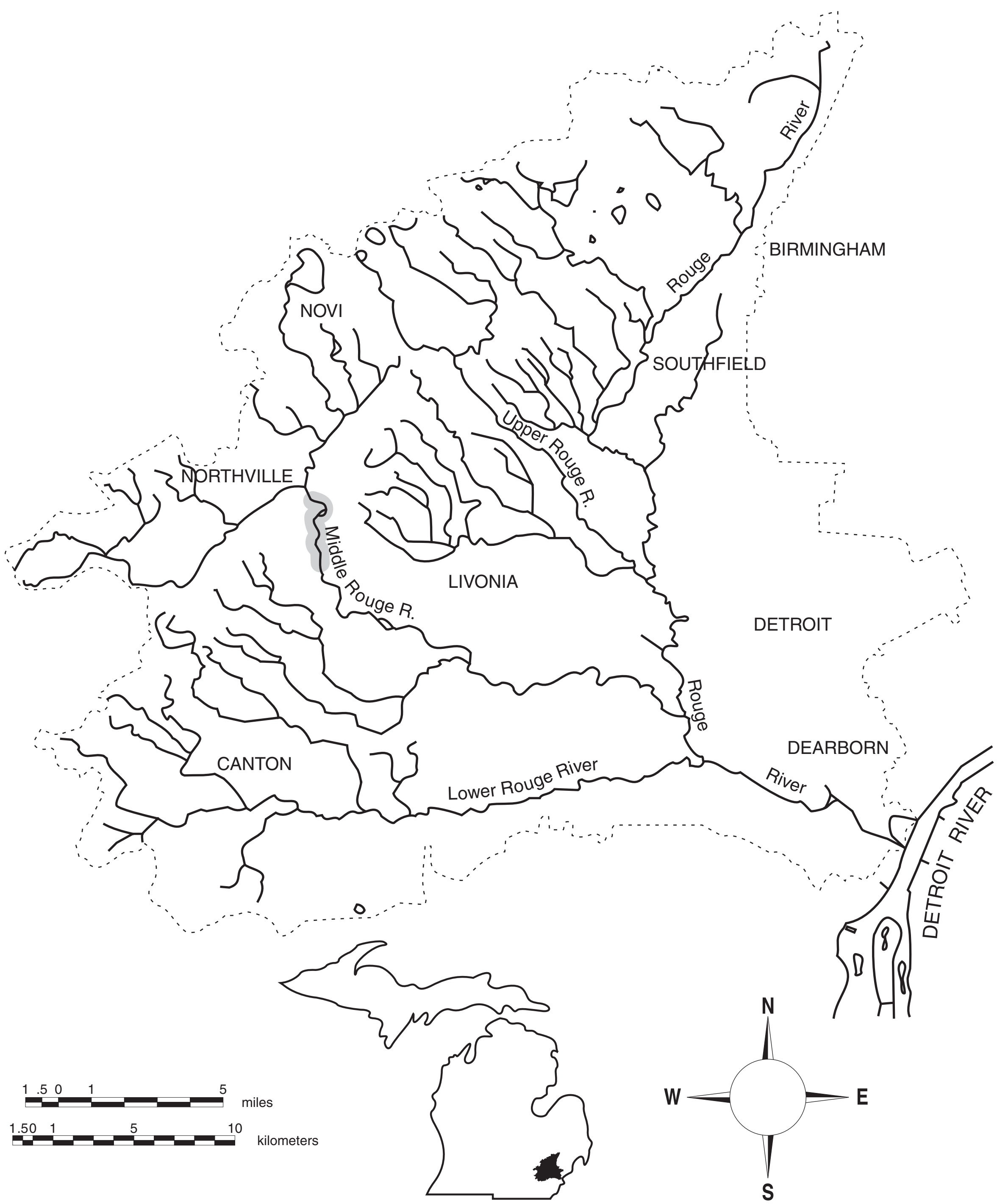


White crappie (*Pomoxis annularis*)

Habitat:

feeding
- lakes and impoundments >5 acres
- sluggish pools of moderate to large low-gradient rivers
- no substrate preference
- can tolerate severe turbidity and rapid siltation

spawning
- various substrates usually beside rooted aquatic vegetation
- sometimes under banks

