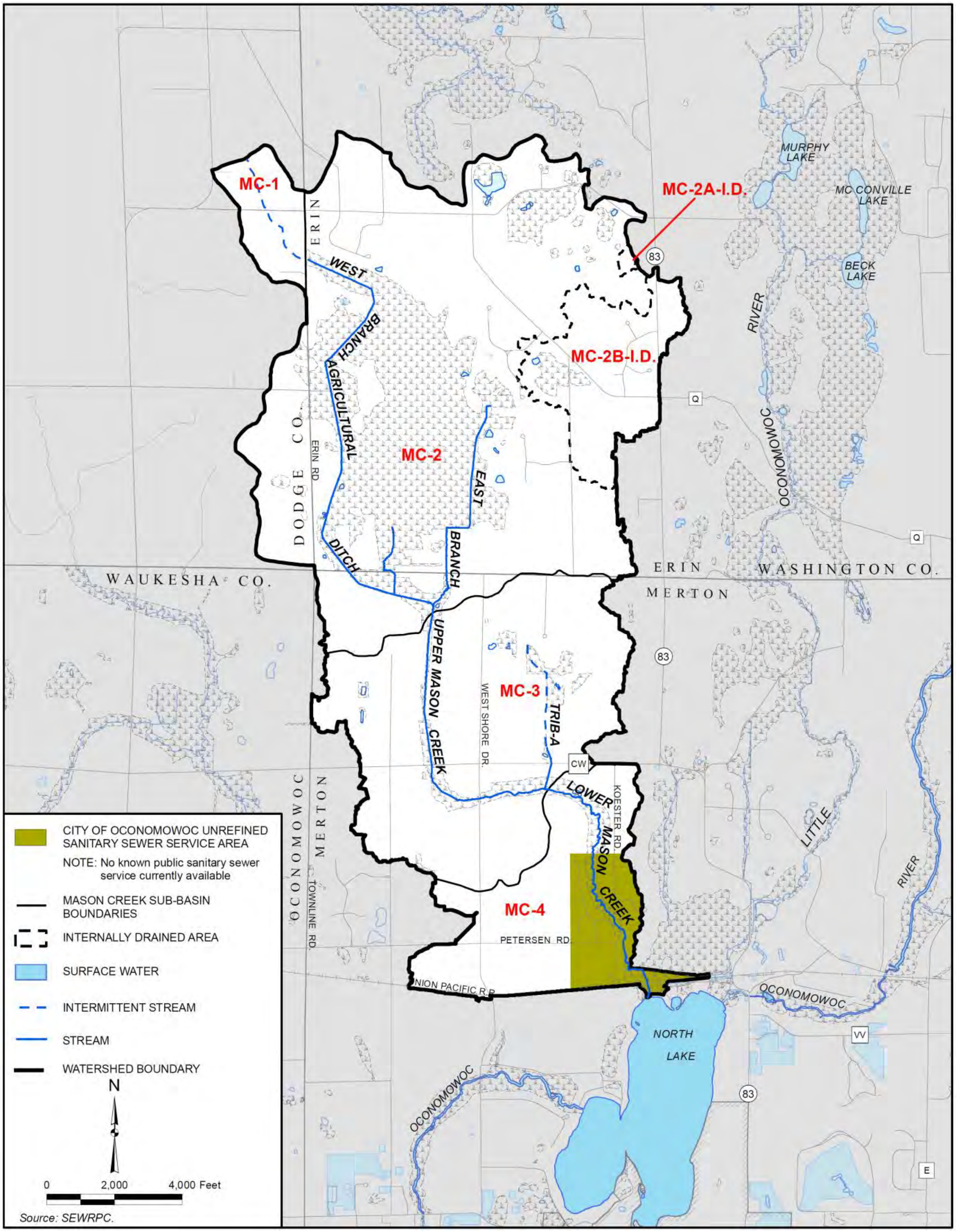
Map II-3

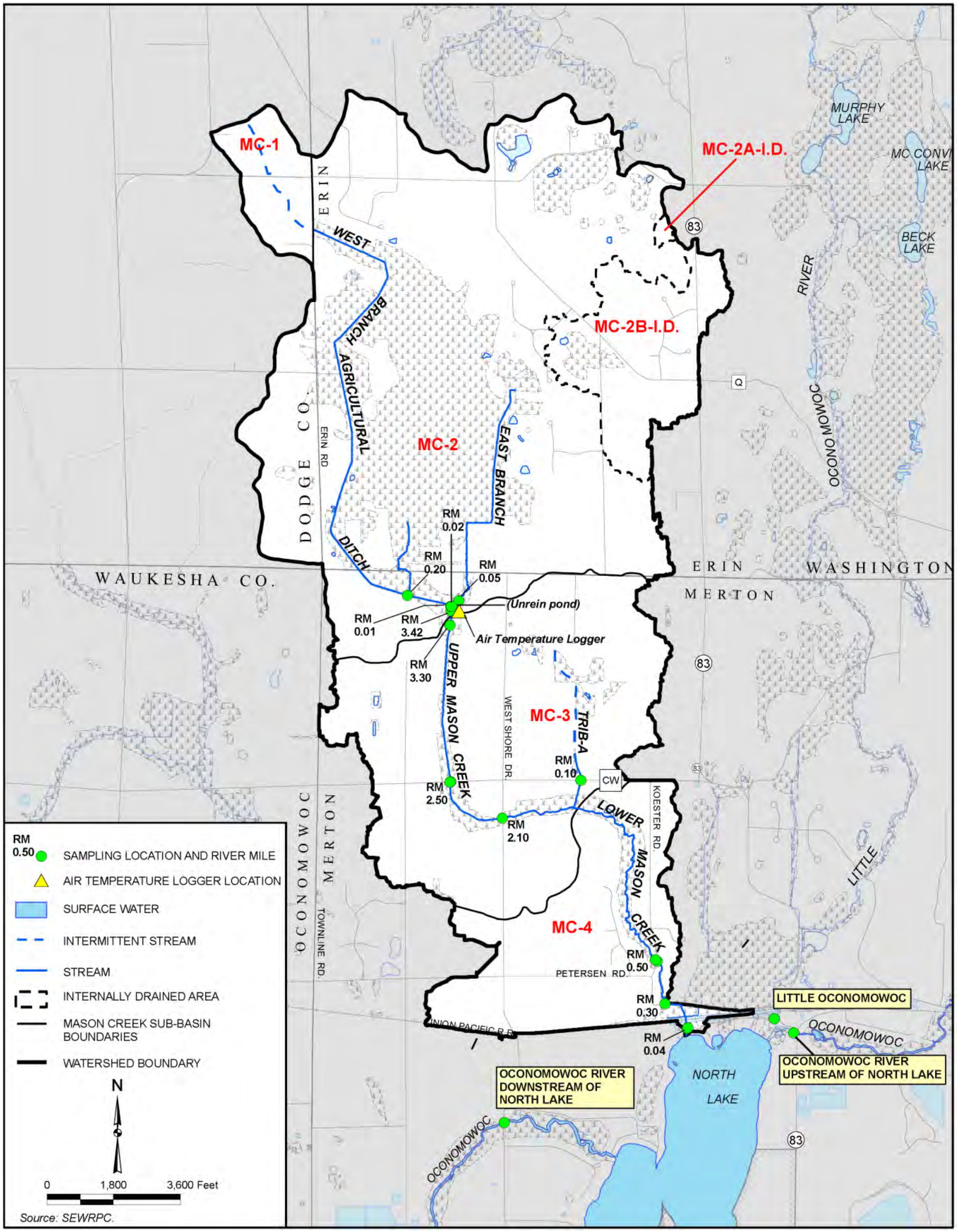
PLANNED SANITARY SEWER SERVICE AREA WITHIN THE MASON CREEK WATERSHED: 2015



Source: SEWRPC.

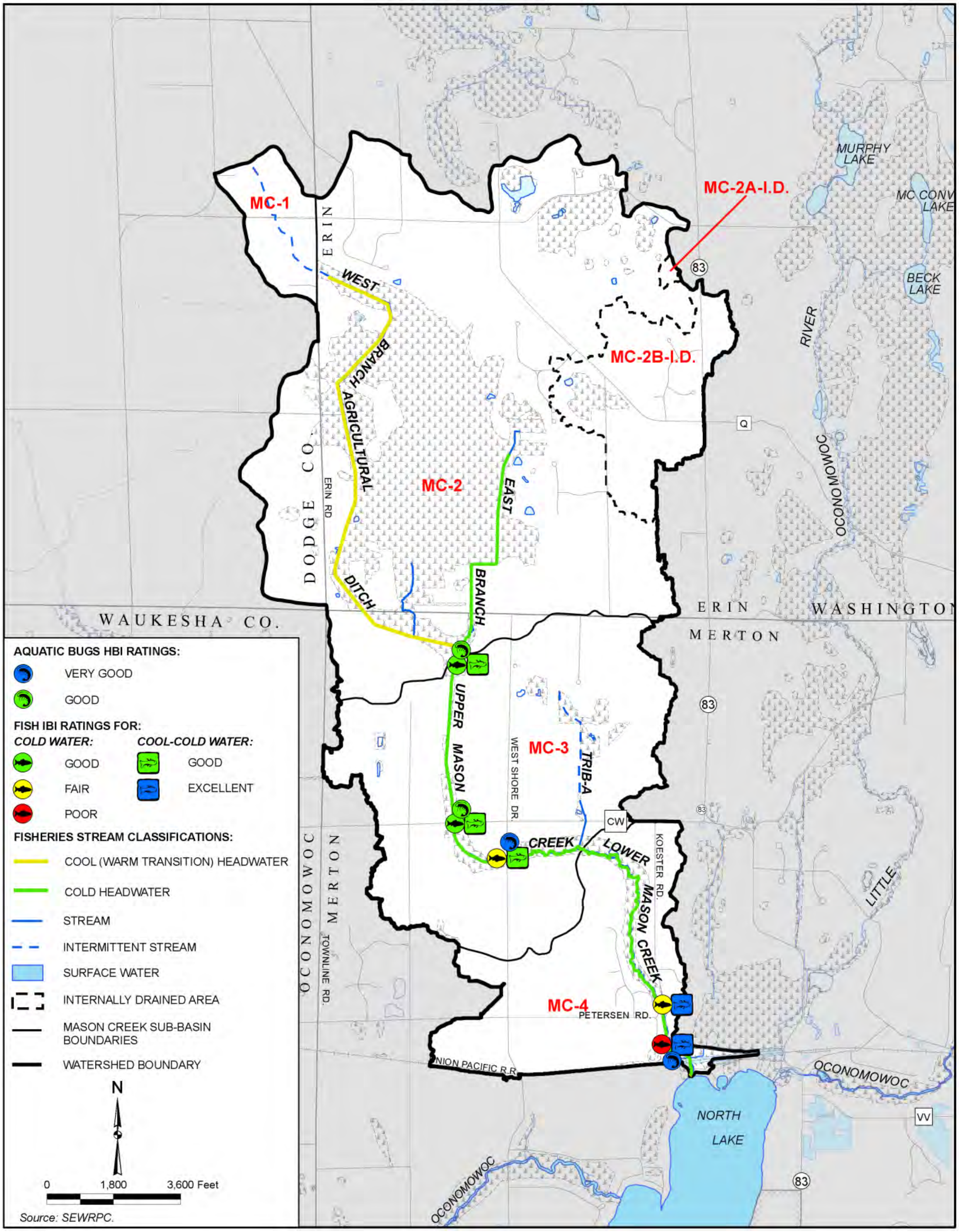
Map II-4

WATER CHEMISTRY AND TEMPERATURE MONITORING STATIONS WITHIN THE MASON CREEK WATERSHED: 2009-2014



Map II-5

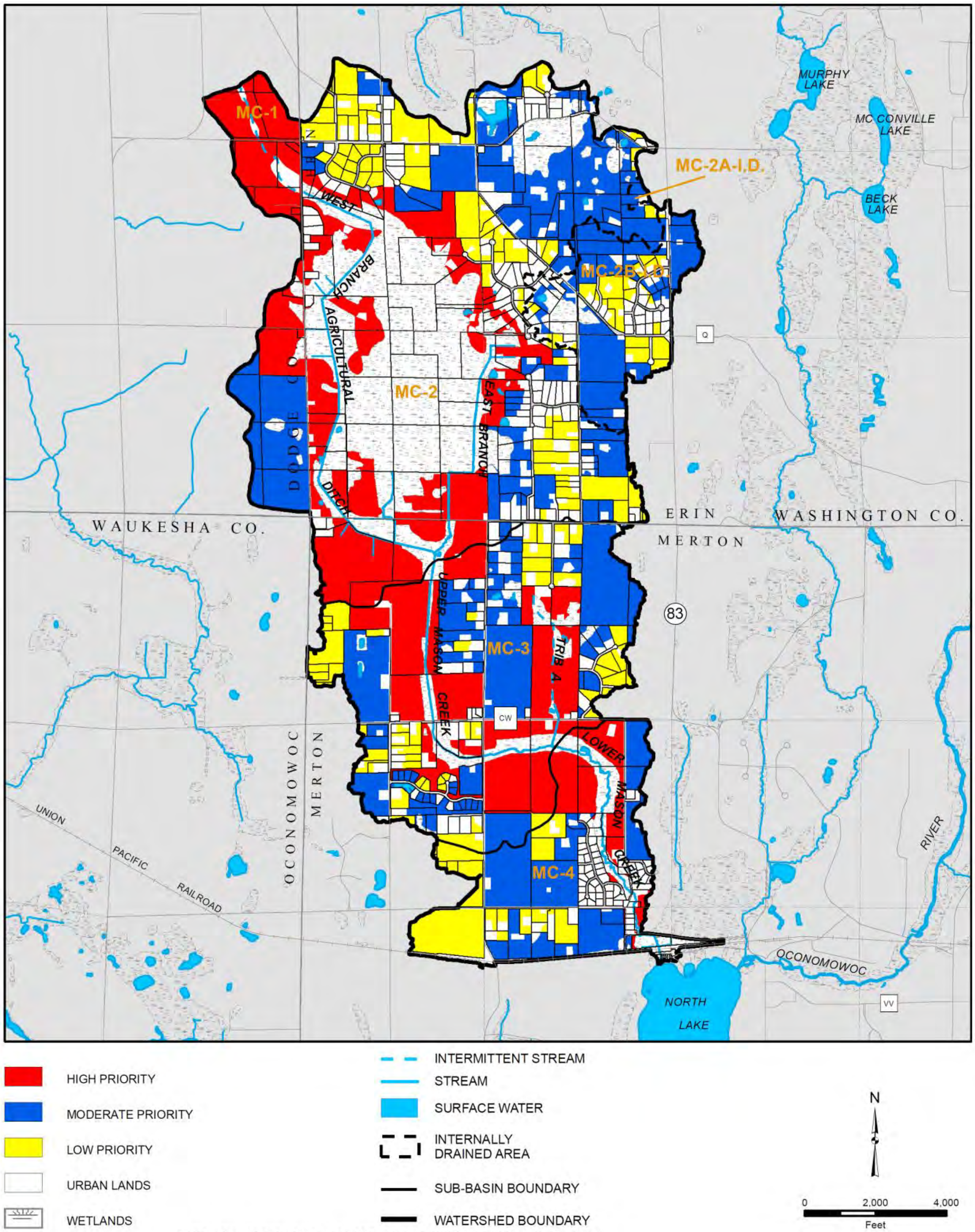
FISH AND AQUATIC BUGS SAMPLING LOCATIONS AND FISHERIES STREAM CLASSIFICATIONS WITHIN THE MASON CREEK WATERSHED: 2008, 2013, AND 2014



Source: SEWRPC.

Map II-6

PRIORITIZATION AMONG PARCELS FOR IMPLEMENTATION OF AGRICULTURAL BMPs WITHIN THE MASON CREEK WATERSHED: 2015

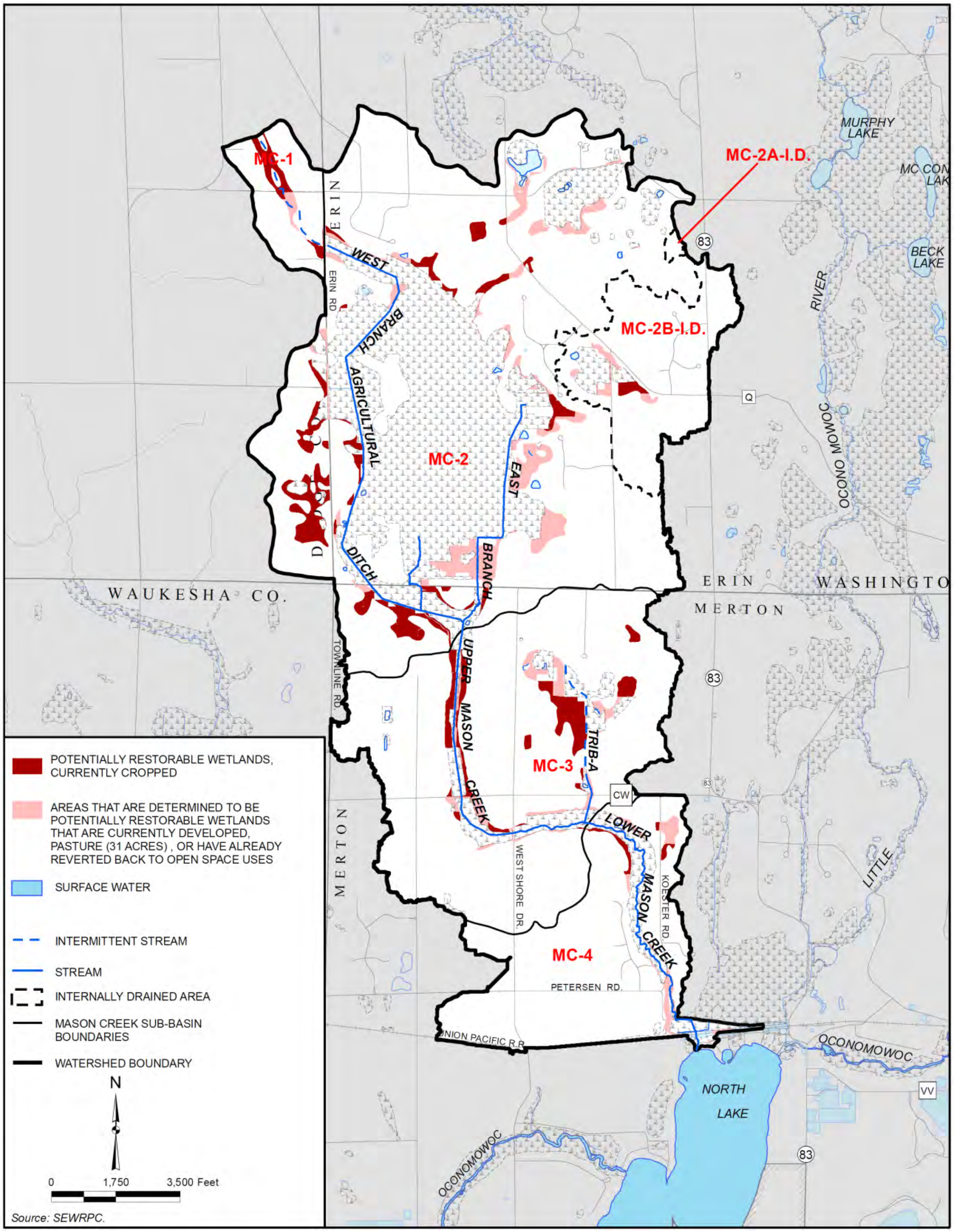


NOTE: SOME AREAS PRIORITIZED FOR IMPLEMENTATION OF AGRICULTURAL BMPS CONSIST OF PLATTED LANDS THAT ARE CURRENTLY FARMED.

Source: SEWRPC

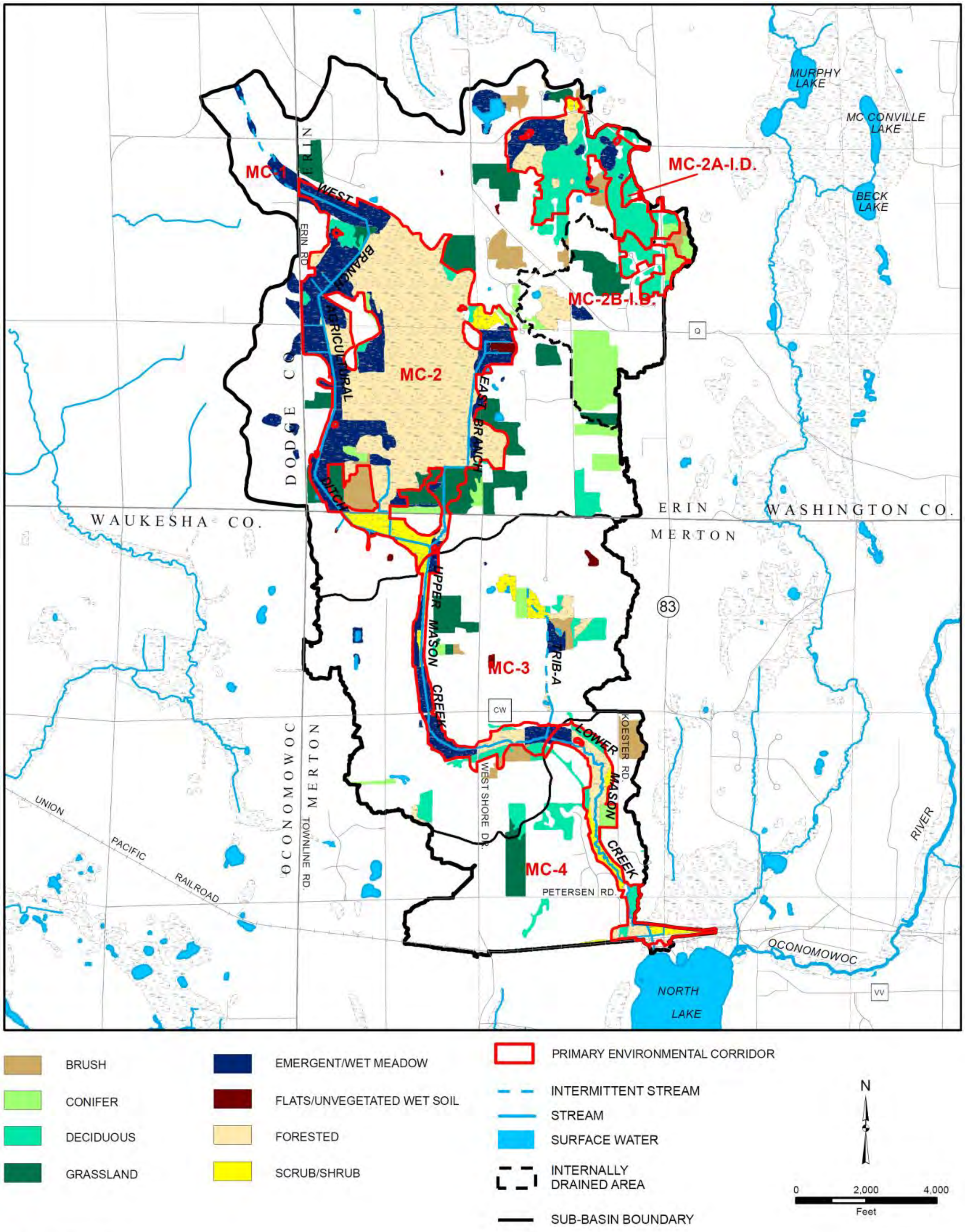
Map II-7

POTENTIALLY RESTORABLE WETLANDS WITHIN THE MASON CREEK WATERSHED: 2015



Map II-8

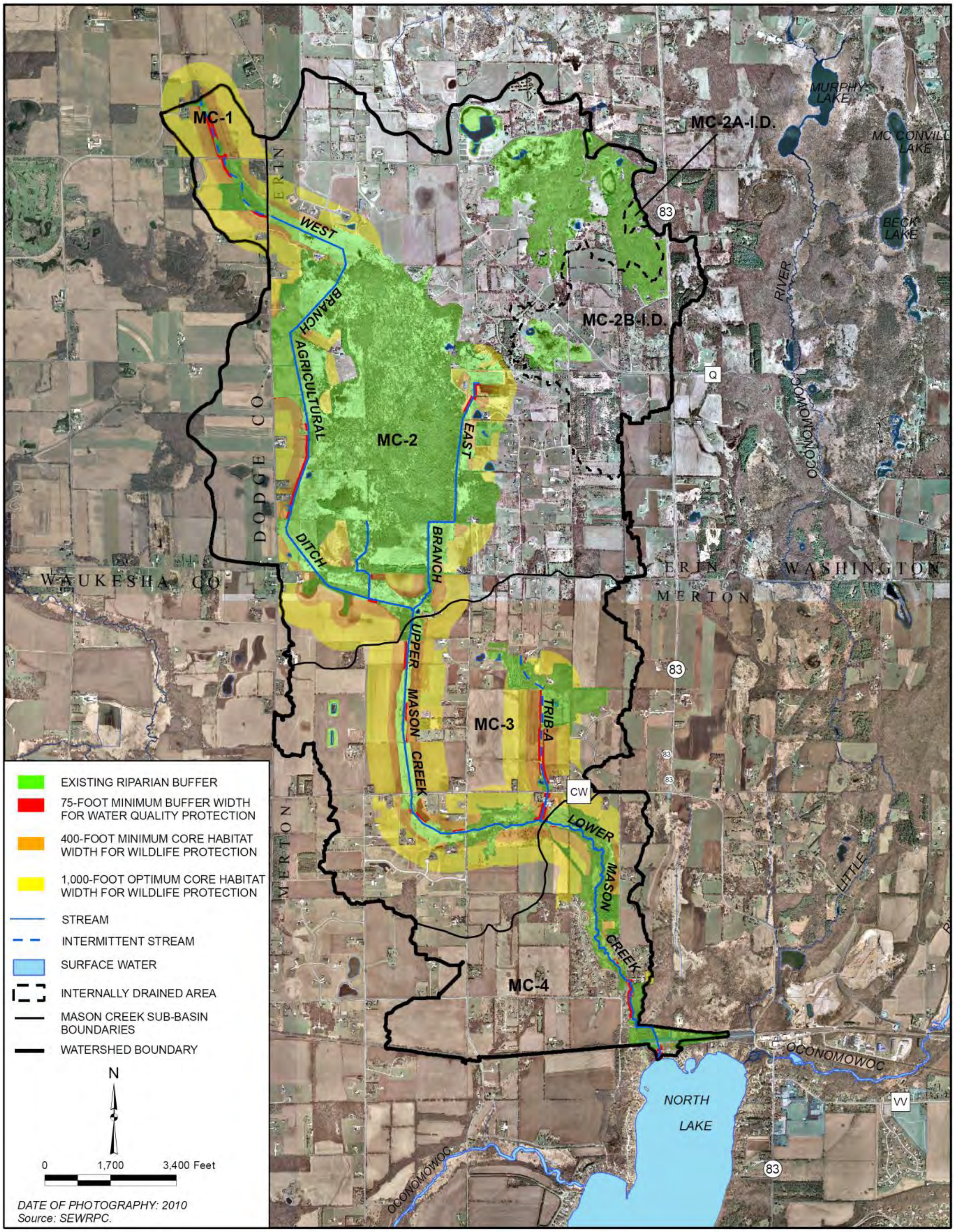
UPLAND AND WETLAND COVER TYPES LOCATED INSIDE AND OUTSIDE OF PRIMARY ENVIRONMENTAL CORRIDOR BOUNDARIES WITHIN THE MASON CREEK WATERSHED: 2010



Source: SEWRPC.

