Upper Mississippi River
Clean Water Act Monitoring Strategy 2013-2022

Recommended Monitoring Plan

February 2014

Upper Mississippi River Basin Association

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Contents

Cover photo courtesy of the Wisconsin Department of Natural Resources.

I. Background

Need for a UMR Clean Water Act Monitoring Strategy

Presently, there is no coordinated or comprehensive Clean Water Act (CWA)-focused water quality monitoring strategy for the Upper Mississippi River (UMR). The states' CWA monitoring currently consists of a relatively small number of main channel fixed stations where physical and chemical data are periodically collected. There are considerable spatial gaps in monitoring and limited data available to assess the River's condition and to measure change. Levels of monitoring effort also vary significantly among the states.

Outside of state CWA programs, other federal, regional, state, and local entities conduct UMR monitoring to meet their own objectives, producing important and extensive data sets. However, these are not designed for CWA purposes and as such are limited in their applicability to the states' water quality programs. Additionally, none of the other efforts cover the UMR's full spatial extent.

The net result of current monitoring approaches is CWA assessments of the River that are neither comprehensive nor consistent among states. This severely limits the states' ability to identify problem areas, target management actions, and measure progress in protecting UMR water quality. Simply put, better information via improved and coordinated monitoring is needed for the states' CWA programs to be as efficient and effective as possible on the UMR.

Recognizing the need for comprehensive and coordinated CWA monitoring, the states worked through the Upper Mississippi River Basin Association (UMRBA) in a two-year project to develop a UMR CWA monitoring strategy. UMRBA is the regional interstate organization formed by the Governors of Illinois, Iowa, Minnesota, Missouri, and Wisconsin to coordinate the states' river-related programs. The Governors, in a 2007 joint statement, identified UMRBA as the body to work with the states in coordinating their CWA programs for the River.

This project was financially supported by the Illinois Environmental Protection Agency (EPA), using CWA Section 106 Monitoring Initiative funds from the United States Environmental Protection Agency (US EPA) and was a collaborative effort of UMRBA's Water Quality Task Force (WQTF). The Midwest Biodiversity Institute (MBI) served as project contractor.

Monitoring Strategy Scope and Goals

At the outset of the project, the WQTF defined the strategy's scope and goals as follows:

Scope

▪ **Include chemical, physical, and biological parameters**.

▪ **Address all four major UMR designated uses - aquatic life, drinking water, recreation, and fish consumption** - where these uses are assigned.

▪ **Address the full longitudinal extent of the interstate UMR,** extending from the St. Croix River confluence at Prescott, Wisconsin to the Ohio River confluence at Cairo, Illinois and incorporating all four longitudinal reaches identified in UMRBA's 2012 *Aquatic Life Designated Uses* (ALDU) report. Additionally, Minnesota has expressed willingness to extend the monitoring approach identified by the WQTF up to the Minneapolis-St. Paul area on its intra-state portion of the UMR.

▪ **Address the four lateral strata - main channel, side channel, impounded, and contiguous backwater** - identified in the ALDU report, to the extent monitoring tools exist for these strata. If tools do not exist, development needs will be identified. Among strata, the flowing mainstem

(i.e., main channel and side channels) is the highest priority for strategy development.

Ultimately, the WQTF determined that tools for off-channel assessment need more development at this time. Therefore, this *Recommended Monitoring Plan* described in this document focuses on the main and side channels, with the understanding that off-channel areas should be included in the future.

Goals

▪ **A central goal of the monitoring strategy is to support improved assessment of the UMR under the CWA.** Specifically, this means the strategy is explicitly designed to collect biological, chemical, and physical data for use by states in their CWA Section 305(b) assessments and Section 303(d) impairment listings; which are expected to become increasingly comprehensive and consistent among states as their shared dataset grows.

▪ **Data collected under the monitoring strategy will also aid other key CWA program functions** including water quality standards development, NPDES permits, TMDLs, nonpoint source assessment and management, and measurement of nutrient loading from UMR tributaries.

▪ Additionally, and importantly, **data produced by monitoring under the strategy will be of value in detecting changes and improvements in the UMR's condition over time as water quality management actions are implemented.**

Please see the "Monitoring Function" section of this document for more details on how data may be used to support monitoring goals.

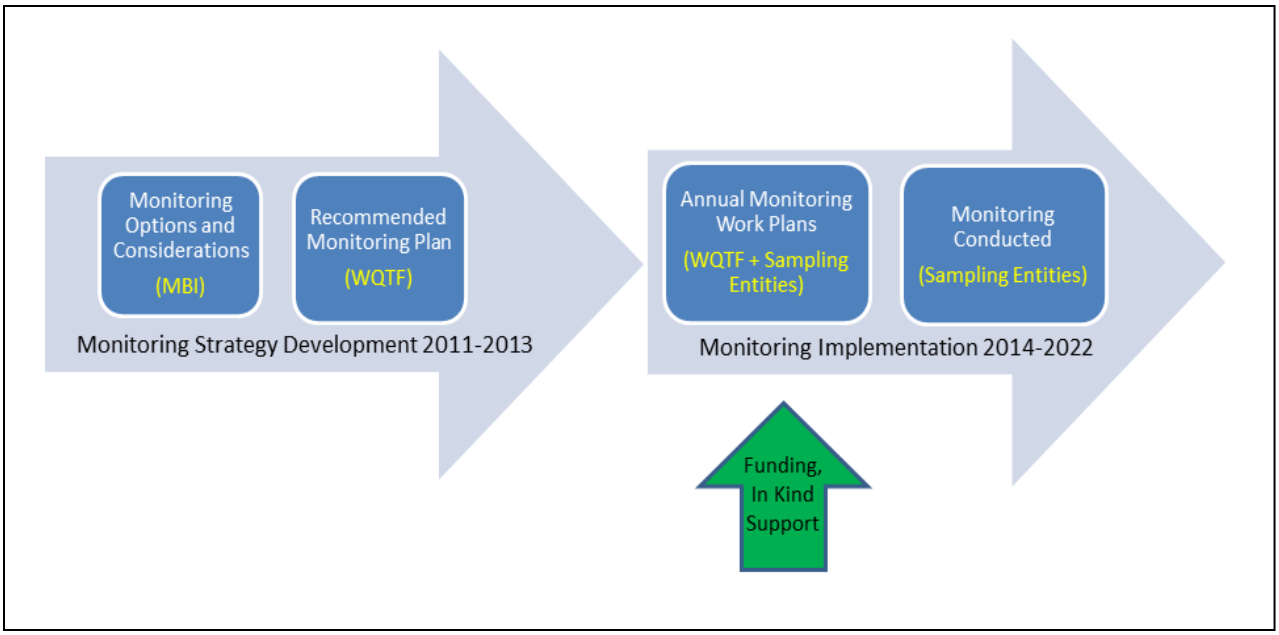
Monitoring Strategy Development Process

The monitoring strategy project incorporated a process of work sessions and document development culminating in this *UMR CWA Recommended Monitoring Plan*. The *Plan* sets the stage for improved CWA monitoring and assessment on the UMR, as funds and other resources become available for implementation (see Figure 1).

The WQTF's consideration of monitoring options included a review of existing and potential approaches to UMR monitoring, including the USACE Upper Mississippi River Restoration Environmental Management Program's Long Term Resource Monitoring Program (UMRR-EMP LTRMP), the US EPA Environmental Monitoring and Assessment Program (EMAP), state programs, and approaches implemented on other large rivers. The strategy's *Monitoring Options and Considerations* document compiled comprehensive information for the WQTF's use in crafting this *Recommended Monitoring Plan*.

In particular, the *Options and Considerations* document included information regarding potential monitoring designs, how these designs meet monitoring strategy goals, indicator selection, implications of monitoring choices for assessment, and cost estimates for various monitoring approaches.

Figure 1: Monitoring Strategy Development Process



Support for the Recommended Monitoring Plan

The member states of the Upper Mississippi River Basin Association (UMRBA) – Iowa, Illinois, Minnesota, Missouri, and Wisconsin – all support implementation of the *UMR CWA Recommended Monitoring Plan*. The UMRBA Board unanimously adopted the *UMR CWA Recommended Monitoring Plan* on February 25, 2014.

For More Information

Further information regarding the states' *Recommended Monitoring Plan* is presented in the remainder of this document. Both this *Recommended Monitoring Plan* and the *Options and Considerations* document can be found on the UMRBA website at www.umrba.org/wq.htm. Questions regarding the monitoring strategy can also be addressed to UMRBA Water Quality Program Director Dave Hokanson at 651-224-2880 or dhokanson@umrba.org.