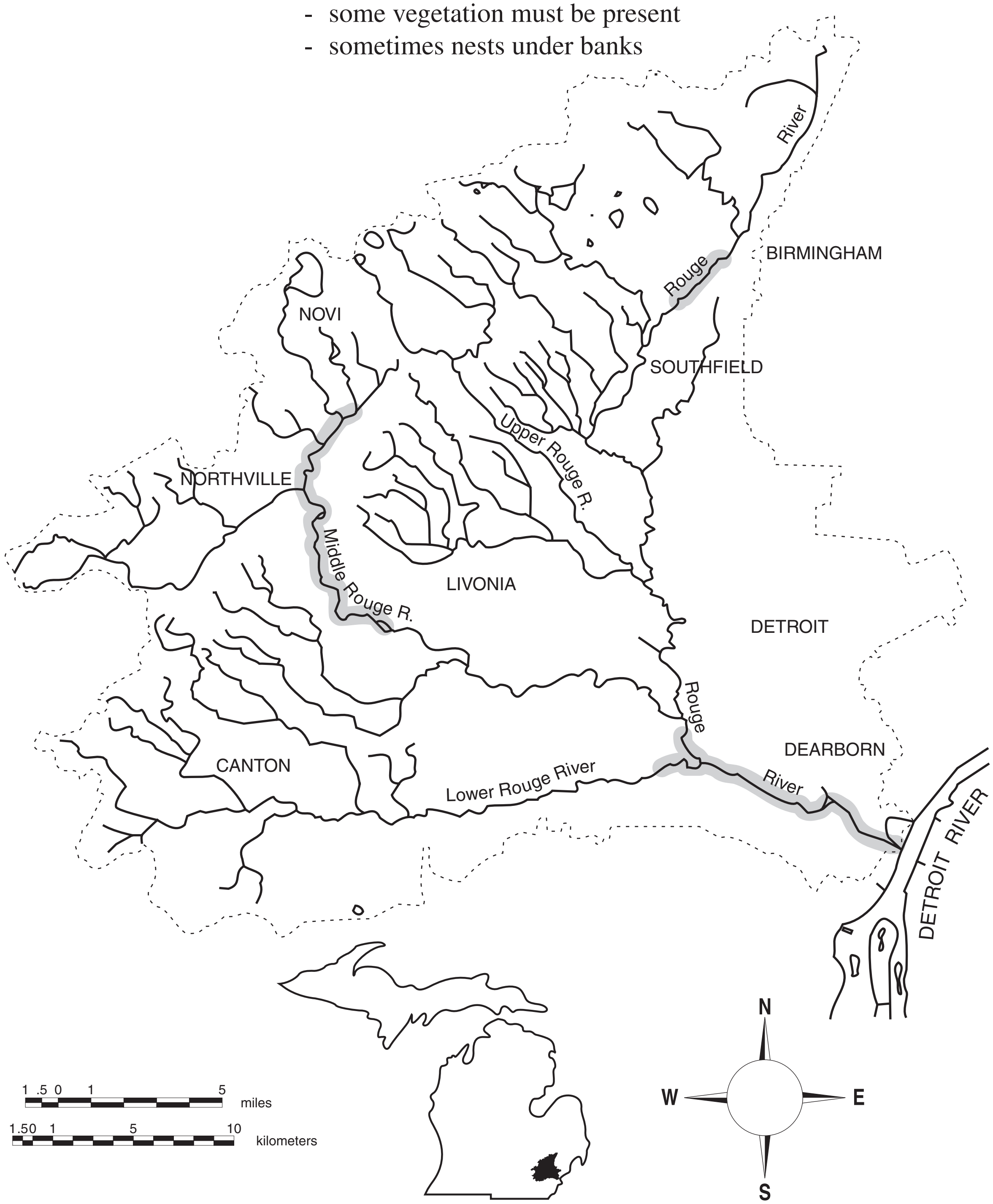


Black crappie (*Pomoxis nigromaculatus*)

Habitat:

feeding
- larger clear non-silty low-gradient rivers; also in lakes and impoundments
- clean hard sand or muck substrate
- associated with submerged aquatic vegetation
- does not tolerate silt or turbidity well

spawning
- nests in gravel, sand, or mud substrate
- some vegetation must be present
- sometimes nests under banks