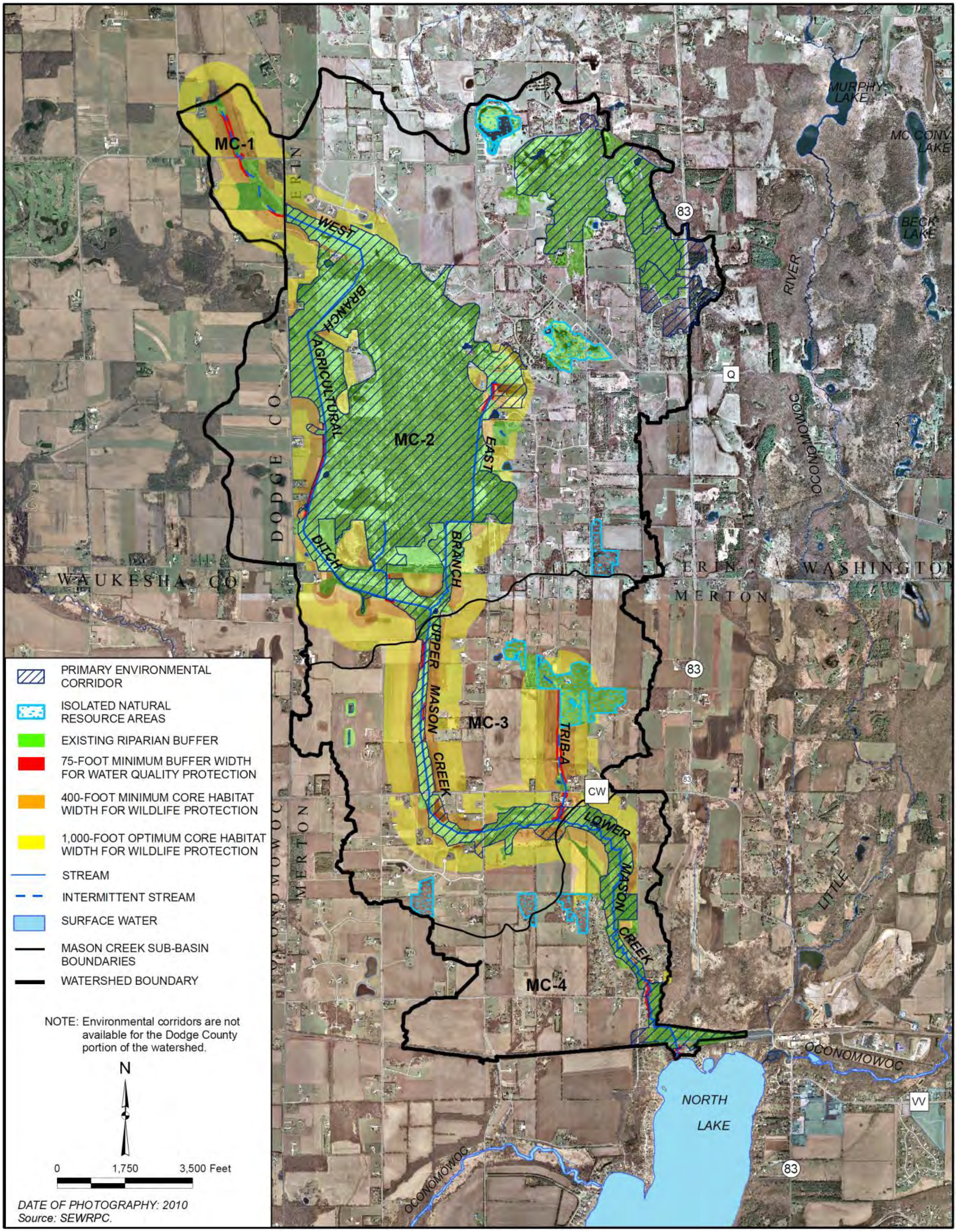
Map II-9

EXISTING RIPARIAN BUFFER AND POTENTIAL BUFFER ZONES WITHIN THE MASON CREEK WATERSHED: 2010



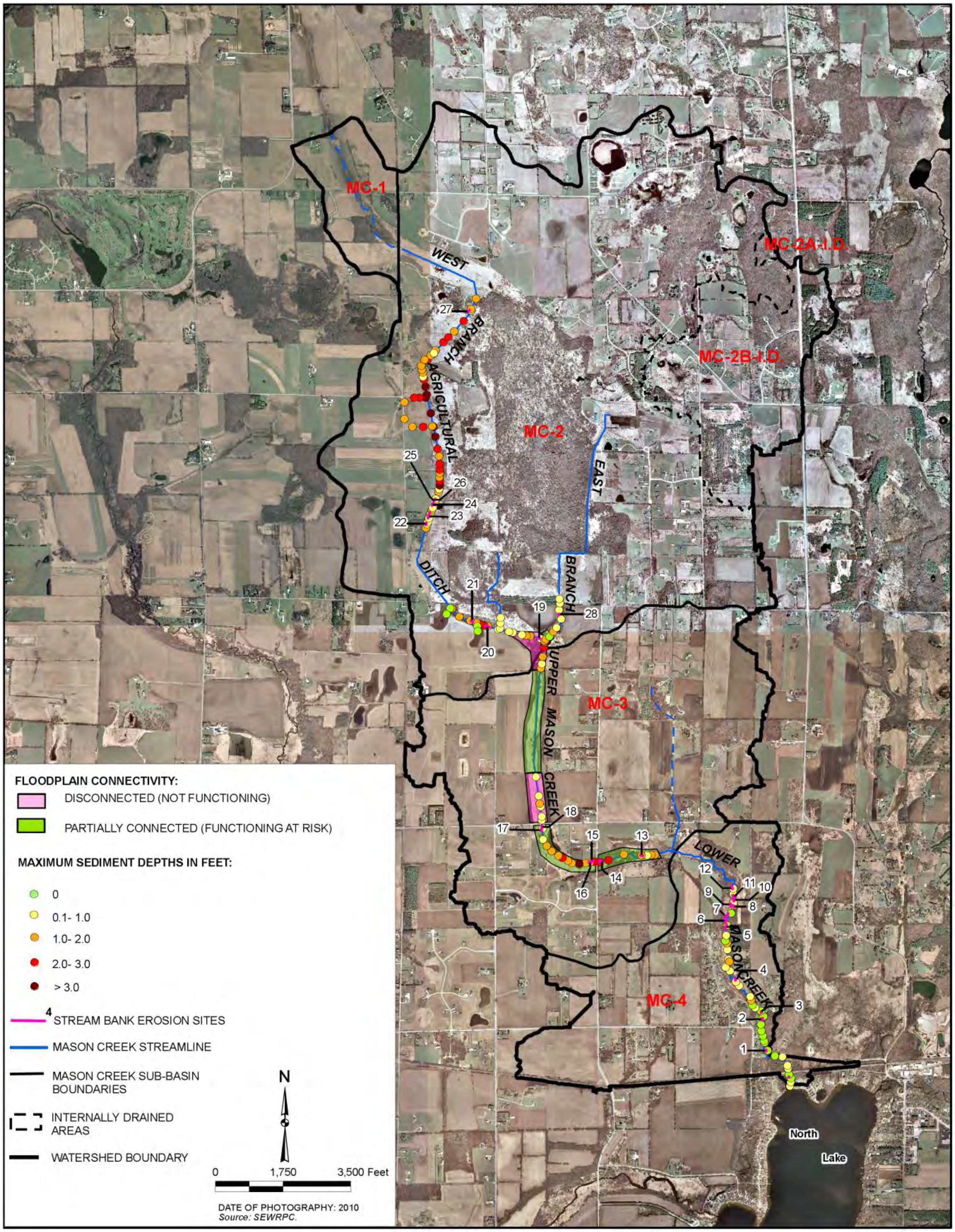
Map II-10

EXISTING RIPARIAN BUFFER AND ENVIRONMENTAL CORRIDORS WITHIN THE MASON CREEK WATERSHED: 2010



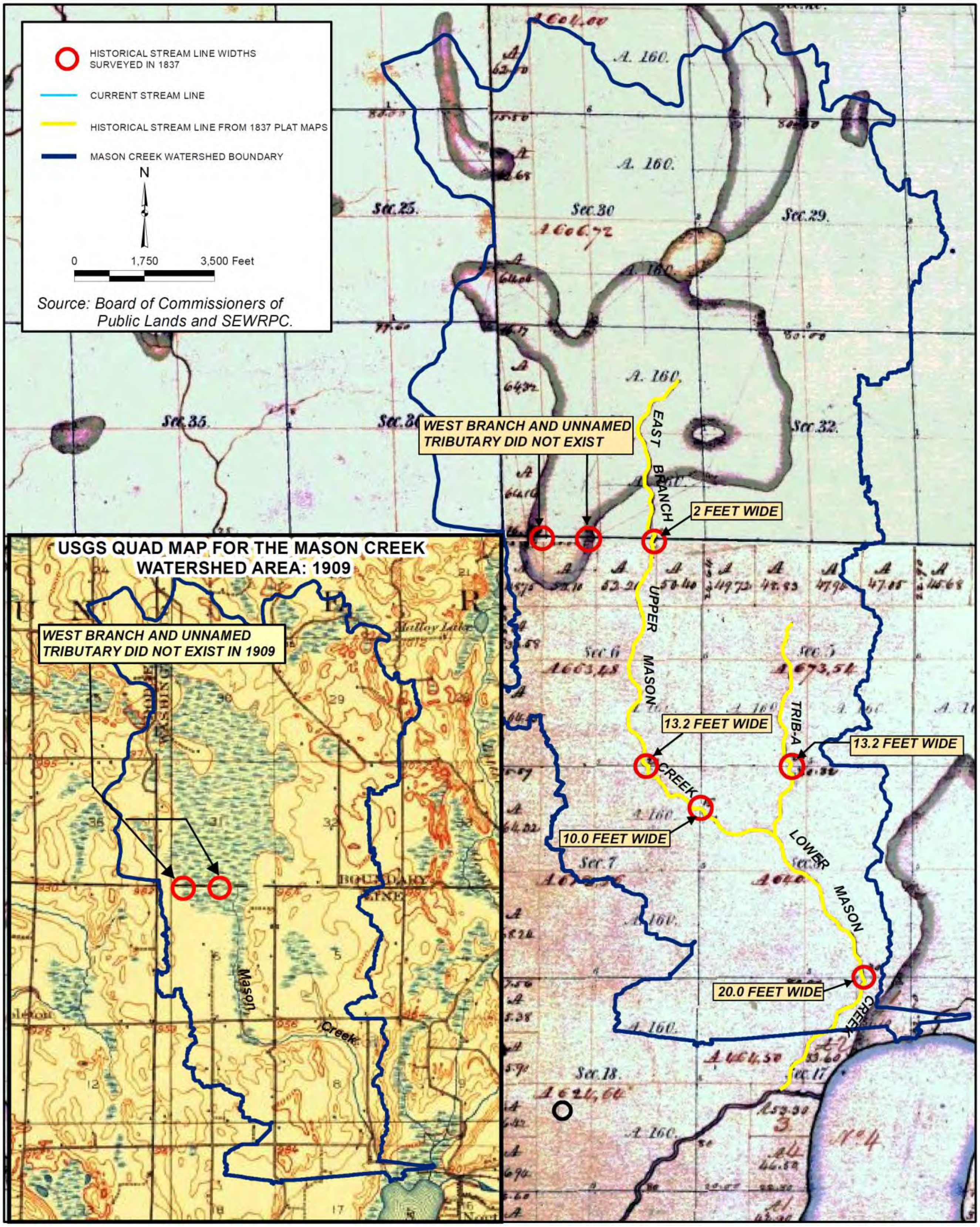
Map II-11

MAXIMUM SEDIMENT DEPTHS, STREAM BANK EROSION SITES, AND FLOODPLAIN CONNECTIVITY WITHIN MASON CREEK: 2014



Map II-12

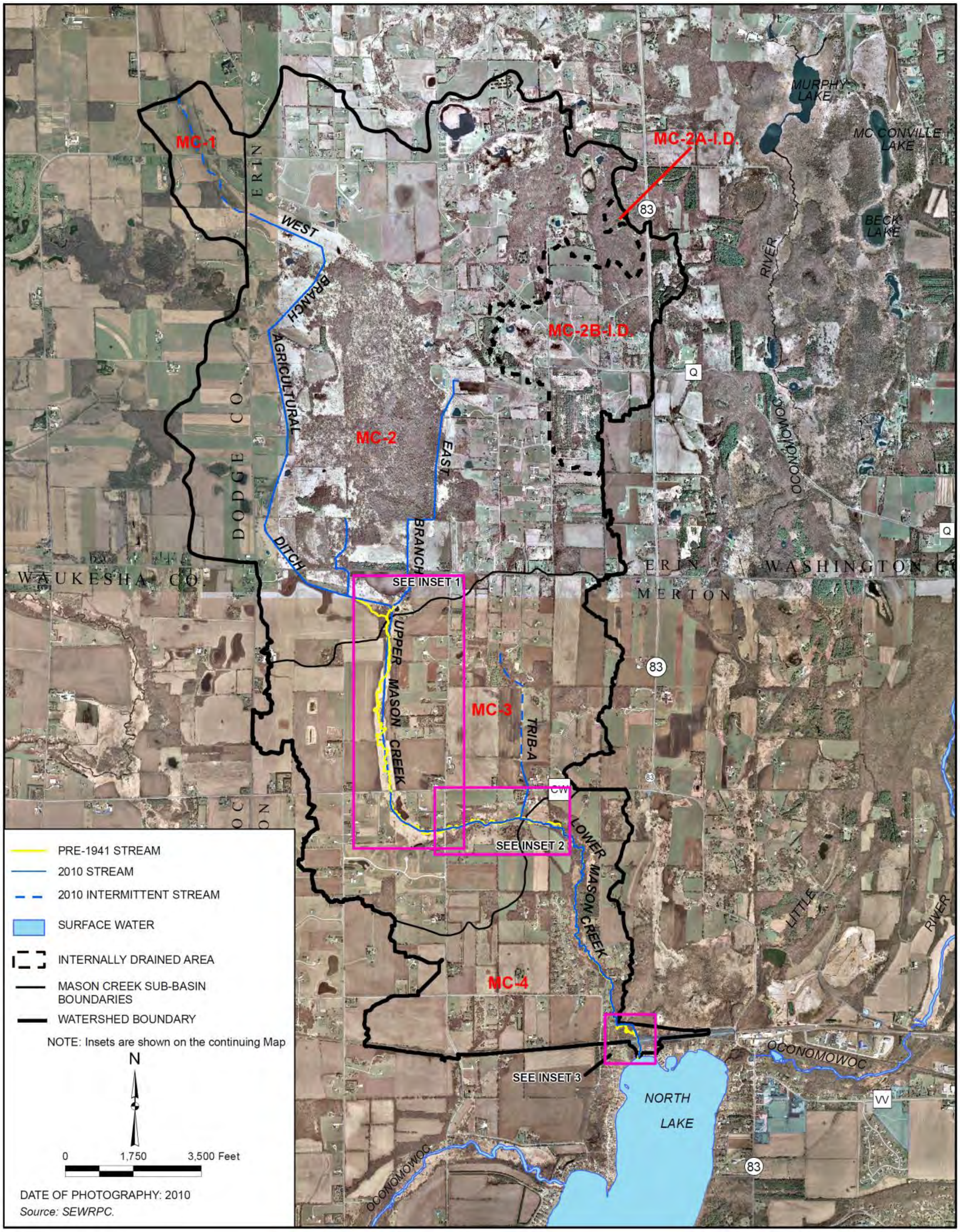
HISTORICAL 1837 PLAT MAP AND 1909 USGS QUAD MAP FOR THE MASON CREEK WATERSHED AREA



PRELIMINARY DRAFT

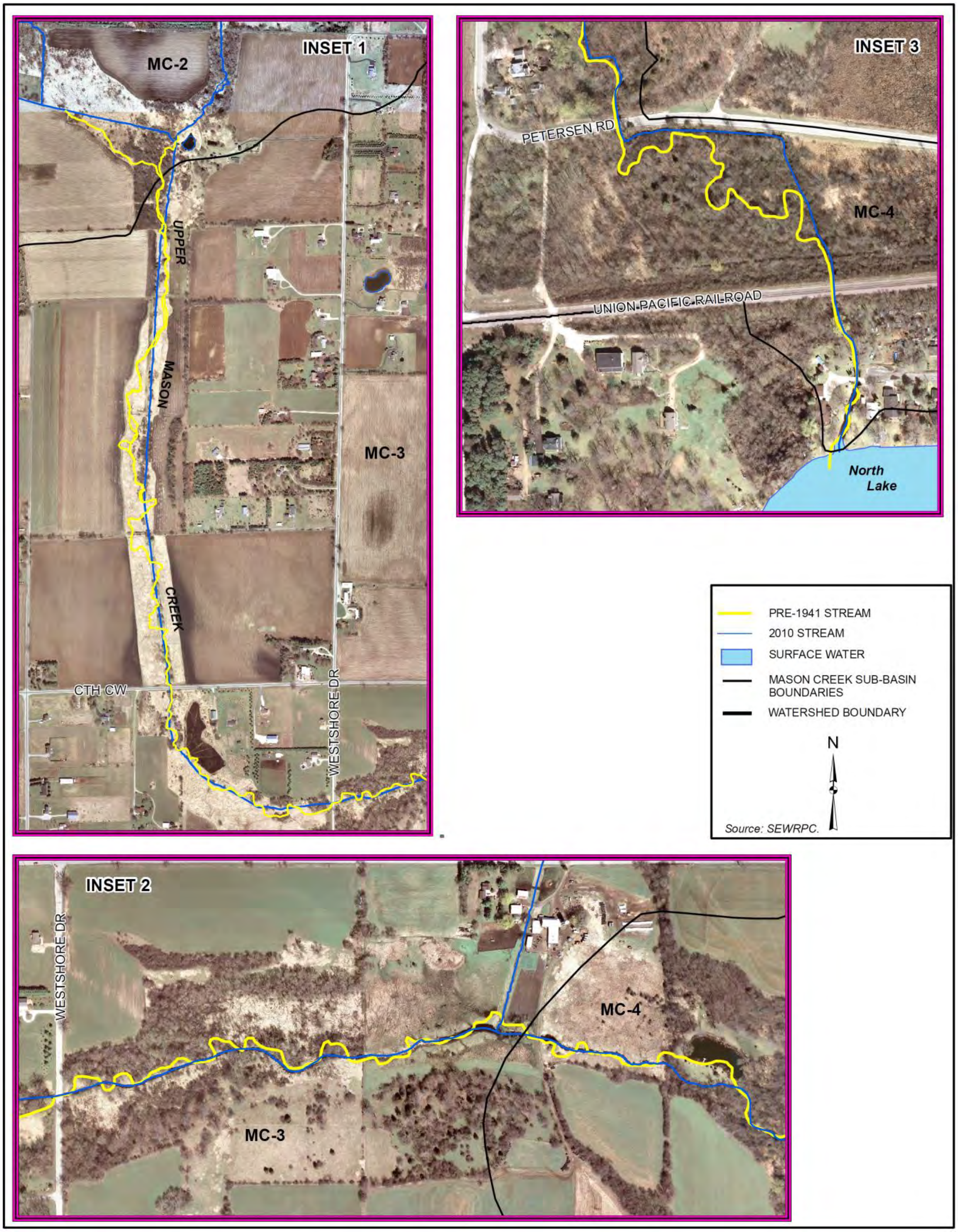
Map II-13

COMPARISON OF HISTORICAL AND CURRENT STREAM CHANNEL CHANGES WITHIN THE MASON CREEK WATERSHED: PRE-1941 VERSUS 2010



Insets 1 through 3 of Map II-13

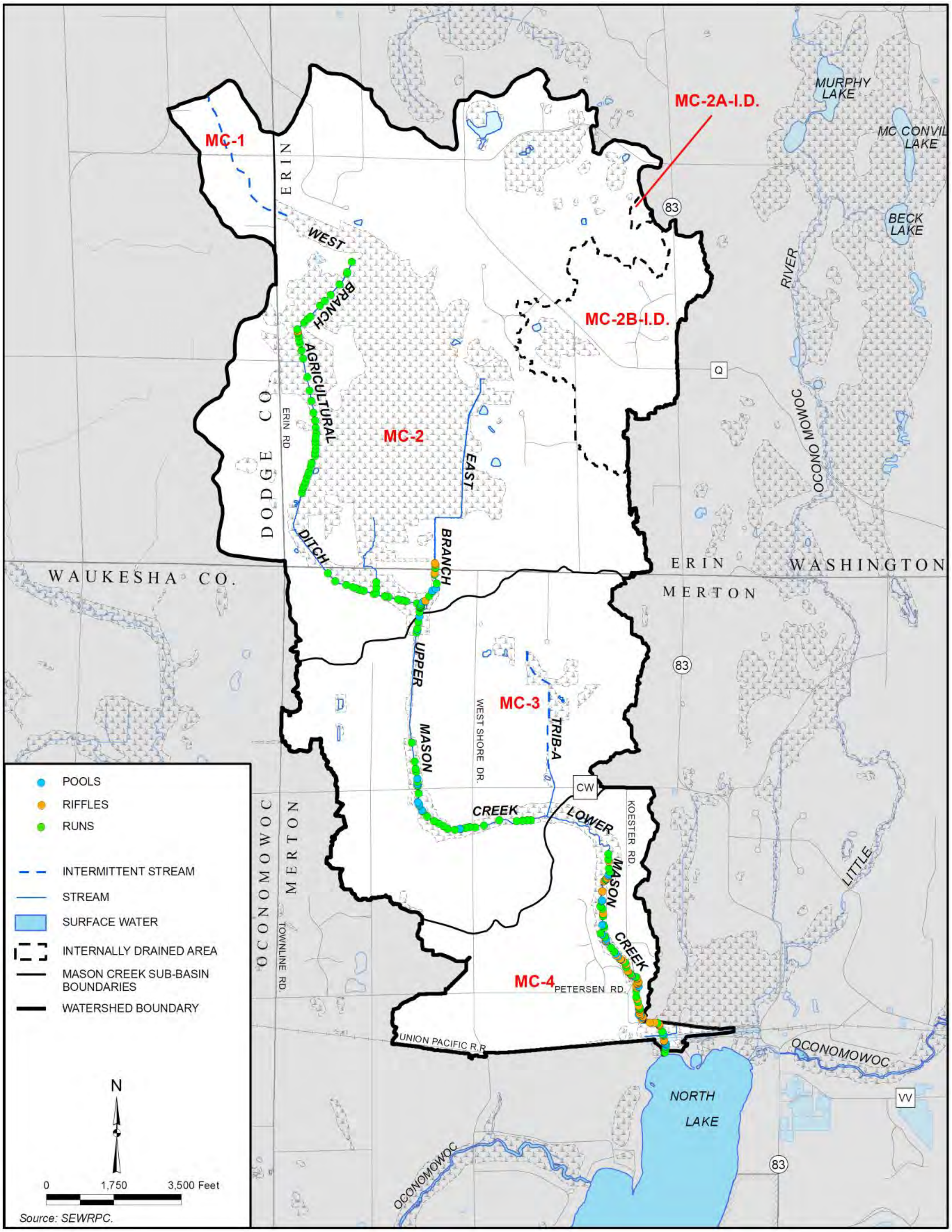
COMPARISON OF HISTORIC AND CURRENT STREAM CHANNEL CHANGES WITHIN THE MASON CREEK WATERSHED: PRE-1941 VERSUS 2010



PRELIMINARY DRAFT

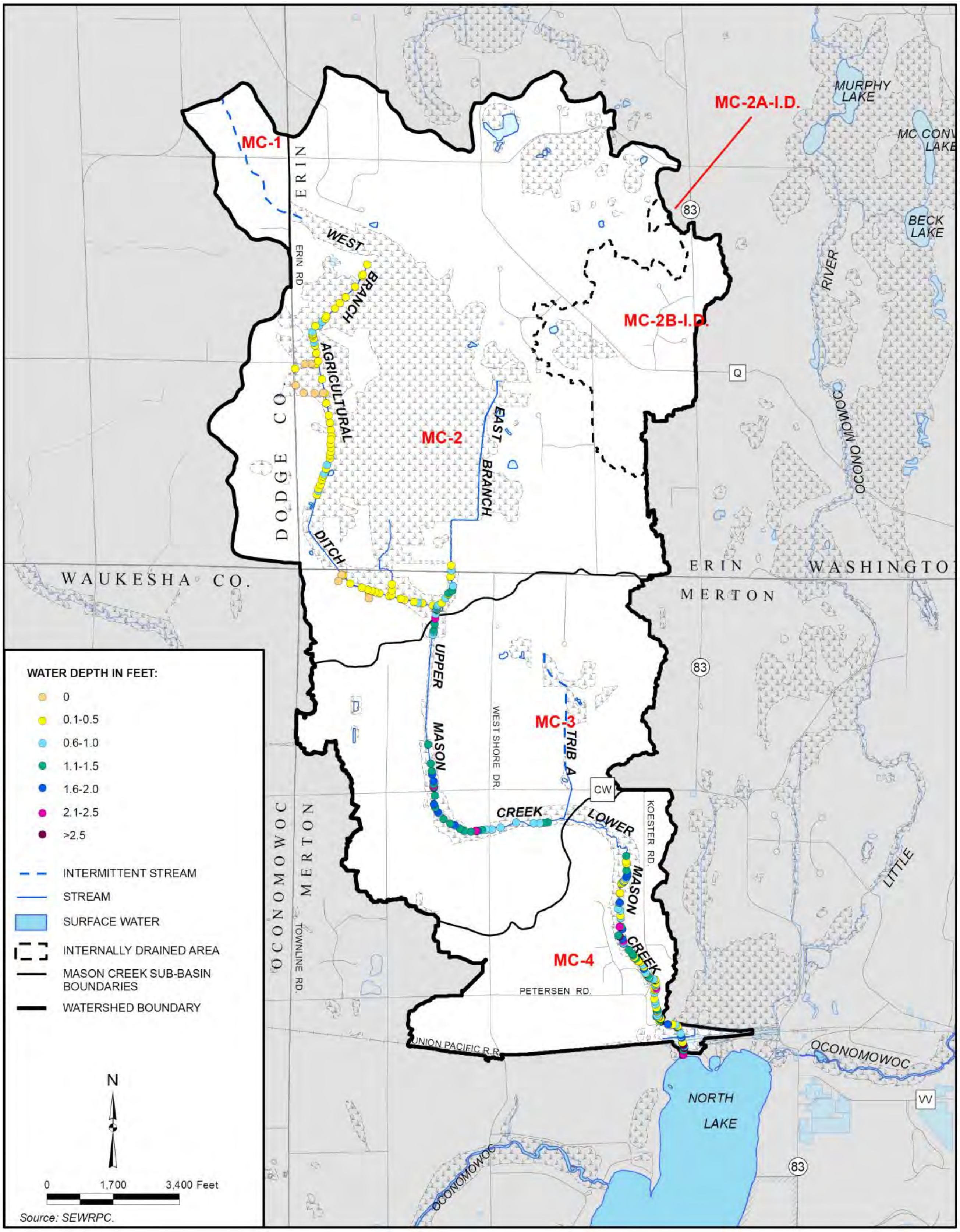
Map II-14

AQUATIC HABITAT TYPES WITHIN THE MASON CREEK WATERSHED: 2014



Map II-15

MAXIMUM WATER DEPTHS MEASURED WITHIN THE MASON CREEK WATERSHED: 2014



Source: SEWRPC.

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10/24/2016, 11/14/2016

SEWRPC Community Assistance Planning Report No. 321

MASON CREEK WATERSHED PROTECTION PLAN

Chapter III

PLAN RECOMMENDATIONS

WATERSHED GOALS AND MANAGEMENT OBJECTIVES, AND PLAN IMPLEMENTATION

This protection plan is designed to serve as a practical guide for the management of water quality within the Mason Creek watershed and for the management of the land surfaces that drain directly and indirectly to the stream and, consequently, to downstream waterbodies, including North Lake, the Oconomowoc River, and ultimately the Rock River. Hence, developing an approach for meeting the pollution load limits established under the Rock River Total Maximum Daily Load (TMDL) study was a major focus of this watershed plan. However, as shown in Table III-1, that focus was only one component of the overall watershed goals and management objectives that were established to address critical issues in the watershed based on watershed inventory results and stakeholder meetings.

This watershed protection plan was prepared in the context of the Southeastern Wisconsin Regional Planning Commission's (SEWRPC) regional water quality management plan,[1] the Oconomowoc River watershed plans,[2] the

[1]*SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan For Southeastern Wisconsin: 2000, Volumes One through Three, *1978-1979. SEWRPC Memorandum Report No. 93, A Regional Water Quality Management Plan For Southeastern Wisconsin: An Update and Status Report, March 1995.*

[2]*City Of Oconomowoc,* Oconomowoc Watershed Protection Program, Waukesha County, Wisconsin, *prepared by Ruekert & Mielke, Inc., February 2016; and, Wisconsin Department of Natural Resources,* A Nonpoint Source Control Plan for the Oconomowoc River Priority Watershed Project, *Publication WR-194-86, 1986.*

North Lake management plans,[3] the County Land and Water Resources Management Plans (LWRMP),[4] the County multi-jurisdictional and comprehensive development plans,[5] and the Rock River watershed plans.[6] Therefore, this plan represents a refinement of these regional, county, and watershed-scale plans and it enables successful implementation of recommendations at a smaller, 8.2-square mile (5,275-acre) watershed scale. In particular, the Washington and Waukesha County Land and Water Resource Management Plans (LWRMP) priority issues, goals, objectives, and implementation work plan elements formed the basis of the recommendations outlined below. Hence, continued implementation and funding to support the County LWRMP work plan elements which support recommendations of this plan for the Mason Creek watershed is critical to the successful implementation of this plan.

The improvements that would result from implementing the recommendations in this plan would represent steps toward achieving the overall goal of restoring and improving the water resources of the Mason Creek watershed consistent with the goals and prioritized water quality issues identified in Tables III-1 and III-2. However, this watershed protection plan goes beyond incorporating recent and ongoing watershed management programs and initiatives. Consequently, the successful implementation of this plan is contingent upon a strategy of community coordination, partnership among stakeholders, and development of farmer-led watershed-based improvements to develop innovative solutions (see "*Engagement Strategy*" section below).

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[3]*SEWRPC Community Assistance Planning Report No. 54,* A Water Quality Management Plan for North Lake, Waukesha County, Wisconsin, *1982; North Lake Management District,* North Lake and Tributary Limnological Survey 2011-2012*, prepared by Jerry Kaster, Aquatic Environmental Consulting, 2012; and, SEWRPC Community Assistance Planning Report No. 315,* A Water Resources Management Plan for the Village of Chenequa, Waukesha County*, Wisconsin, 2014.*

[4]*Washington County Land Conservation Committee,* Washington County Land and Water Resource Management Plan 2011-2020 (2nd Revision), *June 2010; Waukesha County Department of Parks and Land Use Land Resources Division,* Waukesha County Land and Water Resource Management Plan 2012 Update*, January 2012.*

[5] *SEWRPC Community Assistance and Planning Report No. 287,* A Multi-Jurisdictional Comprehensive Plan For Washington County: 2035, *April 2008; and, Waukesha County Department of Parks and Land Use,* A Comprehensive Development Plan for Waukesha County: Waukesha County, Wisconsin, *prepared by the Waukesha County Department of Parks and Land Use, Waukesha County University of Wisconsin-Extension, Waukesha County Municipalities, February 2009.*

[6]*WDNR,* Upper Rock River Basin Areawide Water Quality Management Plan, *Wisconsin Water Quality Management Program, May 1989; WDNR,* Upper Rock River Basin Water Quality Management Plan, A Five-Year Plan to Protect and Enhance our Water Resources, *December 1995; WDNR,* The State of the Rock River Basin, Your River Neighborhood ~ The Rock River Basin, *PUBL # WT-668-2002, April 2002; and, U. S. Environmental Protection Agency (USEPA) and Wisconsin Department of Natural Resources (WDNR),* Total Maximum Daily Loads for Total Phosphorus and Total Suspended Solids in the Rock River Basin: Columbia, Dane, Dodge, Fond du Lac, Green, Green Lake, Jefferson, Rock, Walworth, Washington, and Waukesha Counties, Wisconsin, *July 2011.*

Linking the TMDL to Implementation of Water Quality Improvements

The Rock River TMDL study was approved by the U.S. Environmental Protection Agency (USEPA) and the Wisconsin Department of Natural Resources (WDNR) in 2011,[7] and relied largely on modelled data to quantify pollutant loads and load (unpermitted nonpoint source) and wasteload (permitted point source) allocations. It is important to consider both the TMDL study and additional information obtained since its completion when developing the implementation actions that may improve water quality within the Mason Creek watershed. It should be noted that due to the nature of modeling uncertainty and the fact that agricultural nonpoint source loads are not regulated under the Federal Clean Water Act (CWA), achieving the wasteload allocations contained in the TMDL study would be expected to improve water quality conditions, but would not necessarily result in attainment of the phosphorus and sediment water quality standards in Mason Creek. Although TMDL load and wasteload allocations were used to establish the benchmark goals, the success of the management actions proposed under this plan will be improvements in measured ambient or instream water quality rather than attainment of load and wasteload allocations.

The City of Oconomowoc has identified adaptive management as the preferred compliance alternative to meet its Wisconsin Pollutant Discharge Elimination System (WPDES) permit requirements for its wastewater treatment facility (WWTF) and municipal separate storm sewer system (MS4) under Chapters NR 217, "Effluent Standards and Limitations for Phosphorus," and NR 216, "Storm Water Discharge Permits," respectively, of the *Wisconsin Administrative Code*. The permitted final mass-based limits for total suspended solids (TSS) and total phosphorus (TP) are derived from the Rock River TMDL approved by the USEPA and WDNR in 2011 as mentioned above.[8] The City submitted a preliminary Watershed Adaptive Management Request Form 3200-139 on February 23, 2015, and the WDNR approved their Adaptive Management Plan (AMP) on September 15, 2015. The AMP spans three WPDES permit terms or 15 years, with the understanding that progress must be demonstrated by the beginning of the third term. Under the AMP, a total phosphorus concentration of 0.075 mg/L must be achieved at the confluence of the Rock and Oconomowoc Rivers in the next 15 years. The City has developed the Oconomowoc Watershed Protection Program (see "*Information and Education*" section below for more details),[9] which includes the Mason Creek watershed, to address the AMP and achievement of water quality criteria.

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[7]*USEPA and WDNR, July 2011, op. cit.*

[8]*Ibid.*

[9]*City Of Oconomowoc,* Oconomowoc Watershed Protection Program Report, Waukesha County, Wisconsin, *prepared by Ruekert & Mielke, Inc., February 2016.*

Hence, it is recommended that the local partners within the Mason Creek watershed continue to participate in the ongoing Oconomowoc River watershed adaptive management program as the management actions described within this report are implemented. The management actions discussed in detail in subsequent sections were chosen because it is anticipated that they will have the greatest effect on improving water quality within the Mason Creek watershed and will promote achievement of 1) the load and wasteload allocations specified under the 2011 TMDL study and 2) the objectives of the 2016 Oconomowoc Watershed Protection Program. As actions recommended under this plan are implemented, water quality data are collected, and new information and technology become available, Washington County and Waukesha County and the City of Oconomowoc, in consultation with Federal and State agencies and municipalities and other partners, will evaluate the effectiveness of recommended actions and possibly modify or discontinue actions that are deemed ineffective and implement other actions consistent with the plan objectives.

Linking the TMDL to Stream Restoration

Restoration is not solely applicable to severely degraded streams. Although it can be used as an effective tool to return a degraded system to a pre-disturbance condition, restoration is also an important tool for preventing environmental degradation.[10]

Restoration has been defined in a number of different ways. On the most basic level, restoration is the process of returning a damaged ecosystem to its condition prior to disturbance.[11] The long-term goal of restoration is to imitate an earlier natural, self-sustaining ecosystem that is in equilibrium with the surrounding landscape.[12] A National Research Council report defines restoration as a holistic process:[13]

> *Restoration is … the return of an ecosystem to a close approximation of its condition prior to disturbance. In restoration, ecological damage to the resource is repaired. Both the structure and the functions of the ecosystem are recreated … The goal is to emulate a natural, functioning, self-regulating system that is integrated with the ecological landscape in which it occurs.*

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[10]*USEPA, Ecological Restoration - EPA 841-F-95-007, November 1995, see website http://water.epa.gov/type/watersheds/archives/chap1.cfm*

[11]*Cairns, John, Jr. The status of the theoretical and applied science of restoration ecology.* The Environmental Professional, *Volume 13, pp. 186-194, 1991.*

[12]*Berger, John J. The federal mandate to restore: laws and policies on environmental restoration.* The Environmental Professional, *Volume 13, pp. 195-206, 1991.*

[13]*National Research Council,* Restoration of Aquatic Systems: Science, Technology, and Public Policy, *Washington, D.C., 1992.*

As with other water resource management alternatives, restoration must address questions concerning practicality, predictability of outcomes, and overall effectiveness of specific techniques.[14] Additionally, because ecological systems are complex, and may take years to reach equilibrium or fully demonstrate the effects of restoration and other management activities, seeing or measuring results of restoration efforts may take a long time.

