Long Term Resource Monitoring
FY21 SOW

Enhancing Restoration and Advancing Knowledge of the Upper Mississippi River

Addressing the
FY2015–2025 UMRR Strategic Plan

The Upper Mississippi River Restoration (UMRR) Program for the Upper Mississippi River System (UMRS) is first comprehensive program for ecosystem restoration, scientific research, and monitoring on a large river system in the Nation and the world. The UMRS is one of this Nation's unique natural resources. The ecosystem provides habitat to a wide array of fish and wildlife species distributed among a complex assortment of flowing channels, floodplain lakes, backwaters, wetlands, and floodplain forests. With an ecosystem as diverse and complex as the UMRS, many of its processes and their interrelationships are not well known. One way to help understand this multifaceted system is through environmental monitoring. The UMRR Long Term Resource Monitoring (LTRM) data provides the scientific foundation required for sound management actions, effective river restoration projects, and informed environmental policy decisions for the UMRS.

The value of UMRR LTRM's long term data set continues to grow. It serves as a foundation for the restoration of the UMRS by revealing patterns and trends, establishing benchmarks of the current state for comparison to future conditions, serving as an early warning of change, supporting planning and management through the identification of key issues and trends, and evaluating the effectiveness of restoration and management actions on the UMRS.

Table of Contents

FY21 UMRR LTRM (Base Monitoring) Scope of Work

This Scope of Work (SOW) describes tasks in support of the US Army Corps of Engineers' Upper Mississippi River Restoration (UMRR) Program Long Term Resource Monitoring (LTRM) element, authorized by Congress in the 1986 Water Resources Development Act to be performed by the USGS-Upper Midwest Environmental Sciences Center (UMESC) in La Crosse, Wisconsin, and six state-operated field stations (Illinois, Iowa, Minnesota, Missouri, and Wisconsin). This long term monitoring directly supports Upper Mississippi River System (UMRS) understanding, critical for successful UMRS restoration by the UMRR. This SOW complements those work items in the UMRR Science in Support of Restoration and Management FY19 SOW.

A comprehensive monitoring program consists of environmental monitoring, research, systemic data acquisition, modeling, and information delivery to provide a solid scientific foundation upon which resource managers and policy makers base management actions and develop environmental policy.

Aquatic Vegetation Component

The objective of the UMRR LTRM Aquatic Vegetation Component is to collect quantitative data on the distribution and abundance of aquatic vegetation in the Upper Mississippi River System (UMRS) and to conduct research related to aquatic vegetation for understanding its status, trends, ecological functions, and responses to disturbances and UMRR restoration activities. Aquatic vegetation in the UMRS is desirable because of its many values, most notably as food for migratory waterfowl (Korschgen et al. 1988) and habitat for fish. Monitoring data are collected within three LTRM study reaches in the UMRS (Pools 4, 8, and 13 on the Upper Mississippi River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols.

Methods

For monitoring aquatic vegetation, sampling will be conducted following the LTRM aquatic vegetation standard sampling protocol (Yin et al. 2000). A total of 1,350 sites will be surveyed, including 450 in Pool 4, 450 in Pool 8, and 450 in Pool 13 (Table 1). The presence/absence and abundance of aquatic plant species at each site will be measured and recorded. Pool-wide estimates of abundance and percent frequency of occurrence will be derived by pooling data over all strata.

Products and Milestones

Tracking number	Products	Staff	Milestones
2021A1	Complete data entry and QA/QC of 2020 data; 1250 observations.		
	a. Data entry completed and submission of data to USGS	Lund, Drake, Bales	30 November 2020
	b. Data loaded on level 2 browsers	Schlifer	15 December 2020