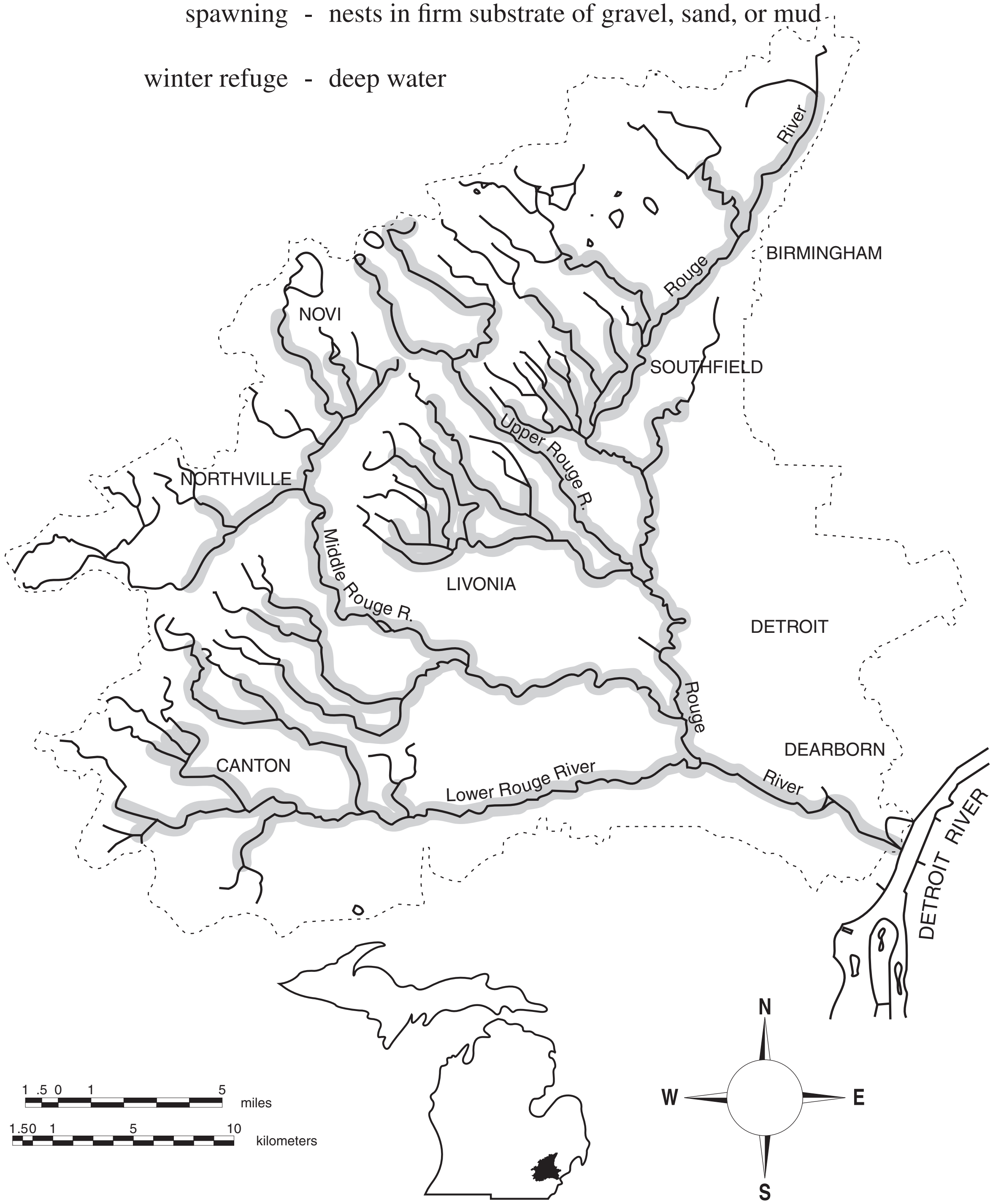
Hybrid sunfish (*Lepomis x Lepomis spp.*)