Therefore, under this plan, **ecological restoration is considered as an important tool for preventing environmental degradation and as a means of restoring degraded chemical, physical, and/or biological components of the Mason Creek system to an improved condition**. Strengthening structural or functional elements through restoration can help increase a stream system's tolerance to stressors which lead to environmental degradation. By so doing, water quality and aquatic and terrestrial habitat will be improved, which, in turn, will lead to improvements in the aquatic and terrestrial communities that depend on that water.[15]

This watershed protection plan envisions that restoration techniques be applied as a management action within the context of the Rock River TMDL pollutant load reduction goals as implemented through traditional regulatory actions (such as point source permits) and through voluntary programs (such as implementation of nonpoint source BMPs). Implementation of stream restoration techniques along with regulatory and voluntary actions would contribute to addressing the numeric or narrative water quality criteria and designated water use objectives for Mason Creek. In the context of the TMDL, stream restoration can also address nonattainment of a designated use (e.g., a coldwater fishery) or a narrative criterion that refers explicitly to habitat quality or biological diversity. The recommended management strategy would be to combine point and nonpoint source load reductions and instream ecological restoration techniques. It is important to note that stream restoration is an important and vital pollution reduction strategy to meet TMDL goals for phosphorus and sediment, but stream restoration should not be implemented for the sole purpose of nutrient or sediment reduction in this watershed.[16]

Scope of Restoration

Restoration must consider all sources of stress on a stream and is, therefore, not restricted to instream mitigation of impacts. The health and protection of a waterbody cannot be separated from the watershed ecosystem, and

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[14]*Caldwell, Lynton Keith, "Restoration ecology as public policy,"* The Environmental Professional, *Volume 13, pp. 275-284, 1991.*

[15]*T Travis Brown, Terry L. Derting, and Kenneth Fairbanks, "The Effects of Stream Channelization and Restoration on Mammal Species and Habitat in Riparian Corridors,"* Journal of the Kentucky Academy of Science, *69(1):37-49. 2008*

[16]*Richard Starr, Bill Stack, and Lisa Fraley-McNeal,* "Stream Restoration as a Pollutant Reduction Strategy," *Center for Watershed Protection's 2014 Watershed & Stormwater Management Webcast Series September 10, 2014.*

restoration must address all watershed processes that degrade an ecological system (e.g., sediment loading from eroding gullies or construction sites or increased polluted runoff from impervious areas). The intimate connection of rivers and watersheds is succinctly expressed by Doppelt and others:[17]

> *Most people think of rivers simply as water flowing through a channel. This narrow view fails to capture the actual complexity and diversity of riverine systems, and is one of the reasons for failed policies. In the past 15 years many scientific studies and reports have documented that riverine systems are intimately coupled with and created by the characteristics of their catchment basins, or watersheds. The concept of the watershed includes four-dimensional processes that connect the longitudinal (upstream-downstream), lateral (floodplains-upland), and vertical (hyporheic or groundwater zone-stream channel) dimensions, each differing temporally.*

Therefore, restoration is an integral part of a broad, watershed-based approach for achieving water resource goals. Specifically, restoration is the re-establishment of the chemical, physical, and biological components of an aquatic ecosystem that have been compromised by stressors such as point or nonpoint sources of pollution, habitat degradation, hydromodification (i.e., channelization), and others that are summarized above.

Restoration Techniques

This plan emphasizes and endorses the use of natural restoration techniques. Natural techniques such as stream channel remeandering that restore a system's ability to approach a pre-disturbance condition are distinct from treatment technologies or artificial structures that are inserted into the system. Natural restoration techniques also use materials indigenous to the ecosystem and apply concepts such as natural channel design into the dynamics of a river system in an attempt to create conditions in which ecosystem processes can withstand and diminish the impact of stressors that lead to environmental degradation. **Channelization has been extensive throughout the Mason Creek watershed and that is one of the major determinants of limited instream habitat, water quality, and biological condition impairments—particularly in the West Branch Agricultural Ditch and Upper Mason Creek reaches.** The extensive ditching has disabled this stream system’s ability to capture, store, and process/treat sediment and nutrient loads. Therefore, the only way to restore this system’s hydrologic and hydraulic function and associated sediment transport capacity and streambed stability is to physically reconstruct this wetland/stream complex to its historic configuration. the following two distinct areas are designated for restoration of hydrology, sediment transport, and floodplain connectivity to address the impaired water quality and excessive instream streambed loads and to improve habitat conditions for brook trout and their associated coldwater community assemblages (see Map III-1, Priority Areas 1 through 4):

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[17]*Doppelt, B., M. Scurlock, C. Frissell, and J. Karr.* Entering the Watershed: A New Approach to Save America's River Ecosystems, *The Pacific Rivers Council, Island Press, Washington, DC, and Covelo, CA, 1993.*

West Branch Agricultural Ditch Sediment Retention/Wetland Restoration Improvement Area-Restore this agricultural ditch and associated floodplain area to a wetland/lowland swamp with associated shallow groundwater hydrology.

It is important to note that the West Branch Agricultural Ditch is not a natural stream—it is an excavated agricultural drainage ditch. It has not supported brook trout in the past nor does it currently support trout, which means the lower portion of this reach was improperly designated by WDNR staff as a coldwater trout stream. It was constructed sometime between 1909 and 1937 solely for improvement of agricultural drainage and to collect flow from drain tiles in adjacent farmland. This ditch was primarily constructed through Houghton mucky peat soils (historically part of the Mason Creek Swamp natural area) which are very deep, anoxic, highly flocculent, and easily erodible. Hence, this ditch and associated area is largely responsible for the continued impairments and degraded water quality conditions of Mason Creek in terms of increased temperatures, low dissolved oxygen, and significant sediment and nutrient loads.

Restoration techniques in this area should focus on detaining, capturing, slowing down and/or treating stormwater runoff, increasing dry weather water levels and flow, and preventing chronic upland-sourced sediment and nutrient loads from entering Upper and Lower Mason Creek as well as North Lake. The excessive bedload sediments in the West Branch Agricultural Ditch are recommended to be addressed by installing a series of ditch plugs to restore wetland and hydrology of this area (see Appendix H). Since there is an adopted Federal Emergency Management Agency (FEMA) floodplain delineated along this ditch, it is important that construction of the ditch plugs not increase the one-percent-annual-probability flood elevation. Therefore, a floodplain modeling study would be required to ensure the design of the agricultural ditch plugs will not increase the flood elevation or flood additional existing cropland. In addition, grassed waterways and/or check dams/ditch turnouts are recommended to address bedload sediments in, and stormwater runoff from, gullies and roadway ditches that discharge directly into the West Branch Agricultural Ditch (see Appendix G).

Upper Mason Creek Brook Trout Habitat Restoration Area-Restore this stream to approximate its original channel alignment, location, slope, sinuosity, pool-riffle structure, and floodplain connectivity, including improving fish passage.

Despite having more than 70 years to recover from channelization that occurred prior to 1941, this reach has not been able to redevelop more natural or appropriate sinuosities, pool-riffle structure, or sediment transport capabilities. The ditching in this reach has created conditions for excessive sediment bedload that is contributing to the impairment of Mason Creek and North Lake. Therefore, it is obvious that, due to the low slopes or energies within this stream system, the only way to restore stream function within this system is to reconstruct it. Recent research has revealed that channelized streams have the negative effect of minimizing water residence time and biological nutrient processing, which can be mitigated by restoring floodplain connectivity to reduce pollutant loads and improve metabolism in agricultural streams. The benefits of floodplain restoration are most apparent during high flow events (during inundation) and floodplains are more effective at assimilating nutrients when the floodplains are vegetated with appropriate native plants. Hence, improving the floodplain connectivity will help Mason Creek reduce and manage pollutant runoff and be more resilient. Reconstructing meanders or restoring a more natural sinuosity, particularly in low-gradient systems like Mason Creek, is one of the most effective ways to restore instream habitat and the ability of this system to transport sediment and to function more like a healthy river system. **However, since the upstream West Branch Agricultural Ditch reach is delivering sediment into downstream reaches, it is critical to note that sediment bedload prevention/mitigation should be completed in the most upstream West Branch Agricultural Ditch and associated drainage ditches before remeandering of the Upper Mason Creek reach. This approach would also address the worst condition reach first (see "*Maintain and Restore Instream Habitat*" section below for more details).**

Restoration techniques in this area should focus on improving floodplain connectivity and pool-riffle structure combined with wetland restoration in an effort to capture, detain, slow down, and treat stormwater runoff; increase dry weather flow; and prevent chronic sediment and nutrient loads from entering Mason Creek. The excessive bedload sediments in this reach are recommended to be addressed by abandoning these ditched areas and reconstructing a new channel alignment (see Figure II-39). In particular, the highest priorities or best locations to restore the historical stream alignment are where the original channel lengths that were cut off during channel straightening still exist. The bankfull width and depth dimensions discussed above and shown in Figure II-37 should be applied as part of the stream restoration design parameters and goals for Upper Mason Creek (see also Appendix I). In addition, the historical stream channel alignment of pre-1941 conditions (see Map III-1, Priority Areas 2 through 4) should be used to approximate the appropriate design parameters and goals for slope, sinuosity, and belt width; radius of curvature of the bends; and location and distribution of low flow pool, riffle, and run habitat dimensions.

This plan recommends a comprehensive watershed perspective for restoration that considers interactions among stressors in developing effective long-term solutions. To facilitate the assessment and development of management strategies, three zones have been identified for categorizing stressors and restoration strategies and associated management activities. In actuality, however, the zones below are broadly connected ecologically.

- The instream zone is generally the area that contains the stream's non-peak flows. Instream techniques are applied directly in the stream channel (e.g., channel reconfiguration and realignment to restore geometry, meanders, sinuosity, substrate composition, structural complexity, re-aeration, or streambank stability).

- The riparian corridor includes the stream channel and also extends some distance out from the water's edge and its extent can vary based on differences in local topography, stream bottom, soil type, water quality, ground elevation, and surrounding vegetation. Riparian techniques are applied outside of the stream channel in the riparian corridor (e.g., re-establishing vegetative canopy, increasing the width of riparian corridor, or restoring cropland to wetland and/or upland habitat).

- The upland zone consists of those areas beyond the riparian corridor within a stream's watershed that generate nonpoint source runoff to the stream and whose infiltration and topographic characteristics control stream hydrology. Upland, or surrounding watershed, techniques (e.g., agricultural and urban best management practices or BMPs) are generally related to the control of nonpoint source inputs from the watershed, including runoff characteristics from increased imperviousness of the watershed.

Stream restoration can be a mosaic of instream, riparian, and upland techniques, including BMPs, to be used in combination to eliminate or reduce the impact of stressors (both chemical and nonchemical) on aquatic ecosystems and reverse the degradation and loss of ecosystem functions. Instream restoration practices often need to be accompanied by techniques in the riparian area and/or the surrounding watershed. For example, restoration may involve rebuilding the infrastructure of a stream system (e.g., reconfiguration of channel morphology, re-establishment of riffle substrates, re-establishment of riparian vegetation, and stabilization of streambanks, accompanied by control of excess sediment and chemical loadings within the watershed) to achieve and maintain stream integrity.

Balancing and integrating instream, riparian, and surrounding watershed approaches is essential. A restoration plan could involve a combination of techniques, depending on environmental conditions and stressors to be addressed. Instream and riparian techniques directly restore the integrity of stream habitat, whereas surrounding watershed techniques focus on the elimination or mitigation of sources of stressors that cause the habitat degradation. Because techniques applied in the surrounding watershed tend to facilitate a system's ability to restore itself, instream techniques may not always be necessary. However, if instream and/or riparian techniques are selected to restore the integrity of the physical habitat, measures that eliminate or mitigate sources of stressors that caused the degradation should also be included; otherwise, the restoration effort may fail. Therefore, surrounding watershed techniques should, as a general rule, be considered prior to or in conjunction with the use of instream and riparian techniques. Because many projects need to address both causes and symptoms of stream degradation, combining instream, riparian, and surrounding watershed approaches is often appropriate and is recommended under this watershed plan for Mason Creek.

Stream Functions Pyramid - A Tool for Assessing Success of Stream Restoration Projects

The USEPA and the U.S. Fish and Wildlife Service developed a function-based framework for stream restoration goals, performance standards, and standard operating procedures.[18] The framework consists of the stream functions pyramid, a five-level, hierarchical framework that categorizes stream functions and the parameters that describe those functions as shown in Figure III-1.

Stream restoration practitioners have long sought an adequate way to determine the success of restoration projects. Part of the problem lies in failure to link stream restoration with the restoration of stream function. For example, many restoration project goals fail to recognize the full range of stream functions and how they support each other.[19]

The difference in the pre-restoration functional condition and the post restoration functional condition is known as functional lift. The functional lift can be used to quantify the overall benefit of any proposed stream restoration project or to develop stream mitigation credits.

The stream functions pyramid provides a framework for assessing stream functions, setting design goals, and evaluating performance. The pyramid shows that restoration of functions must occur in a certain order for maximum functional lift to occur, but it is important to note that there is an iterative process among these levels over time while working towards achieving the desired goals and adjusting as necessary.

Hydrology functions create the base of the pyramid. These functions determine how much water is produced by the watershed and include measures such as the rainfall-runoff relationship and bankfull discharge determination. Hydraulic functions are shown above hydrology functions and describe the flow dynamics in the channel and floodplain where floodplain connectivity and flow dynamics are critical measures. Geomorphic functions are next and integrate the hydrology and hydraulic functions to transport sediment and create diverse bed forms.

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[18]*Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012.* A Function-Based Framework for Stream Assessment and Restoration Projects. *US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC EPA 843-K-12-006; Fischenich, J.C.*, Functional objectives for stream restoration, *EMRRP Technical Notes Collection (ERDC TN-EMRRP-SR-52). Vicksburg, MS: U.S. Army Engineer Research and Development Center, 2006, www.wes.army.mil/el/emrrp*

[19]*Federal mitigation guidelines already require stream restoration practitioners to determine the functional improvement of their project.*

Once this structure is in place, physiochemical functions can improve, including increased dissolved oxygen, lower stream temperature, denitrification, and organic processing. The biological functions are at the top of the pyramid because they rely on all of the other functions. The biological functions include the life cycles of fish and macroinvertebrates and riparian conditions.

The stream functions pyramid helps practitioners set goals to ensure that the design addresses the appropriate functions. Research has shown that many assessment protocols and project designs ignore the base level functions of hydrology, hydraulics, and geomorphology. Conversely, it is not always obvious or understood that land use practices or implementation of agricultural or urban BMPs are actually a form of stream restoration, which is a major component of a comprehensive approach to watershed management.

Hence, it is recommended that this hierarchical framework and associated functional lift be used to help guide project implementation in setting design goals and evaluating performance for the Mason Creek watershed. For example, as previously mentioned, two of the major goals of this watershed plan are to improve water quality by reducing phosphorus and sediment loads from adjacent land uses (i.e., functional levels 1-4) and to improve fisheries and habitat to increase the abundance and diversity of a native coldwater brook trout fishery (i.e., functional levels 1-5). In addition, the pyramid can be used to design monitoring plans that quantify functional lift by using the baseline functional capacity of the stream corridor as summarized in the sections above concerning the hydrology, hydraulics, geomorphology, physicochemical, and biological parameters and reference conditions throughout the watershed. Figure III-1 illustrates the relationships between function-based parameters and the five levels of the functional categories and their interdependence. The design should focus on improving impaired functions, rather than just focusing on channel form (i.e., channel dimension, pattern, and profile). Monitoring can then quantify the improvement or lift in each of those functions.[20] Inherent in the achievement of these water quality and fishery goals will be a concomitant improvement in other dimensions and goals of this plan that include recreation, economic development, property values, quality of life, and aesthetics.

MANAGEMENT MEASURES IMPLEMENTATION

The Mason Creek watershed plan presents recommended management measures needed over the next 10 years to improve and/or restore the hydrologic, hydraulic, geomorphologic, physiochemical, and biological functions of this system as summarized in Table III-1. The plan indicates 1) a timeline for when specific practices and projects, referred to as targeted management measures, should be completed; 2) estimated costs for practice and project implementation, 3) agencies responsible for implementation to meet targeted load reductions for the TMDL, and 4)

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[20]*Richard Starr, US Fish and Wildlife Service, Chesapeake Bay Field Office, see website http://www.fws.gov/chesapeakebay/Newsletter/Fall11/Pyramid/Pyramid.html*

general management measures to meet the goals and management objectives of this plan. This chapter includes an information and education component to incorporate recent and ongoing watershed management programs and initiatives, information on potential funding sources, and recommendations for measuring and assessing implementation success.

Consistent with the CWA, the plan is designed to address the physical, chemical, and biological health of the watershed and its water resources. The plan recommendations are divided into four main management objectives (see Table III-1) that include:

- To reduce the loads of sediment and phosphorus from upland sources to improve water quality and enhance and restore stream form and function;
- Reduce the volume and velocity of runoff from upland areas to streams, increase soil infiltration, and protect groundwater recharge;
- Maintain and expand wetland, fish, and wildlife habitats and populations; and,
- Increase public awareness of water quality issues and participation in watershed conservation activities.

These recommendations provide guidance for the management of the water resources within the watershed with respect to a variety of general and specific factors and issues that contribute to the problems related to impairing the hydrologic, hydraulic, geomorphologic, physiochemical, and biological functions of Mason Creek as detailed in Chapter II. While the presentation of recommendations is organized according to the four main management objective sections below, the implementation of many of these recommendations will also have beneficial effects among multiple dimensions of stream function as demonstrated in Figure III-1. Hence, it is important to keep in mind that the stream functions pyramid provides a framework to assess stream functions, set design goals, and evaluate performance. The pyramid shows that restoration of functions must occur in a certain order for maximum functional lift (improvement) to occur, and that there is an iterative process among these levels over time while working towards achieving the desired goals and adjusting management actions as necessary for the 10-year timeframe and beyond. This iterative process is described in the *Information and Education* and the *Measuring Plan Progress and Success* subsections below.

Recommended Actions Associated with Management Objective to Reduce the Loads of Sediment and Phosphorus from Upland Sources to Improve Water Quality and to Enhance and Restore Stream Form and Function

Rural nonpoint runoff is the greatest source of pollutant loads, and potential load reductions, within the Mason Creek watershed, thus, the majority of the targeted management measures are focused on cropland best management practices (BMPs) as shown in Table III-3. Specifically, targeted cropland BMPs recommended in this watershed include use of cover crops and no till practices, increased implementation of nutrient management plans, and expansion of potentially restorable wetlands and riparian buffers. Installation of grassed waterways was also identified as having potential to reduce pollutant loads in this system. Streambank erosion sites were identified and prioritized, but not determined to be a significant source of pollutants to Mason Creek. However, one severe streambank erosion site was recommended to be addressed and other sites were recommended to be monitored and addressed if they become worse. In contrast, streambed load was found to be a significant source of sediment and impairment within Mason Creek, particularly in the West Branch Agricultural Ditch and Upper Mason Creek reaches, and addressing these problems areas would immediately improve water quality as well as enhance instream fisheries habitat and wildlife (see "*Maintain and Restore Instream Habitat*" section below for more details).

Existing runoff management standards have been established by the State of Wisconsin. Chapter NR 151, "Runoff Management," of the *Wisconsin Administrative Code* provides runoff management standards and prohibitions for agriculture. However, experience in the State has indicated that a combination of regulation and informed local decision making by landowners/operators is needed to achieve water quality improvements consistent with the attainment of water quality standards and criteria.[21] Although this plan recognizes the importance of continued funding and staff to ensure adherence to State and local standards, it goes beyond reliance on regulation and enforcement. This plan's focused strategy is to rely on empowered local decision makers crafting unique solutions that work for the Mason Creek watershed in an effort to ultimately exceed compliance standards. This strategy is designed to augment ongoing programs such as the City of Oconomowoc's Adaptive Management Program and the work of Washington County and Waukesha County staff in working with landowners and operators to implement innovative and effective conservation practices continued through collaboration amongst the County, State, and Federal agencies (see *Information and Education* section below). Implementation of practices that promote improved nutrient management and BMPs to reduce runoff and soil loss, that promote improved soil health, and that provide and protect natural habitats for wildlife, will insure that farming will remain a viable way of life for many years to come within this watershed.

Point Source Pollution

As summarized in Chapter II, the Town of Merton is the only designated MS4 community in the watershed. The permit requires the Town to reduce polluted stormwater runoff to meet the targeted TMDL wasteload allocations by implementing stormwater management programs with best management practices. Waukesha County is currently designated as an MS4, but there are no County facilities covered under that permit that are located within the Mason Creek watershed. Nonetheless, the Town of Merton entered into an intergovernmental agreement with the County for stormwater management planning in March 2008. The Town and County work cooperatively to

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[21]*The Minnesota Pollution Control, Wisconsin Department of Natural Resources, and The St. Croix Basin Water Resources Planning Team*, Implementation Plan for the Lake St. Croix Nutrient Total Maximum Daily Load, *prepared by LimnoTech, February 2013.*

create urban stormwater public education messages, and to develop and enforce construction and post-construction site pollution control ordinances.

Targeted Load Reductions

Pollution load reductions for upland BMPs, gullies, and streambanks were estimated using the USEPA Spreadsheet Tool for Estimating Pollutant Loading (STEPL) as shown in Table III-4. Based upon the Rock River TMDL model agricultural baseline loading for Mason Creek (model Reach 24), **load reductions for the Mason Creek watershed need to meet or exceed 92 percent (5,355 lbs) for Total Phosphorus (TP) and 93 percent (883 tons) for Total Suspended Sediment (TSS) from the median annual nonpoint baseline load as shown in Table II-4.**

Based upon prior agricultural BMPs applied to cropland, gully stabilization, and riparian buffers implemented throughout the watershed as summarized in Chapter II, it is estimated that the Mason Creek watershed is already achieving 35 percent and 36 percent pollutant load reductions in TP and TSS, respectively, as noted in Table III-4.

The load reductions anticipated through implementation of the targeted management measures recommended under this plan are estimated to be 4,151 pounds (41 percent) of TP per year and 1,880 tons (68 percent) of TSS per year (see Table III-4). Therefore, the existing load reductions combined with the proposed pollutant load reductions in this plan would achieve approximately 76 percent TP reduction and meet the TSS reduction called for under the TMDL study for the Mason Creek watershed.

Agricultural Best Management Practices (BMPs) - (Table III-3, Part 1)

Although it is difficult to specify at the watershed planning level where agricultural BMPs will be implemented within the Mason Creek watershed, since such specification depends on factors such as the receptiveness of landowners to such installations, the availability of adequate cost share funding, and technical assistance, this section is intended to provide some guidance for prioritizing projects. As a general rule, effectiveness of BMPs in improving water quality decreases with distance from a waterbody. **Therefore, it is recommended that the prioritization scheme as illustrated on Map II-6 be used to guide implementation of agricultural BMPs by landowners and farmers within the Mason Creek watershed to address the highest priority or critical parcel sites for which pollutant loads can be most cost-effectively reduced.** However, it is also important to note that in order to reach the watershed-wide target load reductions, it will require implementing BMPs among high, moderate, and low priority agricultural areas throughout the watershed.

Increase No-Till from 50 to 75 Percent

Removing crop residue through tillage operations leads to soil erosion. When soil is tilled, more soil is exposed to erosive forces, leading to nutrient- and sediment-laden surface runoff. No-till farming is the practice where the soil is undisturbed except for where the seed is placed in the soil. No-till planters disturb less than 15 percent of the row width. The combination of minimal ground disturbance and minimal removal of crop residue contribute to a more stable soil surface that is less susceptible to erosion and the accompanying washoff of nonpoint source pollutants. No-till benefits are recognized in several areas.

By not turning soil over to prepare a seed bed, the soil structure of pores and channels formed throughout the soil surface layers remains intact and does not become compacted, allowing precipitation to effectively infiltrate and resulting in less surface runoff. The residue left behind after crop harvest is left to breakdown naturally, increasing the amount of organic matter in the soil. Decaying residue cycles nutrients back into the soil, decreasing reliance on fertilizers. Soil with higher organic matter generally has the capacity to absorb and hold more water, and then release it to crops during the growing season.

Some soils are better suited to no till than others. Soil warming and drying may be slower in the spring especially on poorly drained soils causing plants to germinate more slowly. Since the soil is not turned over, undesirable weeds may be harder to control and herbicide use could increase. The benefits of no-till are not realized until the practice has been in place for many consecutive years. To be effective, no-till must be done as part of a system of crop rotation, nutrient management, and integrated pest management. Managing weeds and the residue resulting from no-till requires the farmer to be committed to changing additional interdependent farming practices, and will likely require purchasing new equipment or modifying existing equipment.

Increase Cover Crops from 0 to 50 percent

The establishment of cover crops is the practice of planting grasses, legumes, forbs or other herbaceous plants for seasonal cover and conservation purposes. Common cover crops used in Wisconsin include winter hardy plants such as barley, rye and wheat. Other less common, but also effective cover crops include oats, spring wheat, hairy vetch, red clover, turnips, canola, radishes, and triticale.[22]

Cover crops can help reduce phosphorus and sediment loads by reducing erosion and improving infiltration. Cover crops grow and remain during the fallow months when corn and soybean fields would be bare. The use of cover crops for erosion control requires maintaining nearly continuous ground cover to protect the soil against raindrop impact. Having continuous plant cover increases infiltration, reduces flow and runoff across the soil surface, and binds soil particles to plant roots.

[22] *See UW-Extension website for more information at http://fyi.uwex.edu/covercrop/*

A cover crop slows the velocity of runoff from rainfall and snowmelt, reducing soil loss due to sheet and rill erosion. Decreased soil loss and runoff translates to reduced transport from farmland of nutrients, pesticides, herbicides, and harmful pathogens associated with manure that degrade the quality of surface waters, and could pose a threat to human health. Over time, a cover crop regimen will increase organic matter in the soil, leading to improvements in soil structure, stability, and increased moisture and nutrient holding capacity for plant growth.

Recent findings based on an annual cover crop survey by the U.S. Department of Agriculture (USDA) Sustainable Agriculture Research and Education program, recommend that a variety of strategies be employed to promote planting of cover crops. Education, sharing new research results, appropriate technical assistance, low-cost seed, and in some cases, financial incentives will be necessary to encourage more farmers to adopt cover crops.[23]

<u>Increase Land Under Nutrient Management Plans from 50 to 100 percent</u>

The goal of a nutrient management plan is to reduce excess nutrient applications to cropland and to thereby reduce nutrient runoff to lakes, streams, and groundwater. Nutrient management plans consider the amounts and types of nutrients, and timing of nutrient application, to obtain desired yields while minimizing the risk of surface water and groundwater contamination. Plans must be prepared by a qualified planner, which may be the farmer or a certified crop adviser. Soil testing is done on each field so the farmer knows where nutrients are needed and where they are not, and also takes into account tillage and residue management practices. Plans help farmers allocate nutrients economically while also helping to ensure they are not over-applying nutrients, which could cause water quality impacts.

<u>Install Additional Grass Waterways</u>

A grassed waterway is used to carry runoff water from the field. Grassed waterways are constructed in natural drainage ways by grading a wide, shallow channel and planting the area in sod-forming grasses. When needed to help or keep vegetation established on sites having prolonged flows, high water tables, or seepage problems, the installation of subsurface drains, underground outlets, or other hard engineered components may be necessary. An effective grass waterway carries runoff water from the field and the grass prevents the water from forming a gulley. The vegetation may also trap some sediment washed from cropland, absorb some chemicals and nutrients in the runoff water, and provide cover for small birds and animals. Grass waterways fill with sediment over time and need to be rejuvenated by removing sediments, regrading, and planting.

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[23] *Download USDA report at website http://www.sare.org/Learning-Center/From-the-Field/North-Central-SARE-From-the-Field/2015-Cover-Crop-Survey-Analysis*

A total of seven high priority gullies/concentrated flow areas (4,392 linear feet or 0.83 miles) are proposed to be addressed by installing grassed waterways in these locations as shown on Map B-3 in Appendix B. As indicated in Figure II-29 two of the priority gullies/concentrated flow areas were stabilized while still promoting productive agricultural practices. Hence, five high priority gullies/concentrated flow areas remain. **Since several of these concentrated flow areas are roadway ditches or connected to roadway ditches, the use of check dams/ditch turnouts or some other grade control structure to temporarily impound and/or slow stormwater down and facilitate water quality improvement through infiltration, filtration, and sediment deposition is recommended (see Appendix G)**.

Initiate Assessment and Evaluation of BMPs

The 10-year targeted management measures matrix in Table III-3 details the milestones and indicators for each practice. **It also is recommended that installed BMPs be inspected at least annually to ensure that they are functioning as designed or are not deteriorating.** In addition, as described below, the assessment of the health of the soil in fields where management recommendations are implemented will foster dialog and action applicable to multiple objectives of this plan that goes beyond only making recommendations regarding improving surface water quality.

Soil Health Indicator

Soil is made up of different sized mineral particles (sand, silt, and clay), organic matter, and numerous species of living organisms. Soil health is the capacity of soil to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. Soil properties can change in response to management or climate impacts. Various soil properties can be measured and thus make good indicators of soil quality.

Indicators can be physical, chemical, or biological properties, processes, or characteristics of soils. One physical indicator useful for assessing soil health is the rate at which water infiltrates. The infiltration rate is the time it takes a given amount of water to enter the soil and is expressed as inches per hour. Infiltration will vary depending upon the amount of sand, silt, and clay that makes up a particular soil type. Infiltration rate is also dependent upon how intact the structure and system of pores and channels are within the soil. Soils with well-developed structure and continuous channels infiltrate water quickly and less runoff occurs. Some management practices such as no-till and the use of cover crops, increase organic matter and have a positive effect on soil quality and infiltration rates. No-till also improves soil health by minimizing compaction and breaking of soil pores and channels. This in turn increases the amount of water that soils can absorb. Other management practices, such as tilling the soil when wet, adversely affect soil quality by increasing compaction. Sufficient water must infiltrate the soil profile for optimum crop production. Water that infiltrates through porous soils recharges groundwater aquifers and helps to sustain the baseflow in streams.

It is recommended that, as part of the implementation plan, soil health be monitored on properties where agricultural BMPs are implemented by using the physical, chemical, and/or biological indicators of soil health as summarized in Appendix E. For example, documenting that water infiltration rates improve over time, or is sustained at rates indicating healthy soil structure, will validate the continued use of the particular BMPs.

Convert 6.4 Percent of the Watershed Area to Riparian Buffers/Restored Wetland/Filter Strip (Table III-3, Part 2)
The few existing wetlands in the watershed are found along the main stem of the Creek. The predominant hydric soils in the watershed are very productive when the water table is lowered. The water table has been lowered by tile systems that are installed below the ground surface for the purpose of draining water from the soils and conveying it to Mason Creek or a tributary to the Creek, although the exact extent and distribution of tile systems is unknown.

As summarized in Chapter I of this report, the pre-settlement wetlands in the Mason Creek watershed likely contained prairie elements, particularly wetlands that were not seasonally inundated for prolonged periods (see restoration Appendix D). Areas in permanent vegetation, some wetlands, and native grassland habitats in particular, also infiltrate water and reduce polluted runoff. Restoration of wetland and associated upland prairie habitats, particularly within the 1,000-foot optimal wildlife habitat riparian buffer zone, is an important recommendation to achieve the water quality and wildlife goals of this plan. Wetland restoration can be done by disabling drain tile, installing water control structures, and establishing embankments to settle out sediment and associated nutrient loads.

Restoring wetlands will increase the diversity of native plants, provide wildlife habitat for species of concern, and improve both the biological and hydrological connectivity of the watershed, which is further described in the "*Protect and Expand Riparian Buffers*" section below.

However, implementing restoration of wetlands will be difficult since it involves taking agricultural land out of production (see "*Riparian Corridor Conditions*" section in Chapter II of this report). More specifically, **it is recommended to restore a total of 345 acres of wetland/riparian buffers/filter strips (25 acres within the 75-foot wide zone adjacent to the stream, 205 acres of currently farmed potentially restorable wetlands back to wetland, and 125 acres of currently farmed steep sloped lands to filter strips) along Mason Creek and its**

associated tributaries (as shown on Map B-2 in Appendix B) to help meet the pollutant load reduction goals for this watershed.[24]

Harvestable Buffers

Although converting cropland to restored wetland within 1,000 feet of a waterway is considered a high priority, expansion of riparian buffers to a minimum width of 75 feet on each side adjacent to all waterways as shown on Map B-2 in Appendix B is considered the highest priority in terms of pollutant load reduction in the Mason Creek watershed. In addition, 75-foot-wide riparian buffers are envisioned to be harvestable, so that farmers can periodically harvest the grasses to feed livestock. Expansions of restored wetland/riparian buffers to the 400 and 1,000 foot widths are most likely to be located where crop yield losses have been found to be greatest, such as in fields with steep slopes or high erosion scores or fields within the one-percent-annual-probability (100-year recurrence interval) floodplain. As described in Chapter II, crop yield losses have been found to be greatest along the edges of drainage ditches that tend to get flooded. Therefore, converting such marginal, relatively low-yield cropland to a buffer may not necessarily reduce overall yields as summarized in the *"Best Management Practices/Programs for Riparian Buffers"* section in Chapter II of this report. In addition, restoration of wetlands within riparian buffers out to the 400- and 1,000-foot widths is most likely to be achievable when agricultural land is converted to urban uses. Such fields where this is planned to occur are shown on Map I-6 in Chapter I of this report. The plan implementation period will likely be the last opportunity to establish such critical protective boundaries around waterways before urban structures and roadway networks are constructed (see the "*Maintain and Expand Wetland, Fish, and Wildlife Habitat*" section below for more details).