II. Monitoring Design and Function

Monitoring Design

Mainstem Monitoring Design Overview

The *UMR CWA Recommended Monitoring Plan* is structured as a series of networks that uniquely and comprehensively provide information to support the assessment of aquatic life, fish consumption, recreation, and drinking water use attainment on the UMR. These networks also support the calculation of nutrient and sediment loading in major UMR tributaries and its mainstem.

Table 1 summarizes the recommended UMR mainstem CWA monitoring design, showing the functions supported and indicator groups sampled for the networks. The WQTF has selected this hybrid monitoring design – probabilistic plus fixed sites approach – from among candidate designs as it provides for assessment of all four major uses, is roughly in the middle in terms of likely time and costs to complete when compared to other options, fits well with existing monitoring programs, and is comparable to approaches implemented on other large water bodies (e.g., the Ohio River). Overall, the WQTF feels that its combination of probabilistic and fixed site approaches will support robust CWA assessment by the states.

See the "Monitoring Function" section of this document for details on how the data generated by these networks may be utilized.

Table 1: Recommended UMR CWA Monitoring Design (Main & Side Channels)

<table>
<tr><th rowspan="2">Function</th><th colspan="4">Clean Water Act Assessment</th><th rowspan="2">Index Calibration</th><th rowspan="2">Nutrient and Sediment Loading</th></tr>
<tr><th>Aquatic Life Use Assessment</th><th>Fish Consumption Use Assessment</th><th>Recreation Use Assessment</th><th>Drinking Water Use Assessment</th></tr>
<tr><td>Indicator Groups Included*</td><td>Biological communities
Water chemistry
Physical habitat</td><td>Fillets from target species and feeding groups</td><td>E. coli</td><td>Water chemistry</td><td>Biological communities
Water chemistry
Physical habitat</td><td>Water chemistry</td></tr>
<tr><td rowspan="7">Monitoring Networks Utilized**</td><td colspan="3">Reach-based probabilistic monitoring</td><td></td><td>Reach-based probabilistic</td><td></td></tr>
<tr><td>Mainstem fixed network</td><td></td><td colspan="3">Mainstem fixed network</td></tr>
<tr><td>Aquatic life follow-up</td><td colspan="3"></td><td>Aquatic life follow-up</td><td></td></tr>
<tr><td></td><td>Fish consumption state targeted or follow-up</td><td colspan="4"></td></tr>
<tr><td colspan="2"></td><td>Recreation targeted (urban areas)</td><td colspan="3"></td></tr>
<tr><td colspan="3"></td><td>Drinking water targeted sites (at PWSs)</td><td></td><td></td></tr>
<tr><td colspan="5"></td><td>Tributary loading network</td></tr>
</table>

*See Table 4 for detailed description of parameters included in each monitoring network.

**See Table 3 for detailed description of each monitoring network design.

Assessment Reach Definition

Via a 2003 Memorandum of Understanding, the states recognize thirteen minimum UMR CWA assessment reaches (Table 2) defined by 8-digit hydrologic unit codes (HUCs). The WQTF has affirmed these reaches as an appropriate scale around which to organize River monitoring, assessment, and water quality management. As such, the UMR CWA recommended monitoring design supports assessment at the "13 reach" level. In some cases (e.g., targeted drinking water monitoring) assessment at a finer spatial scale is supported or other localized information is provided as a result of the monitoring. Additionally, as noted earlier, Minnesota has indicated an interest in extending monitoring under this recommended design up to the Minneapolis-St. Paul area (approximately river mile 870).

Table 2: Interstate UMR Minimum CWA Assessment Reaches

Reach Number	Reach Name (Description/8-digit HUC code)	River Miles	Segment Length (miles)
1	**Assessment Reach 1 (Rush-Vermillion)** (St. Croix River to Chippewa River/ HUC 07040001)	811.5-763.4	48.1
2	**Assessment Reach 2 (Buffalo-Whitewater)** (Chippewa River to Lock & Dam 6/ HUC 07040003)	763.4-714.2	49.2
3	**Assessment Reach 3 (La Crosse-Pine)** (Lock & Dam 6 to Root River/HUC 07040006)	714.2-693.7	20.5
4	**Assessment Reach 4 (Coon-Yellow)** (Root River to Wisconsin River/HUC 07060001)	693.7-630.7	63.0
5	**Assessment Reach 5 (Grant-Maquoketa)** (Wisconsin River to Lock & Dam 11/ HUC 07060003)	630.7-583.0	47.7
6	**Assessment Reach 6 (Apple-Plum)** (Lock & Dam 11 to Lock & Dam 13/ HUC 07060005)	583.0-522.5	60.5
7	**Assessment Reach 7 (Copperas-Duck)** (Lock & Dam 13 to Iowa River/ HUC 07080101)	522.5-434.0	88.5
8	**Assessment Reach 8 (Flint-Henderson)** (Iowa River to Des Moines River/ HUC 07080104)	434.0-361.4	72.6
9	**Assessment Reach 9 (Bear-Wyaconda)** (Des Moines River to Lock & Dam 21/ HUC 07110001)	361.4-324.9	36.5
10	**Assessment Reach 10 (The Sny)** (Lock & Dam 21 to Cuivre River/ HUC 07110004)	324.9-236.7	88.2
11	**Assessment Reach 11 (Peruque-Piasa)** (Cuivre River to Missouri River/ HUC 07110009)	236.7-195.7	41.0
12	**Assessment Reach 12 (Cahokia-Joachim)** (Missouri River to Kaskaskia River/ HUC 07140101)	195.7-118.0	77.7
13	**Assessment Reach 13 (Upper Miss-Cape Girardeau)** (Kaskaskia River to Ohio River/ HUC 07140105)	118.0-0	118.0

Network Descriptions

Details regarding the monitoring networks, including spatial design, index period, frequency, and sampling duration are presented in Table 3. Networks are presented according to the designated use assessment or other function they support.

Table 3: Monitoring Networks by CWA Designated Use

Aquatic Life Use Monitoring					
Spatial Design	**Index Period**	**Number of Sites**	**Media & Frequency (per index period)**	**Sampling Duration**	**Comments**
Reach-Based Probabilistic	July to September	15 sites per reach (195 sites) plus 15 index sites river-wide for a total of 210 sites	Fish and habitat: 1x Macroinvertebrates: 1x Water Chemistry: 3x	2 years (to complete entire UMR)	Macroinvertebrate collection methods are currently in review.
		100 sites per reach, six reaches only (n=600)	Submersed Aquatic Vegetation (SAV): 1x	2 years (to complete six reaches)	Reaches 1-6 only. Sampled independently from other media. Field parameters also collected.
Aquatic Life Follow-up	July to September	Variable (dependent on results of initial sampling)	Fish and habitat: 1x Macroinvertebrates: 1x Water Chemistry: 3x SAV: 1x Sediment Chemistry: 1x	1 year (follows initial sampling)	Focus on localized areas of known or likely impairments for confirmation, stressor identification, and biotic index maintenance/development.

Fish Consumption Use Monitoring					
Spatial Design	**Index Period**	**Number of Sites**	**Media & Frequency (per index period)**	**Sampling Duration**	**Comments**
Reach-Based Probabilistic	July to September	15 sites per reach (n=195)	Fillets from preferred species list and feeding groups analyzed at a minimum for organics and mercury (Hg): 1x	2 years (to complete entire UMR)	Collected in conjunction with fish community sampling. Additional time may be necessary to acquire adequate sample.
Fish Consumption State Targeted or Follow-up	July to September	Minimum of 2 sites per reach to resample contaminated sites identified through the probabilistic sampling (n=26), or Select sites requested by State's to support UMR fish advisories	Fillets from preferred species list and feeding groups analyzed at a minimum for organics and mercury (Hg): 1x	1 year (follows initial sampling)	
Recreation Use Monitoring					
Spatial Design	**Index Period**	**Number of Sites**	**Media & Frequency (per index period)**	**Sampling Duration**	**Comments**
Reach-Based Probabilistic	July to September	15 sites per reach (n=195)	*E. coli*: 3x	2 years (to complete entire UMR)	Collected at biological monitoring sites in conjunction with other water quality sampling activities.
Recreation Targeted (Urban Areas)	April to October	Minimum of 3 sites located upstream, downtown and downstream of 8 urban population areas (n=24)	*E. coli:* 3x	2 years (to complete entire UMR)	Areas are: Cape Girardeau, MO St. Louis, MO/IL area Quincy, IL Quad City area (*Bettendorf, IA; Davenport, IA; Moline, IL; and Rock Island, IL)* Dubuque, IA La Crosse, WI Winona, MN Red Wing, MN Sampling also includes field measurements.
Drinking Water Use					
Spatial Design	**Index Period**	**Number of Sites**	**Media & Frequency (per index period)**	**Sampling Duration**	**Comments**
Drinking Water Targeted (at Public Water Systems)	Year Round	19 sites	Water Chemistry: 12x	Ongoing	Samples collected once per month at community public water systems. See list in Appendix 1. May be co-located or combined with UMR Fixed sites when in proximity to each other.