	c. QA/QC scripts run and data corrections sent to Field Stations	Larson, Schlifer,	28 December 2020
	d. Field Station QA/QC with corrections to USGS	Lund, Drake, Bales	15 January 2021
	e. Corrections made and data moved to public Web Browser	Larson, Schlifer, Caucutt	30 January 2021
2021A2	Web-based: Creating surface distribution maps for aquatic plant species in Pools 4, 8, and 13; 2020 data	Larson, Schlifer	31 July 2021
2021A3	Wisconsin DNR annual summary report 2020 that combines current year observations from LTRM with previous years' data, for the fish, aquatic vegetation, and water quality components.	Drake, Bartels, Hoff, Kalas, Carhart	30 Sept 2021
2021A4	Complete aquatic vegetation sampling for Pools 4, 8, and 13 (Table 1)	Larson, Lund, Drake, Bales	31 August 2021
2021A5	Pool 4 Graphical summary and maps of aquatic vegetation current status and long-term trends.	Lund	30 Dec. 2021
2021A6	Pool 8 Graphical summary and maps of aquatic vegetation current status and long-term trends.	Drake, Carhart	30 Dec. 2021
Intended for distribution			
LTRM completion report: Evaluation of a "Trace" Plant Density Score in LTRM Vegetation Monitoring (New Milestone 2020BIO3a; in USGS review)			
Manuscript: Estimated annual summer submersed aquatic macrophyte standing stocks (1998 - 2018) in three large reaches of the Upper Mississippi River. (2020A8; Accepted for publication with revisions; IP-122160)			
Manuscript: Species-specific wet-dry mass calibrations for common submersed macrophytes in the Upper Mississippi River (2020A9; Submitted to Aquatic Botany)			

Fisheries Component

The objective of the UMRR LTRM Fisheries Component is to collect quantitative data on the distribution and abundance of fish species and communities in the UMRS and to conduct research related to fishes for understanding resource status and trends, ecological functions, and response to disturbances and UMRR restoration activities. The UMRS is probably the most biologically productive and economically important large floodplain river system in the United States (Patrick 1998; U.S. Geological Survey 1999), and fish are one of the most important goods and services the UMRS provides to humans (Carlander 1954). Fishes within the UMRS are the subject of commercial and recreational fisheries, both of which contribute substantially to local economies (Fremling et al. 1989). Scientists and fishery managers also recognize fish communities as an integrative index for a complex set of physical and biological conditions on the UMRS.

Data are collected within six LTRM study reaches in the UMRS (Pools 4, 8, 13, and 26 and Open River Reach on the Upper Mississippi River and La Grange Pool on the Illinois River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols (Ratcliff et al. 2014).

Methods

For monitoring fish, sampling will be conducted following the LTRM study plan and standard protocols (Ratcliff et al. 2014) as modified from Ickes and Burkhardt 2002. Species abundance, size structure, and community composition and structure will be measured over time. Between 250 and 400 samples will be collected in each study area (Table 1). Sample allocation will be based on a stratified random design, where strata include contiguous backwaters, main channel borders, main channel wingdams, impounded areas, and secondary channel borders. Tailwaters in the impounded reaches and tributary mouths in the Open River will be sampled under a fixed site design. Sampling effort will be allocated independently and equally across 3 sampling periods (June 15–July 31; August 1–September 15; September 16–October 31) to minimize risks of annual data loss during flood periods and to characterize seasonal patterns in abundance and habitat use. Pool-wide estimates of abundance will be derived by pooling data over all strata.

Products and Milestones

Tracking number	Products	Staff	Milestones
2021B1	Complete data entry, QA/QC of 2020 fish data; ~1,590 observations		
	a. Data entry completed and submission of data to USGS	DeLain, Bartels, Bowler, Hine, Gittinger, West, Solomon, Maxson	31 January 2021
	b. Data loaded on level 2 browsers; QA/QC scripts run and data corrections sent to Field Stations	Ickes, Schlifer	15 February 2021
	c. Field Station QA/QC with corrections to USGS	DeLain, Bartels, Bowler, Hine, West, Solomon, Maxson	15 March 2021
	d. Corrections made and data moved to public Web Browser	Ickes and Schlifer	30 March 2021
2021B2	Update Graphical Browser with 2020 data on Public Web Server.	Ickes, DeLain, Bartels, Bowler, Hine, West, Solomon, Maxson, Schlifer	31 May 2021