Restore and Stabilize Degraded Streambanks (Table III-3, Part 3)

The survey conducted by SEWRPC staff assessed erosion sites based on bank slope, length, and height of active erosion at each site. To rank priority streambank stabilization sites, the SEWRPC staff estimated the annual load of sediment contributed to the Creek by each site. Results of these surveys are summarized in Figure II-22 in Chapter II of this report and shown on Map B-3 in Appendix B. All the erosion sites and their associated severity are detailed in the "STEPL Load Reduction Results for Streambank Restoration Practices" section in Appendix B.

The estimated costs for recommended streambank stabilization projects within the Mason Creek watershed are set forth in Table III-4. The costs were estimated based on an assumed typical stabilization approach and they include

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[24]*Note that the targeted total acreage indicated in Tables III-3 and III-4 can be reduced, due to the recent ten acres of cropland that was converted to approximately five acres of riparian buffer and five acres of potentially restorable wetland as summarized in Figure II-29.*

mobilization, regrading and revegetating banks, and rock toe stabilization (see the constructed project shown in Figure II-31). In the case of that project, preliminary plan, profile, and cross section details were provided by SEWRPC staff. Additional costs of permitting, inspection, and other contingency costs were not included. **Note that revegetation of the banks using bioengineering techniques and expansion of the vegetative buffer slopes was an important component of the stabilization of this streambank and revegetation also provides wildlife habitat. The project shown in Figure II-31, can be used as a demonstration project for future projects in this watershed.**

Based on the results of the surveys conducted within the Mason Creek watershed, this plan makes the following recommendations regarding streambank erosion:

1. Since the highest priority eroding site was recently addressed (see Figure II-31), it is recommended that the remaining 27 low priority erosion sites totaling approximately 2,055 lineal feet as identified on Map B-2 in Appendix B be monitored and addressed if they become worse or more severe.

2. That the design and implementation of the streambank stabilization projects ensure that the stream is reconnected to its floodplain when practicable, and that consideration be given to restoring stream reaches to their historical channel alignment prior to channelization (see "*Streambank Erosion and Restoration Priorities*" section below).[25]

Recommended Actions to Reduce the Volume and Velocity of Runoff from Upland Areas to Streams, Increase Soil Infiltration, and Protect Groundwater Recharge

In some cases, load reductions and/or specific targeted goals associated with recommendations within this section have been addressed under management measures described above (e.g., riparian buffers). In other cases, load reduction goals were either not quantified due to them being outside the scope of this project (e.g., green infrastructure projects) or not lending themselves to quantification (e.g., protection of groundwater recharge areas). However, implementation of those recommendations would lead to pollutant load reductions beyond what was modeled and will be vital to the long-term protection of Mason Creek within the 10-year timeframe and beyond. Implementation of these recommendations would contribute to improving the hydrologic,

[25]*If restoration of floodplain connectivity and/or addressing channelization were incorporated into the pollutant reduction estimates for the severe and moderate eroding streambank sites within the Mason Creek watershed, the pollutant load reductions would be significantly higher than what was modeled using STEPL.*

hydraulic, geomorphology, physiochemical, and biological functions of this stream system to achieve the water quality (Tables II-1 though II-6), biological quality (Tables II-9 and II-11), and habitat quality (Table II-16) criteria and/or targets for the Mason Creek watershed.

Agricultural and, to a lesser extent, urban development have brought significant changes to the landscape and have produced profound effects on the surface water hydrology within the Mason Creek watershed. These landscape changes historically have included modification of the drainage patterns, hardening of surfaces, alteration of groundwater infiltration within urbanized areas, straightening and ditching of streams, and installation of drain tile systems in agricultural areas. These changes to the landscape generally act to increase the volume and rate of runoff from precipitation events, leading to flashiness in stream flow. This flashiness reduces streambank and streambed stability, increases pollutant loading, and changes the sediment dynamics within the stream system. These changes in turn reduce the availability of habitat and degrade its quality.

The objective of the recommendations set forth below is to promote restoration of the hydrologic and hydraulic function of Mason Creek and its associated watershed so that stream discharges more closely emulate the levels that are thought to have occurred prior to agricultural or urban development. Specifically, decreases in average flow magnitude, high flow magnitude, high flow frequency, and/or high flow duration are sought to provide potential improvements to the algal, invertebrate, and fish communities within the Mason Creek watershed.

Agricultural Surface Water Hydrology

Drain tiles have been installed within agricultural lands to clear fields of rainwater as rapidly as possible and keep them productive. Most stream channels located in agricultural areas of the watershed have been deepened and straightened to facilitate the flow of water from agricultural subsurface drainage outlets, to maximize conveyance of agricultural drain water, to maximize the amount of land available for cultivation, and to make the land easier to cultivate. The following recommendations are intended to mitigate the impacts of channelization and installation of drain tile on the surface water hydrology:

1. **It is recommended that natural surface hydrology be restored by reducing, to the extent feasible, unnecessary drain tile systems and retrofitting needed systems.** Specific measures that can be taken to accomplish this recommendation include:

    - Working with landowners to remove or disconnect any unneeded or unwanted tile systems (see Map III-1, Priority Area 1).
    - Working with landowners to integrate water control structures within drain tile systems to reduce tile flow during periods when a higher water table would not present a problem for crop

production. (See "*General Rural Nonpoint Source Pollution Control Measures*" section below for information on drainage water management.)

2. **It is recommended that natural landscape elements be restored to slow down water and reduce flashiness and its negative effects on aquatic habitat quality.** Specific measures that can be taken to accomplish this recommendation include:

- **Improving the connectivity of Mason Creek to its floodplain,** improving instream habitat, and reducing streambed erosion **within the following priority reaches:**
    1. **West Branch Agricultural Ditch-Install a series of ditch plugs to promote wetland restoration and prevent bedload sediment transport (see Appendix H, and Map III-1, Priority Area 1), and install series of check dams/ditch turnouts within gullies/concentrated flow areas/roadside ditches to capture sediment and reduce water velocities (see Appendix G, Map III-1, Priority Area 1).**
    2. **Upper Mason Creek-Reconnect and/or reconstruct historical stream channels (i.e., remeandering) to promote wetland restoration, reduce water velocities, and prevent bedload sediment transport (see Map III-1, Priority Area 2).**
- Considering expanding buffers to include areas of high and very high groundwater recharge potential.
- Considering installing saturated buffers in agricultural areas of the watershed, where feasible. (See "*General Rural Nonpoint Source Pollution Control Measures*" section below for information on saturated buffers.)

General Rural Nonpoint Source Pollution Control Measures

Nonpoint source pollution contributed by rural stormwater runoff constitutes the major source of water pollution in the Mason Creek watershed. Therefore, in addition to the targeted management measures summarized above, the following additional strategies are also recommended.

1. **Continue to support the ongoing Farmer Leadership Group established as part of the Oconomowoc Watershed Protection Program (OWPP) and Adaptive Management Programs administered through the City of Oconomowoc, and expand this collaborative model of water quality improvement through farmer engagement among the priority parcel areas in the Mason Creek watershed (see Map II-6)**.[26] This program should be designed to improve water quality in

[26]*City Of Oconomowoc*, Oconomowoc Watershed Protection Program, Waukesha County, Wisconsin, *prepared by Ruekert & Mielke, Inc., February 2016; see more details at website at http://oconomowocwatershed.com/*

Mason Creek through reduced pollutant loads; to increase knowledge about, and engagement with, water quality issues, including the adoption of conservation practices; and to develop leadership around water quality issues among farmers in the watershed.

2. **That implementation of the agricultural BMPs summarized above (see *"Targeted Load Reductions"* section above) be a higher priority on agricultural fields that are located in areas of high and very high groundwater recharge** (see Map I-9).

3. **That the application of practices to reduce soil loss from cropland be expanded to attain erosion rates less than "T," the tolerable soil loss rate.**[27] This is envisioned to be accomplished through a combination of practices including, but not limited to, expanded no till, grassed waterways, use of cover crops, and riparian buffers (see targeted management measures in Tables III-3 and III-4). The applicable measures should be determined by the development of farm management plans which are consistent with the County land and water resource management plans.

4. **That nutrient management plans be prepared for all agricultural operations in the watershed that do not currently have them, and that manure and other nutrients be applied to fields in accordance with nutrient management plans** (see targeted management measures in Tables III-3 and III-4). **The provision of barnyard runoff control systems and six months of manure storage are also recommended for all livestock operations in the watershed as well as maintaining exclusion of livestock from waterbodies and adjacent riparian areas.** To facilitate this, **it is recommended that the WDNR consider increasing levels of cost-share funding to enable a higher level of implementation of the best management practices needed to meet the NR 151 performance standards**.

5. **That pilot projects be conducted under field conditions in the watershed to evaluate the performance of two potential strategies for treating tile drainage—drain water management and saturated buffers. Those pilot projects would help determine whether these practices would be useful in reducing contributions of pollutants, especially nutrients, from agricultural fields with tile drainage.**

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[27] *"T-value" is the tolerable soil loss rate—the maximum level of soil erosion that will permit a high level of crop productivity to be sustained economically and indefinitely, as determined by the U.S. Natural Resource Conservation Service. "Excessive" cropland erosion refers to erosion in excess of the tolerable rate, or T-value.*

Because of the nature of the soils present in portions of the watershed, much of the agricultural land is artificially drained through the use of subsurface drain tile. These tiles often discharge directly into streams, or into ditches that discharge into streams. Because they provide a direct pathway from fields to surface waterbodies, drain tiles can allow water and pollutants to bypass agricultural BMPs, especially riparian buffers, reducing their effectiveness. Research conducted at the University of Wisconsin Discovery Farms illustrates this bypass effect.[28] In fields with intact drain tile, between 15 to 34 percent of the total phosphorus, 78 to 87 percent of the nitrogen, and about 25 percent of the sediment leaving the field moved through the drain tile system. In fields with damaged drain tile (i.e., tile blow outs), about 65 percent of the total phosphorus and the majority of sediment leaving the fields traveled through drain tile. These results show that drain tiles can constitute a major pathway through which sediment and nutrients travel from agricultural fields to surface waters.

Because the performance of drainage water management and saturated buffers with respect to removing phosphorus and with respect to the types of conditions present within the Mason Creek watershed are not well understood, it would be desirable to conduct pilot projects in the watershed under which these practices could be installed and their performance evaluated. County conservation staff could use the results of such pilot projects to devise strategies for addressing the “bypassing effect” of drain tiles for each of these practices as summarized below.

a) **Drainage water management** is the practice of using a water control structure in a main, submain, or lateral drain to vary the depth of water at the drain outlet. When this is done, the water table must rise above the invert elevation of the outlet for drainage to occur. This allows the minimum depth of the water table under the field to be controlled to reduce flow from the tile during periods when a higher water table would not present a problem for crop production. For example, for a field managed using a corn-soybean rotation, the outlet water depth, as determined by the control structure, would be:

- Raised after harvest to limit drainage outflow and reduce the delivery of nutrients to ditches and streams during the off-season,
- Lowered in early spring and again in the fall so the drain can flow freely before field operations such as planting or harvesting, and
- Raised again after planting and spring field operations to create the potential to store water for the crop to use during the summer.

[28] *Eric Cooley, “Nutrients Discharging from Drain Tiles in Eastern Wisconsin,” Presentation at the Eighth Annual Clean Rivers, Clean Lake Conference, Milwaukee, Wisconsin, April 30, 2012.*

Drainage water management can reduce nutrient loads to receiving streams. Studies have found reductions in annual nitrate loads ranging between 15 percent and 75 percent, depending upon location, climate, soil type, and cropping practice.[29] Few data are available regarding the performance of this practice with respect to phosphorus.

b) **Saturated buffers**, unlike ordinary riparian buffers, capture and treat water from tile drainage. A saturated buffer has a control structure that redirects flow from a main tile line through a lateral distribution line into the buffer. Once within the buffer soils, the water redirected from the tile percolates deeper into the soil or gets taken up by vegetation. In its study at Bear Creek in Iowa, the Leopold Center for Sustainable Agriculture at Iowa State University found that the use of a saturated buffer reduced annual nitrate loads by about 55 percent. While no data have yet been collected regarding the performance of saturated buffers with respect to phosphorus, it would be expected that uptake by plants growing within the buffers would reduce the amount of phosphorus contributed to streams.

Urban Surface Water Hydrology

Historically, the approach to managing increases in rates and volumes of runoff within urbanized areas often involved the construction of storm sewer and/or open channel systems to convey stormwater to streams as quickly and efficiently as possible. In recent years, flooding, water quality impairment, and environmental degradation have demonstrated the need for an alternative approach to urban stormwater management. Consequently, current approaches to stormwater management seek to manage runoff using a variety of measures, including detention, retention, infiltration, and filtration, better mimicking the disposition of precipitation on an undisturbed landscape.

1. **It is recommended that natural surface hydrology be restored to the degree practicable by reducing impervious cover and associated runoff in urbanized areas.** Specific measures that can be taken to accomplish this recommendation include:

   - In addition to implementing the recommendations described in the "*Protect Areas of High Groundwater Recharge Potential*" section below, it is recommended that new urban development be accomplished to minimize impacts on areas of high groundwater recharge potential and that infiltration practices be installed in cases where development affecting areas of high groundwater recharge potential cannot reasonably be avoided or in areas where development already exists. If new urban development is to take place in areas of high recharge potential, it is recommended

[29]*University Cooperative Extension Service Publication No. WQ-44, August, 2006.*

that this development incorporate green technologies designed to maintain infiltration functions consistent with high groundwater recharge potential.

2. **It is recommended that natural landscape elements be restored to "slow down water" and reduce the magnitude of flashiness in streamflow and its negative effects on aquatic habitat quality.** Specific measures that can be taken to accomplish this recommendation include:

- **It is recommended that riparian buffers and environmental corridors be established, expanded, or protected from development[30] to allow the capture of significant rainfall (see Map B-2 in Appendix B).** As noted in Chapter II, when impervious surfaces increase, there are often negative changes to streams. If steps are not taken to mitigate these negative effects, Mason Creek will lose biological integrity with continued urban growth over time.

- **The use of green infrastructure to manage stormwater in the Mason Creek watershed is recommended**. The USEPA defines green infrastructure as follows (see http://www.epa.gov/green-infrastructure/what-green-infrastructure):
"Green infrastructure uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments. At the city or county scale, green infrastructure is a patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the neighborhood or site scale, stormwater management systems that mimic nature soak up and store water. …an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure management approaches and technologies infiltrate, evapotranspire, capture, and reuse stormwater to maintain or restore natural hydrologies."[31] This is an approach that helps infiltrate and store rainwater in more natural ways. Green infrastructure complements the gray infrastructure, such as sanitary sewer pipes, storm sewers, and water reclamation facilities that have been, and will continue to be, the backbone for meeting water quality and stormwater management goals. While green infrastructure cannot entirely replace the capacity of gray

[30]*Restrictions on development in primary environmental corridors, and certain secondary environmental corridors, are already applied throughout the Southeastern Wisconsin Region under the sanitary sewer service area planning process conducted by the Regional Planning Commission in its role as the designated areawide water quality planning agency for the Region. However, the Mason Creek watershed lies outside of a sanitary sewer service area. Thus, urban development in the watershed would be subject to municipal and/or County review, but, at present, not to review through the sewer service area planning process. .*

[31]*U.S. Environmental Protection Agency,* Reducing Stormwater Costs through Low Impact Development Strategies and Practices, *2007.*

infrastructure in urban areas, it can improve water quality through treatment of stormwater runoff and reduce the volume of stormwater runoff to Mason Creek during small storms.

- **It is recommended that the counties and municipalities in the Mason Creek watershed review their municipal codes to identify barriers to the implementation of green infrastructure practices within their jurisdictions.** Municipal codes and ordinances have a broad impact on the use of green infrastructure. Depending on their specifics, they can provide incentives for, or present barriers to, the implementation of green infrastructure by the private and public sectors. Modifications to local codes, ordinances, and review processes can encourage municipalities, builders, and developers as well as property owners to implement green infrastructure practices.

- **It is recommended that developers be encouraged to incorporate infiltration in stormwater management designs and that local local government consider groundwater recharge as an integral part of new development proposals.** Some Southeastern Wisconsin communities have integrated analysis of groundwater and surface water impact into the process through which developers obtain permission to build new buildings and subdivisions.[32]

Urban Stormwater Runoff Pollution Control Measures

Although rural nonpoint source loads are currently substantially greater than urban nonpoint source loads in the watershed, a review of planned land use conditions indicates that urban loads would be expected to increase. Therefore, addressing urban stormwater runoff is an important element that needs to be included in this plan. The following recommendations are targeted at reducing the contributions of pollutants from these sources through a variety of strategies:

1. **It is recommended that urban nonpoint source controls be implemented that are consistent with the standards set forth in Chapter NR 151 of the *Wisconsin Administrative Code*.** By implementing controls to meet or exceed the standards of Chapter NR 151, municipalities will address the control of construction site erosion; the control of stormwater pollution from areas of existing and planned urban development, redevelopment, and infill; and infiltration of stormwater runoff from areas of new development.

[32] *The Village of Richfield in Washington County is such an example. More information may be found at the Village's website: http://www.richfieldwi.gov/index.aspx?NID=300*

2. **It is recommended that the Town of Merton design its illicit discharge detection and elimination (IDDE) program developed under the MS4 permit to monitor outfalls to reduce pathogens and fecal indicator bacteria.**

3. **It is recommended that Waukesha County continue to work closely with the Town of Merton in the development of its permit, information and education program, and stormwater infrastructure mapping.**

   - **It is recommended that the Town of Merton and Waukesha County develop a standard digital format, labelling, and coordinate system for mapping stormwater infrastructure** to establish a model format that can be applied by other municipalities in the future, enabling inventories among municipalities to be readily compared and merged at the scale of watersheds.

   - **It is recommended that consideration be given to installing floating islands or floating treatment wetland technologies in existing and/or planned wet stormwater detention basins or stormwater wetlands**, where applicable, as shown in Figure III-2, to reduce nutrient and other pollutant loads to Mason Creek.

4. **It is recommended that, at a minimum, County-enforced inspection and maintenance programs be implemented for all new or replacement private onsite wastewater treatment systems (POWTS) constructed after the date on which the County adopted private sewage system programs, that voluntary County programs be instituted to inventory and inspect POWTS that were constructed prior to the dates on which the County adopted private sewage system programs, and that the WDNR and the County work together to strengthen oversight and enforcement of regulations for disposal of septage and to increase funding to adequately staff and implement such programs.** Regulations regarding POWTS set forth by the Wisconsin Department of Safety and Professional Services in Section SPS 383.255 of the *Wisconsin Administrative Code* mandate an expansion of county and municipal POWTS programs. Under the current rules, units of government are required to complete inventories of POWTS in their jurisdictions by October 1, 2017, and have the other elements of the program in place by October 1, 2019. Thus, **it is recommended that the county and municipalities in the watershed implement expanded POWTS programs in accordance with the deadlines given in SPS 383.255**.

5. **Should any CAFOs be established within the watershed, it is recommended that nutrient management requirements for such operations be based upon the conditions given in their WPDES permits.**

Protect Areas of High Groundwater Recharge Potential

Groundwater recharge within the Mason Creek watershed supplies water to the shallow aquifers, which, in turn, provide the baseflow to the Creek and its tributaries. Baseflow is essential to maintaining the natural hydrology, instream habitat, and the overall health of the Creek, particularly during the droughts and low flow periods which may occur more frequently as climate change occurs. Thus, the maintenance and improvement of groundwater recharge is a crucial part of any plan that hopes to maintain or improve water quality and instream habitat conditions within the watershed.

Traditional urban development increases the area of impervious surfaces which, in the absence of green infrastructure or other land development measures to promote infiltration of runoff, reduces infiltration volumes into the shallow aquifer. This reduction in infiltration reduces the baseflows provided by the shallow groundwater system. This loss of baseflow can lead to substantial loss in stream depth and volume, increased water temperatures, loss of critical fish and other aquatic organism habitat, increased potential for summer fish kills caused by low dissolved oxygen concentrations, and loss or degradation of the coldwater fishery. The 2035 planned land use data presented in Chapter I of this report show that some planned land use changes are located in areas that have been identified as having high and very high groundwater recharge potential (see Maps I-6 and I-9 in Chapter I of this report). Maintaining the groundwater recharge provided by these areas is important to preserve baseflows to the surface water system of the watershed.

1. **Specific recommended management measures to protect groundwater recharge potential include:**
   - During local government consideration of new development plans, examine the regional groundwater recharge potential maps[33] to identify and, where practicable, avoid installing impervious surfaces in areas of high and very high groundwater recharge potential areas and during the siting, design, and installation of sewers, water lines, and other buried utilities which could intercept groundwater flows.;

   - Protection and preservation of areas classified as high and very high groundwater recharge through conservation easements, land purchases, or voluntary incentive-based measures. Such protection should also incorporate preservation of environmental corridors, isolated natural resource areas, prime and other agricultural areas, and open lands that are associated with cluster, or open space, developments that facilitate groundwater recharge;

[33]*SEWRPC Planning Report No. 52,* A Regional Water Supply Plan for Southeastern Wisconsin, *December 2010.*

It is recognized that in some cases, it will not be possible to avoid locating urban development on or near areas of high groundwater recharge. In these cases, it is even more crucial to implement supplemental measures to maintain both groundwater levels and groundwater quality.

2. **It is recommended that mitigation measures be implemented to reduce the impacts of any future urban development on groundwater recharge quality and quantity.** Specific measures that can be taken to accomplish this recommendation include:

- Reviewing and updating as necessary, local and county land use regulations to promote where appropriate, cluster, or open space, development practices that provide for the clustering of new development so as to minimize potential reductions in groundwater recharge.

- Maintaining infiltration and recharge rates as close to existing rates as practicable by incorporating runoff management recommendations for enhancing infiltration using low-impact design standards in accordance with the regional water supply plan. Some examples of infiltration techniques and low-impact design include:

    - Bioretention cells
    - Elimination of curb and gutter street cross sections
    - Grassed swales
    - Green parking design
    - Infiltration trenches
    - Permeable pavement
    - Rain barrels and cisterns
    - Rain gardens
    - Riparian buffers
    - Sand and organic filters
    - Soil amendments
    - Tree boxes
    - Vegetated filter strips
    - Vegetated roofs

Under current conditions, the extent of urban development within the Mason Creek watershed is potentially sufficient to negatively affect the groundwater quantity and quality in shallow aquifers, and in turn water quantity and water quality within Mason Creek and its tributaries. Implementing projects that seek to restore the natural precipitation infiltration characteristics have the potential to mitigate these effects.

3. **It is recommended that measures be taken to reduce the impact of existing urban development on groundwater recharge and groundwater quality.** Specific measures that can be taken to accomplish this recommendation include:

- Increasing the infiltration of urban runoff at those sites where it can be achieved without degrading groundwater quality;Retrofitting current urban development to improve infiltration of rainfall and snowmelt using innovative BMPs that are associated with low-impact development including bioretention and rain garden projects,[34] disconnection of downspouts from sewer systems, installation of porous pavement, and other green infrastructure practices, as recommended above (also see the information on green infrastructure provided in the preceding *"Urban Surface Water Hydrology"* section); and

- Applying the stormwater management technical standards developed by the WDNR in the design of stormwater management facilities. In particular, the potential for pollutants to enter groundwater through infiltration should be considered in the design of infiltration facilities such as, infiltration trenches, infiltration basins, bioretention facilities, rain gardens, grassed swales, and stormwater detention basins. This consideration is especially important in areas with shallow depths to groundwater and in areas where chloride compounds may be used for winter road and parking area maintenance.

  Although infiltration into soils provides some level of pollution reduction, shallow aquifers can be vulnerable to pollution. Within the Mason Creek watershed, there are specific areas associated with particular land uses that could potentially contribute pollutants to groundwater. These areas include agricultural fields and areas of urban land use located in high groundwater recharge areas which could act as sources of pollution due to over-fertilization and pesticide use. Pollutants contributed by these areas can infiltrate into groundwater during rain events. This pollution needs to be prevented to the greatest extent practicable to avoid contaminating the groundwater and the

[34]*Roger Bannerman, WDNR and partners; Menasha Biofiltration Retention Research Project, Middleton, WI, 2008; N.J. LeFevre, J.D. Davidson, and G.L. Oberts,* Bioretention of Simulated Snowmelt: Cold Climate Performance and Design Criteria, *Water Environment Research Foundation (WERF), 2008; William R. Selbig and Nicholas Balster*, Evaluation of Turf Grass and Prairie Vegetated Rain Gardens in a Clay and Sand Soil: Madison, Wisconsin, Water Years 2004-2008*, In cooperation with the City of Madison and Wisconsin Department of Natural Resources, USGS Scientific Investigations Report, in draft.*

baseflow of Mason Creek and its tributaries. It also is important that nutrient and chemical applications not occur during periods when groundwater levels are known to be high.

Recommended Actions Associated With Management Objective to Maintain and Expand Wetland, Fish, and Wildlife Habitats

Implementation of plan recommendations related to habitat would lead to further pollutant load reductions beyond what was modeled under this study and will be vital to the long-term protection of Mason Creek within the 10-year plan timeframe and beyond. Implementation of these recommendations would contribute to improving the hydrologic, hydraulic, geomorphology, physiochemical, and biological functions of this stream system to achieve the water quality (Tables II-1 though II-6), biological quality (Tables II-9 and II-11), and habitat quality (Table II-16) criteria and/or targets for the Mason Creek watershed.

The presence of healthy wildlife communities, including populations of animals such as deer, fish, amphibians, reptiles, birds, and small mammals, is a significant indicator of a healthy watershed. This is largely because wildlife populations require large, well-connected natural areas, which are associated with good water quality and good aquatic and terrestrial habitat. The presence of healthy wildlife populations provides recreational opportunities, such as bird watching, hunting, fishing, and nature hiking.

Maintain and Improve Wildlife Habitat

The environmental corridors and isolated natural resource areas (Map I-7), as well as the Mason Creek Swamp designated natural area (Map I-8) contain the most pristine lands in the watershed. These areas are crucial to wildlife maintenance and enhancement due to their continuity, size, and proximity to Mason Creek and its associated tributaries. Maps II-9 and II-10 indicate the extent and distribution of existing and potential riparian buffers and their relationship with the location of primary environmental corridor and isolated natural resource areas within the Mason Creek watershed. Map III-2 is provided to guide wildlife enhancement activities toward protecting, enhancing, and connecting these resources. It also indicates the existing and potential buffer areas in the watershed, which are identified to provide guidance as to where buffer development and land purchase and easements should be focused when attempting to enhance wildlife. As summarized above within the "*Targeted Load Reductions*" section, increasing the amount of riparian buffers/restored wetland by 6.4 percent to meet pollutant load reductions within the priority areas as shown in Map B-2 in Appendix B will also help to achieve significant improvements to fish and wildlife habitat within the Mason Creek watershed. This would double the amount of existing wetland/riparian buffers within the Mason Creek watershed from about 27 to 33.6 percent, an amount of buffered lands that is consistent with goals to protect and restore wildlife in other watersheds.[35] Therefore, these important riparian areas are considered a high priority for buffer establishment to reduce pollutant loads and to protect and restore hydrological function and improve wildlife within this watershed. In addition, consideration should also be given to protecting networks of wetland and upland habitat communities in both rural and urban settings.

In general, the goals of the recommendations included on Map III-2 are to protect and expand primary environmental corridors to the extent feasible while maximizing connections between isolated natural areas and the corridors. These connections can be prioritized for expansion by establishing buffers out to the 75-foot, 400-foot, and 1,000-foot distances as shown on Map II-9. Measures taken to carry out these recommendations will ultimately significantly benefit the wildlife in the Mason Creek watershed.

To maintain and improve wildlife populations in the Mason Creek watershed, the following recommendations have been developed:

1. **It is recommended that wildlife habitat be preserved and expanded through protection of primary environmental corridors and isolated natural resources areas (Map I-7) where feasible; natural areas and critical species habitats (Map I-8); and through establishment of additional riparian buffers** (see Map III-2 and Map B-2 in Appendix B)**.** Establishment of riparian buffers should occur particularly at those sites where development of a buffer can be located contiguous with an environmental corridor or natural area and may result in a potential expansion and/or protection of such areas (see Figure II-29 for demonstration of this concept). Specific measures that can be taken to accomplish this recommendation include:

    - Implementing recommendations for the acquisition and protection of wetland and woodland/upland areas that have been identified for acquisition in the adopted regional natural areas and critical species habitat protection and management plan.[36] Implementation of these recommendations, in addition to those set forth in the adopted park and open space plans for

[35]*Environment Canada,* How Much Habitat is Enough? *Third Edition, Environment Canada, Toronto, Ontario, 2013*

[36]*SEWRPC Planning Report No. 42,* A Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin, *September 1997*; *SEWRPC*, Amendment to the Natural Areas and Critical Species Habitat Protection and Management Plan for the Southeastern Wisconsin Region, *December 2010*.

Washington and Waukesha Counties,[37] would complement the protection and preservation of environmentally sensitive lands.

- The management and restoration of wetlands and upland buffers should be prioritized near and within existing natural areas. In particular, installation of grassland buffers upslope from the Mason Creek Swamp and restoration of potentially restorable wetland adjacent to the Mason Creek Swamp would alleviate further degradation to the remaining high quality natural communities within these natural areas.

- Conducting targeted vegetation inventories to assess floristic quality as well as invasive species presence and abundance to guide management of existing natural areas and newly restored riparian buffers/wetland and upland habitat areas.

- Conserving and managing wooded areas that contain oak or hickory for future oak and hickory recruitment.

- Conserving and managing areas with excessive non-native invasive plant species to promote native vegetation, particularly adjacent to riparian waterways.

2. **It is recommended that habitat fragmentation be reduced by preserving and further enhancing connections between riparian buffer areas, open spaces, critical species habitat sites, and natural areas.** Specific measures that can be taken to accomplish this recommendation include:

- Establishing corridors and buffers of natural habitat connecting isolated wetlands to nearby upland areas to allow reptiles and amphibians safe access to upland habitats necessary for certain life history stages. In general, priority should be given to the restoration of wetlands and upland buffers that enhance or create upland-wetland habitat complexes or increase connectivity between Mason Creek, its associated natural areas and other wetlands, and nearby stands of existing woodland;

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[37] *SEWRPC Community Assistance Planning Report No. 136,* A Park and Open Space Plan for Washington County, *March 2004, see website at http://www.co.washington.wi.us/departments.iml?mdl=departments.mdl&ID=POS; and, Waukesha County Parks and Land Use,* Park and Open Space Acquisition Plan for Waukesha County, *Updated May 2012, see website at http://www.waukeshacounty.gov/uploadedFiles/Media/PDF/Parks_and_Land_Use/Planning_and_Zoning/Open_Space_Maps/OpenSpace%20Entire%20County.pdf*

- Maintaining connections between streams and overbank floodplains so as to continue to protect and preserve fish and wildlife habitat and water quality benefits, making use of open lands, riparian corridors, and park lands in floodprone areas, as appropriate;

- Maintaining connections between streams and wetlands, wetland and upland complexes, wetlands and ephemeral and/or perennial ponds, and multiple ponds, all of which provide redundancy in available habitat quality and quantity necessary to help ensure wildlife diversity; and

- For existing and future roadway projects, considering various pre- and post-construction measures to prevent, mitigate, or compensate for road impacts on surrounding habitats and wildlife, particularly when crossing waterways.[38] The expansion of the road network contributes to landscape fragmentation, which is recognized as one of the major threats to biodiversity for amphibians, reptiles, and mammals. In addition to reduction of road casualties for wildlife, project success should also be based upon restoring ecological processes. Goals of a successful mitigation project should include the following six elements.[39] Actions to implement projects would have to be coordinated with the WDNR, the Dodge and Washington County Highway Departments, the Waukesha County Public Works Department, local public works departments, and/or the Wisconsin Department of Transportation (WisDOT):

    - Reduction of roadkill rates following mitigation;
    - Maintenance of habitat connectivity;
    - Promotion of gene flow among populations;
    - Confirmation that biological requirements are met;
    - Allowance for dispersal and recolonization; and
    - Maintenance of processes and ecosystem function to support sustainable populations of target organisms.

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[38]*Forman, R. T. T., et al.,* Road Ecology: Science and Solutions*, Island Press, Washington, D.C. 481 pp., 2003.*

[39]*Kimberly M. Andrews, J. Whitfield Gibbons, and Denim M. Jochimsen,* Literature Synthesis of the Effects of Roads and Vehicles on Amphibians and Reptiles*, Federal Highway Administration (FHWA), U.S. Department of Transportation, Report No. FHWA-HEP-08-005, Washington, D.C., 151 pp., October 2006.*

3. **It is recommended that best management practices aimed at maintaining wildlife be implemented. These practices should consist of voluntary, educational, or incentive-based programs.** Specific measures that can be taken to accomplish this recommendation include:

- Encouraging agricultural landowners to enroll in Federal programs which provide incentives to restore habitats on agricultural lands such as the Conservation Reserve Program, the Wetland Reserve Program, the Wildlife Habitat Incentives Program, or the Landowner Incentive Program; and

- Encouraging homeowners and businesses within the 1,000-foot optimal habitat zone to consider landscaping that would enhance wildlife by providing connections (see Appendix C) or lanes through the properties. These programs should encourage the use of native plants that provide cover and food for wildlife.