UMR Fixed Network (ALU, Recreation and Drinking Water uses, loading, trends)					
Spatial Design	**Index Period**	**Number of Sites**	**Media & Frequency (per index period)**	**Sampling Duration**	**Comments**
Mainstem Fixed Network	Year Round (chemistry, discharge) May to October (bacteria)	11 UMR sites	Water Chemistry: 12x *E. coli*: 6x Discharge: 12x (from existing USGS and USACE gaging stations)	Ongoing	Collected monthly during the index period at UMR fixed sites. See Appendix 2 for 10 mainstem sites (shaded rows). Recommend at least one additional site between Keokuk, IA and Alton, IL. Samples will be collected at Lock & Dams or by boat in the open river.
UMR Tributary Loading Network					
Spatial Design	**Index Period**	**Number of Sites**	**Media & Frequency (per index period)**	**Sampling Duration**	**Comments**
Tributary Loading Network	Year Round	34 tributary sites	Water Chemistry: 12x Discharge: 12x (from existing USGS and USACE gaging stations)	Ongoing	See Appendix 2 for a list of 34 tributary sites. Network is separate from UMR assessment efforts but supported by the Monitoring Strategy for assessing nutrient loads and trends on the UMR. All but one of these sites already an established monitoring site (under various programs).

Indicators Monitored

The indicators to be monitored within each network are listed in Table 4. Indicators shown here are primarily "core" indicators, meaning that they are collected in all routine monitoring. The exception is sediment chemistry, which is only monitored during aquatic life follow-up sampling. Additionally, further "supplemental" indicators may be added to routine and/or follow-up sampling when initial monitoring or other information (e.g., known source of contamination) identifies the need to analyze a more extensive set of indicators.

As biological indicators rely on specific sampling methods and index calculations, those recommended for use in this monitoring plan are further described in the following paragraphs.

Fish – The WQTF recommends using the Great River Fish Index (GRFIn), developed by US EPA's EMAP-GRE program. Per the 2011 *UMR CWA Biological Assessment Guidance Document*, the Impounded Mississippi River GRFIn should be used through Reach 11 and the Missouri River GRFIn should be applied in Reaches 12 and 13. Use of EMAP-GRE fish sampling methods supports the calculation of GRFIn scores, as does the aggregation of data collected using UMRR-EMP LTRMP methods.

Macroinvertebrates – UMRBA's 2011 *UMR CWA Biological Assessment Guidance Document* recommends using a modification of the Great Rivers Macroinvertebrate Index (GRMIn) for the impounded UMR and the Missouri River GRMIn for the Open River. However, the WQTF is currently awaiting the outcome of a comparison study (i.e., comparing EMAP-GRE kick sampling to artificial substrate methods) before making a final recommendation regarding macroinvertebrate index and sampling methods.

Submersed Aquatic Vegetation (SAV) – The WQTF recommends the use of the Submersed Macrophyte Index (SMI) developed by Minnesota and Wisconsin, along with its accompanying sampling method, on Reaches 1-6 only as this is the most well-documented historic extent of SAV.

Table 4: Indicators to be Sampled in Monitoring Networks

		Reach-Based Probabilistic Monitoring (and Aquatic Life Follow-Up Monitoring)				Mainstem Fixed Network	Fish Consumpt. Targeted	Recreation Targeted (Urban)	Drinking Water Targeted Sites	Tributary Loading Network
		Biological Monitoring	*Water Chemistry*	*Sediment Chemistry**	*Fish Tissue*	*Water Chemistry*	*Fish Tissue*	*Water Chemistry*	*Water Chemistry*	*Water Chemistry*
Biological Communities										
	Fish	X								
	Vegetation	X								
	Macroinvertebrates	X								
Fish Tissue										
	Mercury (Hg)				X		X			
	Organics (Incl. PCBs)				X		X			
Field										
	Water Temperature		X			X			X	X
	DO (conc.& sat)		X			X				X
	pH		X			X			X	X
	Conductivity		X			X			X	X
	Turbidity		X			X			X	X
	Secchi Depth		X							
Nutrients										
	NO3+NO2		X			X			X	X
	TN		X	X		X			X	X
	NHx		X			X				X
	TP		X	X		X			X	X
	DP		X			X				X
	Chlorophyll a		X			X				X
Bacteria										
	Escherichia coli		X			X		X		
Miscellaneous										
	BOD		X							
	Chloride		X			X				
	Sulfate		X			X				
	TSS		X			X				X
	TOC or DOC			X		X			X	
	Hardness (Ca & Mg)		X			X			X	X
	Alkalinity		X			X				
	Fluoride					X			X	
	Phenols					X			X	
Metals										
	Aluminum (Al)		X			X				
	Boron (B)		X			X			X	
	Barium (Ba)		X			X			X	
	Beryllium (Be)		X							
	Calcium (Ca)		X			X			X	
	Cadmium (Cd)		X	X		X			X	
	Chromium (Cr)		X	X		X				
	Cobalt (Co)		X			X				
	Copper (Cu)		X	X		X				
	Iron (Fe)		X	X		X			X	
	Lead (Pb)		X	X		X				
	Magnesium (Mg)		X			X			X	
	Manganese (Mn)		X	X		X			X	
	Nickel (Ni)		X	X		X				
	Potassium (K)		X			X				
	Silver (Ag)		X	X		X				
	Sodium (Na)		X			X				
	Strontium (Sr)		X			X				
	Vanadium (V)		X			X				
	Zinc (Zn)		X	X		X				
Other										
	Arsenic (As)			X		X			X	
	Mercury (Hg)			X		X				
	Selenium (Se)					X			X	
Organics										
	VOCs, Pesticides, Other			X					X	
Physical Habitat and Characteristics										
	Substrate	X								
	Depth	X								
	Velocity	X								
	Discharge					X				X

*Sediment chemistry collected in follow-up sampling only.

Monitoring Function

Overall, the purpose of the monitoring strategy is to provide the states with a sound, comprehensive, consistent data set in order to address information gaps; improve the characterization of the River's condition in CWA assessments; better identify stressors and water quality impairments; target CWA-related management actions; and track changes and improvements over time. By establishing a shared template for monitoring on the UMR, the *Recommended Plan* should also help improve efficiencies by reducing duplication of effort and increasing compatibility of collected data.

UMR CWA Assessment

The primary outcome supported by the *Recommended Monitoring Plan* is improved CWA assessment of the UMR by the states. Data acquired under the strategy will support the states' assessment of the flowing mainstem (i.e., main channel and side channels) to determine whether CWA goals for the UMR's four major designated uses (aquatic life, drinking water, fish consumption, and recreation) are being met. Most specifically, it provides enhanced data to improve the states' abilities to carry out their CWA Section 305(b) assessment and 303(d) listing responsibilities, with the expectation that these characterizations become more accurate in reflecting the River's condition due to enhanced spatial and parameter coverage. Therefore, data collected under the monitoring strategy must provide information that supports both 305(b) assessment and 303(d) listing, a fact which is reflected in the WQTF's monitoring design choices.

While other existing and previous programs and projects have investigated assessment (EMAP-GRE), evaluated the system for other purposes (UMRR-EMP LTRMP), or sampled portions of the river (state and regional programs), none have provided the ability to comprehensively support Clean Water Act assessment on an ongoing basis. Achieving this is seen by the WQTF as a key outcome of implementing this *Recommended Monitoring Plan*.

Further, the monitoring recommended herein provides for the incorporation of biology into CWA assessment on the UMR, an element not currently part of the states' CWA assessments of the River.

Impact on States' Assessment and Listing Processes – Data collected under the *Recommended Monitoring Plan* will be utilized by the states in their existing CWA Section 305(b) assessment and 303(d) listing processes, as is the case for other readily available data sets. The chief and immediate impact will be state assessments and listings that are informed by an enhanced, comprehensive underlying data set and therefore are more reflective of the River's water quality condition. Further, as the amount of data accumulated under the *Recommended Plan* grows, CWA assessment and listing outcomes are expected to be increasingly consistent among states as the shared data set becomes more central to their decision-making.

Adoption of the monitoring strategy itself does not directly or immediately impact the states' assessment and listing methodologies, nor their water quality standards. States will continue to conduct their own assessment and listing processes for the UMR using their own water quality standards, though these decisions will increasingly be informed by a more robust, shared data set. Additionally, the WQTF plans to examine the feasibility and potential scope of a shared, UMR CWA assessment. Table 5 illustrates both near term and potential longer term use of data generated under the strategy.