2021B3	Complete fisheries sampling for Pools 4, 8, 13, 26, the Open River Reach, and La Grange Pool (Table 1)	Ickes, DeLain, Bartels, Bowler, Hine, West, Solomon, Maxson	31 October 2021
2021B4	Sample collection, database increment, Summary letter on Asian carp age and growth: collection of cleithral bones	Solomon, Maxson	31 January 2021
2021B8(D)	Database increment: Stratified random day electrofishing samples collected in Pools 9–11	TBD	30 Sept 2021
2021B9(D)	Database increment: Stratified random day electrofishing samples collected in Pools 16–18	TBD	30 Sept 2021
Intended for distribution			
LTRM Completion report, compilation of 3 years of sampling: Fisheries (2009R1Fish; Chick et al.) (in USGS review; minor grammatical corrections needed then will be posted on LTRM Fish page)			
Manuscript: A synthesis on river floodplain connectivity and lateral fish passage in the Upper Mississippi River (2021B11; Submitted to USGS review; IP-123678)			
LTRM Fact Sheet: Tree map tool for visualizing fish data, with example of native versus non-native fish biomass (2013B16) (Programming code for TreeMap being re-written; once completed Fact Sheet will be edited)			

Water Quality Component

The objective of the UMRR LTRM's water quality component is to conduct monitoring and research to obtain basic limnological information required to (1) increase understanding of the ecological structure and functioning of the UMRS, (2) document the status and trends of ecological conditions in the UMRS, and (3) contribute to the evaluation of management alternatives and actions in the UMRS. The water quality component focuses on a subset of limnological variables related to habitat quality and ecosystem function that includes physicochemical features, suspended sediment, and major plant nutrients known to be significant to aquatic habitat in this system.

Data are collected within six LTRM study reaches in the UMRS (Pools 4, 8, 13, 26, and Open River Reach on the Upper Mississippi River and La Grange Pool on the Illinois River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols (Soballe and Fischer 2004).

Methods

For monitoring water quality, limnological variables (physicochemical characteristics, suspended solids, chlorophyll a, phytoplankton [archived], and major plant nutrients) will be monitored at both stratified random sites (SRS) and at fixed sampling sites (FSS) according to LTRM protocols.

Fixed site sampling
Fixed site sampling will be conducted as in FY2006 except for modifications made in 2010 for Pools 4 and 8 (Table 1).

Stratified random sampling
Stratified random sampling will be conducted at full effort levels (same as FY2000) for fall, winter, spring, and summer episodes (Table 1).

In situ data collection
For both FSS and SRS in situ data will be collected on physicochemical characteristics per the standard protocols (Soballe and Fischer 2004).

Laboratory analyses
Samples for chemical analysis (nitrogen (total N, nitrate/nitrite N, ammonia N), phosphorus (Total P, SRP), and silica) will be collected at all fixed sites and at approximately 35% of all stratified random sampling locations as specified in the sampling design. Samples for fluorometric chlorophyll and suspended solids (total and volatile) will be collected at all SRS and Fixed sites. Sampling and laboratory analyses will be performed following LTRM protocols (Soballe and Fischer 2004) and Standard Methods (American Public Health Association 1992).