Protect and Expand Riparian Buffers

As discussed above, protection and expansion of riparian buffers is an essential component to address both pollutant load reductions (see *"Targeted Load Reductions"* section above) and protection of wildlife. Riparian buffers protect water quality, groundwater quality and recharge, fisheries, wildlife, and ecological resilience to invasive species, and they may reduce potential flooding of structures and harmful effects of climate change (see Appendix C). Hence, preservation and development of riparian buffers are key to the existing and future economic, social, and recreational well-being of the Mason Creek watershed.

As noted above and identified in Map III-2, while this plan recommends protecting and expanding riparian buffer regions to a minimum 75-foot width for water quality protection and, where feasible, an optimum 1,000-foot width for wildlife protection, it is important to note that, for water quality and wildlife protection, the presence of a buffer is always better than the absence of one, even if only to prevent some pollution or allow for better aquatic habitat. Therefore, **it is recommended that efforts be made to establish buffered areas, to the maximum extent practicable up to the optimum width of 1,000 feet and beyond that width in special cases where feasible.**

Specifically land managers and policy makers should focus on the following recommendations in regards to riparian buffers:

1. **It is recommended that existing buffers (see Map III-2) be managed and preserved to the degree practicable. Specific measures that can be taken to accomplish this include:**

- Eradicating invasive species to the extent practical to allow native plant species to become established. Partnerships between landowners, communities, schools, volunteer groups, service organizations, local governments, and through participation in programs offered by the WDNR are critical in such an effort (see Appendices C and D).

- Restoring and establishing native vegetation where needed. Vegetation with a high capability to sequester nitrogen and phosphorous should be considered.

- Conducting educational campaigns and generally promoting low-impact use of existing buffer areas. For example, in some areas row cropping is occurring too close to the roadway ditches, which is a significant source of sediment that discharges directly into Mason Creek during rainfall events.

2. It is recommended that existing riparian buffers be protected through acquisition, purchase, easements, and regulation (See Map B-2 in Appendix B to implement this recommendation). Specific measures that can be taken to accomplish this recommendation include:

- Acquiring public land via donation or purchase and establishing public or private conservation easements on critical lands;

- Applying limits on development within SEWRPC-delineated primary environmental corridors and connecting "vulnerable" existing and potential buffer lands to primary environmental corridors (PEC), secondary environmental corridors (SEC), and isolated natural resource areas (INRA) where feasible. Additional buffer lands may be added to primary environmental corridors if they meet the criteria for inclusion in a corridor, thus extending the restrictions on development that are inherent to primary environmental corridors;[40] and

    i. Conservancy Districts: Each community's zoning ordinance and attendant "Lowland Conservancy" and "Upland Conservancy" district boundaries and associate maps should be based upon the most up-to-date year 2015 PEC, SEC, and INRAs as well as Wisconsin Wetland Inventory (WWI) data and be updated annually or at least every five years.

- Enforcing local zoning regulations to encourage establishment of riparian buffers within the 1-percent-annual-probability floodplain, particularly when the zoning of land changes from agricultural to urban uses.

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[40] *The Town of Merton does not have an upland conservancy zoning district, but this is regulated under Waukesha County ordinance.*

3. **It is recommended that riparian buffers be established to the extent practicable throughout the watershed with a minimum goal of a 75-foot width and an optimal goal of a 1,000-foot width (Map III-2), to meet pollution load reduction goals through establishment of 345 acres of riparian buffers/restored wetlands/filter strips as shown on Map B-2 in Appendix B** (see *"Targeted Load Reductions"* section). These important riparian areas are considered a high priority to protect and restore hydraulic and hydrologic function, reduce pollutant loads, and improve wildlife within this watershed. Specific measures that can be taken to accomplish this recommendation include:

- Establishing undisturbed vegetation along perennial, intermittent, and ephemeral waterways in both urban and rural areas to the extent practicable. The use of native species should be considered where possible;
- Considering installation of harvestable riparian buffers where practicable while the lands remain in agricultural uses; and,

- When lands are converted from agricultural to urban uses, considering establishing larger buffers widths for Mason Creek and its associated tributaries at the 400-foot and 1,000-foot optimal widths or to the 1-percent-annual-probability floodplain boundary, whichever is greater.

4. It is recommended that connections and pathways be established between riparian buffer areas to ensure connectivity and continuity of buffers, environmental corridors, and natural areas. Specific measures that can be taken to accomplish this recommendation include:

- Creative landscaping to promote safe travel corridors and creating essential habitat features within and adjacent to corridors in either urban or agricultural landscapes such as shown in Figure III-3 (e.g., creating ephemeral wetlands or naturalizing stormwater detention basins from mowed grass to natural plant communities using native species);

- Where possible, protecting against fragmentation of riparian buffers by limiting both creation of new road crossings of the mainstem of Mason Creek and tributary streams and encroachment by development and other infrastructure that impacts the structure and function of these riparian areas and reduces their ability to adequately protect waterways and wildlife habitat; and

- Removing abandoned or nonessential roads and other stream crossings where appropriate (see "*Reconnect Aquatic Organism Passage*" section below for more details)

Maintain and Restore Instream Habitat

Since at least the early 1900s, the Mason Creek system has been substantially altered through channelization, agricultural and urban development, road construction, placement of fill, construction of stormwater conveyance systems, and other actions related to agricultural and urban development. These changes have physically, chemically, and hydrologically degraded aquatic habitat and impaired the health of the cold water trout fishery and associated aquatic community. Therefore, the general approach to conserve and protect instream fish and wildlife habitat within the Mason Creek watershed includes four main elements (see below for more details):[41]

- Protect existing high quality components;
- Improve instream flows
- Restore degraded stream channels, wetlands, and riparian areas
- Reconnect mainstream and tributary components of Mason Creek to North Lake by removal of aquatic organism passage barriers

It will be important to maintain and improve, to the extent practical, the physical, chemical, and hydrologic characteristics within the Mason Creek watershed, as well as the habitat integrity, through invasive species management, preservation of riparian buffers, protection of groundwater recharge, preservation and protection of spawning areas and riffles, and restoration of streambeds and banks where appropriate. As habitat among reaches and the connectedness of the stream system are improved over time, there will be improved aquatic organism populations and overall health. Hence, these recommendations are designed to restore natural functions in the Mason Creek watershed, to mitigate the negative impacts of alteration, and to provide essential habitat for fish and wildlife.

Modeling results based upon the overall state of Wisconsin indicated that climate change has the potential to cause the possible extirpation of coldwater brook trout within Mason Creek. This does not mean that Mason Creek will inevitably become unsuitable for brook trout, but it does indicate that it is a likely scenario and that this stream is sensitive to changing air and water temperatures, precipitation, and groundwater discharge. However, climate change stressors are difficult to differentiate from other anthropogenic (i.e., human induced) stressors such as summarized above that include land use changes, hydrologic alteration, invasive species impacts, and riparian buffer clearing, which can have complex and compounded negative effects on inland fisheries.[42] Fortunately, the

[41] *Jack E. Williams, and others, Adaptation and Restoration of Western Trout Streams: Opportunities and Strategies, Fisheries, Vol. 40, No. 7, pages 304-317, July 2015.*

[42] *Abigail J. Lynch, and others, "Climate Change Effects on North American Inland Fish Populations and Assemblages," Fisheries, Volume 41(7), July 2016.*

occurrence of compounded effects indicate that actions to lesson other anthropogenic stressors can mitigate climate change impacts to protect and sustain the fishery.[43] Therefore, in addition to the pollutant load reductions summarized above, to promote the resistance and resilience of the Mason Creek system (see Figure III-4),[44] this plan focuses on reducing instream water temperature and protecting/preserving groundwater discharge (to mitigate against a warming climate and/or reduced precipitation). More specifically, adaptation strategies targeted to increase landscape connectivity such as idealized in Figure III-4 and corridors among habitats, restoring degraded habitats, and removing other threats and stressors such as invasive species or upland erosion are examples of how these strategies can be applied in the context of climate adaptation in the Mason Creek watershed (see Table III-5 for more details). **Therefore, adaptation strategies that promote resistance and build ecological resilience to reduce the impacts of climate change and other stressors in the Mason Creek watershed is the overall strategy in this plan.** That strategy will enable Mason Creek to maintain a sustainable, naturally reproducing population of brook trout and the associated coldwater biotic assemblage for future generations.

Protect Existing High Quality Components

As described in Chapter II of this report (see Map II-5 and Table II-16), the existing highest quality fishery and aquatic habitat within the Mason Creek watershed is located within the East Branch and Lower Mason Creek reaches:

> **East Branch brook trout spawning and rearing habitat protection area-**Protect this area by establishing buffers and improving groundwater supply to the Creek (particularly dry weather flow) and by disabling any drain tiles, refilling any drainage ditches, and enhancing coldwater spawning and rearing habitats (see Priority Area 2 on Map III-1). Consider drainage effects on upstream property owners.
>
> **Lower Mason Creek brook trout habitat protection area-** Protect this area by establishing buffers and improving groundwater supply to the Creek (particularly dry weather flow), disabling any drain tiles, refilling any drainage ditches, and enhancing potential spawning areas as well as deep coldwater pool habitats (see Priority Area 3 on Map III-1).

Branches, tree limbs, root wads, and entire trees that fall into, and collect along, streams are commonly referred to as large woody debris (LWD). LWD plays a vital role in the hydraulic, geomorphic, and biological function of the streams and floodplains within the Mason Creek watershed, which includes wetlands, ponds, creeks, and North

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[43] *Ibid.*

[44] *Jack E. Williams, and others, Adaptation and Restoration of Western Trout Streams: Opportunities and Strategies*, *Fisheries, Vol. 40, No. 7, pages 304-317, July 2015; and, James E. Whitney, and others*, *Physiological Basis of Climate Change Impacts on North American Inland Fisheries, Fisheries, Vol. 41, No. 7, pages 333-345, July 2016.*

Lake.[45] LWD helps control the shape of the channel and provides cover, shelter, resting areas, and feeding opportunities for aquatic organisms over the course of their complex life histories. In addition, the interaction between LWD, water, and sediment has a significant effect on channel form and process, increasing geomorphic complexity and the quality of aquatic habitat.[46] In general, the amount and character of large woody debris was adequate within the Lower Mason Creek, but LWD was absent or only present in limited amounts within the channelized Upper Mason Creek.

- It is recommended that, removal of LWD from streams within the Mason Creek watershed be discouraged, unless it becomes a barrier to fish passage, is causing streambank erosion, or is creating upstream flooding. It is recognized that this will need to be balanced with reasonable removal efforts that are required to reduce the risk of property damage and maintain aquatic organism passage.
- Similarly, it is recommended that both submerged and floating trees be introduced into riparian wetlands and waterways such as the Spring Pond area to enhance fish, amphibian, and reptile habitats.

  It is recommended to periodically monitor for woody debris accumulations within the watershed, particularly at road crossings or associated with streambank erosion, and to dismantle and/or remove them if they become a problem.
- It is also recommended that overall wildlife habitat be enhanced by adding features such as strategically-placed downed trees, brush, rock, or ephemeral wetlands in riparian areas throughout the floodplain (see "*Maintain and Improve Wildlife Habitat*" section above).

- Although there was limited trash and other debris observed within the Mason Creek system, it is recommended that annual or semi-annual surveys be conducted in riparian and instream areas and all trash and debris identified be removed to improve aesthetics and to protect wildlife.

Improve instream flows

In addition to the recommendations set forth in the "*Reduce the Volume and Velocity of Runoff from Upland Areas to Streams, Increase Soil Infiltration, and Protect Groundwater Recharge*" section above, the following recommendations are made:

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[45]*Kingsbury, B.A. and J. Gibson, Habitat Management Guidelines for Amphibians and Reptiles of the Midwestern United States, Partners in Amphibian and Reptile Conservation (PARC), Technical Publication HMG-1, 2nd Edition, 2012.*

[46]*C.J. Brummer, T.B. Abbe, J.R. Sampson, and D.R. Montgomery, "Influence of Vertical Channel Change Associated with Wood Accumulations on Delineating Channel Migration Zones,"* Geomorphology, *Volume 80, pp. 295-309, 2006.*

- Identify opportunities to protect and enhance groundwater recharge, particularly within the headwater areas of this watershed.

- Work with local municipalities to consider establishing ordinances that require consideration of groundwater and groundwater/surface-water interaction effects when issuing permits.

- Work with landowners and farmers in priority areas to encourage implementation of the agricultural BMPs within critical floodplain areas with emphasis on buffer establishment.

Restore degraded stream channels, wetlands, and riparian areas
Restoration of natural conditions within failed wetland drainage projects was also identified as having a high potential to reduce pollutant loads in this system. In such areas, ditch plugs and wetland restorations are recommended to naturalize water flow as detailed in the "*Protect and Expand Riparian Buffers*" sections above. Streambank erosion sites were identified and prioritized. However, it is important to note that streambank erosion is only a small fraction of the overall pollutant load to Mason Creek and the worst eroding site depicted in Figure II-31 has recently been addressed with funding from the North Lake Management District and the OWPP. There are additional moderate and low streambank erosion sites (see Map B-2 in Appendix B), but these are not considered a problem at this time. Some of these sites are located within the Upper Mason Creek reach, but it is anticipated that those will be addressed when the stream remeandering and floodplain connectivity is restored in this reach (see below). There also were some erosion sites located within the Lower Mason Creek, and these streambank sites are recommended to be monitored at least annually and addressed only if they become worse.

The extensive ditching within the West Branch Agricultural Ditch and Upper Mason Creek reaches has disabled this stream system's ability to capture, store, and process/treat sediment and nutrient loads. Therefore, the only way to restore this system's hydrologic and hydraulic function and associated sediment transport capacity and streambank and streambed stability is to physically reconstruct this wetland/stream complex to its historic configuration as described below:

West Branch Agricultural Ditch Sediment Retention/Wetland Restoration Improvement Area -Restore this agricultural ditch and associated floodplain area to a wetland/lowland swamp with associated shallow groundwater hydrology to emulate historic hydrological and ecological conditions, reduce flashiness, and prevent bedload sediments and associated pollutants from being transported downstream. Most of the recommended actions below are potentially eligible for cost sharing, particularly if combined with wetland restoration. This will require cooperation and coordination with the County, Town, and local landowners. More importantly, all of the recommendations below will require cooperation and permission from the local landowner(s) and farmer(s) as well as coordination with the relevant Federal, State, county, and town staffs.

Objective-Detain, capture, slow down, and/or treat stormwater runoff, increase dry weather water levels and flow, and prevent chronic upland-sourced sediment and nutrient loads from entering Mason Creek by installing a series of ditch plugs (see Appendix H) combined with check dams and/or wetland restoration in gullies discharging to the West Branch agricultural ditch (see Map III-1 and Priority Area 1).

Short term strategy:

- Purchase all the land and/or obtain appropriate conservation easements within the floodplain area. Discontinue agricultural production in the floodplain or convert to a harvestable buffer within the minimum buffer distance of 75 feet from the edge of the stream, whichever is greater, and disable drain tiles (see Map III-2). Consider the effects of these actions on upstream property owners.

- Work with landowners and farmers in the floodplain to encourage implementation of agricultural BMPs within this critical floodplain area with emphasis on buffer establishment.

- Install and maintain check dams/ditch turnouts (see Appendix G) or equivalent BMPs within the roadside ditches adjacent to Erin Road/Townline Road, as appropriate to reduce sediment loads to the West Branch Agricultural Ditch and Mason Creek (see approximate locations on Map III-1, Priority Area 1). In addition, work with landowners and farmers to encourage greater setbacks adjacent to roadside ditches with emphasis on buffer establishment.

- Install and maintain agricultural ditch plugs (see Appendix H), partial ditch fill, or equivalent BMPs within the minor drainages/concentrated flow areas (see concentrated flow ditch/gullies on Map III-1, Priority Area 1) tributary to the West Branch Agricultural Ditch. These drainages are very flashy and deliver high loads of sediment-laden water to the West Branch Agricultural Ditch and Mason Creek.

- There are design opportunities on the west side and east side of Erin Road/Townline Road (particularly where there are existing culverts, see Map III-1, Priority Area 1), to store and slow water down during rainfall events to reduce pollutant loads entering Mason Creek. It is recommended to work with the municipalities and landowners to modify or replace existing culverts or construct additional stormwater detention ponds or other BMPs to detain and temporarily store stormwater runoff from fields and the roadway.

- Work with landowners to restore groundwater hydrology by disconnecting drain tiles. More specifically, one landowner who was contacted at the time of the stream survey was interested in disabling tiles on his property, which was shown on Map III-1, Priority Area 1 as "Drain Tile Disconnection Area".

Long term strategy----Challenges associated with this recommendation

- Install a series of ditch plugs (see Appendix H) and/or partial ditch fills using spoil piles from past channelization within the West Branch Agricultural Ditch (see Map III-1, Priority Area 1). This will require cooperation and permission from the local landowner(s) as well as coordination with the relevant Federal, State, County, and Town staff.

  Because this project is located within an agricultural setting (i.e., zoned agricultural land), it does qualify for one or more government wetland restoration programs such as the Conservation Reserve Program (CRP) or Wetland Reserve Program (WRP) (see "*Funding Sources*" section below for further details). This proposed project would likely meet the eligibility requirements for sound wetland restoration as set forth within Chapter NR 353, "Wetland Conservation Activities," of the *Wisconsin Administrative Code*. Hence, this proposed restoration project may be eligible for the NR 353 general permit, because it would likely meet each of the eligibility requirements listed/described below in question/answer format, along with supplementary recommendations:[47]

  Question—Is your project sponsored by the Natural Resources Conservation Service (NRCS), the US Fish and Wildlife Service (FWS) or the Wisconsin Department of Natural Resources (WDNR)?

  Yes—It is recommended that this project be sponsored by the NRCS and/or WDNR through the OWPP in partnership with the City of Oconomowoc's Adaptive Management Program, which will help with design and implementation cost share funding (see "*Funding Sources*" section below for further details).

  Question—Is the purpose of the project wetland conservation? In other words will the project result in the re-establishment or restoration of drained wetlands, enhancement of existing degraded wetlands or creation of new wetlands?

[47]*Alice L. Thompson and Charles S. Luthin, Wetland Restoration Handbook for Wisconsin Landowners, 2nd Edition, 2010; and WDNR Wetland Regulations website at http://dnr.wi.gov/topic/wetlands/restorationpermits.html*

Yes—This project will re-establish drained wetlands and enhance degraded wetlands. The proposed ditch plugs and/or partial ditch fills are designed to reverse the impacts to this wetland and restore groundwater hydrology.

Question—Will the project include one or more activities that are eligible for the general permit and that are consistent with design and construction according to NRCS Field Office Technical Practice Standard 657-"Wetland Restoration"?

This project potentially includes one or more of the following activities:

- Drain tile alteration or removal by disabling a section of drain tile in the project area.
- Disabling artificial surface drains by filling lengths of the ditch downstream of the drainage system to be altered or installation one or more ditch plugs. Ditch fills may be added upstream of ditch plugs or ditch fills may extend for the entire length of the ditch. Ditch plugs may be eliminated if the proposed ditch is completely filled with earth.
- Introducing native plants and managing existing exotic or invasive plant species.

Yes—The potential activities listed above are eligible for the general permit and also are eligible for cost share through the OWPP as an approved wetland restoration technique (see "*Funding Sources*" section below). In addition, **it is recommended that a management plan be included with the permit application**, because maintenance that is described in the project proposal will not require additional WDNR permits in the future. For example, if the management plan includes maintenance of a ditch plug, the project team will be allowed to repair the plug to the original specifications at a later date without needing to obtain another permit. **It also is recommended that re-seeding and planting, burning, herbicide use, and mowing, along with any other future maintenance activities to promote native vegetation and control invasive species, be included in the permit**, which will allow such actions to occur without further WDNR permitting. However, Federal or local permits may be needed for continued maintenance.

Question—Does the project involve activities in navigable waters with prior stream history?

No—There is no stream history associated with the West Branch Agricultural Ditch. More specifically, there was no natural stream within the vicinity of this Ditch prior to its construction sometime between 1909 and 1939. This is based upon information from the 1909 and 1836 plat maps and associated notes as well as the 1892 and 1909 U.S. Geological Survey quadrangle maps (see Chapter II).

Question—Will the project include the construction of a dam, dike, embankment, or low berm that is: less than or equal to 6 feet in height as measured from the natural ground level; or, less than 25 feet in height as measured from the natural ground level with a maximum storage capacity of less than 50 acre-feet?

Yes--It is estimated that the ditch plugs or partial ditch fills will not exceed three to four feet in height, which is the approximate maximum height of the stream banks within the West Branch Agricultural Ditch. In addition, since there is an adopted FEMA floodplain delineated along the Ditch, it is important that construction of the ditch plugs not increase the one-percent-annual-probability flood elevation. Therefore, **completion of a floodplain modeling study is recommended to ensure the location, number, and design details of each agricultural ditch plug or partial ditch fills will not increase the flood elevation or flood additional existing cropland.** The ditch system was designed to reduce water elevations during fair weather periods to promote farming of these lands. The additional stormwater conveyance capacity offered by the relatively small artificial ditch is likely negligible. Therefore, it may be possible to install ditch plugs without raising regulatory floodplain elevations. The ditch plug locations identified on Map III-1 inset Area 1 were placed at two foot elevation intervals to approximate the potential location of a series of ditch plugs, but the exact location and number would have to be verified by modeling, onsite conditions, and permission from landowners. Implementing this project may require moving or retrofitting drain tiles in some areas.

Question—Will the project result in significant adverse impacts to endangered or threatened species, or to historical or cultural resources?

No—This Ditch and the adjacent wetland do not contain any known endangered or threatened species, or impact any historical or cultural resources.

Therefore, based upon the scenario outlined above, it is expected that this proposed wetland restoration project would qualify for the Statewide wetland conservation general permit. However, **it is recommended that the project partners consult with WDNR prior to proceeding with this project.** It is important to note that these proposed wetland restoration actions would help to reduce the sediment and phosphorus loads, below what was modeled under this plan.

Mason Creek brook trout habitat restoration- Restore and/or rehabilitate the degraded channelized reaches and their associated wetlands and riparian areas to improve water quality and brook trout habitat by addressing streambank and streambed sediment loads, recreating pool-riffle structure, and providing floodplain connectivity (see Map III-1, Priority Areas 2 through 4).

Restoring channelized reaches to a more natural state will decrease the pollutant loads beyond what was modelled under this study. The stream will also be able to remove pollutants by increasing 1) water residence time (longer meandering stream length), 2) biological nutrient processing (connected floodplain), 3) sediment transport and storage capabilities, and 4) metabolism.[48] The benefits of floodplain restoration are most apparent during high flow events (during inundation). Floodplains are more effective at assimilating nutrients when they are vegetated with appropriate native plants, so invasive species management is also important (see "*Maintain and Improve Wildlife* Habitat" section above). Restoring natural meanders also has the added benefit of dramatically improving the number and diversity of essential deep pool and shallow riffle habitats that will improve the quality and diversity of the biological community, particularly for brook trout life history requirements. Therefore, this plan makes the following short-term and long-term recommendations to work towards achieving this restoration goal:

Objective-Capture, detain, slow down, and treat stormwater runoff; increase dry weather flow; and prevent chronic sediment and nutrient loads from entering Mason Creek by improving floodplain connectivity and pool-riffle structure (see Figure II-39) combined with wetland restoration (see Map III-1, Priority Areas 2 through 4).

Short term strategies/alternatives:

- Purchase all the land and/or obtain appropriate conservation easements within the floodplain area or a minimum distance of 75 feet from the edge of the stream, whichever is greater. Discontinue agricultural production in the floodplain or 75-foot buffer area or manage that area as harvestable buffer and disconnect or modify drain tiles to promote vegetative uptake of nutrients prior to discharge to the stream (see Map III-1, Priority Areas 2 through 4).

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[48]*Sarah S. Roley, et al., "Floodplain restoration enhance denitrification and reach-scale nitrogen removal in an agricultural stream", Ecological Applications, Volume 22(1), pages 281-297, 2012; Sarah S. Roley, et al., "The influence of floodplain restoration on whole-stream metabolism in an agricultural stream: insights from a 5-year continuous dataset; and, Sarah S. Roley, Jennifer L. Tank, and Maureen A. Williams, "Hydrologic connectivity increases denitrification in the hyporheic zone and restored floodplains of an agricultural stream", Journal of Geophysical Research, Volume 117, pages 1-16, 2012.*

- Work with landowners and farmers with property in the floodplain to encourage implementation of the agricultural BMPs within this critical floodplain area with emphasis on buffer establishment.

- Work to reduce pollutant loads from all roadway ditches. This will require cooperation and coordination with the County, Town, and local landowners. The drainage ditches associated with these roads are very flashy and deliver high loads of sediment-laden water that discharge to Mason Creek, so the goal is to look for design opportunities on all roadways—with a priority on the north side and south side of CTH CW and the east and west sides of Westshore Drive—to store and slow water down during rainfall events to reduce pollutant loads to Mason Creek.

- Work with landowners and other partners to incorporate their needs in a conceptual plan for the proposed stream channel remeandering in the Upper and Lower reaches of Mason Creek (see Priority Areas 2 and 3 as shown in Map III-1). Once preliminary agreements are reached, it will be necessary to conduct a floodplain study to verify that the proposed conceptual remeandering projects will not increase the regulatory floodplain elevations.

    - Relocate the channelized portion of the Lower Mason Creek reach that parallels Petersen Road into its historical channel configuration between Petersen Road and the Union Pacific Railroad bridge (see Map III-1, Priority Area 4). This will simultaneously move the stream channel away from the existing road ditch and increase the number and quality of pool and riffle habitats, improve floodplain connectivity, and increase stream length by 100 feet. This historical channel is still present and this relocation could easily be achieved with construction of simple channel blocks to divert flows back into the old channel. Once flow is diverted, the channelized portion is recommended to remain as deepwater marsh wetland habitat for amphibians and reptiles, which will also function to naturally capture sediments during high flows, thereby reducing loads to the downstream portion of this reach and North Lake. This stream and wetland restoration will require permits and it is recommended that the project partners consult with WDNR prior to proceeding with this project. It is important to note that these proposed stream and wetland restoration actions would help to reduce the sediment and phosphorus loads below what was modeled under this plan.

- It is recommended that a streambank/streambed survey be conducted on the remaining unassessed portion of the East Branch of Mason Creek to identify opportunities to reduce pollutant loads and improve surface water and groundwater quality and quantity. While a large portion of the stream network in the Mason Creek watershed has been surveyed for streambank erosion and streambed deposition as part of this study, the majority of the East Branch remains unassessed. Since this is the only reach where brook trout were observed to be spawning, it is important to identify potentially eroding streambank or streambed sites that could be affecting downstream aquatic habitat in this reach as well as in areas downstream.

Long-term strategy:

- It is recommended that excessive streambed sediments be addressed through creation of a more natural stream system in the impaired Upper Mason Creek reach. This would involve restoring or reconstructing the historical stream sinuosity, pool-riffle habitats, and floodplain connectivity of the Creek. This is a long-term project because remeandering of this reach should not be conducted until sediment bedload prevention/mitigation be completed in the West Branch Agricultural Ditch and associated drainage ditches directly upstream of this reach. Although the location and characteristics of the historical channel within the Upper Mason Creek is known from historical aerial maps, due to many years of agricultural management, this channel no longer exists on the landscape and will have to be reconstructed. It is recommended that this reach be restored to approximate its original (i.e., historical) channel alignment, location, slope, sinuosity, and floodplain connectivity (see Map III-1) within the confines of the needs of stakeholders and landowners. The stream channel design dimensions should be based upon the template or reference low flow and bankfull (i.e., channel forming discharges, see Appendix I) reach conditions in this portion of the Upper Mason Creek reach.

Re-establish Aquatic Organism Passage

Recreational fishing is an important economic activity in the Southeastern Wisconsin Region and North Lake. The maintenance and continuity of the species of economic importance (i.e., gamefish species) and those species on which they depend is associated to a large degree with the protection and restoration of appropriate habitat. To this end, efforts to remove obstructions to fish migration from the mainstem and tributaries of Mason Creek to North Lake are key considerations for the long-term restoration of the fishery, particularly brook trout. Examples of these obstructions are shown in Figure II-40 and further summarized in Appendix J. Removal, replacement, and/or retrofitting of these obstructions should be accompanied by the restoration or re-creation of habitat within the stream and riparian corridor. Such habitat is essential for refuge, rearing, feeding, and spawning of fishes and other organisms. Therefore, designs to improve fish passage through replacement or modification of hydraulic structures should use brook trout swimming abilities as a guide template for passage at critical low flow and bankfull conditions in Mason Creek and should accommodate sediment transport and floodplain connectivity to the extent practicable as illustrated in Figure II-41 (also see fish passage criteria in Appendix J). This will help to improve the biotic integrity of both the streams within the Mason Creek watershed and North Lake. To maintain and restore fish and aquatic organism passage throughout the Mason Creek watershed, the following recommendations have been developed:

1. Removal, replacement, and/or retrofitting of obstructions identified on Map III-1, accompanied by the restoration or re-creation of habitat within the stream and riparian corridor, is essential for refuge, rearing, feeding, and spawning of fishes and other organisms. **Priority for improving passage should be given to restoring connectivity and habitat quality between the mainstem of Mason Creek and North Lake and between the mainstem of the Creek (Upper and Lower reaches) and the East Branch.**

   The description and recommended actions for each of these structures are summarized below:

   - **Lower Mason Creek**
     - **Private drive (Structure No. 7, see Priority Area 4 of Map III-1) at River Mile 0.41**- It is recommended that modification of this structure be a high priority to improve fish passage for brook trout. Replace the existing structure with a single cell structure with a minimum width of 1.2 times the reference reach bankfull conditions (e.g., open bottom box culvert, embedded closed bottom box, or equivalent pipe, see fish passage structure guidance in Appendix J for more details) along with one or more floodplain relief/overbank culverts (see Figure II-41).[49] Modeling will need to be conducted to ensure that the regulatory flood elevation is not increased.[50]
     - **Koester Road (Structure No. 9, see Priority Area 4 of Map III-1) at River Mile 0.5-** it is recommended that modification of this structure be a high priority to improve fish passage for brook trout. Replace the three corrugated metal pipes with a single cell structure with a minimum width of 1.2 times the reference reach bankfull conditions (e.g., open bottom box culvert, embedded closed bottom box, or equivalent pipe, see Appendix J) along with one or more floodplain relief/overbank culverts (see Figure II-41). Given the length of this structure, resting areas are recommended to be incorporated within the bankfull culvert to ensure

[49]*See U.S. Fish and Wildlife Service at* https://www.fws.gov/northeast/mainefisheries/projects/connectivity.html\

[50]*Federal Emergency Management Agency (FEMA)*, Flood Insurance Study (numbers 55133CV002C and 55133CV003C), Waukesha County, Wisconsin, and Incorporated Areas, Volumes 2 and 3, *November 5, 2014, Contact WDNR to obtain copy of Hydraulic/Floodplain Model.*

adequate passage, particularly for brook trout (see Appendix J for more details). Modeling will need to be conducted to ensure that the regulatory flood elevation is not increased.[51]

- **Private drive (Structure No. 12) RM 1.26-** Remove or replace this structure with an appropriately sized culvert or install rock vane(s) in the culvert to raise water levels, reducing water velocity and increasing water depth. If the culvert is replaced, it should be replaced by a single structure that has a minimum width of 1.2 times the reference reach bankfull dimensions and that meets other criteria to ensure adequate fish passage as summarized in Appendix J.

- **Upper Mason Creek**
  - **CTH CW (Structure No. 15, see Priority Area 2 of Map III-1) at RM 2.51-** Remove the roadway fencing and debris accumulated in the channel at the downstream side of the culvert.

  - **Private culverts (Structure No. 16, see Priority Area 2 of Map III-1) at RM 3.28-** Remove both culverts and accumulated debris in the channel.

  - **Private Spring Pond near confluence with East Branch of Mason Creek-**Restore the hydrological connection between the spring pond outlet to Upper Mason Creek by removing the outlet standpipe and associated earthen berm. This connection would restore access to important cold, deepwater habitat in the hottest summer periods and warm, deepwater habitat in the overwintering periods for brook trout and other fishes, amphibians, and reptiles.