Habitat:

feeding - non-flowing clear streams and rivers; also lakes and impoundments
- sand, gravel, or muck containing organic debris substrate
- scattered beds of aquatic vegetation
- cannot tolerate low oxygen or continuous high turbidity and siltation

spawning - nests in firm substrate of gravel, sand, or mud

winter refuge - deep water

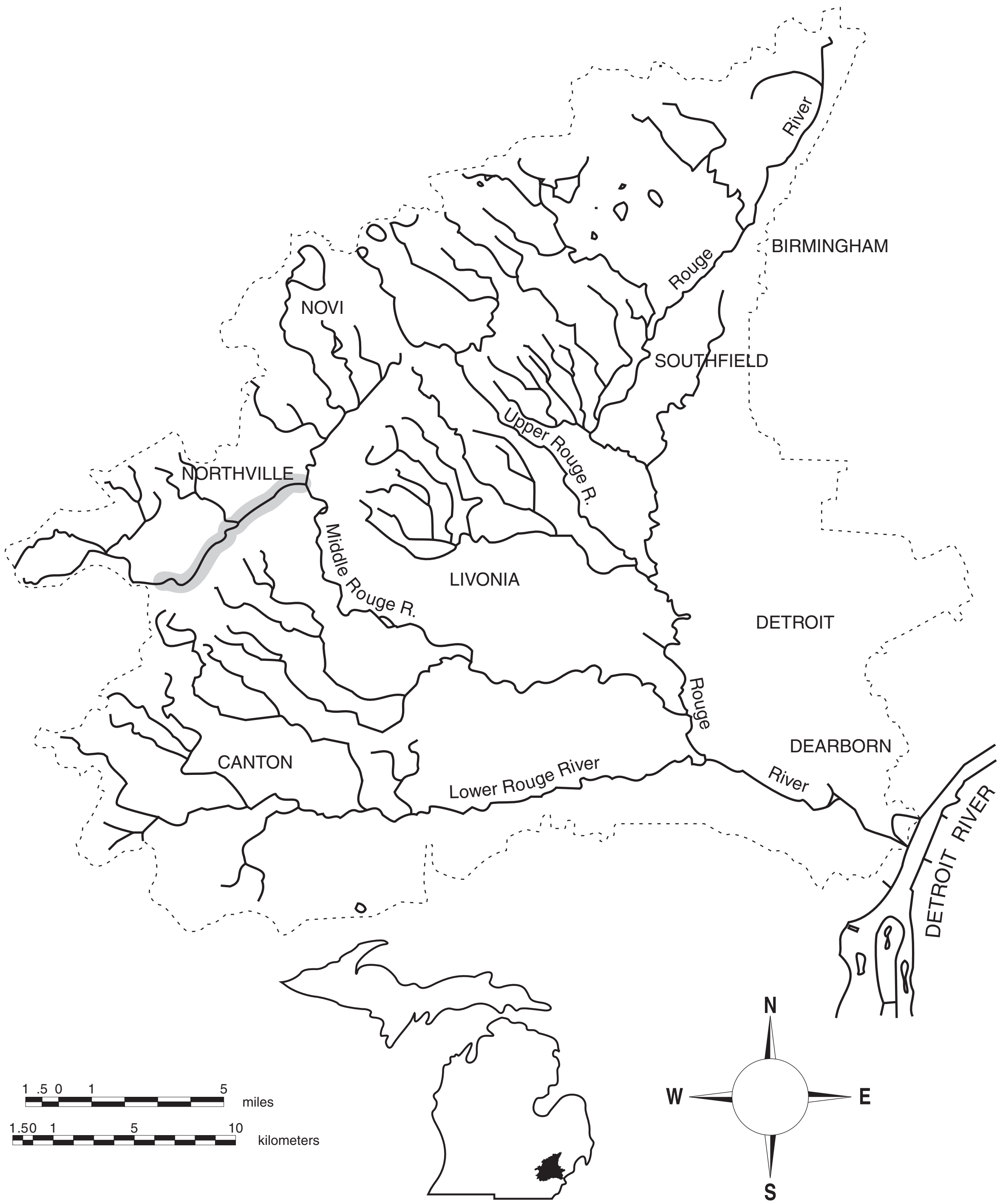


Rainbow darter (*Etheostoma caeruleum*)