While the WQTF has just started its detailed examination of the feasibility of a shared UMR assessment, the *Plan* has been designed to feed

information into both existing state programs as well as potential future shared assessment approaches. As such, the following discussion illustrates in general how monitoring strategy data can be used – either in the context of individual state or shared assessment – to evaluate the attainment of major designated uses on the UMR. Further detail may emerge from the WQTF's feasibility study of shared UMR assessment.

Table 5: Use of Data from Recommended UMR CWA Monitoring

Near Term	**States use data generated under *Recommended Monitoring Plan* in producing their individual 305(b) assessments and 303(d) impairment lists,** as is done with other readily available data.
Longer Term	**The WQTF examines the feasibility of a shared CWA assessment for the UMR** using data from *Recommended Monitoring Plan.* Depending on the outcome of this feasibility study, the states may use monitoring strategy data in such a shared assessment, and consider whether to pursue harmonization of their assessment/ listing methodologies and/or water quality standards applied to the UMR.

Aquatic Life Use Assessment – A central element of the *Recommended Monitoring Plan* is a probabilistic design that supports comprehensive, consistent aquatic life use assessment and also provides data for fish consumption and recreation use assessment. The WQTF recommends a UMR-wide probabilistic design wherein 15 randomly distributed samples are collected from the flowing channels (i.e., main channel and side channels) in each assessment reach. These random samples include biological community, fish tissue, water chemistry, and physical habitat monitoring (see Tables 3 and 4).

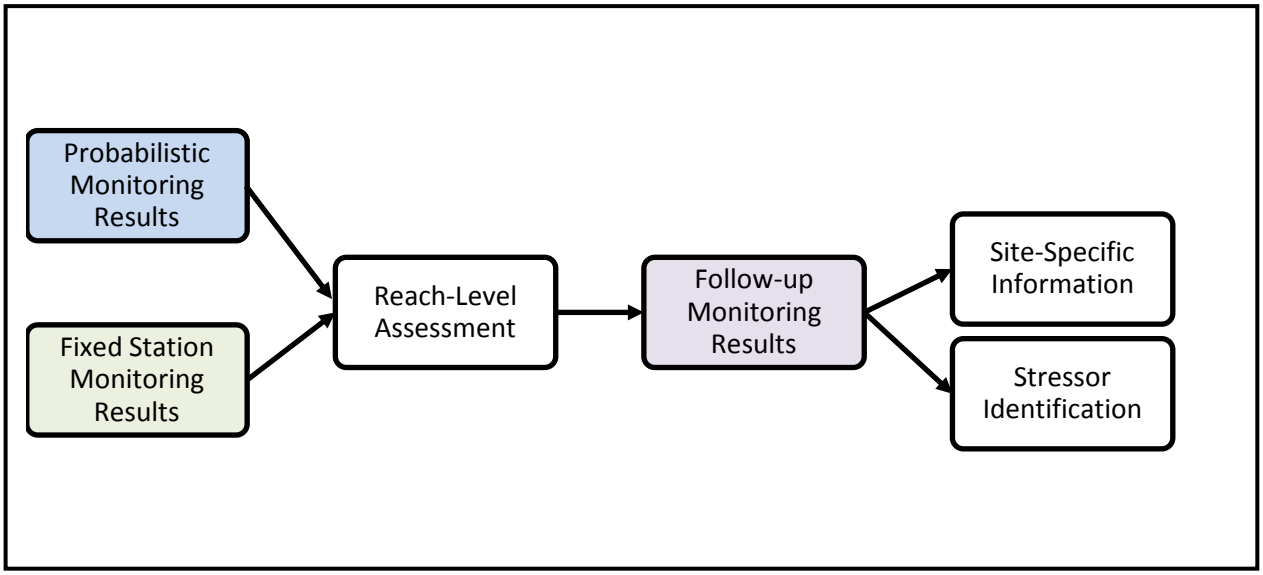
Among the biological indicators monitored in this network, fish assemblage monitoring is seen as critical for immediate incorporation, though the WQTF also plans to include submersed aquatic vegetation (SAV) and macroinvertebrates in biological community monitoring. SAV would only be sampled in Reaches 1-6 and requires a separate sampling design in order to match the vegetation index which has been developed for the UMR. As previously mentioned, the WQTF is awaiting the results of an ongoing comparison study before finalizing its recommendation regarding macroinvertebrate monitoring method(s).

Of note, this probabilistic approach allows for the potential integration of data from UMRR-EMP LTRMP monitoring. See the Implementation section for further details on this.

In addition to the data generated from probabilistic monitoring, aquatic life use assessment can also incorporate data collected at mainstem fixed sites. Follow-up aquatic life use monitoring, conducted in areas where non-attainment has been indicated by initial monitoring, can be utilized to provide site-specific information and stressor identification, as well as to support individual states' impairment listing decisions. Other investigative steps could also be taken when non-attainment is indicated in initial monitoring, to help identify stressors and pollution sources.

Figure 1 illustrates how monitoring data could be integrated into aquatic life use assessment.

Figure 1: Illustration of Aquatic Life Use Assessment Using UMR CWA Monitoring Data



Fish Consumption Use Assessment – The primary information set created under the *Recommended Monitoring Plan* to support fish consumption use assessment is fish tissue data from samples collected as part of the probabilistic, reach-based monitoring network. Fillets from target species and feeding groups would be processed and analyzed for mercury (Hg) and organics, including polychlorinated biphenyls (PCBs).

Following completion of the probabilistic fish tissue sampling, a targeted round of sampling is specified. Sites in this subsequent round would be selected to address: 1) resampling at contaminated sites identified in probabilistic monitoring, and/or 2) requests made by the states to support their fish consumption advisories (FCAs). In some states, issuance of FCAs requires confirmation sampling, as would be provided via follow-up monitoring.

This follow-up monitoring would include Hg and organics, with other supplemental indicators added to the analysis if desired.

Data from both the initial probabilistic monitoring and targeted, follow-up monitoring could be used to produce reach-level assessments, support impairment decisions, and in supplementing states' fish consumption advisories. Information about site-specific contamination would also result from this monitoring. Figure 2 illustrates the potential use of monitoring data in fish consumption use assessment.

Recreation Use Assessment – The *Recommended Monitoring Plan* produces data from three

Figure 2: Illustration of Fish Consumption Use Assessment Using UMR CWA Monitoring Data

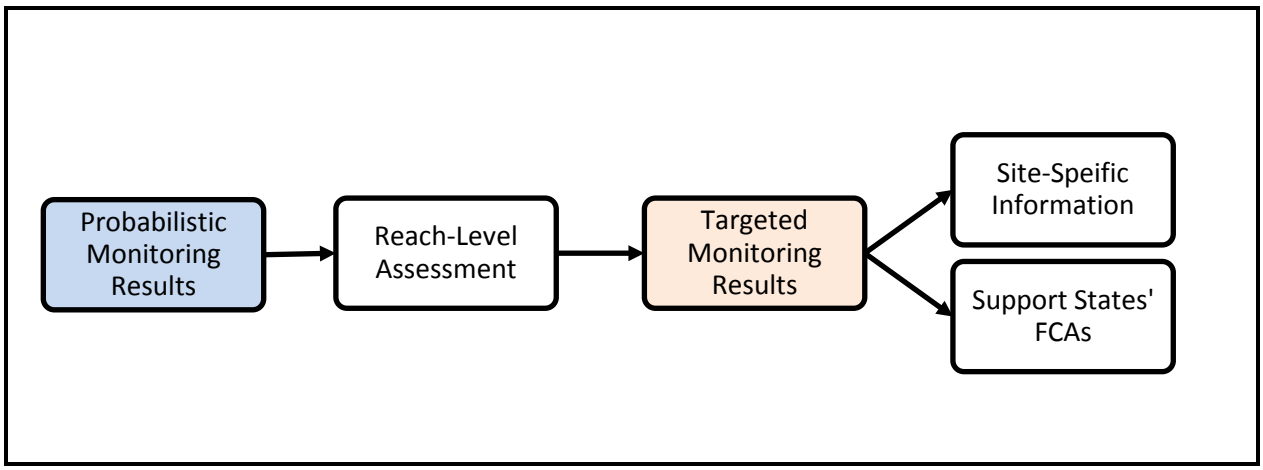
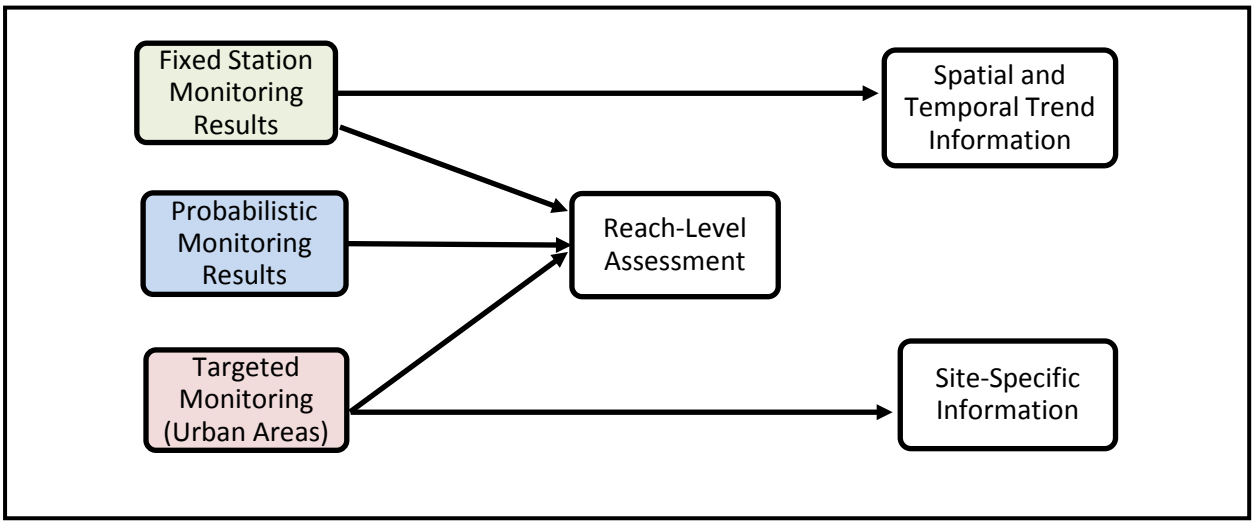