- **East Branch of Mason Creek**

  - **Private drive (Structure No. 19, see Priority Area 2 of Map III-1) at RM 0.05-** Remove all three of the embedded pipes from underneath this ford crossing to enable the previously diverted water to flow over the ford, which will improve water depth for passage, particularly in low-flow time periods. Regrade/reconstruct the downstream edge of the ford as well as the roadway to a more appropriate slope. It is recommended that target water depths of the completed ford be not less than 0.5 foot and water widths be not less than four feet or greater than 10 feet at low flow conditions, and that streambed slopes of this entire ford structure not exceed 2 percent. It may be necessary to install one or more rock vanes (see Figure II-42) to

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[51] *Ibid.*

reduce the overall stream slope through the ford and create deeper water to promote fish passage as well as resting areas.

2. Stream crossings tend to have a cumulative impact on the stream and adjacent lands, as well as an impact on the quality of the water and the fishery. Therefore, it is important to reduce the linear fragmentation of the existing riparian buffers by either removing crossings where possible or by not increasing the number of crossings where practical. It is recognized that access by police, fire protection, and emergency medical services are overriding considerations that must be applied in determining whether the objective of removing a crossing is feasible. This recommendation is only meant to apply to situations where there are more road crossings than necessary to ensure adequate traffic carrying capacity and adequate access for emergency services.
3. Encourage development of plans for replacement and/or retrofitting of obstructions at all mainstem and tributary road crossings to incorporate improvements to aquatic and other organism passage over time as opportunities present themselves (e.g., structure failure, major blockage, or bridge reconstruction or replacement). The recognition that fish populations and other wildlife are often adversely affected by culverts has resulted in numerous designs and guidelines to allow for better fish passage and to help ensure a healthy sustainable fisheries community (see Appendix J).[52]

    - These plans should be developed in partnership with the relevant municipality and the County Highway or Public Works Departments. Actions to improve passage would have to be coordinated with the WDNR, County Highway or Public Works Departments, local public works departments, and/or the Wisconsin Department of Transportation.

    - Consider annual or biannual surveys of the Mason Creek system to assess capabilities to maintain fish passage at all road or railway crossings, particularly identifying obstructions due to debris accumulation or beaver dams, and to identify where actions need to be taken to improve passage.

Recommended Actions Associated With Management Objective to Increase Public Awareness of Water Quality Issues and Participation in Watershed Conservation Activities

The recommendations presented within this section are designed to enhance both public understanding of the plan and participation to implement plan recommendations. More specifically, this section contains 1) recommendations related to an information and education component, 2) details on how to measure and track plan implementation progress and success,, and 3) interim measurable milestones and established criteria.

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[52]*B.G. Dane,* "A Review and Resolution of Fish Passage Problems at Culvert Sites in British Columbia," *Canada Fisheries and Marine Sciences Technical Report 810, 1978. Chris Katopodis,* "Introduction to Fishway Design," *Freshwater Institute Central and Arctic Region Department of Fisheries and Oceans, January, 1992.*

Information and Education

The information and education component of this plan is designed to increase participation in conservation programs and implementation of conservation practices by informing the landowners and farm operators of assistance and tools available to them and providing emerging information on cover crop, no-till implementation strategies, and other recommended BMPs. Creating education and partnership opportunities for elected officials and representatives of organizations active in the watershed are also integral to the information and education plan. Riparian landowners and the general public will need to be informed of the importance of land and water connections and the necessity of improving in-stream and wildlife habitat and water quality.

Civic Engagement

Civic engagement is essential to the implementation of watershed plans. Technical advisors and funding agencies are key to successfully completing watershed projects, but having an engaged core of committed municipalities, citizens, business leaders, grassroots organizations, and local agencies is paramount. When the entire group is willing and able to understand each other's goals and are committed to work together, implementation plans lead to successful on the ground projects. Stakeholders who are affected by the watershed plan, who can provide information on the issues in the watershed, and who work to implement existing programs or plans that incorporate similar goals should actively participate.

Driving Forces

Within the watershed, stakeholders have worked together at varying scales to improve water quality for many decades. In the 1980s, the watershed was part of the Oconomowoc River Priority Watershed Project that facilitated the implementation of agricultural BMPs through joint efforts of the Counties, WDNR, and NRCS.[53] More recently, interest in improving the quality of water in the Oconomowoc River watershed led to the formation of the Oconomowoc Watershed Protection Program (OWPP) and Adaptive Management Program administered through the City of Oconomowoc. The mission of the OWPP is stated as "*Working in Partnership to Protect and Improve Soil and Water Quality in the Oconomowoc River Watershed*" (see Figure III-5). The OWPP is composed of community groups, State and Federal agencies, nonprofit organizations, and other local interest groups. The diverse membership works collaboratively to implement recommendations established under the WDNR-approved Adaptive Management Program by organizing, prioritizing, and coordinating land management and outreach activities.[54] The NRCS, Washington County, and Waukesha County have provided technical guidance to farmers and the OWPP to help implement agricultural management improvement projects to improve water quality.

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[53] *WDNR,* Oconomowoc River Priority Watershed Project, *1986.*

[54] *Op. cit., City Of Oconomowoc, February 2016.*

Additional funds became available from the USDA in 2015 through successful acquisition by the City of Oconomowoc of a Regional Conservation Partnership Program (RCPP) grant (see "Funding Sources" for more details). The main goal of this RCPP grant/project is to improve water quality within and downstream of the Oconomowoc River watershed. The City of Oconomowoc is leading this project by working with producers and many other partners to improve water quality. A secondary objective is working with agricultural producers to improve water quality by reducing soil loss and nutrients within the watershed. [55] There are 21 potential agricultural sites currently involved with this program and project partners are able to provide up to $500,000 toward conservation efforts within the Oconomowoc River watershed.[56] The program includes two recent projects to improve water quality by increasing stream side buffer strips and addressing streambank erosion as shown in Figures II-29 and II-31, respectively, within the Mason Creek watershed.

In 2014, the USEPA directed that the majority of funds available through the Clean Water Act for pollution abatement projects for waters that are designated as being impaired are to be used in watersheds with a WDNR- and USEPA-approved plan that meets the USEPA nine key elements of a watershed-based plan. Since Mason Creek is located within the Rock River basin, and the basin has been designated as impaired by excess phosphorus and sediment, it is necessary to establish and implement a plan that meets the USEPA nine key elements.

Stakeholders

Efforts to educate, inform, and engage Mason Creek watershed stakeholders about the watershed protection plan process has been accomplished through the convening of stakeholder and community meetings. Stakeholder input has been a key factor in developing objectives, and refining priority projects and programs. Community input about issues of concern is reflected in the results of a questionnaire that was distributed early in the outreach effort. Community meetings have also provided a means to develop goals, share progress on the development of the protection plan, and receive input from the public. The questionnaire results established that water clarity, agricultural runoff, garbage and trash in natural areas, invasive species, and pesticide use topped the list of water concerns (see Table III-2).

The following stakeholders were identified during the information and education process:

- Agricultural Producers
- Businesses
- Southeastern Wisconsin Regional Planning Commission
- Tall Pines Conservancy

[55]*See http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/farmbill/rcpp/?cid=stelprdb1267903*

[56]*Tyler Langan, "Oconomowoc Watershed Program Embraced by Area Farmers", Lake County Now, June 29, 2016, http://archive.lakecountrynow.com/news/oconomowocfocus/oconomowoc-watershed-program-embraced-by-area-farmers-b99753337z1-384897571.html*

- City of Oconomowoc Wastewater Utility
- Clean Water Association
- Crop Advisors
- Farmers
- Landowners
- North Lake Management District
- Rock River Coalition
- Ruekert-Mielke, consulting engineers
- School Districts
- Towns of Merton and Erin
- Universities and Colleges
- University of Wisconsin Extension Service
- USDA - Farm Service Agency
- USDA - Natural Resources Conservation Service
- Washington County
- Waukesha County
- Wisconsin Department of Natural Resources

Goals

The goals and recommended actions for this information and education plan are based on the USEPA 2008 effective information and education watershed plan components as well as questionnaire results, work group meetings, and stakeholders.[57] The plan addresses elements such as creating appropriate messages to targeted audiences, distributing the message, and periodic evaluation of the information and education program. Most importantly, it is envisioned that the identified stakeholders within and adjacent to the Mason Creek watershed will continue to partner and work together to implement the plan.

The goal of the Mason Creek watershed protection plan is to provide information that local decision makers, farmers and landowners, and watershed residents can use to improve and protect the natural resources of the Mason Creek watershed. More specifically, the goal is to promote active stewardship among residents, farmers, landowners, businesses, community associations, as well as governmental and non-governmental organizations.

To increase public awareness of water quality issues and increase participation in watershed conservation activities, the education and information plan includes the following elements and specific actions (proposed timelines are summarized in Table III-6):

- Inform the general public about the fish and wildlife species known to reside in the watershed, their habitat requirements, and management practices required to sustain them.
- Inform agricultural landowners and operators about the plan, its recommended BMPs, and technical and funding assistance available.

- Inform nonresident agricultural landowners about local, State and Federal opportunities for funding and technical assistance.

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[57]*U.S. Environmental Protection Agency (USEPA),* Handbook for Developing Watershed Plans to Restore and Protect Our Waters*, USEPA 841-B-08-002, March 2008.*

- Inform riparian landowners about opportunities to improve wildlife habitat, and provide information about programs to fund expanding riparian buffers and restoring wetlands.

- Inform local officials about the protection plan and its goals, and work with them to adopt this plan through partnership building (see "*Measuring Plan Progress and Success*" section below).

- Promote increased stewardship through enhancements of recreational use and access, where practicable.
- Host workshops, meetings, and events that landowners can attend to learn about conservation practices. **More specifically, the OWPP should continue to host events such as the 2nd Annual Watershed Paddle and Protect the Monarchs Workshop and the 1st Annual Healthy Lake Conference.**

Engagement Strategy

Different target audiences require different educational messages delivered in a customized fashion. The agricultural landowners are the audience with the greatest potential to reduce pollutant loads and to partner to expand wetland and wildlife habitat. It is estimated that a large proportion of the lands in agricultural row crop production are farmed through lease agreements. The landowners who lease their properties often plan to sell their land when development pressure creates a favorable market. Engaging both the landowner and operator requires understanding their perspectives and goals. This will require a greater amount of effort and resources than the other defined target audiences. Farmer-led watershed improvement efforts are working effectively in several locations in the Midwest. **It is recommended that the plan implementing organizations continue to work with stakeholders in the Mason Creek watershed to encourage participation in the Farmer Leadership Group (see Appendix K regarding farmer-led models) established as part of the Oconomowoc Watershed Protection Program (OWPP)**.

Other Watershed Initiatives

The Rock River Coalition is a nonprofit organization founded in 1994 that works to build alliances and consensus among all stakeholders to protect the Rock River watershed. Its members are private citizens, businesses, conservation and historic organizations, Chambers of Commerce, and local and State agency staff. Their mission is to educate and provide opportunities for people of diverse interests to work together to improve the environmental, recreational, cultural, and economic resources of the Rock River Basin. The Coalition addresses issues related to the water quality of the Rock River by developing programs such as stream and wetland monitoring programs and convening a task force to improve urban stormwater runoff.

Measuring Plan Progress and Success

Monitoring of plan progress will be an essential component of achieving the desired water quality goals. Plan progress and success will be measured by water quality improvement, progress of best management practice implementation, and by participation rates in public awareness and education efforts.

Adoption of the watershed protection plan by the local legislative bodies and the existing local, county, State, and Federal agencies concerned is recommended and also an essential component of tracking progress and success as well as highly desirable to assure a common understanding among these various entities. In addition, formal plan adoption may also be required for some State and Federal financial aid eligibility. Adoption of the recommended watershed protection plan will assist a unit or agency of government to more fully integrate the protection plan elements into existing work plans and enable staffs to program the necessary implementation work.

Due to the uncertainty inherent in any modeling effort and likely variability in the efficiency of the best management practices, an adaptive management approach should be taken with the Mason Creek watershed (see Figure III-6). After the implementation of practices and monitoring of water quality, the effectiveness of the plan should be evaluated annually as part of the ongoing OWPP and Adaptive Management Programs as well as every five years coincident with the Washington County and Waukesha County Land and Water Resource Management Plan (LWRMP) updates (see "*Tracking of Progress and Success of Plan*" section below). If progress is not being made, the plan will be reevaluated. Adjustments should be made to the plan based on plan progress and any additional new data, management tools, and/or BMPs.

Evaluation of Existing Water Quality Monitoring and Data Collection Programs

Due to ongoing monitoring by the City of Oconomowoc, Water Action Volunteers in partnership with Waukesha County and the North Lake Management District, and special assessment by the University of Wisconsin-Milwaukee, there is a good baseline to assess water quality conditions mostly within the lower and middle portions of Mason Creek. Therefore, continued monitoring at stations and establishing at least two additional stations in upstream reaches in the West Branch Agricultural Ditch and East Branch of Mason Creek (see Map II-5) will be instrumental in detecting changing trends in the future. More specifically, continued monitoring at these stations may also be used in the future to support the following objectives:

- Determining water quality standards attainment,
- Identifying causes and sources of water quality impairments,
- Supporting the implementation of water management programs, and
- Supporting the evaluation of program effectiveness.

The WDNR periodically conducts biological sampling in the watershed. Most recently, in 2014 it conducted fishery and macroinvertebrate surveys at three sampling stations in the mainstem of Mason Creek, which largely indicated that the biological community is meeting fair to good quality standards, but no mussel survey has ever been conducted in this river system. Hence, it is recommended that local partners work with WDNR to conduct surveys on Mason Creek as part of the WDNR Mussel Monitoring Program of Wisconsin.[58]

The North Lake Management District conducts regular water quality monitoring within North Lake, including participation in the WDNR Citizen Lake Monitoring program.

Identification of Additional Monitoring Needs

There are adequate data available to assess the majority of physical, chemical, and biological water quality and designated use standards that need to be assessed to measure the progress and effectiveness of the watershed plan. However, most of this data is focused within the lower portions of the watershed. So, adding at least two monitoring stations in the upper parts of the watershed, one in the West Branch Agricultural Ditch and one in the East Branch of Mason Creek, would greatly assist in determining improvements in water quality as projects are implemented. No recent sampling has been conducted on fecal coliform bacteria or *Escherichia coli* to be able to adequately determine if water use objectives related to these parameters are being met.

Stream Water Quality Monitoring Recommendations

It is important to assess the condition of water quality, biological communities, and habitat in the watershed and determine whether these conditions are improving or deteriorating. It is, therefore, important to establish and maintain a robust program to monitor and assess conditions within the watershed. Such a monitoring program should integrate and coordinate the use of the monitoring resources of multiple agencies and groups, generate monitoring data that are scientifically defensible and relevant to the decision-making process, and manage and report data in ways that are meaningful and understandable to decision makers and other affected parties. This watershed protection plan recommends maintaining the existing monitoring network and expanding monitoring in the watershed to continue to fill data gaps. Toward these ends, the plan includes the following recommendations for water quality monitoring:

1. **That current water quality monitoring program activities in the Mason Creek watershed continue, and the efforts of the local units of government, organizations, and agencies conducting these activities be supported and maintained.**

[58] *Heather Kaarakka, Wisconsin Department of Natural Resources, "Several paths to build up mussels,"* Wisconsin Natural Resources Magazine*, June 2010 (*http://dnr.wi.gov/wnrmag/2010/06/mussels.htm).

2. **That the water quality monitoring network in the Mason Creek watershed be expanded and modified as recommended below. It is envisioned that this would be accomplished through the Water Action Volunteers Program (WAV) administered through Waukesha County in collaboration with the WDNR and the University of Wisconsin-Cooperative Extension (UWEX).**[59]

    - **That up to three Level 1 WAV monitoring stations be established during the growing season from May to October, at each of the locations described below.**

        - *Upper Mason Creek at CTH CW (RM 2.5)*-The City of Oconomowoc already monitors for total phosphorus at this location, so additional Level 1 monitoring will add important supplemental information to assess this portion of the mainstem of Mason Creek.[60]
        - The *West Branch Agricultural Ditch site* just upstream of the confluence with the East Branch can be used to monitor that entire sub-basin. Permission would need to be obtained from the landowner to access this site.

        - The *East Branch site* just upstream of the confluence with the West Branch Agricultural Ditch can be used to monitor that entire sub-basin. Permission would need to be obtained from the landowner to access this site.

    - That the two existing and three proposed WAV sites be upgraded to Level 2 monitoring sites, if funding opportunities are found. This level of WAV monitoring includes deployment of continuous temperature monitoring devices, called thermistors (e.g., HOBOs or TidBits) that are placed in the stream and record temperature every hour until they are removed from the stream and data are downloaded to a computer. In addition, volunteers use meters to monitor pH and dissolved oxygen. The downside is that this level of monitoring will have higher equipment costs. **However, high resolution (i.e., hourly records) water temperature monitoring at these sites is recommended.** In addition to tracking improvements in water quality as BMPs are implemented, this detailed temperature monitoring (along with chemical and biological monitoring) will help distinguish between climate change-related stressors and other anthropogenic (i.e., human induced) stressors,

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[59]*Water Action Volunteer (WAV) Citizen Stream Monitoring Program, http://watermonitoring.uwex.edu/wav/monitoring/.*

[60]*Level 1 volunteers monitor dissolved oxygen, temperature, transparency, streamflow, habitat, and macroinvertebrates at each stream site each month from May through October.*

which will provide better understanding and decision-support tools among reaches in this watershed. For example, such detailed monitoring will allow real time tracking of daily maximum temperature extremes within and among reaches, seasonal changes, and year to year changes that could reflect climate change.

- That the two proposed WAV sites in the West Branch Agricultural Ditch and East Branch of Mason Creek be upgraded to Level 3 monitoring sites, at least periodically, particularly to obtain data on total phosphorus concentrations. Since the City of Oconomowoc is already monitoring for total phosphorus at Northwoods Drive (RM 0.04) and CTH CW (RM 2.5), capturing total phosphorus concentrations at each of the suggested stations located farther upstream would help to further refine existing loads/baseline conditions and assess improvements in load reductions in the future, once agricultural BMPs are implemented.

- Encourage the public to volunteer to become "Mud Chasers" as part of a new monitoring program being organized by the City of Oconomowoc. These volunteers will go out in storms and look for areas where sediment is flowing off the land and into waterways.[61] However, it is important to note that permission to monitor runoff will be sought from private landowners. Using rain gauges, cameras, and sampling bottles, the Mud Chasers will focus on specific impaired streams, helping to determine where total suspended sediment/ nonpoint source runoff is coming from within the Mason Creek watershed.

3. **That the WDNR continue to conduct biological monitoring of fishes and macroinvertebrates at the three stations previously sampled, as indicated on Map II-5, at a minimum of once every three to five years.**

   - That local partners consider conducting wildlife surveys for fishes and other organisms such as mussels, amphibians, and reptiles within the Mason Creek watershed with WDNR staff and/or other wildlife experts. For example, **it is recommended that annual spawning count surveys be conducted in the fall season on the East Branch of Mason Creek, Trib-A, and Lower Mason Creek reaches to identify the number of spawning adult brook trout as well as the location and distribution of redds (i.e., shallow, excavated nests in gravel substrates) among riffle habitats.** However, it is important to note that permission to monitor will need to be obtained from private landowners.

[61] *See website for volunteer information, http://www.oconomowoc-wi.gov/DocumentCenter/View/3470*

- **That local partners consider coordinating data collection in the Mason Creek watershed with monitoring in North Lake.** Greater coordination among the time and date of sample collections between these two systems will allow greater interpretation and understanding of realtime conditions and potential linkages or responses between these systems.

All water chemistry samples from the sites should continue to be analyzed by a State-certified lab to analyze trends and gauge the impact of watershed management practices. The monitoring program should continue to follow the guidance set forth in WDNR protocols and laboratory analysis should follow standards as applicable for stream monitoring.[62] In addition, to assist data reporting and to ensure that data is preserved in a safe and reliable source and is publicly available, **it is recommended that all water quality monitoring continue to be conducted as part of a managed and publically available (through the WDNR Surface Water Integrated Monitoring System (volunteer access) (SWIMS) database or equivalent) program.**

It is anticipated that the City of Oconomowoc will continue to collect total phosphorus monitoring data on the two stations in Mason Creek on a monthly basis from May through October for at least the next 10 years. Since this monitoring is part of the ongoing compliance for the City of Oconomowoc's WPDES permit and its adaptive management program, the costs for this monitoring are not included under this plan.

It also is anticipated that volunteers will continue to collect monitoring data on a monthly basis in Mason Creek from May through October for the existing two WAV stream sites. It will cost Waukesha County approximately $1,000 over 10 years ($200 per site for laboratory analysis costs for Level 1 monitoring plus $40 per year to cover all five watershed sites for equipment, supplies, shipping and replacement parts) (see Table III-7) to support monitoring at the three recommended additional sites, assuming volunteer monitoring. However, additional monitoring for nutrients and total suspended solids, should be considered for these sites in Mason Creek.[63] It is anticipated that recruitment, training, and volunteer support costs will be incorporated as part of the ongoing technical services staff support provided by Waukesha County. It is also estimated that upgrading to Level 2 monitoring for all five sites would cost an additional $3,600 over ten years. As shown in Table III-7, these costs are mostly associated with equipment upgrades. It is anticipated that the City of Oconomowoc Water Utility will continue monitoring for total phosphorus at two of the five recommended monitoring sites. Therefore, it is estimated that Level 3 total phosphorus monitoring at three sites would cost $513 per year and up to $5,130 over ten years. The total cost of water quality

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[62]*Wisconsin State Laboratory of Hygiene, see website at http://www.slh.wisc.edu/research/capabilities/*

[63]F*or about $90 per sample, the University of Wisconsin-Steven Point lab can analyze total suspended solids, chloride, ammonium nitrogen, nitrate + nitrite, reactive and total phosphorus, and total Kjeldahl nitrogen.*

monitoring over the 10 year period is estimated to range from $0 (Level 1 monitoring) to up to $8,730 (includes annual Level 2 and 3 monitoring) (see Table III-7).

Periodically Analyze Monitoring Data and Report Results

Data analysis is an integral component of the water quality management process. For monitoring programs to be useful in guiding management decisions, generating good data is not enough. The data must be processed and presented in a manner that aids understanding of the spatial and temporal patterns in water quality. The data must be placed into a context that reveals the existing state of water quality conditions and any changes or trends occurring in those conditions. This should be a context that takes the natural processes and characteristics of the watershed into account, that allows the impact of human activities upon the watershed to be understood, and that enables the consequences of management action to be predicted. Establishing such a context requires that monitoring data be periodically analyzed, interpreted, and summarized. This should be done at a frequency that provides decision makers and managers with reasonably current information while recognizing the substantial effort that is required to analyze and interpret data from all the sites within the watershed.

Therefore, to assist data reporting, **it is recommended that all existing and any future water quality monitoring data for Mason Creek be preserved in a safe and reliable source, and that the data be publicly available.**

It is recommended that monitoring data for the Mason Creek watershed be collated, analyzed, and reported at one-year intervals by the City of Oconomowoc, and incorporated in the relevant County land and water resource management plan at five-year intervals. The analyses, results, and conclusions of those reports should be published and made available to the public and to the agencies and organizations involved in the management of the Mason Creek watershed.

<u>Implementation Tracking Mechanism</u>

For this plan to be most effective, it is important to track the projects and recommendations that are implemented. This could be best accomplished by having a reporting mechanism through which the organizations implementing recommendations of this plan report the initiation and completion of projects to some agency or agencies that would oversee the monitoring of implementation. The role of the overseeing agency or agencies would be to receive these reports, periodically compile this information, and evaluate the status of the implementation of the watershed restoration plan.

As described in more detail in the "*Tracking of Progress and Success of Plan*" section below, **it is recommended that all organizations acting to implement this plan report the initiation and completion of projects implementing plan recommendations to the City of Oconomowoc and That the City work with Washington and Waukesha County staff to identify ongoing and completed implementation projects.**

Evaluating the State of Plan Implementation

It is recommended that the Mason Creek Watershed Plan Advisory Group be maintained as a continuing committee to provide advice and coordination for plan implementation and to evaluate the state of implementation of this plan. Consideration should be given to adding members to this Group as needed, with these additional members being drawn primarily from local units of governments and private organizations that are actively implementing plan recommendations.

It is recommended that the Advisory Group meet annually (at a minimum) to evaluate the status of plan implementation. This evaluation will include review of the project reports from all group members as well as other available information relevant to evaluating plan implementation.

The Advisory Group will evaluate progress in plan implementation against the milestones set forth in Table III-3. These milestones reflect the land areas affected, load reductions, and schedule for plan implementation set forth in Table III-3. Based upon its evaluation, the Advisory Group will make a determination as to whether plan implementation is proceeding in accordance with the schedule. Based upon this determination, it will provide advice to organizations implementing the plan regarding implementation strategies.

As part of its review process, and consistent with the adaptive management approach as shown in Figure III-6, the Advisory Group will examine the plan and efforts to implement it to determine whether any adjustments or modifications in plan recommendations or priorities are warranted. The issues that should be addressed in this review include, but are not limited to:

- Whether conditions within the watershed have changed in ways that require adjustment of the plan,
- Whether public priorities with respect to the focus areas of the plan have changed,
- Whether the regulatory environment with respect to the focus areas of the plan has changed,
- The degree and extent of progress made in implementing recommended actions,
- Whether the elements and priorities of the plan need modification,
- Whether new plan elements are needed, and
- Whether applicable funding programs and levels of funding have changed.

Tracking of Progress and Success of Plan

As summarized in the *"Driving Forces"* section above, the City of Oconomowoc has developed the Oconomowoc watershed program to monitor and curtail nutrient pollution throughout the entire Oconomowoc River watershed. The

City has established and implemented a comprehensive monitoring program and appointed a part-time administrator to facilitate and implement improvement projects and information and education programming throughout the Oconomowoc River watershed, which includes the Mason Creek watershed . Hence, the City and its partners, through the Oconomowoc watershed program group, are already implementing a range of agricultural projects and educational programs, as well as monitoring some 30 sites around the watershed.

The State also requires that Counties administer a variety of programs and regulations related to the protection of land and water resources. Hence, both Washington County and Waukesha County are already committed to monitoring, tracking, and evaluating conservation activities, actions, policies, and programs to address land and water resources management concerns and issues as part of their five-year workplan (i.e., Land and Water Resources Management Plan).

Therefore, **it is recommended that the City of Oconomowoc be the lead entity responsible for tracking progress of this plan and that the city work with Washington and Waukesha Counties ion that effort. The extent of this tracking is largely contingent upon continued collaboration and support of local partners. Hence, City of Oconomowoc staff may need to increase communication and coordination among County staff along with NRCS, WDNR, and other local partners to track progress, report implementation of practices, and improvements in water quality over time. Reports should be completed annually by the City of Oconomowoc, and an intensive review and analysis of plan implementation success should be conducted at five to ten-year intervals, incorporating information from the Washington County and Waukesha County Land and Water Resources Management Work Plans.**

Progress and success of implementation of the Mason Creek watershed protection plan should be tracked based on the following four metrics: 1) Information and education activities and participation, 2) Pollution reduction evaluation based on BMPs installed, 3) Water quality monitoring, and 4) Administrative review (see below for more details).

Nearly all the local partners or Advisory Group members implement information and education activities throughout the watershed, so **it is important that each of these agencies and/or organizations provide a brief summary update of activities to the City of Oconomowoc for inclusion in the annual watershed report. The Advisory Group should consider designating a member to attend the annual Rock River Coalition (RRC) meeting to stay informed regarding ongoing progress and activities in the larger Rock River basin.**

1. Information and education reports should include:
   a. Number of landowners/operators in the watershed.
   b. Number of eligible landowners/operators in the watershed.

c. Number of landowners/operators contacted.

d. Number of cost-share agreements signed.

e. Number and type of information and education (I&E) activities held, who led the activity, how many were invited, how many attended, and any measurable results of I&E activities.

f. Number of informational flyers/brochures distributed per given time period.

g. Number of individual contacts with landowners in the watershed.

h. Comments or suggestions for future activities.

2. Pollution reduction management measures reporting should consider the following elements:
   a. Planned and completed BMPs.
   b. Pollutant load reductions and percent of goal planned and achieved.
   c. Cost-share funding source of planned and installed BMPs.
   d. Numbers of field checks to make sure nutrient management plans are being followed by landowners.
   e. Number of field checks to make sure practices are being operated and maintained properly.
   f. Tracking of the agricultural fields and practices selected and funded by a point source to meet permit compliance requirements through adaptive management or water quality trading to assure that Section 319 funds are not being used to implement practices that are part of a point source permit compliance strategy.
   g. Number of new and alternative technologies and management measures used and incorporated into the plan.

3. Water Quality Monitoring Reporting Parameters:
   a. Annual summer and monthly mean total phosphorus concentrations from City of Oconomowoc stream monitoring stations.
   b. Total phosphorus, dissolved reactive phosphorus, total suspended solids, temperatures, and clarity data from volunteer sampling (Water Action Volunteer Monitoring Program and Citizen Lake Monitoring on North Lake).
   c. Macroinvertebrate Index of Biotic Integrity (WDNR and Water Action Volunteer Monitoring Program).
   d. Fishery Index of Biotic Integrity and species abundance and diversity; brook trout abundance, including improvements in spawning, juvenile, and adults; and improvements in fish species diversity and abundance in North Lake, particularly improvements in the abundance of the two-story (Cisco Coregonus artedii or Lake Herring) coldwater fishery, (WDNR or University staff).

4. Administrative Review tracking and reporting should include:
    a. Status of grants relating to project.
    b. Status of project administration including data management, staff training, and BMP monitoring.
    c. Status of nutrient management planning and easement acquisition and development.
    d. Number of cost-share agreements.
    e. Total amount of money spent on cost-share agreements.
    f. Total amount of landowner reimbursements.
    g. Staff salary and fringe benefits expenditures.
    h. Staff travel expenditures.
    i. Information and education expenditures.
    j. Equipment, materials, and supply expenses.
    k. Professional services and staff support costs.
    l. Total expenditures among Counties.
    m. Number of adaptive management contracts.

Information and Education Indicators of Success

The indicators of success and targeted schedule of completion are provided in Table III-6.

Water Quality Monitoring Indicators of Success

Water quality monitoring indicators of success for the Mason Creek watershed would include achievement of applicable water quality criteria for coldwater streams including temperature, non-regulatory water quality guidelines, and progress toward annual and daily load and wasteload allocation reduction goals for phosphorus and sediment (see Tables II-1 through II-6 in Chapter II of this report). Water quality indicators should also include biological quality (e.g., improvement of the fishery community coldwater IBI classification) and habitat quality criteria and/or targets for the Mason Creek watershed (see Tables II-9, II-11, and II-16 in Chapter II of this report). Other plan recommendations, particularly some of those focused on habitat improvement, may produce ancillary water quality benefits, but such benefits were not directly quantifiable in terms of a pollutant load reduction (e.g., floodplain connectivity or fish passage improvements). Indicators of success for management measures are set forth in Table III-1 and additional hydrologic, hydraulic, geomorphologic, physiochemical, and biological functional parameters to monitor are listed in Figure III-1 (see "Stream Functions Pyramid - A Tool for Assessing Success of Stream Restoration Projects" section above).

Any improvements in the abundance, distribution, and population size structure (i.e., survival, growth, and reproduction) of brook trout within Mason Creek also would be an indicator of water quality success. Such an assessment would consider expansion of spawning areas, number of spawning adults, number of spawning redds, hatching success, overwintering juvenile abundance, and increases in the number of juvenile and adult fishes.

Improvement of the fishery community IBI coldwater classification and in macroinvertebrate indices, including mussel species diversity and abundance, are another key water quality indicators of success in the Mason Creek watershed.

Improvements in water quality indicators in North Lake should also be considered as indicators of success. More specifically, reduced pollutant loads to surface waters within the Mason Creek watershed should produce improvements in water quality constituents in North Lake such as total phosphorus, secchi depth, chlorophyll-a, water temperature, and dissolved oxygen, and in the fishery community abundance and diversity. **It is recommended that improvement of the cisco population in North Lake and restoration of the "two story" fishery be used as assessment criteria to determine whether implementation of pollutant load reductions within the Mason Creek watershed are successful.** Using the estimated oxythermal niche boundary, which is a combination of limiting dissolved oxygen (DO) concentrations and temperatures, would provide a benchmark for quantifying potential refuge habitat in North Lake and potential risks of extinction and for measuring the effectiveness of efforts in the Mason Creek watershed in protecting North Lake. Hence, the effects of hypolimnetic oxygen changes on cisco thermal habitat could be quantified without having to conduct fishery surveys by comparing relative positions of oxythermal conditions measured with ongoing summer profiles collected on North Lake. Mapped profiles of temperature and DO concentrations through the entire water column would probably approach the oxythermal niche boundary (e.g., lethal temperature is 23.0^{o}C at 5.0 mg/L DO concentration, 22.0^{o}C at 3.0 mg/L DO concentration, and 19.5^{o}C at 1.0 mg/L DO concentration) as thermal habitat deteriorates, particularly in late summer.[64] In other words, because cisco require cold well-oxygenated waters, they are sentinels of the health of the lakes they inhabit, so increased abundance of the existing self-sustaining naturally reproducing population of cisco within North Lake would be a key indicator that the overall quality of the Lake ecosystem is improving. This should be considered as part of the evaluation of the overall effectiveness of plan implementation.