Products and Milestones

Tracking number	Products	Staff	Milestones
2021D1	Complete calendar year 2020 fixed-site and SRS water quality sampling	Jankowski, Burdis, Kalas, Kueter, L. Gittinger, Kellerhals, Fulgoni	31 December 2020
2021D2	Complete laboratory sample analysis of 2020 fixed site and SRS data; Laboratory data loaded to Oracle data base.	Yuan, Schlifer	15 March 2021
2021D3	1st Quarter of laboratory sample analysis (~12,600)	Yuan, Manier, Burdis, Kalas, Kueter, L. Gittinger, Cook, Fulgoni	30 December 2021
2021D4	2nd Quarter of laboratory sample analysis (~12,600)	Yuan, Manier, Burdis, Kalas, Kueter, L. Gittinger, Kellerhals, Fulgoni	30 March 2021
2021D5	3rd Quarter of laboratory sample analysis (~12,600)	Yuan, Manier, Burdis, Kalas, Kueter, L. Gittinger, Kellerhals, Fulgoni	29 June 2021
2021D6	4th Quarter of laboratory sample analysis (~12,600)	Yuan, Manier, Burdis, Kalas, Kueter, L. Gittinger, Kellerhals, Fulgoni	28 September 2021
2021D7	Complete QA/QC of calendar year 2020 fixed-site and SRS data.		
	a. Data loaded on level 2 browsers; QA/QC scripts run; SAS QA/QC programs updated and sent to Field Stations with data.	Schlifer, Jankowski	30 March 2021
	b. Field Station QA/QC; USGS QA/QC.	Jankowski, Burdis, Kalas, Kueter, L. Gittinger, Kellerhals, Fulgoni	15 April 2021
	c. Corrections made and data moved to public Web Browser	Schlifer, Jankowski	30 April 2021
2021D8	Complete FY2020 fixed site and SRS sampling for Pools 4, 8, 13, 26, Open River Reach, and La Grange Pool (Table 1)	Jankowski, Burdis, Kalas, Kueter, L. Gittinger, Kellerhals, Fulgoni	30 Sept 2021
2021D9	WEB-based annual Water Quality Component Update w/2020 data on Server.	Schlifer, Jankowski	30 May 2021
2021D10	Operational Support to the UMRR LTRM Element. Serve as in-house Field Station for USGS for consultation and support on various LTRM-wide topics	Kalas, Hoff, Bartel, Drake	30 Sept 2021
	On-going		
2019D12	Draft LTRM Completion Report: Assessment of Phytoplankton Samples collected by the Upper Mississippi River Restoration Program-Long Term Resource Monitoring Water Quality Component	Fulgoni and Jankowski	30-Dec-2020
2021D12	Final LTRM Completion Report: Assessment of Phytoplankton Samples collected by the Upper Mississippi River Restoration Program-Long Term Resource Monitoring Water Quality Component	Fulgoni and Jankowski	30 March 2021
2017D10	Draft LTRM Completion report: Evaluation of water quality data from automated sampling platforms	Soeken-Gittinger, Lubinski, Chick, Houser	30-Sep-2017

Intended for distribution
Completion report, compilation of 3 years of sampling: Water Quality (2009R1WQ; Giblin, Burdis) (in USGS review; minor grammatical corrections needed then will be posted on LTRM WQ page)
Manuscript: Nutrients and dissolved oxygen in the UMRS: improving our understanding of winter conditions and their implications for structure and function of the river (2014D12; Houser) (under revision)

Spatial Data Component

The objective of the UMRR LTRM's spatial data component (formerly Land Cover / Land Use with GIS support) is to develop spatial data sets and use them to investigate the ecological structure and function of the UMRS. Two basic data sets provide the template for nearly all other mapping and data collection efforts within LTRM: Land Cover / Land Use and Topo-bathymetry maps. These data sets also underpin several other derivative mapping products (e.g., vegetation community and habitat maps, flood inundation maps, aquatic areas maps) and spatial modelling platforms (e.g., sedimentation, forest succession, aquatic vegetation, wind and wave models), which are routinely used to investigate status and trends of various ecological structures and functions (USGS 1995, Johnson and Hagerty 2008, De Jager et al. 2018), document system-wide habitat needs (Theiling et al. 2000 , McCain et al. 2018), and evaluate potential impacts of habitat restoration projects.