Figure 3: Illustration of Recreation Use Assessment Using UMR CWA Monitoring Data



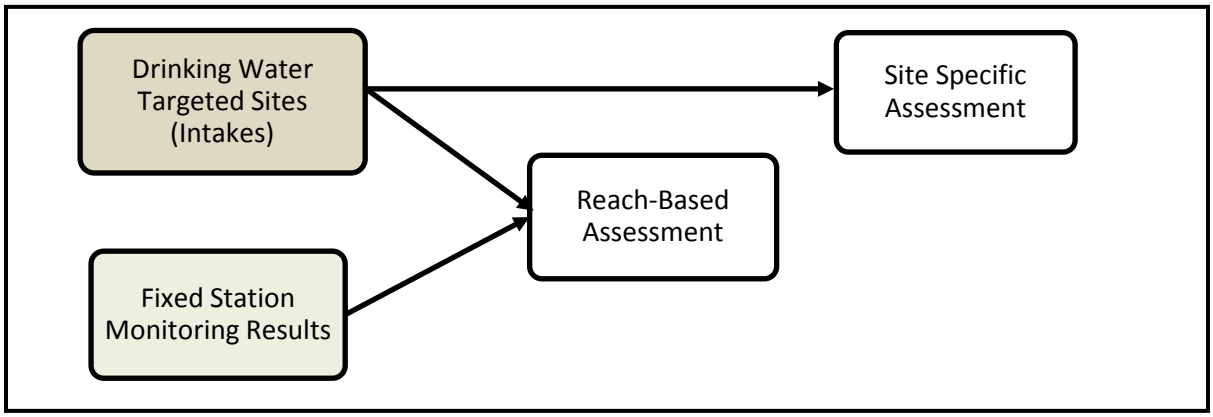
monitoring networks which can be utilized in recreation use assessment: 1) *Escherichia coliform (E. coli)* samples collected alongside other parameters at probabilistic monitoring sites, 2) *E. coli* samples collected in selected urban areas, and 3) *E. coli* samples collected at mainstem fixed sites. Urban area samples would be collected upstream, downtown, and downstream of eight selected urban areas (see Table 3).

Information from these networks can be used to produce not only reach-based assessments, but also to characterize the condition of some of the more intensively used area on the river, and to make statements about how conditions change along the run of the river and during different flow conditions. Figure 3 illustrates the potential use of data in recreation use assessment.

Drinking Water Use Assessment – Drinking water use assessment is different from other uses in that it is not designated in all areas of the river. Specifically, Illinois and Missouri assign this use to the entirety of the UMR within their borders, Iowa designates the use at intake locations only, and Minnesota and Wisconsin do not assign the use to the interstate UMR as they have no intakes present on the interstate River.

Data from the monitoring strategy therefore provides information at the intake points to allow for point-specific assessment if needed. Intake-specific data can also be combined with fixed site data, to provide information for reach-scale assessment in cases where this is needed. See Figure 4. Additionally, results from intake sites can provide information to support aquatic life use assessment.

Figure 4: Illustration of Drinking Water Use Assessment Using UMR CWA Monitoring Data



Index Calibration and Maintenance – A network of index sites located in the lower reaches of major UMR tributaries supplements the mainstem design. This includes a total of 15 sites on selected major tributaries including the St. Croix River, Minnesota River, Chippewa River, Wisconsin River, Rock River, Iowa River, and Kaskaskia River. These index sites are intended to supply "background" data across all indicators, providing comparison points for mainstem conditions. This data is important for the calibration and maintenance of biological indices, in establishing attainable thresholds for chemical, physical, and biological parameters, and "anchoring" a biological condition gradient for the determination of stress/response relationships that can be applied to stressor and impairment diagnosis on a site-specific, reach scale and system-wide basis. This function of "index calibration and maintenance" is important in assuring that index scores emerging from the monitoring strategy are both reliable and representative of the River's condition.

In some cases, the tributary locations included among the index sites may approximate "least impacted" conditions, which can be particularly helpful in setting attainment thresholds and anchoring the upper end of the biological condition gradient. In other cases, the tributary may be at a lower quality condition than the mainstem itself. As data are collected from these locations over time, a determination can be made as to whether any of the locations can be considered as "least impacted."

Nutrient and Sediment Loading

In addition to the CWA assessment-focused use of monitoring data described in the previous paragraphs, the *Recommended Monitoring Plan* has also been designed to help better quantify nutrient and sediment loading to the UMR mainstem. This is increasingly important given the states' and federal agencies' work to reduce nutrient loading via state nutrient reduction strategies and programs such as the Mississippi River Basin Health Watersheds Initiative (MRBI), and the importance of measuring outcomes from these activities.

Specifically, the WQTF has identified 34 tributary locations, with paired water quality and stream gaging sites, as recommended for incorporation into a UMR tributary loading network. These sites would be monitored for a consistent set of sediment, nutrient, and discharge parameters. The same parameters would also be collected at the 11 mainstem fixed stations. Taken together, results from these 45 sites (see Figure 5) would create a comprehensive, ongoing data set to support nutrient and sediment loading measurements. Importantly, nearly all of these sites are currently in existence and are actively monitored. As such, the "establishment" of this network may largely be an exercise in coordination, harmonization of parameters sampled, and data sharing.

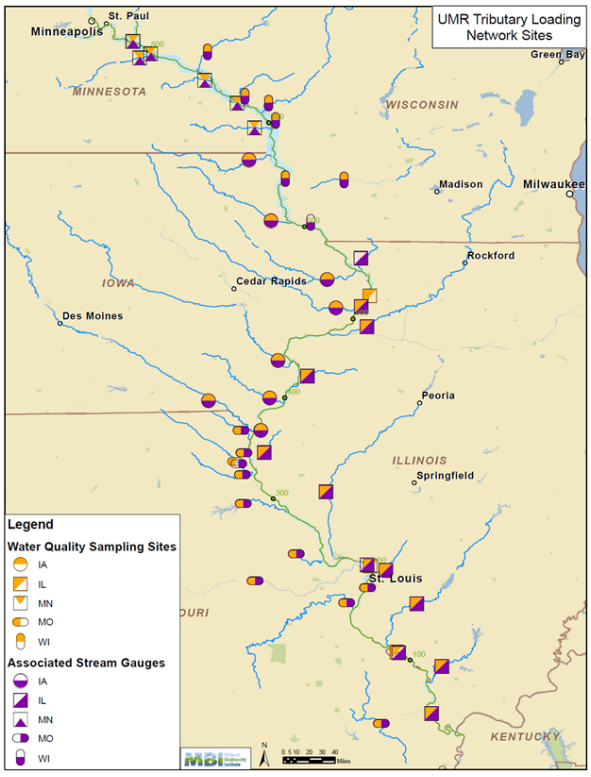


Figure 5: Tributary and Mainstem "Loading Network" Sites

Also of note, the Gulf Hypoxia Task Force has initiated a Monitoring Collaborative effort to

identify key water quality monitoring locations throughout the basin for the purposes of assessing loading and impacts on Gulf Hypoxia. The WQTF has communicated with leaders of this initiative to encourage consistency between the WQTF's UMR tributary loading network recommendations and the recommendations of the Monitoring Collaborative.