In addition, continuous long-term temperature monitoring can help distinguish climate-induced environmental changes from other anthropogenic alternations or stressors such as pollutant loads, non-native species, or habitat degradation.[65] For example, establishing that mean or maximum daily water temperatures do not exceed or continue

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[64]*Peter C. Jacobson and others, "Field Estimation of a Lethal Oxythermal Niche Boundary for Adult Ciscoes in Minnesota Lakes," Transactions of the American Fisheries Society, Volume 137, pages 1464-1474, 2008.*

[65]*James E. Whitney and others, "Physiological Basis of Climate Change Impacts on North American Inland Fishes," Fisheries, Volume 41(No.7), pages 333-345, July 2016.*

to not exceed 21.0°C among reaches, which is the ecological temperature threshold for brook trout,[66] would be an indicator of water quality success. Such improvements would also be key indicators of sustained and/or improvements in groundwater discharge or stream shading habitat enhancements. In contrast, a documented trend of increases in mean or maximum daily temperatures over time would be an indicator of global climate warming impacts or stressors within Mason Creek, which would allow more informed decision making and adjustment of management strategies.

COST ANALYSIS

Cost estimates based on current USDA NRCS payment rates for adoption of conservation practices, incentives payments to attain necessary farmer participation, and installation rates for conservation projects are summarized in Table III-8. Current conservation project installation rates were obtained through conversations with county conservation technicians, UW-Extension, and NRCS staff. The total cost to implement the watershed plan over 10 years is estimated to be **$1,603,811**, as shown below.

- **$1,567,881** to implement best management practices (see Tables III-4 and III-8)
- **$27,200** needed for Information and Education (see Table III-6)
- From **$0** (Level 1 monitoring) to **$8,730** (Level 2 and 3 monitoring, rather than Level 1) needed for Water Quality Monitoring (see Table III-7)
- Technical assistance will continue to be provided through ongoing programs

The City of Oconomowoc's Adaptive Management Program/Oconomowoc Watershed Protection Program (OWPP) Coordinator will continue to be funded by the City of Oconomowoc along with NRCS staff and ongoing Washington County Land & Water Conservation Division staff and Waukesha County Parks and Land Use staff to provide technical assistance to implement projects over the next 10 year time period.

It is also important to note that the summary of total project costs above does not include several additional wetland and stream restoration practices that include: ditch plugs, grade control structures (sedimentation basins and check dams), stream remeandering, and riverine channel and floodplain restoration (see Table III-8). Due to the uncertainty of the number and/or size of these potential BMPs, permitting issues, and willingness of landowners to implement the projects, it was not feasible to calculate a total cost for these practices. However, approximate unit area costs were provided for each of these practices as shown in Table III-8 to help develop cost estimates to implement these projects in the future. In addition, all of these practices are cost sharable through the OWPP and/or NRCS programs, which means that technical assistance for design and permitting costs are also supported.

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[66]*Chadwick, J.G., K.H. Nislow, and S.D. McCormick, "Thermal Onset of Cellular and Endocrine Stress Responses Corresponding to Ecological Limits in Brook Trout, and Iconic Cold-Water Fish," Conservation Physiology, 3:cov017, 2015.*

Operation and Maintenance

This plan will require a landowner to agree to a 5 or 10-year maintenance period for practices such as vegetated buffers/wetland restoration, grassed waterways, and streambank stabilization. For practices such as no till, cover crops, and nutrient management, landowners are required to maintain the practice for each period that cost sharing is available.

FUNDING SOURCES

There are several State and Federal programs as well as local entities that currently provide funding for conservation practices as listed and briefly described below. However, as previously noted, the greatest potential for funding projects within the Mason Creek watershed is through the City of Oconomowoc Wastewater Utility's recently established "Adaptive Management Program" to address its permitted phosphorus point source loads.[67]

The Adaptive management approach was determined to provide the most economically feasible option for the City of Oconomowoc Wastewater Utility to meet their wasteload allocation. Under that approach, point sources (i.e., City of Oconomowoc) provide funding for best management practices to be applied in the Oconomowoc River watershed and receive credit for the pollution load reductions from those practices. Federal Clean Water Act Section 319 nonpoint source management funds cannot be used implement practices that are part of a point source permit compliance strategy. Adaptive management focuses on compliance with phosphorus criteria, as opposed to the water quality trading option, which focuses on compliance with a discharge limit (see Table III-9).

Adaptive management is a phosphorus compliance option that allows point and nonpoint sources (e.g., agricultural producers, stormwater utilities, wastewater treatment plants, and developers) to work together to improve water quality in those waters not meeting phosphorus water quality standards. This option recognizes that the excess phosphorus accumulating in lakes and streams comes from a variety of sources, and that reductions in both point and nonpoint sources are frequently needed to achieve water quality goals. By working in their watershed with landowners, municipalities, and counties to target sources of phosphorus runoff, point source dischargers can minimize their overall investment while helping achieve compliance with water quality-based criteria and improving water quality. Guidance is available from the WDNR that describes adaptive management and how to

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[67] *The WDNR approved the City of Oconomowoc's Adaptive Management Plan (AMP) for the Oconomowoc River watershed on September 15, 2015 (see "Linking the TMDL to Implementation" section above for more details).*

develop a successful adaptive management strategy.[68] Adaptive management is only applicable to phosphorus discharges.

The Oconomowoc Watershed Protection Program (OWPP) was the first adaptive management program of its kind in the State and in the nation. The OWPP, which included a partnership with the NCRS, was awarded a Regional Conservation Partnership Program (RCPP) grant in 2015 (see *"Driving Forces"* section above for more details). This partnership allows funding from the NRCS, the City of Oconomowoc, and other project partners to be used to offer incentives and matching funding for projects and practices to reduce phosphorus loads to the streams of the Oconomowoc River watershed, including Mason Creek. Hence, the Oconomowoc Adaptive Management program offers a flexible and robust cost share funding program to assist landowners/farmers with the installation of upgraded conservation practices in agricultural and urban landscapes. For example, financial packages are currently available for farmers to implement agricultural BMPs through the OWPP and/or the NRCS programs. In addition, the OWPP will pay farmers up to $250/acre/year for any agricultural land taken out of crop production.[69]

Through these efforts, a significant reduction in phosphorus-laden runoff entering the lakes and streams of the Oconomowoc River watershed (including Mason Creek) is anticipated within the next 10 years. Other benefits of the OWPP in addition to improving surface water quality will be enhanced habitat and wildlife, reduced aquatic weed growth and algal blooms, and, removal of currently-impaired waters from the Federal Clean Water Act Section 303(d) impaired waters list.

Federal and State Funding Sources

Brief descriptions of available funding programs are set forth below:

- **Environmental Quality Incentives Program (EQIP)—**Federal program that provides financial and technical assistance to implement conservation practices that address resource concerns. Farmers receive flat rate payments for installing and implementing runoff management practices. It is important to note that the current Regional Conservation Partnership Program (RCPP) grant for the Oconomowoc River watershed is provided through EQIP, so landowners in the Mason Creek watershed should contact the City of Oconomowoc to participate in this program. The following agricultural practices are eligible for cost

[68]*Wisconsin Department of Natural Resources,* Adaptive Management Technical Handbook: A Guidance Document for Stakeholders, *Guidance Number 3800-2013-01, January 7, 2013.*

[69]*Contact Darrell Smith, Watershed Agriculture Coordinator (phone: 414-313-4323, email: natural@sbcglobal.net), or Thomas Steinbach, Watershed Director (phone: 262-569-2192, email: tsteinbach@oconomowoc-wi.gov), from the OWPP for more information.*

sharing (see also documents posted on the Wisconsin NRCS website and payment rates for the Oconomowoc River RCPP-EQIP):

- Access Control
- Access Road
- Composting Facility
- Conservation Cover
- Contour Buffer Strips
- Contour Farming
- Cover Crop
- Critical Area Planting
- Diversion
- Fence
- Field Border
- Filter Strip
- Forage and Biomass Planting
- Grade Stabilization Structure
- Grassed Waterway
- Heavy Use Area Protection
- Lined Waterway or Outlet
- Livestock Pipeline
- Mulching
- Obstruction Removal
- Prescribed Grazing
- Residue Management/No-Till
- Riparian Forest Buffer
- Roof Runoff Structure
- Sediment Basin
- Spoil Spreading
- Stream Crossing
- Streambank and Shoreline Protection
- Strip cropping
- Structure for Water Control
- Subsurface Drain
- Terrace

- Trails and Walkways
- Tree/Shrub Establishment
- Tree/Shrub Site Preparation
- Underground Outlet
- Vegetated Treatment Area
- Water and Sediment Control Basin
- Water Well
- Watering Facility
- Wetland Restoration

- **Conservation Reserve Program (CRP)—**A Federal land conservation program administered by the Farm Service Agency. Farmers enrolled in the program receive a yearly rental payment for environmentally sensitive land that they agree to remove from production. Contracts are 10 to 15 years in length. Eligible practices include buffers for wildlife habitat, wetland buffers, riparian buffers, wetland restoration, filter strips, grass waterways, shelter belts, living snow fences, contour grass strips, and shallow water areas for wildlife.

- **Conservation Reserve Enhancement Program (CREP)—**Federal program provides funding for practice installation, rental payments, and an installation incentive. A 15-year contract or perpetual contract conservation easement can be entered into. Eligible practices include filter strips, buffer strips, wetland restoration, tall grass prairie and oak savanna restoration, grassed waterway, and permanent native grasses.

- **Agricultural Conservation Easement Program (ACEP)—**New Federal program that consolidates three former programs (Wetlands Reserve Program, Grassland Reserve Program, and Farm and Ranchlands Protection Program). Under this program, NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land.

- **Targeted Runoff Management (TRM) Grant Program—**State program that offers competitive grants for local governments for controlling nonpoint source pollution. Grants reimburse costs for agricultural or urban runoff management practices in critical areas with surface water or groundwater quality concerns. The cost-share rate for TRM projects is up to 70 percent of eligible costs.

- **Conservation Stewardship Program (CSP)—**Federal program that offers funding for participants that take additional steps to improve resource condition. Program provides two types of funding through five-year contracts: 1) annual payments for installing new practices and maintaining existing practices and 2) supplemental payments for adopting a resource-conserving crop rotation.

- **Farmable Wetlands Program (FWP)—**Federal program designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. The Farm Service Agency runs the program through the Conservation Reserve Program with assistance from other government agencies and local conservation groups.

- **Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP)**—Beginning in 2016, grants will become available for farmer-led projects to protect water quality in Wisconsin. DATCP will administer this program. Grant funding will be available for farmer-led activities to reduce nonpoint source pollution in their watersheds.[70] Farmer-led groups must:

    - Include at least five eligible farmers who form a group in collaboration with a government agency, an educational organization, or a nonprofit conservation group,
    - Help other farmers in the watershed voluntarily work to reduce nonpoint source pollution, and
    - Contribute at least 50 percent of the costs that are eligible for grant funds.

- **Wisconsin Department of Natural Resources (WDNR)**—Beginning in 2016, grants are available to establish streambank easements along Mason Creek.[71] The Knowles-Nelson Stewardship - Stream Bank Protection Program (SBP) aims to provide public access for angling and protect water quality and fish habitat along quality streams threatened by agricultural and urban runoff.

  The SBP purchases easements directly from landowners. In return for payment, the landowner allows public fishing and WDNR management activities along the stream corridor on his or her property. The easement area is generally 66 feet of land from the streambank on either side of the stream. Easements are perpetual and remain on the land even if it sold or deeded to an heir. The SBP program has been popular with landowners and anglers. Landowners enjoy the ability to sell part of their rights in their property and in some cases get assistance in restoring the stream corridor from WDNR or local conservation clubs, while anglers enjoy access to streams that provide high quality recreational experiences.

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[70]*See website at http://datcp.wi.gov/Environment/Land_and_Water_Conservation/index.aspx?Id=237*

[71]*See website for more details at http://dnr.wi.gov/topic/fishing/streambank/*

Local Funding Sources

Brief descriptions of available funding organizations are set forth below:

Land Trusts

Landowners also have the option of working with a land trust to preserve land. Land trusts preserve private land through conservation easements, purchase land from owners, and accept donated land. Tall Pines Conservancy is a very active land trust working within the Mason Creek watershed and a key partner of the Oconomowoc Watershed Protection Program (OWPP).[72]

North Lake Management District

Landowners also have the option of working with the North Lake Management District to implement projects.[73] The North Lake Management District has provided funding to reduce pollutant loads entering Mason Creek through establishing riparian buffers adjacent to cropland and reducing streambank erosion (see Figures II-29 and II-31).

Trout Unlimited

Landowners could partner with the Southeast Wisconsin Chapter of Trout Unlimited (TU) to help fund projects, because Mason Creek is a trout stream. TU is a national organization dedicated to conserve, protect, and restore North America's coldwater fisheries and their watersheds.[74] TU has been involved in many fisheries restoration projects with experience in collaborative work at the local, state and national levels.

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[72] *See website for contacts and information at http://tallpinesconservancy.org/*

[73] *See website for contacts at https://nlmd.org/*

[74] *See Southeast Wisconsin Chapter website for contacts at http://www.tu.org/conservation/conservation-issues*

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SEWRPC Community Assistance Planning Report No. 321

MASON CREEK WATERSHED PROTECTION PLAN

Chapter III

PLAN RECOMMENDATIONS

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TABLES

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Table III-1

MASON CREEK WATERSHED GOALS, INDICATORS, CAUSE OR SOURCE OF IMPACT, AND MANAGEMENT OBJECTIVES

Goal	Indicators	Cause or Source of Impact	Management Objective
Promote active stewardship among residents, farmers, landowners, businesses, community associations, as well as governmental and non-governmental organizations.	Dialog & Bridging Events; Network Development; Customized Information and Education; Multiple information streams/ meetings to promote Capacity & Leadership training	Lack of awareness, environmental services not given programmatic value, lack of funding,	Increase public awareness of water quality issues and participation in watershed conservation activities
Manage and develop lands in a manner that is consistent with the protection of living resources: avoid habitat fragmentation and encourage the preservation and enhancement of wetlands and wildlife corridors including providing and preserving connections with upland habitats and through sensitive landscaping practices.	Riparian buffers/ wetlands, wetland-upland complexes, streambank erosion, stream channelization/ditching, limited floodplain connectivity, macroinvertebrate quality, fishery biotic integrity, brook trout abundance and spawning redd counts, Cisco abundance in North Lake, floristic quality index	Inadequate riparian vegetation, ditching, loss of wetlands, increased fragmentation within and among natural areas and environmental corridors, excessively groomed landscapes	Maintain and expand wetland, fish, and wildlife habitats and populations
Minimize the further degradation of surface water and preserve, restore, and maintain the high quality of all waterbodies within the watershed	Surface water quality to achieve WDNR/ USEPA water quality standards including, but not limited to, total phosphorus and total suspended sediment	High phosphorus levels causing algal growth and decreased dissolved oxygen. Cropland and barnyard runoff, lack of funding	Reduce the loads of sediment and phosphorus from upland sources to improve water quality and to enhance and restore stream form and function.
Identify opportunities to improve the quality of the land and water (including groundwater) resources within the watershed by reducing both nonpoint agricultural and urban runoff.	Peak flow discharges and flooding during heavy precipitation events, groundwater recharge, streambank stability, fishery quality, macroinvertebrate quality, and improved soil health	Channelization to promote agricultural drainage & associated streambed loads, inadequate stormwater practices, lack of riparian buffers, tile drainage, poor soil health, lack of funding	Reduce the volume and velocity of runoff from upland areas to streams, increase soil infiltration, and protect groundwater recharge

Source: SEWRPC.

Table III-2

SURVEY RESULTS ON RANKING CURRENT WATER QUALITY AND QUANTITY ISSUES IN THE MASON CREEK WATERSHED: 2013

Water Quality and Quantity Issues	Average Score (Ranked 1-High, 5-Low)
Water Clarity	1.8
Agricultural runoff	1.9
Garbage and trash in natural areas	1.9
Invasive species	1.9
Pesticide use	1.9
Sedimentation	2.0
Urban runoff	2.0
Fishery quality	2.0
Streambed and bank erosion	2.0
Groundwater Recharge	2.1
Wetland protection	2.2
Extent of algae	2.2
Weed growth	2.3
Flooding	2.3
Water depth	2.3
Upland (prairie or woodland) protection	2.4
Water Supply	2.6
Urbanization	2.6
Big gamefish quality	2.6
Temperature	2.6
Ordinance enforcement	3.0
Bugs	3.1
Traffic noise	3.2
Development of new ordinances	3.4
Bacteria related to swimming	4.1

Source: Tall Pines Conservancy and SEWRPC.

Table III-3

10-YEAR TARGETED MANAGEMENT MEASURES PLAN MATRIX FOR THE MASON CREEK WATERSHED: 2015

Recommendations	Indicators	Milestones			Timeline	Funding Sources[a]	Implementation[b]
		0 to 3 Years	3 to 7 Years	7 to 10 Years			
1) **Agricultural BMPs:** Reduce the amount of sediment and phosphorus loading from agricultural fields and uplands							
a) Increase use of no till in watershed area from 50 to 75 percent (promote transition of conservation tillage to no till practices)	Number of acres cropland with conservation practice applied	124	246	124	0-10 years	EQIP, TRM, CSP, AM, NLMD	NRCS; Dodge, Washington, and Waukesha Counties; Local Partners
b) Increase use of cover crops in watershed area from 0 to 50 percent	Number of acres cropland with conservation practice applied	247	493	247	0-10 years	EQIP, TRM, CSP, AM, NLMD	NRCS; Dodge, Washington, and Waukesha Counties; Local Partners
c) Increase implementation of land under nutrient management plans from 50 to 100 percent	Number of acres cropland with conservation practice applied	247	493	247	0-10 years	EQIP, TRM, CSP, AM, NLMD	NRCS; Dodge, Washington, and Waukesha Counties; Local Partners
d) Installation of grassed waterways in priority areas	Number of linear feet of grassed waterways installed	1,098	2,196	1,098	0-10 years	EQIP, CREP, AM, NLMD	NRCS; Dodge, Washington, and Waukesha Counties; Local Partners

Table III-3 continued

Recommendations	Indicators	Milestones			Timeline	Funding Sources[a]	Implementation[b]
		0 to 3 Years	3 to 7 Years	7 to 10 Years			
2) Riparian Buffers/Wetland Restoration/Filter Strip Installation: Convert cropped wetland back to wetland and cropped steep slopes to filter strips							
a) Installation of 75 foot wide minimum riparian buffers/harvestable buffers	Number of acres of riparian buffers installed	6	13	6	0-10 years	CREP/CRP, EQIP, AM, NLMD	NRCS; Dodge, Washington, and Waukesha Counties; Local Partners
b) Conversion of Currently Farmed Potentially Restorable Wetland Back to Wetland	Number of acres of restored wetland	51	103	51	0-10 years	CREP/CRP, EQIP, AM, NLMD	NRCS; Dodge, Washington, and Waukesha Counties; Local Partners
c) Conversion of Currently Farmed Steep Sloped Lands to Filter Strips	Number of acres of riparian buffers installed	31	63	31	0-10 years	CREP/CRP, EQIP, AM, NLMD	NRCS; Dodge, Washington, and Waukesha Counties; Local Partners
d) Document decrease in surface water runoff by evaluating soil infiltration rates on select projects above	Number of farms/agricultural landowners checked	5	7	3	0-10 years	N/A	NRCS; Washington and Waukesha Counties; Local Partners
3) Restore and Stabilize Degraded Streambanks							
a) Restore high priority eroded stream banks	Number of linear feet of streambank stabilized	114	0	0	0-10 years	NLMD	NRCS; Washington and Waukesha Counties; WDNR; Local Partners

NOTE: *A combination of the listed practices will be applied to agricultural fields to get the desired reductions required by the Rock River TMDL. Not all practices listed will be applied to each field. The combinations of practices applied will vary by field. In most cases just applying one practice to a field will not get desired reductions and a combination of two to three practices will be necessary to get desired reductions.*

[a]*Funding sources include Adaptive Management (AM) administered through the City of Oconomowoc Wastewater Utility, the Conservation Reserve Enhancement Program (CREP), the Conservation Reserve Program (CRP), the Environmental Quality Incentives Program (EQUIP), and North Lake Management District (NLMD).*

[b]*Local Partners include the following: Townships of Ashippun, Erin, and Merton; City of Oconomowoc Wastewater Utility; North Lake Management District; Tall Pines Conservancy; and Rock River Coalition.*

Source: NRCS and SEWRPC.

Table III-4

ESTIMATED LOAD REDUCTIONS FOR WATERSHEDWIDE MANAGEMENT MEASURES FOR THE MASON CREEK WATERSHED: 2015[a]
(percent reduction calculated from STEPL modeling)

Management Measure Category	Total Units (size/length)	Total Cost[b]	Estimated Load Reduction[a]			
			TP (pounds per year)	Percent	TSS (tons per year)	Percent
Agricultural BMPs Applied to Cropland[c]						
No Till	494 acres	$9,702	1,319	13.10	356	12.90
Cover Crops	987 acres	$59,368	1,031	10.24	320	11.60
Nutrient Management Plans	987 acres	$52,311	664	6.60	229	8.30
Gully Stabilization						
Grassed Waterways	4,392 feet	$19,500	314	3.12	409	14.82
Riparian Buffers/Wetland Restoration/Filter Strips						
Restore 75 Foot Wide Minimum Riparian Buffers	25 acres	$1,420,000	49	0.49	33	1.20
Restore Farmed Potentially Restorable Wetlands	205 acres		433	4.30	295	10.69
Convert Farmed Steep Sloped Lands to Filter Strips	125 acres		337	3.35	232	8.41
Streambank Restoration						
High Priority Site	114 feet	$7,000	3.6	<0.1	5.8	0.3
Total	- -	**$1,567,881**	**4,151**	**41**	**1,880**	**68**

Note: This table only shows the pollutant reductions for Total Phosphorus (TP) and Total Suspended Sediment (TSS) as required under the Rock River TMDL, but nitrogen and BOD were also modeled as summarized in Appendix B.

[a]*Based upon past Agricultural BMPs applied to cropland, gully stabilization, and riparian buffers implemented throughout the watershed, it is estimated that the Mason Creek watershed is already achieving a 35 percent and 36 percent pollutant load reduction in Total Phosphorus (TP) and Total Suspended Sediment (TSS), respectively. Therefore, the existing load reductions combined with the proposed pollutant load reductions would achieve approximately 76 percent TP reduction and meet the TSS reduction recommended by the TMDL.*

[b]*See Table III-8.*

[c]*In reality a combination of practices will likely be applied to the majority of the crop fields in the watershed, but it is difficult to know who or where such practices would be adopted. So, the upland practices have separate existing levels of implementation and target goals and were modelled individually. However, it is important to note that when multiple practices are installed/implemented simultaneously, they are much more effective than if they were implemented separately. Therefore, the modelled load reductions calculated within Appendix B are likely a conservative estimate of potential load reductions in this watershed, which should be kept in mind when implementing and tracking progress in this planning effort.*

Source: Washington County, Waukesha County, and SEWRPC.

Table III-5

COMPARISONS OF POTENTIAL CLIMATE EFFECTS, CORRESPONDING ADAPTATION STRATEGIES, AND RESTORATION ACTIONS WITHIN THE MASON CREEK WATERSHED: 2016

Climate Effects	Adaptation Strategy	Restoration Actions
Warmer Summer Temperatures	Increase stream shading and increase cool water habitat and refuge areas; maintain or increase direct groundwater discharge to stream; minimize water surface area	Restore native riparian vegetation and improve overhead cover to increase shading; increase stream meanders to promote deep water habitats; protect groundwater recharge areas; promote access to critical habitat through improved instream connectivity
Earlier peak flows in spring, reduced summer flows, and more drought-like occurrences	Increase capacity to detain runoff on a landscape scale (e.g., minimize artificial drainage features such as ditches and tile lines); recharge aquifers; increase in-stream and riparian refuge habitats	Restore wetlands; increase buffer width; protect groundwater recharge; increase channel meanders and enhance hyporheic flows; restore instream flows; increase number and size of deep pool habitats; improve access to critical refuge habitats for fishes
Increased flooding with greater intensity storm events and higher flows, increased flashiness, and higher flows in winter	Increase time of concentration by increasing capacity of the landscape to detain water; increase flood conveyance capacity and floodplain connectivity to absorb and dissipate flow energy	Reconnect and restore floodplain connectivity; expand and revegetate riparian areas; improve overall system connectivity including fish passage
Increased cumulative stress to stream systems	Reduce other sources of stress to minimize cumulative impact of increased climate stressors	Reduce pollutant sources throughout watershed, particularly from agriculture; mitigate impervious surfaces and stormwater impacts; actively manage natural areas to retain habitat value and stormwater detention benefits (e.g., manage invasive species); develop ordinances that protect key resource features (e.g., groundwater).

Note: The adaptation strategies and restoration actions can often mitigate one or more climate effects simultaneously.

Source: Adapted from Jack E. Williams, and others, Adaptation and Restoration of Western Trout Streams: Opportunities and Strategies, Fisheries, Vol. 40, No. 7, pages 304-317, July 2015, and SEWRPC.

Table III-6

INFORMATION AND EDUCATION PLAN IMPLEMENTATION MATRIX

Information and Education Plan Implementation Matrix							
		Schedule					**Outcome/ Evaluation Metric**
Target Audience	**Actions**	**0–2 Years**	**2–5 Years**	**5–10 Years**	**Cost**	**Implementation**	
General Public	Media notices in newspapers and community newsletters & public presentations	Notice in 2 local newspapers about completion of Mason Creek Protection Plan.	- -	Drivers see watershed signs when entering watershed. Signs create interest to see what watershed project is about		Local Partners	General public is aware of protection plan, understand how the Plan is relevant to them.
		At least 1 presentation to municipal representatives, landowners, and general public.	- -	- -	$1,000	Local Partners	
	Create educational display for County Fair, local libraries, and government offices	At least 1 educational display exhibited at County Fair and 2 other venues.	At least 2 educational displays exhibited at government offices, and local events.	- -	$3,600	Local Partners	People who live, work and recreate in the watershed will understand how the plan improves their community and life, and have a better understanding of how they impact the resources in the watershed. They will be informed of progress and new recommendations for improvements and protections.
	Utilize municipal and community organization websites to post watershed project information	2 Stakeholder groups develop a website page or social media site for watershed plan news and activities.	- -	- -	$2,200	Local Partners	
	Distribute information to watershed residents about Mason Creek Protection Plan goals and recommended actions.	A fact sheet or publication is created about the Plan goals, recommended actions and opportunities for civic involvement and is mailed to residents.	The fact sheet or publication is updated about the Plan goals, recommended actions and opportunities for civic involvement, and is distributed to residents.	The fact sheet or publication is updated to reflect Plan goals, recommended actions and opportunities for civic involvement, and is distributed to residents.	$6,000	Local Partners	

Information and Education Plan Implementation Matrix

Target Audience	Actions	Schedule: 0–2 Years	Schedule: 2–5 Years	Schedule: 5–10 Years	Cost	Implementation	Outcome/ Evaluation Metric
Riparian Landowners	Distribute information to riparian landowners about management actions to protect and promote wildlife habitat, and information about programs to fund riparian buffers and wetlands.	A fact sheet is developed and distributed to riparian landowners about Plan goals, recommended BMP's and available resources.	At least 5 site meetings are held with riparian landowners.	- -	$2,500	NRCS, UWEX, Washington County, Waukesha County, Dodge County, and Local Partners	Riparian landowners will recognize the unique multipurpose functions of the riparian corridor, and learn about resources available to help them improve management of their lands, and restore/improve in stream conditions.
Agricultural Landowners and Operators	Distribute educational information materials about BMP's, and available resources to support implementation.	A fact sheet is developed and distributed to agricultural landowners and operators about Plan goals, recommended BMP's and available resources.	- -	- -	$1,500	NRCS, UWEX, Washington County, Waukesha County, Dodge County, and Local Partners	Agricultural landowners and operators will be informed about recommended BMP's, funding, and technical assistance resources.
	Individual meetings with landowners and operators to provide information and offer technical assistance.	At least 5 personal contacts are made with landowners, and 5 personal contacts are made with operators.	At least 5 personal contacts are made with landowners, and 5 personal contacts are made with operators.	At least 5 personal contacts are made with landowners, and 5 personal contacts are made with operators.	$3,000	NRCS, UWEX, Washington County, Waukesha County, Dodge County, and Local Partners	The interest in BMP's will increase among agricultural landowners and operators.
	Create opportunities for agricultural landowners and operators to share information and build strong connections with other stakeholders through field meetings, workshops.	At least 2 group meetings are held.	At least 2 workshops or tours are held at a demonstration site.	- -	$3,000	NRCS, UWEX, Washington County, Waukesha County, Dodge County, and Local Partners	Agricultural landowners and operators will see successful BMP's and gain knowledge needed to implement similar practices.
		At least 1 educational meeting is held to share information on integrating recommended BMP's effectively.	- -	- -	$1,000	NRCS, UWEX, Washington County, Waukesha County, Dodge County, and Local Partners	Agricultural landowners and operators will learn emerging strategies in cover crop rotations, reduced tillage and nutrient management.

Information and Education Plan Implementation Matrix

Target Audience	Actions	Schedule: 0–2 Years	Schedule: 2–5 Years	Schedule: 5–10 Years	Cost	Implementation	Outcome/ Evaluation Metric
Non Resident Agricultural Landowners	Convene a webinar designed for absent agricultural property owners informing them of the watershed plan, recommendations and available resources.	At least one webinar is held for landowners who lease agriculture lands.	- -	- -	$1,000	NRCS, UWEX, Washington County, Waukesha County, Dodge County, and Local Partners	Nonresident landowners will understand the various strategies available to implement BMP's when working with a lease.
Elected Officials	Convene meetings with local officials and community group representatives to encourage new community connections to foster customized solutions to implementation obstacles.	Presentations are given to at least 2 municipal boards.	At least one workshops is held for local officials.	- -	$2,400	Local Partners	Increased interest among municipalities to restore and improve the natural hydrological functions of Mason Creek, and partner on recommended projects and programs.
				Total Materials Cost	$27,200[a]	- -	- -

NOTE: ***Local Partners*** *include the following: Towns of Ashippun, Erin, and Merton; North Lake Management District; City of Oconomowoc Wastewater Utility; Tall Pines Conservancy; Rock River Coalition.*

[a] *These costs are likely to be offset by the ongoing City of Oconomowoc's Adaptive Management Program, Washington County Land & Water Conservation Division, and Waukesha County Parks and Land Use education and outreach programming activities.*

Source: SEWRPC.

PRELIMINARY DRAFT

Table III-7

ESTIMATED COSTS FOR WATER QUALITY MONITORING RECOMMENDATIONS: 2015

Water Quality Monitoring	Level 1 Cost[a]	Level 2 Cost[b]	Level 3 Cost[c]
East Branch headwaters of Mason Creek- **Proposed New Site**	$0 ($200 per sampling kit)	$400 ($200 tidbit meter/5 years) $0 (YSI meter shared)	$2,400 ($40 per sample x 6 samples/year x 10 years)
West Branch Agricultural Ditch- **Proposed New Site**	$0 ($200 per sampling kit)	$400 ($200 tidbit meter/5 years) $0 (YSI meter shared)	$2,400 ($40 per sample x 6 samples/year x 10 years)
Upper Mason Creek at CTH CW (RM 2.50)- **Proposed New Site**	$0 ($200 per sampling kit)	$400 ($200 tidbit meter/5 years) $0 (YSI meter shared)	$0[d]
Lower Mason Creek at Petersen Road (RM 0.30)- *Existing Monitoring Site*	$0	$400 ($200 tidbit meter/5 years) $0 (YSI meter shared)	Not recommended
Lower Mason Creek at Northwoods Drive (RM 0.10)- *Existing Monitoring Site*	$0	$400 ($200 tidbit meter/5 years) $1,000 (YSI meter shared among all sites)	$0[d]
Supplies and replacement parts for all sites	$0 ($40/year x 10 years)	$250 ($25/year x 10 years) $100 (software) $250 (data shuttle)	$330 ($11/sampling year x 3 sites x 10 years)
Total Cost	**$0**	**$3,600**	**$5,130**

Note: it is anticipated that all monitoring be conducted as part of ongoing Waukesha County Water Action Volunteer (WAV) stream monitoring program, which will provide recruitment, training, and volunteer support services for all (Level 1 through 3) monitoring.