The 2 main goals of LTRM's spatial data component are to:
1) Develop and maintain the LCLU and topobathymetry data sets, including ensuring their accessibility to the UMRR partnership and investigating new and emerging technologies for future use (1FTE, Finley and Strange).
2) Use these data sets and associated derivative products and models to monitor status and trends in the ecological structure and function of the UMRS and better understand the causes and consequences of spatial and temporal change (1FTE, De Jager and Rohweder).

Methods

Goal 1: Develop and maintain the LCLU and topobathymetry data sets, including ensuring their accessibility to the UMRR partnership and investigating new and emerging technologies for future use.

2021 Land Cover Products:

Land Cover / Land Use data are collected every 10 years using standardized protocols consisting of aerial photo acquisition and image interpretation, classification, and delineation (Dieck et al. 2014). While the majority of these efforts are funded through separate scopes of work, the spatial data component maintains remote sensing and resource monitoring expertise, manages existing data and infrastructure, and provides limited on-demand Geographic Information System (GIS) technical assistance to the UMRR partnership.

2021SD1: Orthorectification of scanned photos. Aerial photography of the UMRS was collected in 1975, 1989, 1994, and 2000. Hardcopy prints have been scanned into high resolution digital formats for the long-term preservation and usability of these historical datasets. In FY21, work will continue on the key pools and the St. Paul District to make these datasets accessible to researchers and the public in a useable digital format. This work entails orthorectifying the scanned images and generating mosaics for each year of acquisition and navigational pool/reach of the UMRS.

2021SD2: Draft report on new 3D vegetation mapping solutions. These solutions would be used to replace the now obsolete 3D monitors to allow for the continued mapping of LCU features. Possible options include structure from motion - as is being investigated in conjunction with UW-La Crosse on-sabbatical faculty, and virtual reality environments/headset

2021SD3: SOP for creating 3D elevation products from existing/new medium format digital aerial imagery. This effort would further enable 3D point clouds which are expected to assist with interpretation of floodplain forest using the 2020 systemic imagery

2021SD4: Google Earth webpage. This would assist partners and public in using Google Earth to view and query LTRM data being served in the KMZ format (95% complete; undergoing reconciliation)

2021SD5: Draft report on the feasibility of co-equipping an aerial remote sensing platform with active remote sensors and passive cameras capable of utilizing existing survey grade directly georeferenced GNSS/IMU to create highly accurate 3D products on demand to contribute in landscape and flora interpretation along the UMRS and potential inspection of HREP sites.

2021SD6: Draft report on the equipment, use, and real spatial accuracy of survey capabilities. Using these capabilities, create a database of historically stable surveyed ground points along the UMRS to allow for highly accurate spatial analysis, subsequent orthorectification, rubber sheeting, and other such geospatial technical methods to be applied to LTRM historic or future imagery collections containing the surveyed geologically/temporally stable landmarks. This effort aids in improving existing or in developing new crosswalks for comparison of existing data sets and ensuring that all data sets are in a common coordinate system to enable valuable temporal LCU comparison. Use survey capability to prepare new, more accurate boresight locations for aerial camera calibration to provide the most spatially accurate imagery for use in LCLU products

2021SD: Draft Report on potential LCLU applications for the FLIR A8303SC thermal camera system. Some examples may be the remote detection of surface water temperatures, inlet from tributaries, and outfalls from manmade structures, as well as assessing levees and other retention structures for seepage or other damage from unnatural flow/flooding.

2021 Topobathy Products:

Topobathy data are developed using the methods described in SOP No. GEO 424.01. Lidar and/or bathymetric data are acquired periodically and merged to create a seamless digital elevation model for the UMRS. Other derivative products, such as water depth maps and flood inundation maps utilize the topobathy data. Similar to the LCLU dataset, acquisition of new data and processing of that data are funded through separate scopes of work. However, the spatial data component manages existing data and infrastructure, and provides limited on-demand technical assistance to the UMRR partnership in the use of topobathy data.

2021SD7: Develop a plan for future topo bathymetric data collection
This plan would include a rationale for collecting and updating bathymetric data and identification of areas where new or updated data are needed. This plan would also include identifying derivative products, such has water depth and flood inundation maps, and tools that could be used by the UMRR community to develop custom water depth and flood inundation maps. Finally, identification of new and emerging technology.