Other Data Uses

CWA Functions

Beyond its use in 305(b) assessments and 303(d) impairment listing, as described previously, the WQTF expects that monitoring data will also be utilized in the following CWA functions:

Water Quality Criteria - New and comprehensive data will help the states to better understand appropriate goals and thresholds for water quality in the UMR's various strata. This may lead to potential revision of states' water quality criteria applied to the UMR and greater consistency among the states' criteria on the River.

Aquatic Life Use Designations – As more information becomes available via monitoring conducted under this strategy, it may be possible for the states to further refine and improve aquatic life use designations applied to the River and/or modify the recommended aquatic life classification structure for the UMR as described in UMRBA's 2012 *Aquatic Life Designated Uses* report.

TMDLs and Permits – As improved monitoring allows the states to better understand the River's condition, and as criteria applied to the UMR are potentially revisited, data from the monitoring program can be used to inform any new river-focused TMDLs and permits issued for river-based dischargers.

Nutrients – Both the assessment-focused and tributary loading networks can provide critical information as states implement nutrient reduction strategies. This may include tracking of progress over time, and determining how nutrient levels and impacts vary under different conditions and in different physical locations on the River.

Non-CWA Program Functions

There are many stakeholders on the UMR outside of the states' CWA programs who will be interested in the data produced under this monitoring plan. As such, it is expected that this data set will become a valuable asset in a number of non-CWA settings on the UMR.

III. Implementation

The WQTF recognizes that many questions associated with the *Recommended Monitoring Plan* will need to be addressed as its implementation proceeds. The following is an initial discussion of some of the major implementation considerations identified by the WQTF. While much of the following presumes full implementation of the monitoring strategy (i.e., across the entire UMR) for discussion purposes, the WQTF recognizes that implementation will likely proceed much more incrementally (e.g., in pilot areas initially).

Compatibility with Existing Programs

One of the chief advantages of the *Recommended Monitoring Plan* is that it provides for the greatest level of inter-program compatibility among the options examined by the WQTF. In particular, the *Recommended Plan* allows the greatest opportunity to maximize use of existing monitoring data, thereby leveraging existing resources and minimizing additional costs. Specifically, the recommended plan offers the following synergies:

Compatibility with UMRR-EMP LTRMP - Probabilistic design at the reach level allows for the incorporation of currently-collected UMRR-EMP LTRMP fish and vegetation assemblage data (e.g., LTRMP fish data can be aggregated to allow for reach index score calculation) as well as water chemistry data. This means that important data from several pools is already being collected in a manner useful for CWA assessment.

Compatibility with Existing Fixed Stations - Both the mainstem fixed site network and tributary loading network are largely composed of existing water quality sampling and stream gage sites. While there may be a need to pursue additions to parameters collected and/or monitoring frequencies, the basic infrastructure and data collection for these sites is already in place.

Builds on EMAP-GRE - The probabilistic component of the *Recommended Monitoring Plan* in many ways builds on work done by the EMAP-GRE program during its 2004-6 sampling on the UMR, giving EMAP-GRE information greater value as an historic and compatible data set. Moreover, as previously described, some of the methods and indices developed by EMAP-GRE are incorporated into the *Recommended Monitoring Plan*.

Data Management

The WQTF recognizes that a data management protocol associated with the *Recommended Monitoring Plan* must be established. The WQTF recommends that the data management function should be centralized even if data collection is dispersed among multiple entities. As such, dedicated staff must be assigned to data management and oversight associated with the UMR CWA monitoring program. In terms of the specifics of data storage, the WQTF is open to options including use of an existing data system (state or federal) or a new, separate UMR CWA-specific data system. The WQTF plans to explore data management considerations in detail as it pursues implementation of the *Recommended Monitoring Plan*.

Entities Engaged in Monitoring

The WQTF recognizes the need to identify the entity or entities responsible for conducting the monitoring under this plan, as well as who will carry out data management, quality assurance, and other associated functions. Organizations potentially involved include: state CWA

programs, state-based field stations, UMRBA, USACE, USEPA, USGS, and/or private contractor(s). Various organizational options could also be employed in combination.

Further, the WQTF expects that each state will wish to weigh in regarding its preference for monitoring implementation along its portion of the river.

The monitoring implementation option(s) selected by the states via the WQTF, Water Quality Executive Committee (WQEC), and UMRBA Board will have implications for costs, timing of monitoring, annual staff needs, and quality assurance/quality control processes.

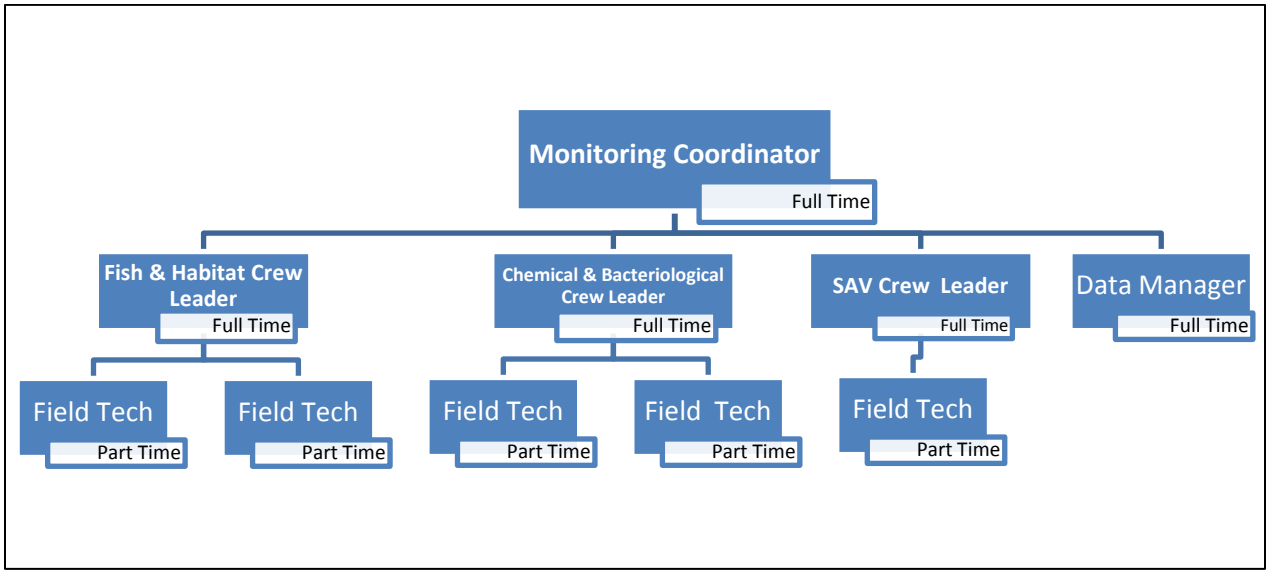
Staffing

Regardless of the particular organizational option(s) selected, the WQTF anticipates the need – at minimum – for one full time staff person dedicated solely to monitoring program oversight. Duties of this individual would include annual monitoring plan design, monitoring coordination, data management/data management oversight, quality assurance/quality control and communication with other River programs. This position is *in addition* to front line staff needed to actually conduct monitoring, perform lab analysis, enter data, etc.

Based on estimates provided in the *Options and Consideration* document, as well as staffing for other large river monitoring efforts, it is anticipated that a total of at least five full time equivalents (FTEs) would be needed to implement the *Recommended Monitoring Plan* in full. These FTEs may be dispersed among multiple organizations and may include a combination of full time and part time positions.

An illustration of possible staffing to support UMR CWA monitoring is shown in Figure 6, based on information presented in the *Options and Considerations* document. Specific staffing will be dependent on funds available, the number of organization(s) engaged in monitoring, and timeframe in which monitoring is completed.

Figure 6: Example UMR CWA Monitoring Staffing Illustration*



**Monitoring coordinator, and possibly data manager, would likely be fully new and UMR-dedicated positions. Other positions may be distributed/divided among several agencies/programs, depending on the implementation approach pursued.*

Time to Complete

If fully funded and staffed, completion of the first full cycle of recommended UMR monitoring is anticipated to take approximately five years. Monitoring could, however, be implemented more quickly or more slowly. This of course affects the annual monitoring cost. As such, the *Recommended Monitoring Plan* is scalable in a temporal sense, in that the amount of monitoring conducted each year can be adjusted in light of available funding. That said, the WQTF recommends that a complete round of monitoring and assessment be completed in no more than five years to maintain currency of data. Figure 7 provides an illustration of initial monitoring and assessment implementation over a five year period.