[a]*If the volunteer monitors are trained and run through the Waukesha County WAV program, monitoring equipment kits and supplies estimated to cost about $1,000 over ten years, will be provided. Volunteers are expected to collect monitoring data monthly from May – October.*

[b]Due to limited availability of tidbit programmable temperature dataloggers and YSI meters, Waukesha County cannot guarantee availability of this equipment, so purchase of this equipment is necessary. The battery in the Tidbit meter is non-replaceable and designed to last five years. A one-time purchase for software and data shuttle totaling $350 to manage, program, and download data from the loggers is included.

[c]These are based upon year 2015 cost estimates and sample laboratory costs include shipping.

[d]It is anticipated that the City of Oconomowoc Water Utility will continue monitoring for total phosphorus monthly from May to October at this site.

Source: WDNR, Waukesha County, City of Oconomowoc Water Utility, and SEWRPC.

Table III-8

TYPICAL COSTS FOR MANAGEMENT MEASURES

BMP	Quantity[a]	Cost per Unit (dollars)	Total Cost (dollars)
Upland Control			
No Till[b] (acres)	494	$19.64	$9,702
Cover Crops[b] (acres)	987	$60.15	$59,368
Nutrient Management[b] (acres)	987	$53.00	$52,311
Grass Waterways (linear feet)	4,392	$4.44	$19,500
Riparian Buffers/Wetland Restoration/Filter Strips (acres)	355	$4,000.00	$1,420,000
Streambank Erosion Control			
Bank Stabilization, High Priority[c] (linear feet)	114	$61.4	$7,000
Technical Assistance			
Conservation/Project Coordinator	- -[d]	- -[d]	- -[d]
Additional Wetland and Stream Measures (see Map III-_ for locations)			
Hydrologic Restoration with Ditch Plug (see Appendix _)	100 foot long embankment example	$6,299.78	- -[e]
Grade Control Structures			
Sedimentation Basin	900 cubic yards example size	$4,106.81	- -[e]
Ditch Check/Check dams (see Appendix _)	10 foot width typical roadside ditch	$200	- -[e]
Stream Remeandering	One linear foot of restored stream	$100.00	- -[e]
Riverine Channel and Floodplain Restoration	15 acres (scenario typical size)	$8,252.34	- -[e]

[a]*See Table III-4.*

[b]*Estimated costs based on cost-sharing for three years.*

[c]*Locations of all streambank erosion sites are identified on Map B-3 in Appendix B. Low priority sites are not represented in this table and are not recommended to be addressed at this time.*

[d]*It is assumed that the City of Oconomowoc's Adaptive Management Program/Oconomowoc Watershed Protection Program (OWPP) Coordinator will continue to be funded along with NRCS staff and* ongoing Washington County Land & Water Conservation Division staff and Waukesha County Parks and Land Use staff *to implement projects over the next 10 year time period. Financial packages are available for farmers to implement agricultural BMPs through the OWPP. In addition, the OWPP will pay farmers up to $250/acre/year for any agricultural land taken out of crop production. Contact Darrell Smith, Watershed Agriculture Coordinator (phone: 414-313-4323, email: natural@sbcglobal.net), or Thomas Steinbach, Watershed Director (phone: 262-569-2192, email: tsteinbach@oconomowoc-wi.gov), from the OWPP for more information.*

[e]*Due to the uncertainty of the number and/or size of these potential BMPs, permitting issues, design costs, and willingness of landowners, it was not feasible to calculate a total project cost for these practices.*

Source: Natural Resource Conservation Service and SEWRPC.

Table III-9

COMPARISON OF ADAPTIVE MANAGEMENT AND WATER QUALITY TRADING

Adaptive Management	Water Quality Trading
Receiving water is exceeding phosphorous loading criteria	The end of pipe discharge is exceeding the allowable limit
More flexible and adaptive to allow cropland practices to show reductions over extended time period	Not as flexible, needs to show stable reductions year to year
Does not use "trade ratios" as modeling factor	Uses "trade ratios" as margin of error factor
Uses stream monitoring to show compliance	Uses models such as SNAP+ or BARNY to show compliance with reduction in loading
Typically used for phosphorus compliance only	Can be used for a variety of pollutants, not just phosphorus
Can be used to quantify phosphorus reductions for up to 15 years	Can be used to demonstrate compliance indefinitely as long as credits are generated

Source: Outagamie County Land Conservation Department, Nonpoint Source Implementation Plan for the Plum and Kankapot Creek Watersheds*, 2014.*

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MASON CREEK WATERSHED PROTECTION PLAN

Chapter III

PLAN RECOMMENDATIONS

FIGURES

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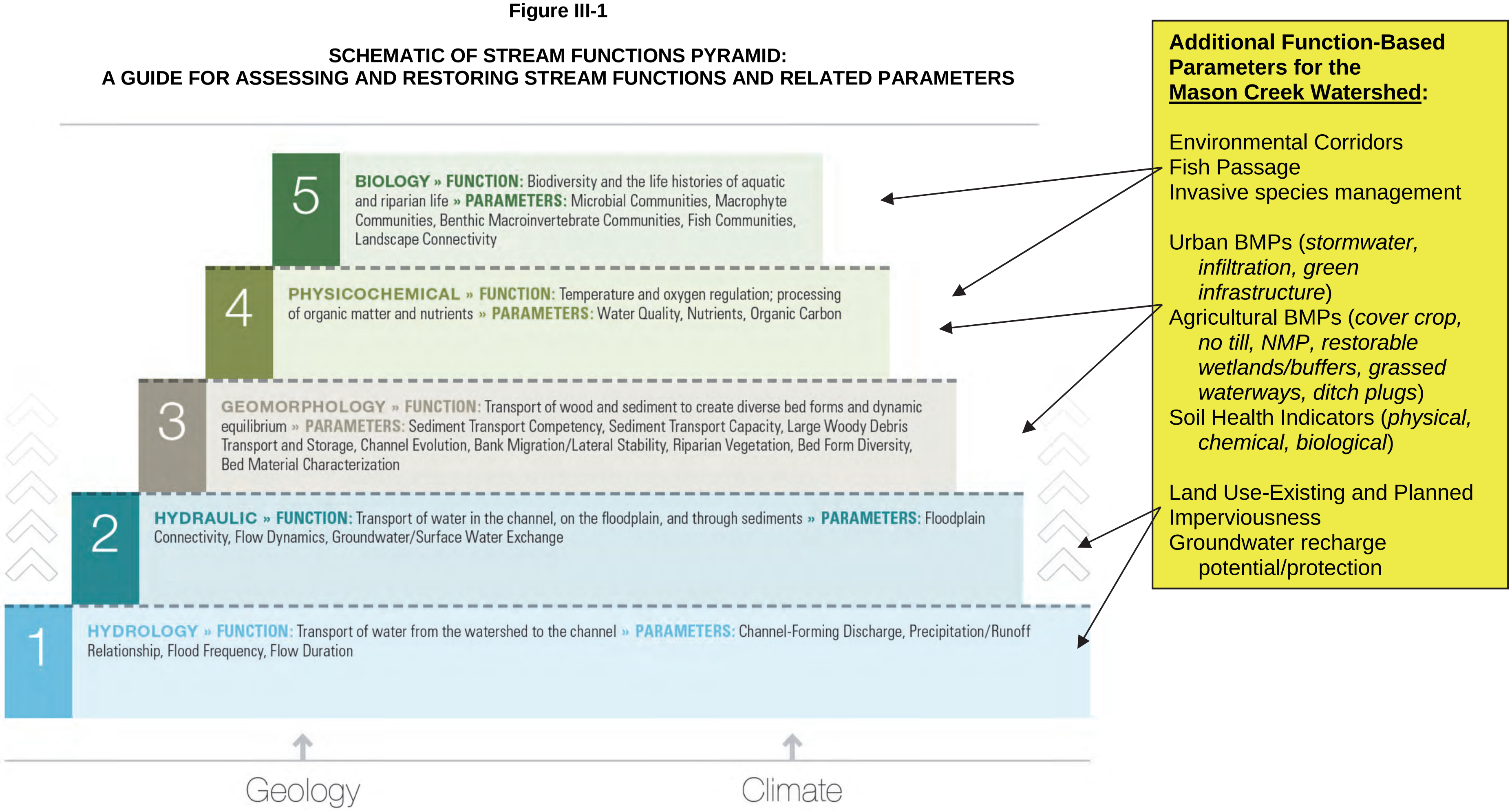
Figure III-1

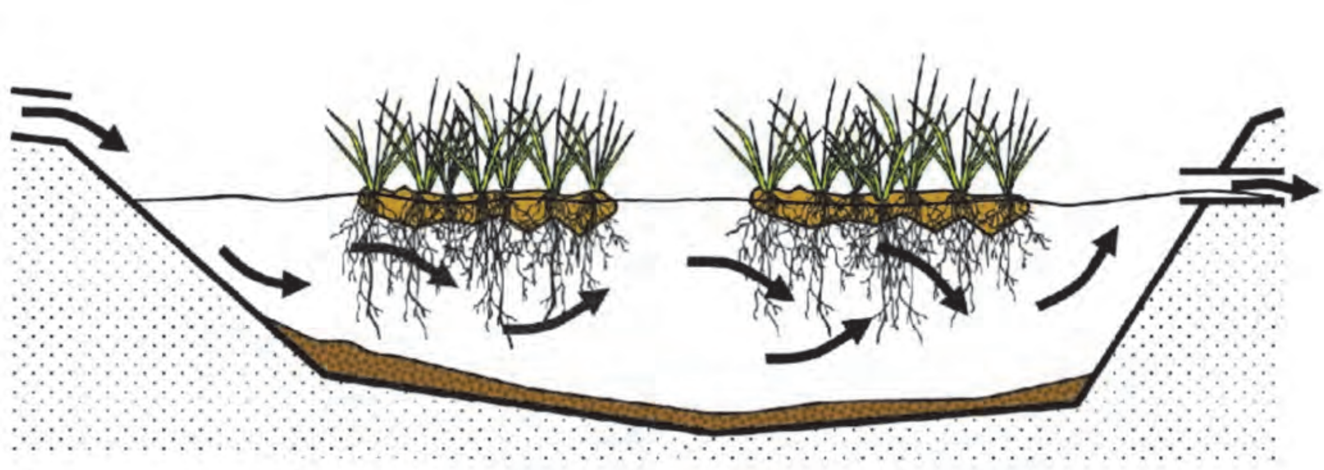
SCHEMATIC OF STREAM FUNCTIONS PYRAMID:
A GUIDE FOR ASSESSING AND RESTORING STREAM FUNCTIONS AND RELATED PARAMETERS



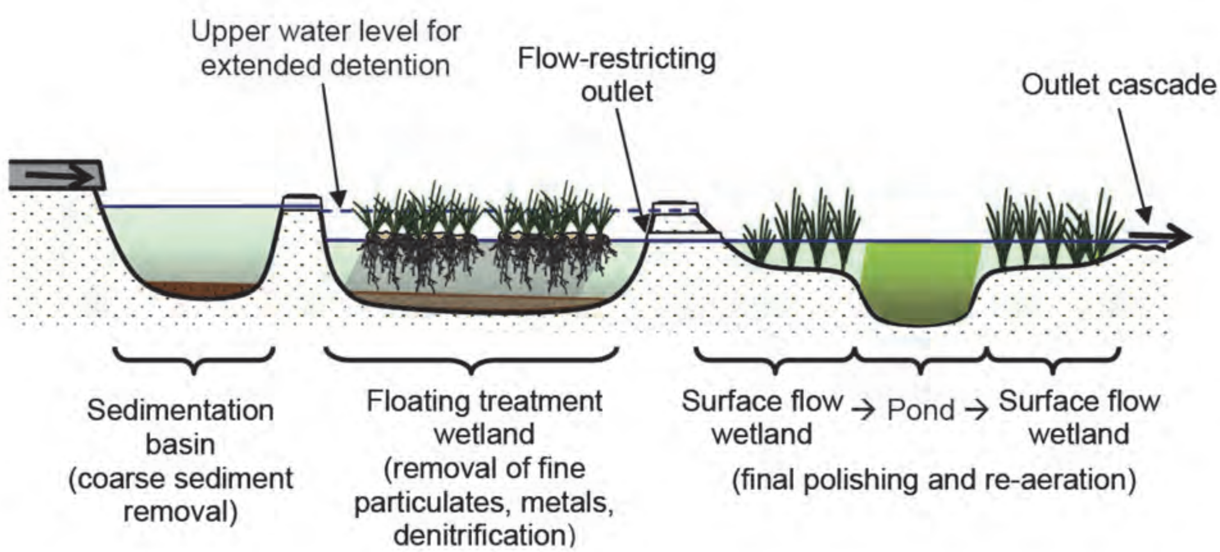
Source: Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012. A Function-Based Framework for Stream Assessment and Restoration Projects. US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC EPA 843-K-12-006; Fischenich, J.C., Functional objectives for stream restoration, EMRRP Technical Notes Collection (ERDC TN-EMRRP-SR-52). Vicksburg, MS: U.S. Army Engineer Research and Development Center, 2006, www.wes.army.mil/el/emrrp; and SEWRPC..

Figure III-2

SCHEMATIC OF FLOATING TREATMENT WETLAND (FTW) DESIGN APPLICATIONS



Emergent plants are grown within a floating artificially constructed material within a wet detention stormwater basin. The roots are directly in contact with the water column and can intercept suspended particles. The roots also provide a high surface area for microbiological activity that aid in adsorbing pollutants



Conceptual longitudinal cross-section through a “newly designed” stormwater treatment system incorporating floating wetlands, ponds, and surface flow wetlands (not to scale).

Source: *Ian Dodkins; Anouska Mendzil; and Leela O’Dea, Floating Treatment Wetlands (FTWs) in Water Treatment: Treatment efficiency and potential benefits of activated carbon, Prepared for: FROG Environmental Ltd, March 2014;* Headley, T.R. and C.C. Tanner, Constructed Wetlands With Floating Emergent Macrophytes: An Innovative Stormwater Treatment Technology, Critical Reviews in Environmental Science and Technology, 42:2261–2310, 2012.

Figure III-3

EXAMPLES OF HABITAT IMPROVEMENT PROJECTS IN AGRICULTURAL AND URBAN LANDSCAPES FOR AMPHIBIANS AND REPTILES

Recreation or reconnection of wetland and upland habitats

Removing obstacles and signage can improve safety and effectiveness of travel between habitats

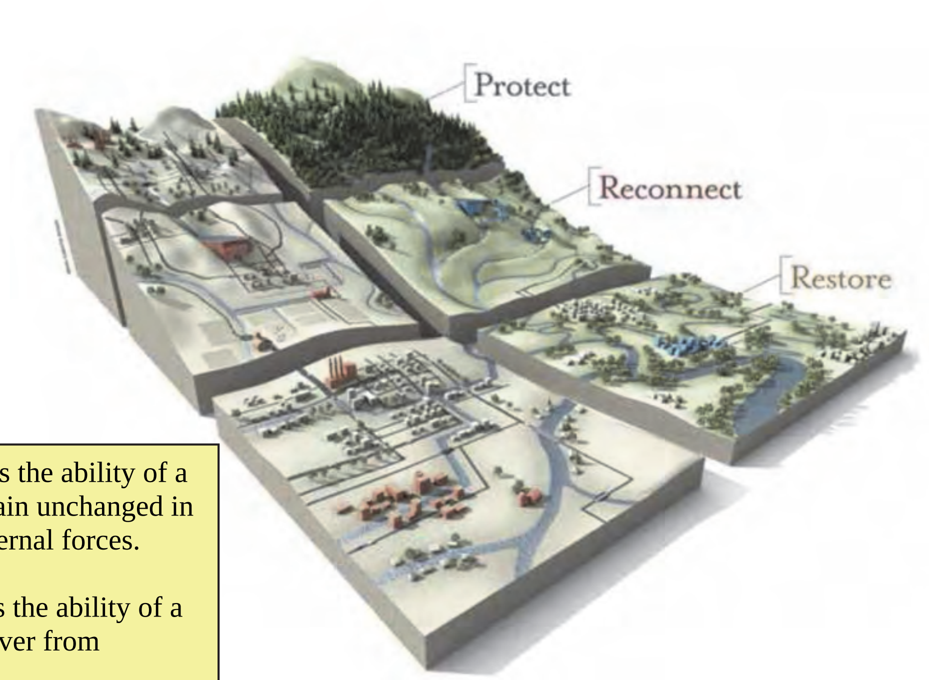
Roadside fences can reduce mortality

Burning can be an effective management tool

Source: Partners in Amphibian and Reptile Conservation (PARC), Habitat Management Guidelines for Amphibians and Reptiles of the Midwestern United States, Technical Publication HMG-1, 2nd Edition. 2012.

Figure III-4

WATERSHED-SCALE APAPTATION STRATEGIES TO PROMOTE ECOLOGICAL RESISTENCE AND RESILIENCE



"***Resistance***" is the ability of a system to remain unchanged in the face of external forces.

"***Resilience***" is the ability of a system to recover from disturbance.

This graphic depicts several strategies that include: protecting the highest quality remaining habitats; increasing landscape connectivity and corridors among occupied habitat patches among water and land features; reconnecting mainstem with tributary reaches through fish passage enhancements and improving instream flows; and, restoring degraded habitats within intensive land use development areas. This graphic was provided courtesy o Bryan Christie Design and Trout Unlimited.

Source: Source: Adapted from Jack E. Williams and other, "Climate Change Adaptation and Restoration of Western Trout Streams: Opportunities and Strategies," Fisheries, Volume 40(No. 7), pages 306-317, July 2015; and SEWRPC

Figure III-5

COMMUNITY ENGAGEMENT STRATEGY WITHIN THE MASON CREEK WATERSHED

Oconomowoc Watershed Protection Program (OWPP)

Mission: Working in Partnership to Protect and Improve Soil and Water Quality in the Oconomowoc River Watershed

About the Program	The **City of Oconomowoc** is embarking on an innovative program called **Adaptive Management** to improve the water quality of the many lakes and rivers in the Oconomowoc River watershed.
Goal	To **reduce non-point source pollution** from urban storm water, construction sites, and agricultural land to improve water quality, thus enabling the City to **reach compliance** with the Department of Natural Resources wastewater and storm water permit requirements in a cost-effective manner.
Benefits	Since the Oconomowoc River is upstream of the Rock River, the program will also **improve the water quality** of the Rock River and aid in the objectives of the Rock River Total Maximum Daily Load rule. The specific pollutants to be reduced are phosphorus and total suspended solids. In addition to improving surface water quality in area streams and lakes, the program will **enhance local wildlife habitat and ecology, control excessive aquatic plant growth and reduce algal blooms.**

Leading the Effort

City of Oconomowoc Wastewater Utility

OCONOMOWOC WASTEWATER UTILITY

Other lead partners: Tall Pines Conservancy and Ruekert & Mielke, Inc.

Other partners:

- American Farmland Trust
- Camp Whitcomb/Mason
- Carmelites of Holy Hill
- Clean Water Association
- Clean Wisconsin
- Erin Meadows Farms
- Greener Oconomowoc
- Jefferson County Land and Water Conservation Department
- Local Engineering Firms
- Local Farmer Leadership Group
- Local Lake Management Districts
- Local Municipalities
- Mid-Kettle Moraine
- National Resource Conservation Service
- Pabst Farms
- Rock River Coalition
- Sand County Foundation
- Southeastern Wisconsin Regional Planning Commission
- Town & Country Resource Conservation & Development, Inc.
- University of Wisconsin - Extension
- UWM School of Freshwater Sciences
- Washington County Land and Water Conservation Department
- Waukesha County Land Resources Divsion of Parks and Land Uses Department
- Wisconsin Department of Agriculture, Trade and Consumer Protection
- Wisconsin Department of Natural Resources

Oconomowoc River Watershed

Healthy Soils
Clean Water
Happy People

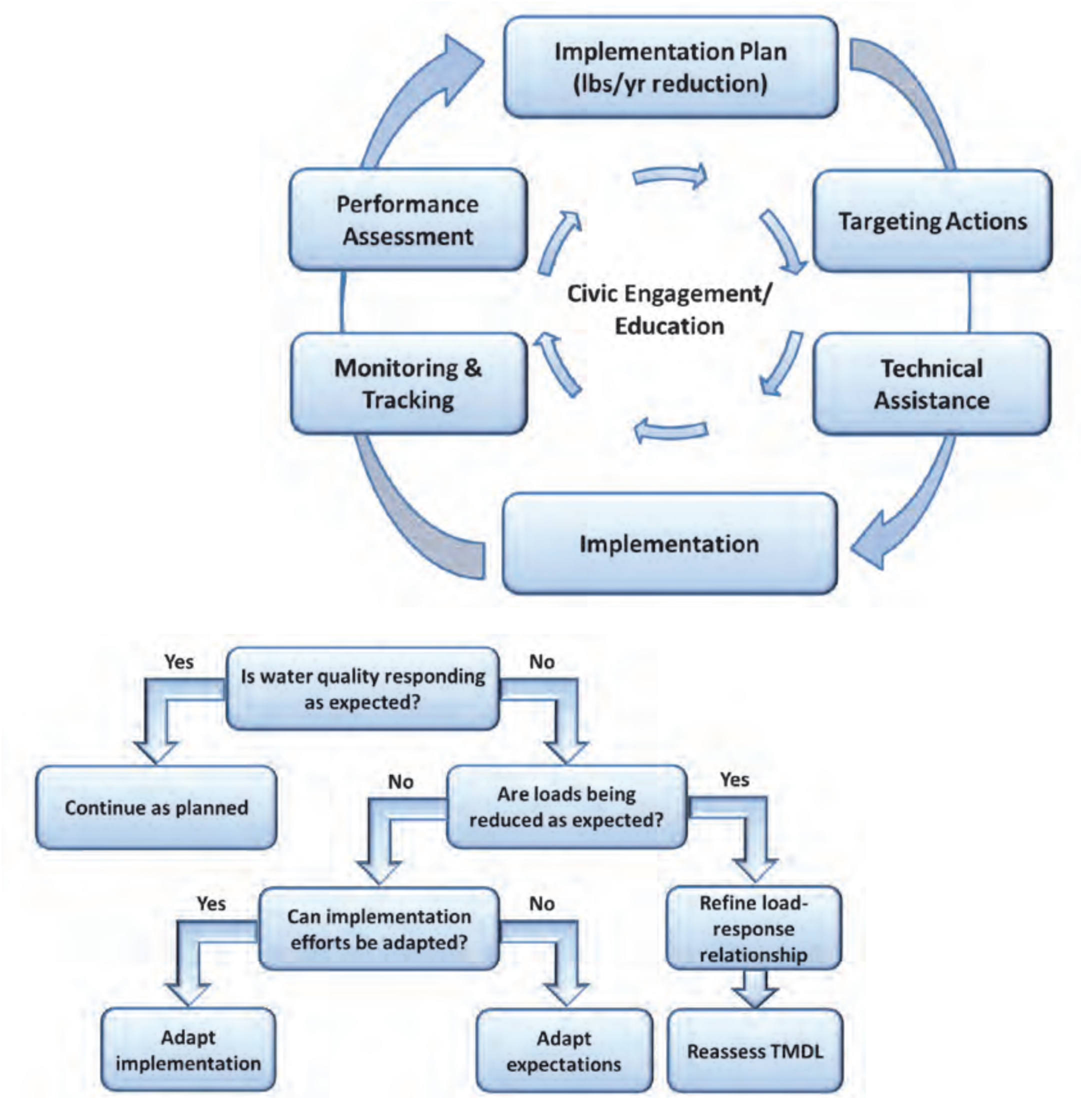
If you would like to learn more, please contact Tom Steinbach at 262-569-2192 or tsteinbach@oconomowoc-wi.gov

Note: The community engagement among local partners and commitment to implementing projects within the Mason Creek watershed is already occurring within the context of the larger ongoing OWPP efforts.

Source: City of Oconomowoc Wastewater Utility and SEWRPC.

Figure III-6

ADAPTIVE MANAGEMENT IMPLEMENTATION FRAMEWORK AND EVALUATION PROCESS



Source: Adapted from the Implementation Plan for Lake St. Croix and SEWRPC.

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Chapter III

PLAN RECOMMENDATIONS

MAPS

PRELIMINARY DRAFT

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Map III-1

PROPOSED WATER QUALITIY AND AQUATIC HABITAT RECOMMENDATIONS AND PRIORITY MANAGEMENT AREAS WITHIN THE MASON CREEK WATERSHED: 2016

Priority Area 1 of Map III-1

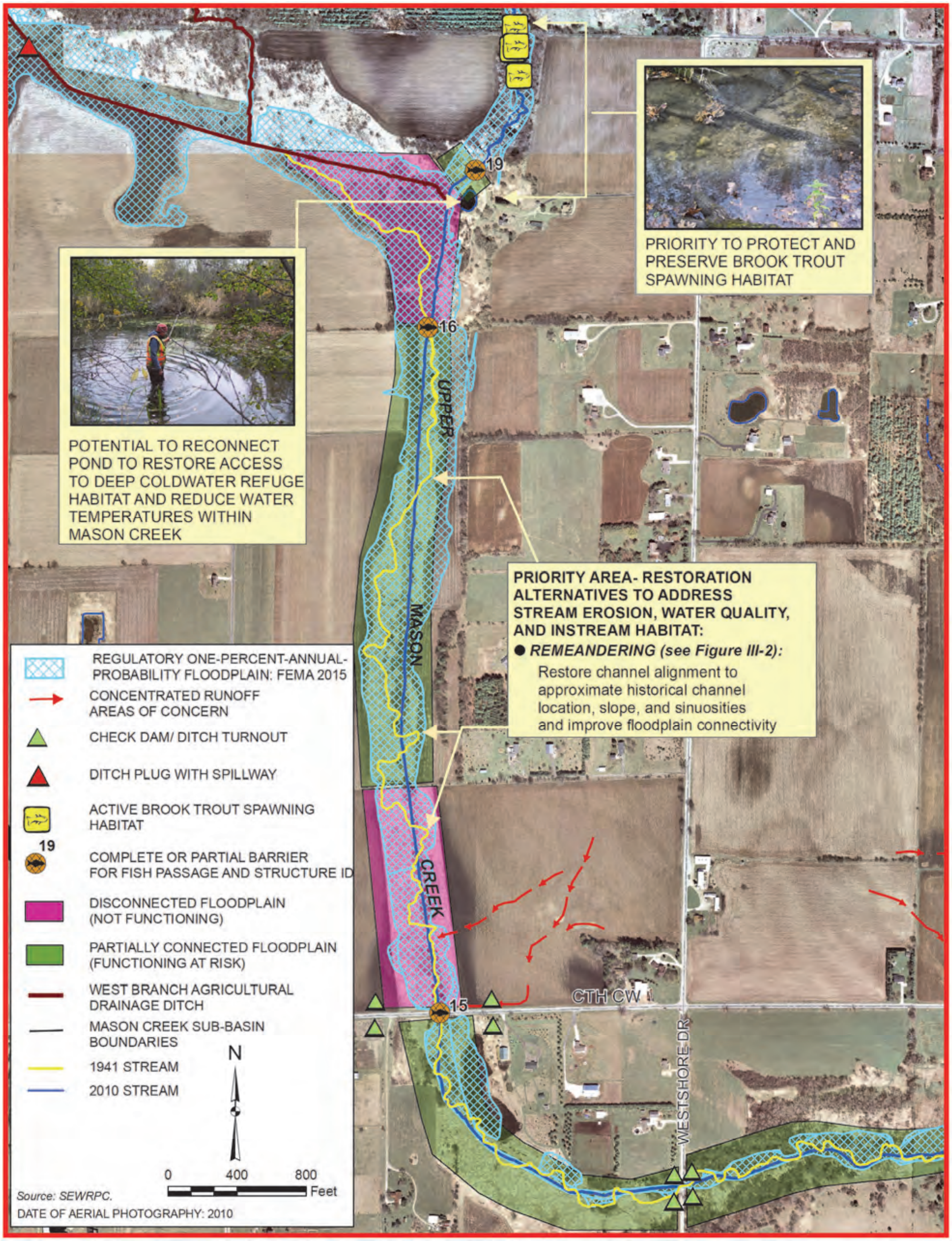
PROPOSED WATER QUALITY ENHANCEMENT RECOMMENDATIONS FOR THE WEST BRANCH AGRICULTURAL DITCH OF MASON CREEK WATERSHED: 2016

Source: SEWRPC.
DATE OF AERIAL PHOTOGRAPHY: 2010

NOTE: Constructing a ditch plug requires specific location and design speficaions with more detailed floodplain modeling.

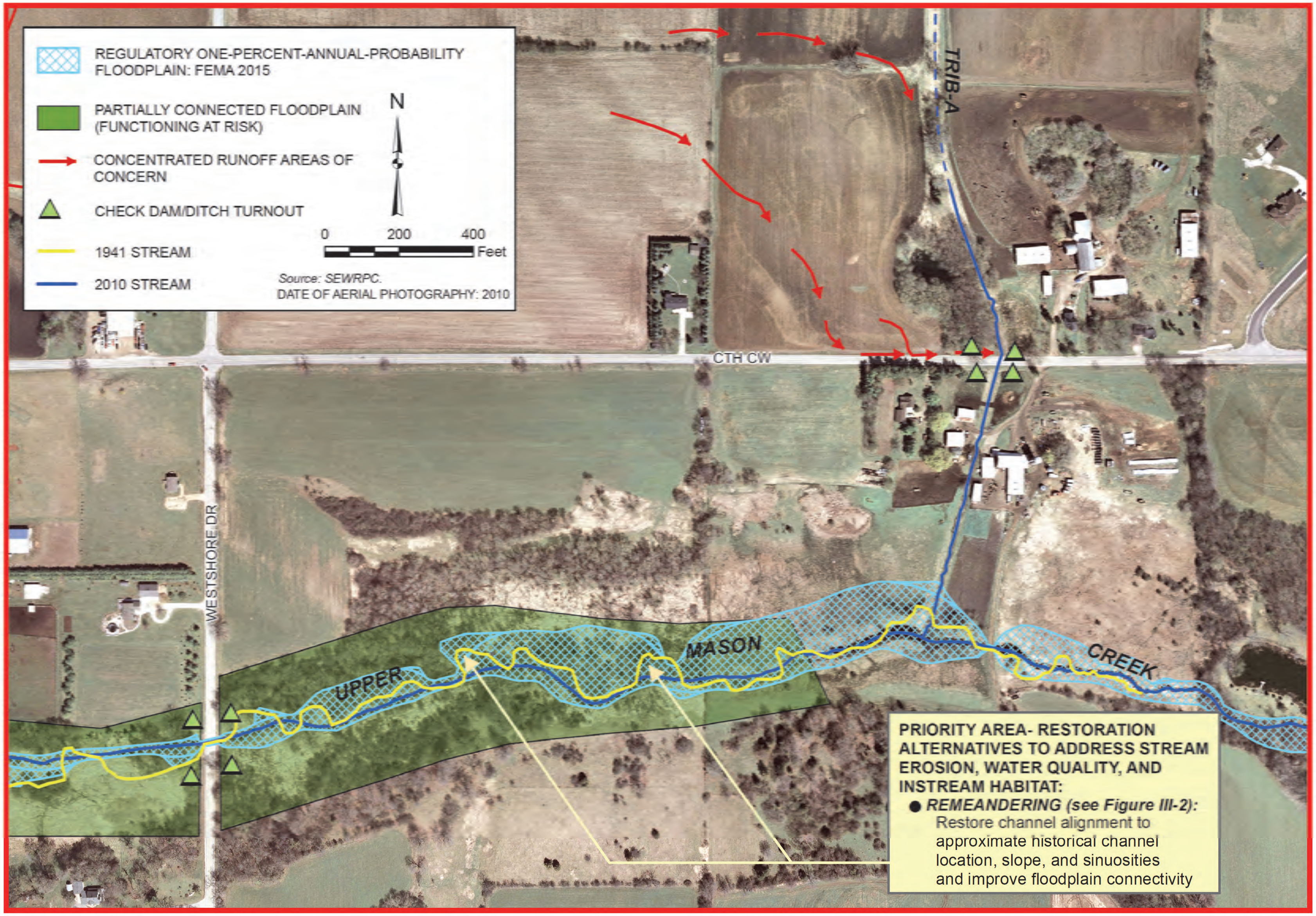
Priority Area 2 of Map III-1

POTENTIAL WATER QUALITY AND AQUATIC HABITAT ENHANCEMENT AREA WITHIN THE MASON CREEK WATERSHED: 2016



Priority Area 3 of Map III-1

POTENTIAL WATER QUALITY AND AQUATIC HABITAT ENHANCEMENTAREA WITHIN THE MASON CREEK WATERSHED: 2016



Priority Area 4 of Map III-1

POTENTIAL WATER QUALITY AND AQUATIC HABITAT ENHANCEMENT
AREA WITHIN THE MASON CREEK WATERSHED: 2016