2021SD8: ArcGIS Server, Tool, and Data Maintenance
Software updates will be applied to the ArcGIS server as needed, as well as installations of patches, new software installations, server backups. Research will be conducted to identify new software and hardware. Web services will be monitored and refreshed when DOI software updates are made to the server. In addition, the SRS data for each component is annually download, formatted, and loaded to the spatial data query tools (one for each trend pool).

Goal 2: Use these data sets and associated derivative products and models to monitor status and trends in the ecological structure and function of the UMRS and better understand the causes and consequences of spatial and temporal change.

Similar to the other LTRM components, the Spatial Data component both collects and analyses data to determine status and trends and investigate their causes and consequences. The spatial data component often develops and uses derivative products that rely on land cover / land use and/or topothymetric data, such as flood inundation, aquatic areas, sedimentation, submersed aquatic vegetation, and floodplain forest models to investigate patterns and processes and make predictions about the future land and aquatic cover of the UMRS. In addition, the Spatial Data component maintains expertise in the field of landscape ecology and provides this expertise to UMRR through HREP project delivery teams, the science planning team, with the focus of assisting the partnership in the interpretation of remote sensing data for ecological applications.

2021SD9: Final Report: Status and Trends. Land and Water cover chapter.
In 2021, work will continue on the LTRM status and trends report. Continued data analysis, and refinement of figures and text that utilize the land cover and bathymetry will occur. Indicators include levee, floodplain forest, aquatic areas, and emergent vegetation.

2021SD10: Draft Report: Evaluating effects of alternative flooding scenarios on forest succession and landcover in the UMRS.

This study will use the Reno Bottoms HREP site to investigate the interactive effects of changes in hydrological regime and forest management practices on future land cover patterns. We will examine patterns in floodplain inundation for temporal trends and subsequent impacts on patterns of forest change and evaluate alternative scenarios of floodplain management and environmental change on patterns of forest succession in the UMRS. Funding for model implementation and data release have been made available through the Reno Bottoms HREP. This work item will consist of using the results of that modelling effort to conduct a scientific investigation.

Products and Milestones

Tracking number	Products	Staff	Milestones
2021SD1	Aerial Photo scanning (ILR)	Strange	30 September 2021
2021SD2	3D Vegetation Mapping Solution Report	Finley	30 June 2021
2021SD3	4-Band to 3D Product SOP	Finley	30 June 2021
2021SD4	Google Earth Help Webpage	Finley	31 December 2020
2021LD5	Co-Located Aerial LIDAR/SAR Report	Finley	30 September 2021
2021SD6	Survey Capability Report and Historic Spatial Database for LCU Mapping	Finley	31 December 2020
2021SD7	Topobathy strategic plan	Strange, De Jager	30 September 2021
2021SD8	Maintenance ArcGIS server	Hlavacek, Fox, Rohweder	30 September 2021
2021SD9	Status and Trends Report: continued data analysis and report writing for status and trends in land / water cover indicators.	De Jager	30 September 2021
2021SD10	Draft Report: Evaluating effects of alternative flooding scenarios on forest succession and landcover in the UMRS.	De Jager	30 September 2021

Data Management

The objective of data management for the UMRR LTRM is to provide for data collection, correction, archive, and distribution of a 90 million dollar database that consists of over 2.2 million records located in 195 tables. The 2.2 million data points currently in the system require regular maintenance and upgrading as technologies change. Also, having a publicly accessible database requires a significant level of security. This is accomplished by having the systems Certified and Accredited by a rigorous, formal process by the USGS Security team.

Methods

Data management tasks include, but are not limited to:

- Review daily logs to ensure data and system integrity and apply application updates.
- Develop and maintain field notebook applications to electronically capture data and begin the initial phase of Quality Control/Quality Assurance (QA/QC).
- Administer and maintain the LTRM database.
- Administer and maintain LTRM hardware, software, and supplies to support LTRM needs.
- Administer, maintain, and update the LTRM public and intranet data browsers to insure access to all LTRM data within USGS security policy.