Habitat:

feeding - gravelly high gradient riffles
- clear, moderate to large streams
- in shallows (average 1 foot)

spawning - gravel or rubble riffles

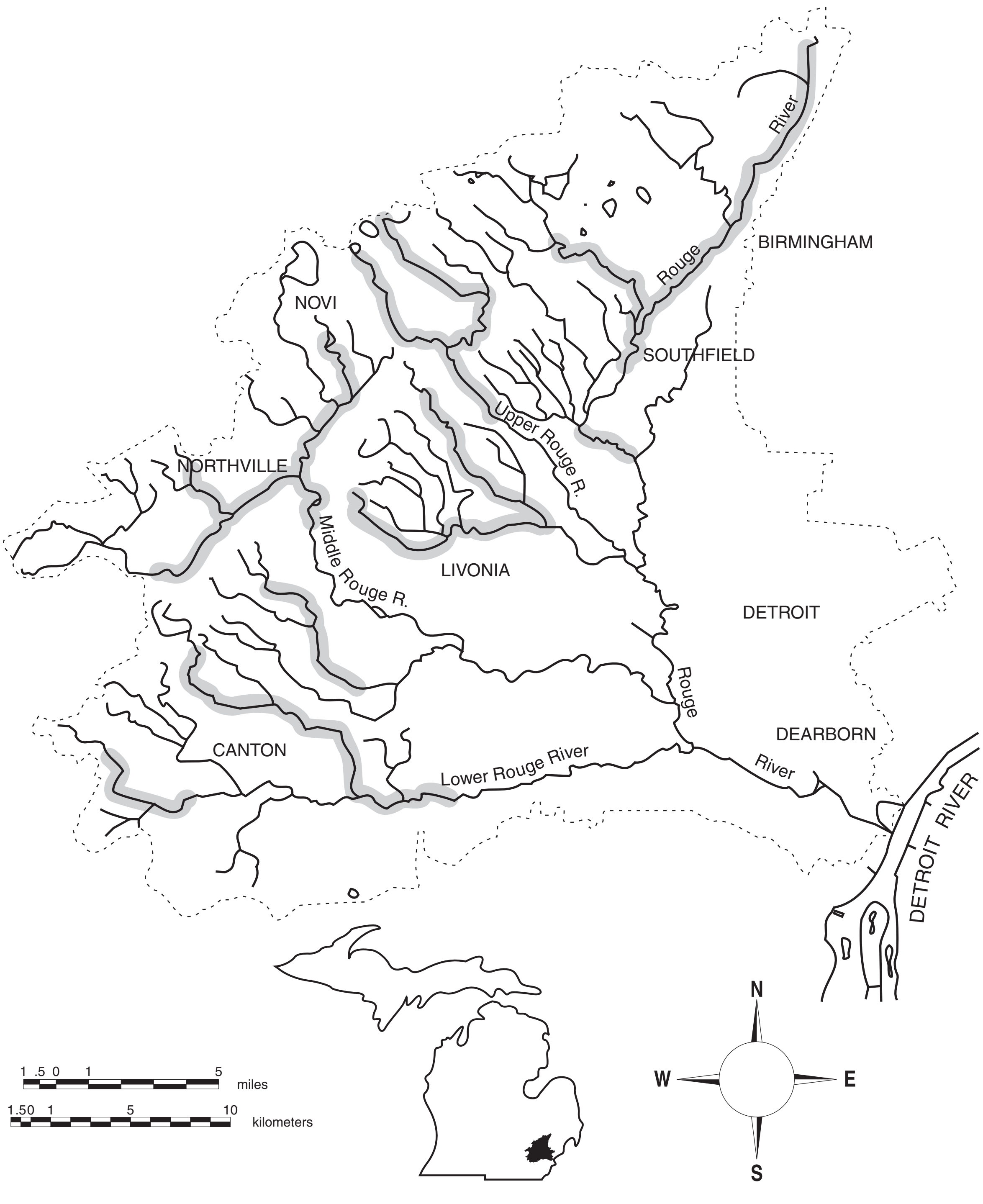


Johnny darter (*Etheostoma nigrum*)