The WQTF further recommends that if monitoring is implemented at a reduced pace, this be achieved by covering less spatial area per year, as opposed to only implementing some of the networks over a larger spatial area.

Figure 7: Possible Monitoring Timeline (Initial Monitoring Cycle, Full Implementation)

	Year 1	Year 2	Year 3	Year 4	Year 5
Initial Staffing & Training, Finalizing Design					
Reach-Based Probabilistic Monitoring					
Mainstem Fixed Monitoring	(Ongoing)				
Aquatic Life Follow-up Monitoring					
Fish Consumption Targeted or Follow-up Monitoring					
Targeted Recreation Monitoring (Urban Areas)					
Targeted Drinking Water Monitoring (PWSs)	(Ongoing)				
Tributary Load Network Monitoring	(Ongoing)				
Revise Monitoring Plan for Next Cycle					

Costs

Monitoring costs will be dependent, as noted previously, on the implementation timeline, the number/type of entities engaged, and other factors. However, some idea of the likely scale of costs can be gained from information contained in the monitoring strategy *Options and Considerations* document, as well as by looking at other large river monitoring programs. Ultimately, costs may best be determined by carrying out pilot projects to execute monitoring as described in the *Recommended Monitoring Plan.*

Estimates from the *Options and Considerations* Document

Cost estimates incorporated in the *Options and Considerations* document provide an approximation of the expense associated with the reach-based probabilistic monitoring component of the *Recommended Monitoring Plan*. Using this information, the reach-based probabilistic monitoring component of the plan is estimated to cost $1.25 million annually (or $2.5 million over two years to complete monitoring of the whole river), with an average per site cost of approximately $13,000.

Importantly, this estimate assumed all monitoring functions were performed by a single entity and incorporated monitoring, analysis, and data management costs. There is potential for significant variation from this estimate if other organizational approaches are pursued.

Additionally, the *Options and Considerations* document estimated index site sampling expense associated with the probabilistic design at a cost of $372,000 over two years. Further, the probabilistic network's monitoring may only take place in two years of an approximately 5 year monitoring cycle. Therefore, the total of approximately $2.8 million (including index sites) for probabilistic sampling may not be incurred evenly across a monitoring cycle.

More importantly, the *Options and Considerations Document* estimates did not incorporate the costs of the other networks described in this *Recommended Monitoring Plan* (e.g., targeted recreation monitoring, drinking water monitoring, tributary loading network). Any costs associated with these networks would be in addition to those for the probabilistic network. Detailed costs estimates for these other networks have not yet been developed, and may be highly dependent on the extent to which existing data sets can be utilized. The WQTF anticipates that pilot projects may be utilized to better determine actual costs.

Other Programs' Monitoring Costs

Another source of cost comparison is to look at other large river monitoring programs. The Ohio River Valley Sanitation Commission (ORSANCO) runs a monitoring program with many similarities to this *Recommended Monitoring Plan*. In many ways, it represents what a "fully functional" CWA monitoring and assessment program may look like on the UMR. Per the *ORSANCO 2011 Annual Report*, the cost of this program in 2011 was approximately $2.6 million, with $1.8 million dedicated to "water quality monitoring and assessment" and approximately $0.75 million dedicated to "biological assessment and research."

US EPA's EMAP-GRE program, which sampled the UMR in 2004-2006 using a design with many similarities to the reach-wide probabilistic approached described herein, saw per site sample costs that – while varying dependent on location and other factors – were fairly consistent with estimates provided in the *Options and Considerations Document,* verifying the validity of the probabilistic network cost estimates.

Additional Considerations and Rough Cost Estimate

An important consideration is that this *Recommended Monitoring Plan* seeks to maximize coordination with existing programs. This will hopefully reduce monitoring and analytical costs, though it may increase the need for staff time devoted to coordination and data compilation/analysis. One of the first steps the WQTF is pursuing in implementation is a crosswalk matching existing monitoring programs to the networks described in the recommended plan, in order to better ascertain what data may already be available to meet monitoring needs.

Additionally, annual costs may vary across a five-year implementation cycle. For example, field and analytical costs may be less in initial "ramp up" year, and more in years where multiple networks are sampled. However, training and administrative expenses may be greatest at the beginning of monitoring and level off over time.

In sum, predicting costs is quite challenging, given that this is very dependent on numerous assumptions, and currently available information provides only partial and/or indirect estimates.

Perhaps the most that can be said at this time, using information from the *Options and Considerations* document and other monitoring programs as guidelines, is that implementation of all the networks within the *Recommended Monitoring Plan* would likely cost on the order of $1 million to $2 million annually, on average.

Funding and In-Kind Resources

No specific source of funding has yet been identified to implement the *Recommended Monitoring Plan*, though the goal of the WQTF and WQEC is to identify a stable, ongoing funding source, as this type of monitoring program can only be successful if it is sustained over time.

UMRBA's Board and the WQEC anticipate utilizing this *Recommended Monitoring Plan* in efforts to secure such funding, while recognizing that monitoring may proceed initially utilizing shorter-term funding and in-kind resources.

Limitations and Constraints

The WQTF feels strongly that the *Recommended Monitoring Plan* is the best alternative to pursue given current knowledge regarding the River, existing data sets, funding possibilities, regulatory responsibilities and institutional structures. That said, the WQTF recognizes that its proposal does not address all the possible functions and components of River monitoring.

In some cases, the WQTF envisions that certain needs – such as monitoring in off-channel strata or the incorporation of continuous monitoring technology – will likely be addressed as assessment tools and technologies develop over time.

In other cases – such as the potential intensification of monitoring to allow for more spatially specific assessment – the WQTF anticipates that having a more robust and consistent data set via the implementation of the *Recommended Monitoring Plan* will allow for better judgment about whether such monitoring modifications are needed.

Further, there are certain needs which are not well addressed via a routine monitoring program such as what is proposed herein. Examples include monitoring in response to algal blooms, which is episodic and requires rapid sampling (typically done by individual states) and special studies to investigate emerging contaminants (which could be coordinated or implemented by the WQTF – as has previously been done in a study of perfluorochemicals). While the WQTF is certainly supportive of these types of monitoring efforts, they appear to fall outside the structure of this *Recommended Monitoring Plan*.

In sum, while no monitoring program is perfect, the WQTF feels that this *Recommended Monitoring Plan* can effectively support UMR CWA assessment in the near term while setting the stage for further improvements in the future.

Flexibility and Future Modification

The intent of this *Recommended Monitoring Plan* is to outline proposed UMR CWA monitoring over the current period (2013-2022), with an understanding that modification and adjustment will no doubt be needed in subsequent periods.

The WQTF feels it is best to proceed now with it preferred monitoring approach, and then adjust as needed in the future. It plans to explicitly revisit the monitoring design in advance of the next monitoring strategy period (2023-2032).

Next Steps

In pursuing implementation of the *Recommended Monitoring Plan*, the WQTF has initiated a comparison of existing program data to *Recommended Plan* specifications, formed a workgroup to examine the feasibility of a shared CWA assessment, begun to consider data management alternatives, and started to identify areas in which to pilot monitoring strategy implementation. The WQTF also plans to engage in outreach to regional monitoring partners to gather their input and explore data sharing opportunities.

Appendix 1: Interstate UMR-Based Community Public Water Systems (adapted from UMR Water Suppliers Coalition Summary, 2006)

Community Public Water System	State	Interstate Assessment Reach	Approximate River Mile	Est. Population Served*	Data Source
E. Moline Water Department	IL	7	490	20,333	2
Moline Water Department	IL	7	486	43,678	1
Iowa-American Water, Davenport	IA	7	484	138,024	1
Rock Island Water Department	IL	7	483	39,684	2
Rock Island Arsenal	IL	7	483	7,800	3
Burlington Municipal Water Works	IA	8	405	35,000	1
Fort Madison Municipal Water Works	IA	8	384	10,715	2
Nauvoo Water Department	IL	8	376	1,063	2
Keokuk Municipal Water Works	IA	8	365	11,427	2
Hamilton Water Department	IL	8	364	3,029	2
Warsaw Water Department	IL	9	360	1,793	2
Quincy Water Department	IL	9	327	40,366	2
Hannibal Water Department	MO	10	309	17,757	2
Louisiana Water Department	MO	10	283	3,863	2
Illinois-American Water, Alton	IL	11	204	85,000	1
Illinois-American Water, Granite City	IL	12	192	31,301	2
City of St. Louis Water Department	MO	12	190	348,169	2
Illinois-American Water, East St.Louis	IL	12	181	31,542	2
Chester Water Department	IL	13	110	8,702	3
Total				1,611,122	

(1) Water Utility

(2) 2000 US census

(3) SDWIS

*Does not include populations of indirectly served systems.