Products and Milestones

Tracking number	Products	Staff	Milestones
2021M1	Update vegetation, fisheries, and water quality component field data entry and correction applications.	Schlifer	30 May 2021
2021M2	Load 2020 component sampling data into Database tables and make data available on Level 2 browsers for field stations to QA/QC.	Schlifer	30 June 2021
2021M3	Assist LTRM Staff with development and review of metadata and databases in conjunction with publishing of reports and manuscripts	Schlifer	On-going

Status and Trends 3rd edition

UMRR LTRM has completed two previous syntheses of status and trends of the UMRS with the most recent being completed in 2008 (Johnson and Hagerty, 2008). A third Status and Trends Report will provide an opportunity to communicate the important changes that have occurred in the UMRS over the LTRM period of record. During 2020 the analysis and writing will be completed and the draft submitted to SPN.

One or more conference calls and possibly a face to face meeting will be needed for the requisite discussions.

References

Johnson, B. L., and K. H. Hagerty, editors. 2008. Status and trends of selected resources of the Upper Mississippi River System. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, December 2008. Technical Report LTRMP 2008-T002. 102 pp + Appendixes A–B

Products and Milestones

Tracking number	Products	Staff	Milestones
2021ST2	Draft Report for partner review	All	7 October 2020
2021ST3	Revised draft to USGS publishing network	All	30 December 2020
2021ST4	Draft S&T3 Fact Sheet	All	TBD

Quarterly Activities

To enhance communication with the UMRR Partnership, LTRM staff at USGS-UMESC and the six state-run field stations will track activities not explicitly listed in this current scope of work. These quarterly activity lists will document activities and accomplishments by Program partners that are not tracked in the milestone table. Activities will include such items as presentations, outreach, technical assistance, data retrieval, and consultation for LTRM Partners including state and federal agencies, NGOs, and academia. These activities demonstrate the value of LTRM data and expert scientific knowledge to clients and customers, and help to identify potential new collaborations that will benefit EMP and river managers. Activity lists will be placed on the web under the A-Team Corner page (http://www.umesc.usgs.gov/ltrmp/ateam.html). This effort addresses a need for increased communication and dissemination of information.

Products and Milestones

Tracking number	Products	Staff	Milestone
2021QR1	Submittal of quarterly activities	All LTRM staff	30 January 2021
2021QR2	Submittal of quarterly activities	All LTRM staff	13 April 2021
2021QR3	Submittal of quarterly activities	All LTRM staff	13 July 2021
2021QR4	Submittal of quarterly activities	All LTRM staff	12 October 2021

FY21 Equipment refreshment

Field Station	Equipment Refreshment
La Crosse	Outboard motor
La Crosse	Velocity Meter
La Crosse	Velocity Meter
La Crosse	Turbidimeter
Bellevue	Ruggedized laptop
Bellevue	Shallow water Anchoring System with installation
Big Rivers	15 HP kicker outboard (Qty. 2)
Big Rivers	GPS/depth finder
Big Rivers	Hydrolab Minisonde 10-meter cable
Big Rivers	Ruggedized laptop
IRBS	New truck to replace current blue truck
IRBS	Ruggedized laptop
IRBS	Ruggedized laptop
IRBS	YSI water quality meter
IRBS	Hydrolab MS5 sonde
Great Rivers	YSI Pro 2030 Multi probe meter
Great Rivers	Hach FH950 flow meter

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U.S. Geological Survey (USGS). 1999. Ecological status and trends of the Upper Mississippi River System 1998. A report of the Long Term Resource Monitoring Program. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. LTRMP 99-T001. 236 pp.

Yin, Y., J. S. Winkelman, and H. A. Langrehr. 2000. Long Term Resource Monitoring Program procedures: Aquatic vegetation monitoring. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. April 2000. LTRMP 95-P002-7. 8 pp. + Appendixes A–C.