Habitat:

feeding - sand and silt substrate
- little to moderate current
- shallow areas of streams, rivers, lakes, and impoundments
- tolerant of many organic and inorganic pollutants and turbidity

spawning - underneath rocks
- in stream pools or protected shallows of lakes

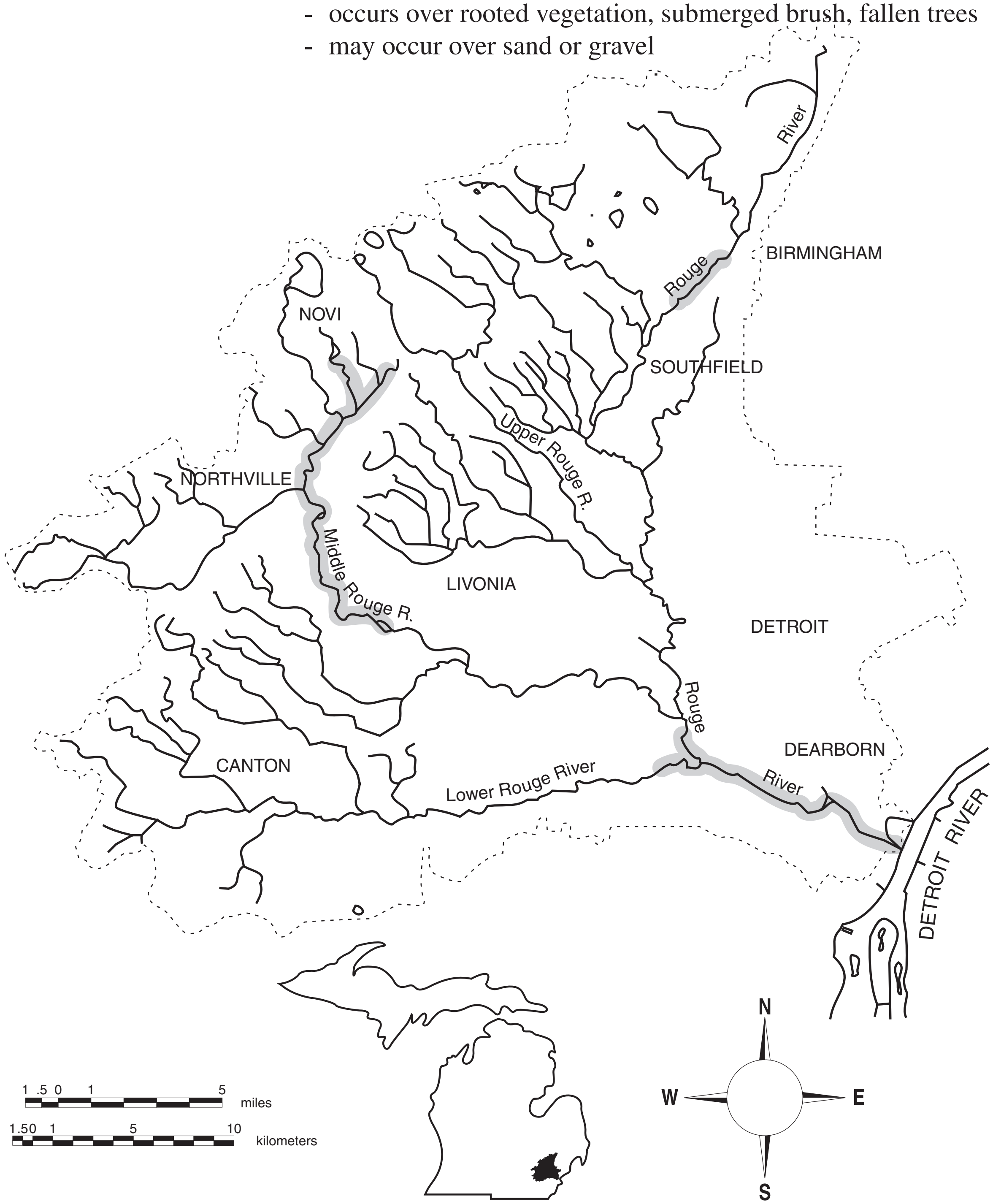


Yellow perch (*Perca flavescens*)

Habitat:

feeding
- clear lakes and impoundments; also Detroit River
- low gradient rivers
- abundance of rooted aquatics
- muck, organic debris, sand, or gravel substrate
- does not tolerate turbidity and siltation

spawning
- shallows of lakes, tributaries of streams
- occurs over rooted vegetation, submerged brush, fallen trees
- may occur over sand or gravel