Appendix 2: Proposed UMR Fixed Site and Tributary Loading Network Sites (non-shaded rows are tributary sites, shaded rows mainstem sites)

Waterbody	UMR River Mile/ Tributary Confluence	Water Quality Site Location Name	State	Existing Water Quality Station - Agency	Existing Water Quality Station - ID	Existing WQ Site LatDD	Existing WQ Site LongDD	Associated USGS Gage*	Gage LatDD*	Gage LongDD*	8digit_Huc*	Total Watershed Drainage (sq. miles)*
Mississippi River-Lock and Dam 2	815.3	Prescott (Beginning of Mainstem UMR)	MN	MCES	UMR 815.6	44.765300	92.870560	05344500	44.747836	-92.813099	07040001	39,990
St. Croix River	811.3	Near Prescott (MCES)	MN	MCES/WDNR	SC 0.3	44.749167	-92.804444	05344490	44.749167	-92.804444	07030005	7,650
Mississippi River-Lock and Dam 3	796.9	Near Red Wing (MCES) Gage at Prescott	MN	MCES/WDNR	UM 796.9	44.610000	-92.610278	05344500	44.61	-92.610278	07040002	45,170
Cannon River	795.5	Welch	MN	MPCA	MN S000-003	44.564490	-92.731703	05355200	44.56449	-92.731703	07040002	1,340
Chippewa River	763.5	At Durand	WI	WDNR	473008	44.631000	-91.971333	05369500	44.631	-91.971333	07050005	9,010
Zumbro River	750.0	Kellogg	MN	MPCA	MN S004-384	44.312173	-92.003869	05374900	44.312173	-92.003869	07040004	1,408
Mississippi River-Winona	725.5	Winona	MN	MPCA	MN S000-096	44.056685	-91.637093	05378500	44.056685	-91.637093	07040003	59,200
Trempealeau River	717.0	At Dodge	WI	WDNR	623039	44.131667	-91.552778	05379500	44.131667	-91.552778	07040005	643
Black River	708.0	Near Galesville	WI	WDNR	623001	44.060278	-91.287222	05382000	44.060278	-91.287222	07040007	1,756
La Crosse River	698.4	At La Crosse	WI	WDNR/LTRMP	323017	43.860833	-91.210278	05383075	43.860833	-91.210278	07040006	471
Root River	693.7	Near Mound Prairie	MN	MPCA	MN S004-858	43.781374	-91.446473	05386070	43.781374	-91.446473	07040008	1,664
Upper Iowa River	671.2	New Albin	IA	IA DNR	IA 15030012	43.421111	-91.508611	05388250	43.4211111	-91.508611	07060002	770
Mississippi River-Lock and Dam 9	647.9	Near Lynxville (gage at McGregor, Iowa)	WI	WDNR	123016	43.210028	-91.100583	05389500	43.210028	-91.100583	07060001	66,610
Wisconsin River	630.6	At Muscoda	WI	WDNR	223282	43.198056	-90.443333	05407000	43.198056	-90.4433333	07070005	10,400
Turkey River	608.0	Garber	IA	IA DNR	IA 10220001	42.740000	-91.261667	05412500	42.74	-91.261667	07060004	1,545
Grant River	593.5	At Burton	WI	None	Not Established	N/A	N/A	07060004	42.720278	-90.819167	07060004	269
Maquoketa River	548.0	Maquoketa	IA	IA DNR	IA 10490002	42.083333	-90.632778	05418500	42.083333	-90.632778	07060006	1,553
Apple River	544.5	Near Elizabeth	IL	IL EPA	IL MN-03	41.898300	-90.155300	05418950	42.31882	-90.25432	07060005	207
Mississippi River-Clinton	520.0	Clinton	IL	IL EPA	IL M-12	41.780556	-90.251944	05420500	41.780556	-90.251944	07080101	85,600
Wapsipinicon River	506.8	Near DeWitt	IA	IA DNR	IA 10820001	41.766944	-90.534722	05422000	41.766944	-90.534722	07080103	2,336
Rock River	479.1	Near Joslin	IL	IL EPA	IL P-04	41.556111	-90.185278	05446500	41.556111	-90.185278	07090005	9,549
Iowa River	433.5	Wapello	IA	IA DNR	IA 10580003	41.178056	-91.181944	05465500	41.178056	-91.181944	07080209	12,500
Henderson Creek	409.9	Near Bald Bluff	IL	IL EPA	IL LD-02	41.001910	-90.853430	05469000	41.00191	-90.85343	07080104	451
Skunk River	396.0	Near Augusta	IA	IA DNR	IA 10560002	40.753611	-91.276944	05474000	40.7536111	-91.276944	07080107	4,312
Mississippi River-Keokuk	364.0	Keokuk	IA	IL EPA	IL K-22	40.392200	-91.376000	05474500	40.393611	-91.374167	07080104	119,000
Des Moines River	361.5	Keosauqua	IA	IA DNR	IA 10890001	40.727780	-91.959444	05490500	40.72778	-91.959444	07100009	14,038

Waterbody	UMR River Mile/ Tributary Confluence	Water Quality Site Location Name	State	Existing Water Quality Station - Agency	Existing Water Quality Station - ID	Existing WQ Site LatDD	Existing WQ Site LongDD	Associated USGS Gage*	Gage LatDD*	Gage LongDD*	8digit_Huc*	Total Watershed Drainage (sq. miles)*
Fox River	354.0	Near Wayland	MO	MO DNR	38/2.6	40.392693	-91.598270	05495000	40.392417	-91.597889	07110001	400
Wyconda River	337.0	Above Canton	MO	MO DNR	47/7	40.142100	-91.565799	05496000	40.142111	-91.565694	07110001	393
Bear Creek	331.0	Near Marcelline	IL	IL EPA	IL KI-02	40.142778	-91.337222	05495500	40.142778	-91.337222	07110001	349
North Fabius River	323.0	Near Ewing	MO	MO DNR	56/17.5	40.045200	-91.659301	05497150	40.018889	-91.621944	07110002	471
South Fabius River	321.0	Near Taylor	MO	MO DNR	71/5.1	39.896938	-91.580281	05500000	39.896639	-91.580167	07110003	620
Salt River	284.1	Near Center	MO	MO DNR	91/41	39.573904	-91.571503	05507800	39.574056	-91.571806	07110007	2,350
Cuivre River	232.0	Near Troy	MO	MO DNR	152/29.8	39.009737	-90.977912	05514500	39.009737	-90.977912	07110008	903
Illinois River	218.0	At Valley City	IL	IL EPA	IL D-32	39.703333	-90.645278	05586100	39.703333	-90.645278	07130011	26,743
Mississippi River-Alton	200.8	Alton	IL	IL EPA	IL J-98	38.870300	-90.152300	05587550	38.886444	-90.182547	07110009	171,500
Missouri River	195.5	At Hermann, 80 miles above mouth	MO	MO DNR	1604/97.9	38.710000	-91.439097	06934500	38.709806	-91.4385	10300200	522,500
Mississippi River-Below St. Louis	180.0	Below St. Louis	MO	MO DNR	1707.02/19.3	38.629000	-90.180998	07010000	38.629	-90.179778	07140101	697,000
Cahokia Creek	174.0	At Edwardsville	IL	IL EPA	IL JQ-05	38.824444	-89.974722	05587900	38.824444	-89.974722	07140101	212
Meramec River	160.5	Near Paulina Hills	MO	MO DNR	2183/10.2	38.462802	-90.414895	07019280	38.462778	-90.414722	07140102	3,980
Kaskaskia River	117.6	Near Okawville	IL	IL EPA	IL O-20	38.450556	-89.627500	05594100	38.450556	-89.6275	07140204	4,393
Mississippi River-Chester	110.0	Chester	IL	IL EPA	IL I-05	37.910800	-89.853600	07020500	37.900742	-89.830211	07140105	708,600
Big Muddy River	75.7	At Murphysboro	IL	IL EPA	IL N-12	37.748056	-89.346667	05599500	37.748056	-89.346667	07140106	2,169
Castor River	49.0	At Greenbriar	MO	MO DNR	2288/6.6	37.108655	-90.025103	07021020	37.108833	-90.025	07140107	423
Mississippi River-Thebes	44.0	Thebes	IL	IL EPA	IL I-84	37.221600	-89.462975	07022000	37.2216	-89.462975	07140105	713,200

* Data from USGS National Water Information System when available.