Table 1. Sampling effort within the UMRR Long Term Resource Monitoring Program element and data collected by each component.

Component	Study Area						Summary of data collected[1]
	4	8	13	26	La Grange	Open River	
Aquatic Vegetation	450 stratified random sample sites over growing season.	450 stratified random sample sites over growing season.	450 stratified random sample sites over growing season.	—[2]	—[2]	—[2]	Species, abundance, frequency, distribution, depth, substrate, detritus
Fisheries	~242 samples; 3 periods: June 15–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites.	~262 samples; 3 periods: June 15–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites.	~300 samples; 3 periods: June 15–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites.	~272 samples; 3 periods: June 15–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites.	~390 samples; 3 periods: June 15–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sites.	~204 samples; 3 periods: June 15–Oct. 30, 5 sampling gears. Mix of stratified random and fixed sites.	Species; catch-per-effort; length; subsample for weight, age, & diet; secchi; water depth, temperature, velocity, conductivity; vegetation density; substrate; dissolved oxygen
Water Quality	135 stratified random sites sampled in each episode (winter, spring, summer, and fall); 14 fixed sites[3]	150 stratified random sites sampled in each episode (winter, spring, summer, and fall); 19 fixed sites[3]	150 stratified random sites sampled in each episode (winter, spring, summer, and fall); 12 fixed sites[3]	121 stratified random sites sampled in each episode (winter, spring, summer, and fall); 11 fixed sites[3]	135 stratified random sites sampled in each episode (winter, spring, summer, and fall); 11 fixed sites[3]	150 stratified random sites sampled in each episode (winter, spring, summer, and fall); 9 fixed sites[3]	Suspended solids, major plant nutrients, chlorophyll a, silica, pH, secchi, temperature, dissolved oxygen, turbidity, conductivity, vegetation type & density, wave height, depth, current velocity, depth of snow/ice, substrate, phaeophytin, phytoplankton (archived),
Land Cover/Land Use	Land Cover/Land Use digital aerial photography was acquired in 2010-2011 and processed in subsequent years. Systemic land cover data for the Upper Mississippi River System is collected approximately every 10 years. To date, systemic land cover has been mapped three times through the UMRR Long Term Resource Monitoring element, in 1989, 2000, and 2010/2011.						

[1]A full list and explanation of data collected by each component is available through the UMRR LTRM data web site at http://www.umesc.usgs.gov/data_library/other/ltrmp_monitoring.html.
[2]Aquatic vegetation is not sampled in Pool 26 and La Grange because previous sampling revealed very low abundance, or in Open River due to a lack of suitable habitat.
[3]Frequency of fixed site sampling is bi-weekly in April, May, and June, and monthly in all other months, with no sampling in December and February (i.e., winter sampling in January only)

Product Definitions

Draft: A draft that has been submitted to the UMRR LTRM's USGS Science Leader or his designee which is ready for review by USGS, USACE, A-Team, or blind review, as needed. This step begins the process of formal USGS peer-review unless the Science Leader deems the product needs more work by the author(s).

Final draft: A document that the authors have edited based on review comments and has been submitted to the LTRM's USGS Science Leader or his designee.

Intended for Distribution: Indicates a final printed version or Web-based report is awaiting distribution and USGS final approval. For other products (i.e., manuscripts) this indicates submission to a journal. *Staff time is still expended at this stage of the report process.*

Summary Letter: A summary letter is a communication to Corps management and associated staff that provides quick information regarding progress on a project or product. They are often based on preliminary data and analyses, and represent interim information. Summary letters are reviewed internally by UMESC, but do not go through USGS peer review. Thus, they are not citable and should not be widely distributed. Summary letters are used only when a more complete and peer reviewed product is expected after more work on a specific project.

Leveraged Product: A product produced by LTRM staff and others outside of LTRM; may include funding from non-sources.