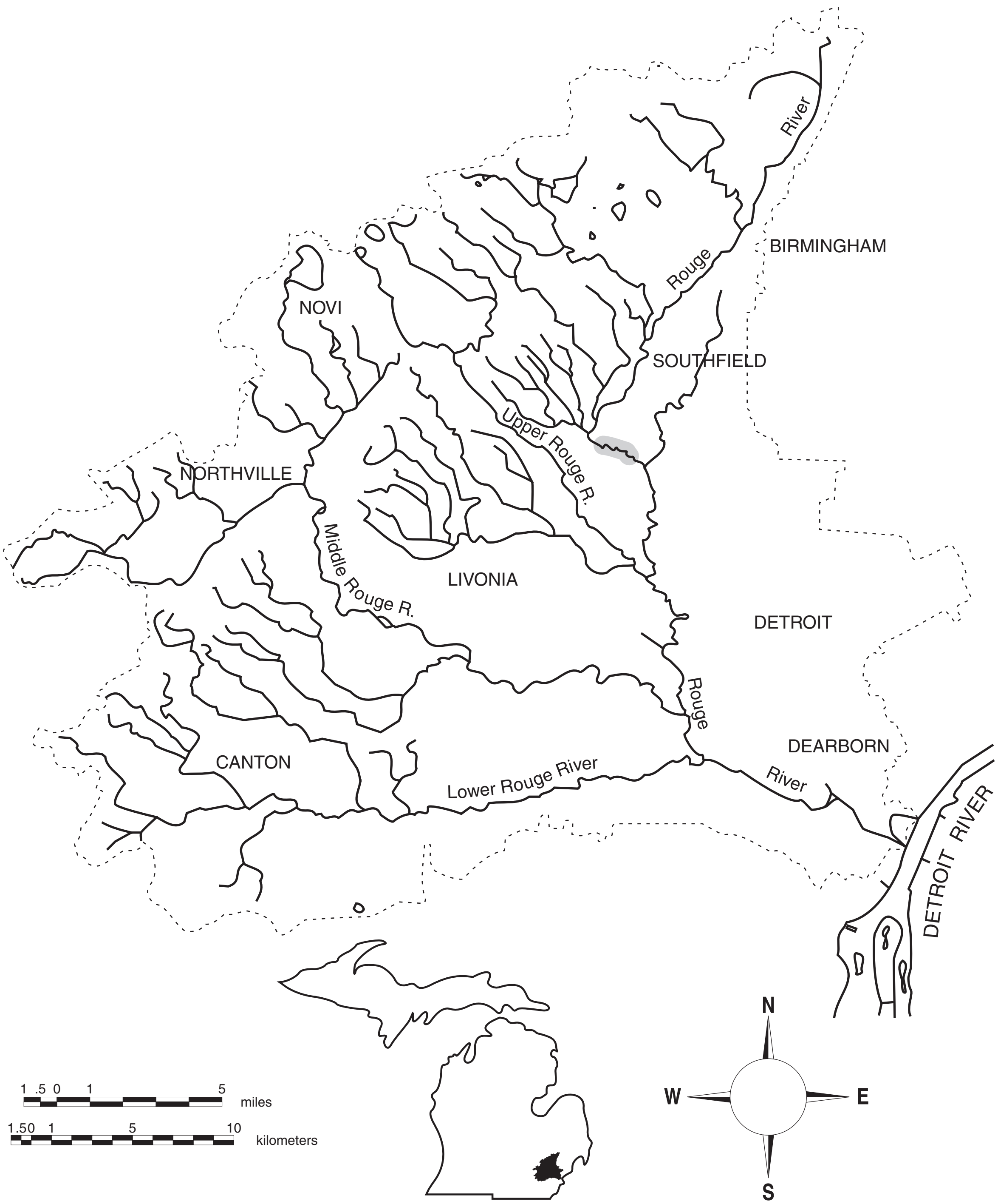


Blackside darter (*Percina maculata*)

Habitat:

feeding - small to medium streams
- low to medium gradient
- gravel and sand substrate
- tolerate some turbidity

spawning - gravel and sand substrate

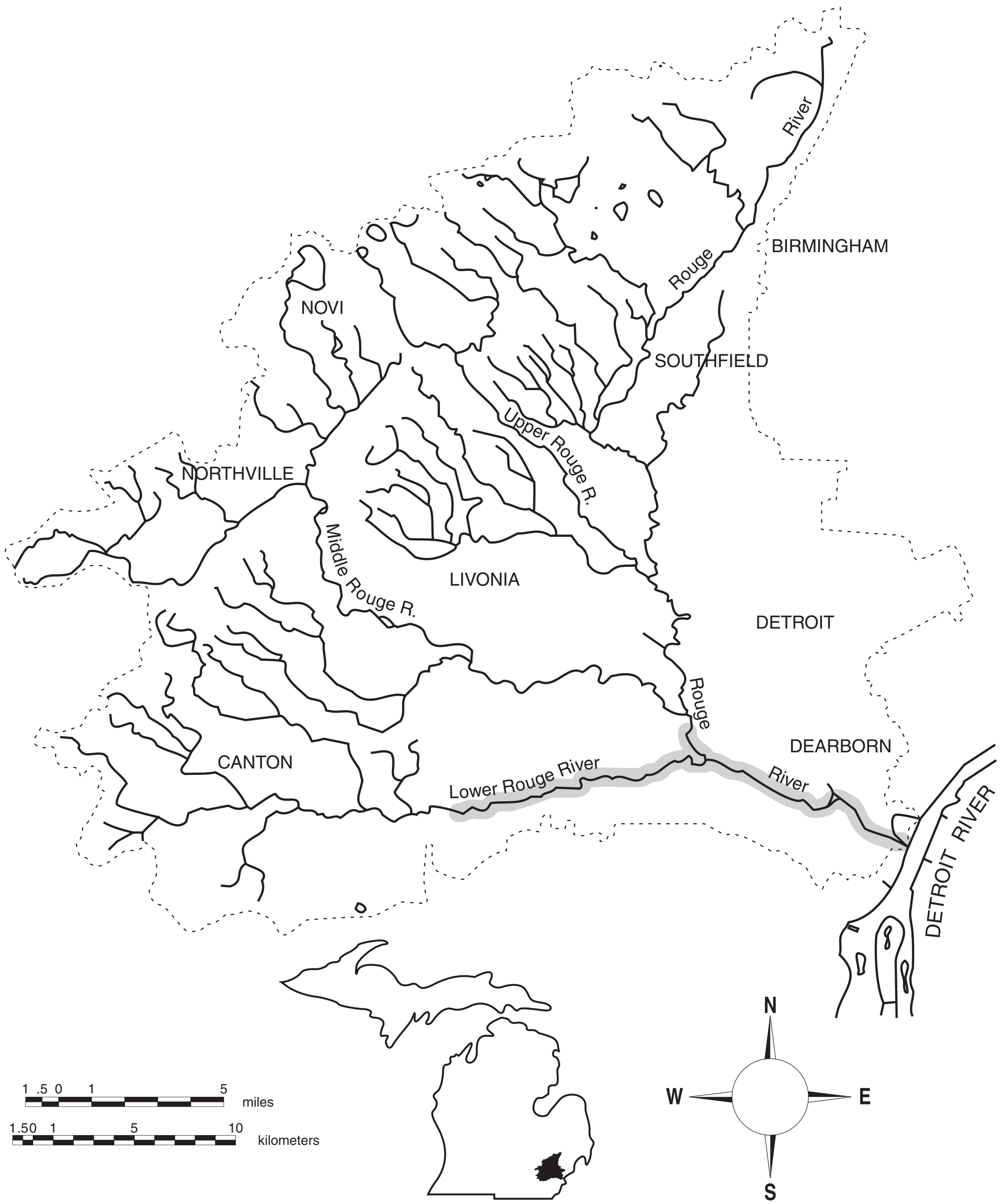


Freshwater drum (*Aplodinotus grunniens*)

Habitat:

feeding - deeper pools of rivers
- in shallows
- prefers clear waters and clean substrates
- can adapt to high turbidity levels

spawning - pelagically, in open water, over sand or mud substrate
- occurs in bays or lower portions of marshes



Index of Common Names