Upper Midwest
Environmental Sciences Center
La Crosse, Wisconsin

Upper Mississippi River Restoration Program Coordinating Committee

Quarterly Meeting

August 9, 2023

Agenda
with
Background
and
Supporting Materials

Upper Midwest Environmental Sciences Center
La Crosse

Upper Mississippi River Restoration Program Coordinating Committee

August 9, 2023

Agenda

[Note: The states, U.S. Army Corps of Engineers, and the Department of the Interior will arrange their respective pre-meetings via conference call prior to the August 9, 2023 quarterly meeting.]

UMRR Coordinating Committee Quarterly Meeting

Time	Attachment	Topic	Presenter
8:00 a.m.		**Welcome and Introductions**	***Sabrina Chandler***, *USFWS*
8:05	A1-A14	**Approval of Minutes of May 24, 2023 Meeting**	
8:10	B1-B4	**Regional Management and Partnership Collaboration** ▪ FY 2023 Fiscal Update and FY 2024 Outlook ▪ Environmental Justice ▪ 2023 HREP Selection ▪ Strategic and Operational Plan Review ▪ Implementation Issues	***Marshall Plumley***, *USACE*
9:20		**Break**	
9:30	C1-C21	**Ecological Status and Trends** ▪ Snapshot Summary Communication Toolkit	 ***Andrew Stephenson***, *UMRBA*
9:40	D1-D9	**Communications** ▪ UMRR Communications Team ▪ External Communications and Outreach Events	 ***Rachel Perrine***, *USACE* ***All***
10:15	 E1-E14 E15-E26 E27-E63	**Program Reports** ▪ Long Term Resource Monitoring and Science – LTRM FY 2023 3rd Quarter Highlights • Pool 13 Research Proposal – USACE LTRM Update ▪ A-Team Report ▪ LTRM Implementation Planning Update ▪ Habitat Restoration District Reports	 ***Jeff Houser***, *USGS* ***Matt O'Hara***, *IL DNR* ***Jeff Houser***, *USGS* ***Angela Deen, Julie Millhollin, Brian Markert***, *USACE*
12:30 p.m.		**Lunch**	

(Continued on next page)

UMRR Coordinating Committee Quarterly Meeting
(Continued)

Time	Attachment	Topic	Presenter
1:30 p.m.		**UMRR Showcase Presentations**	
		▪ Using explainable machine learning to evaluate vulnerability and restoration potential of submersed aquatic vegetation.	***John Delaney***, *USGS*
		▪ Water Quality Lab Tour	***Jeff Houser***, *USGS*
2:45	F1-F13	**Other Business**	
		▪ Future Meeting Schedule	
2:50 p.m.		**Adjourn**	

[Note: The UMRR Coordinating Committee will meet from 3:00 – 4:00 to discuss recommended actions to address implementation issues.]

ATTACHMENT A

Minutes of the May 24, 2023
UMRR Coordinating Committee Quarterly Meeting

(A-1 to A-14)

Minutes of the
Upper Mississippi River Restoration Program
Coordinating Committee

May 24, 2023
Quarterly Meeting

Virtual

Brian Chewning of the U.S. Army Corps of Engineers called the meeting to order at 8:01 a.m. on May 24, 2023. UMRR Coordinating Committee representatives in attendance in-person were Mark Gaikowski (USGS), Chad Craycraft (IL DNR), Vanessa Perry (MN DNR), Matt Vitello (MO DoC), Jim Fischer (WI DNR), and Rich Vaughn (NRCS). Sabrina Chandler (USFWS) and Randy Schultz (IA DNR) attended virtually. A complete list of attendees follows these minutes.

Minutes of the March 1, 2023 Meeting

Chad Craycraft moved and Matt Vitello seconded a motion to approve the draft minutes of the March 1, 2023 UMRR Coordinating Committee meeting as written. The motion carried unanimously.

Regional Management and Partnership Collaboration

FY 2023 Fiscal Update

Marshall Plumley reported that UMRR has obligated over $35 million, or 64.4 percent, of its $55 million FY 2023 funds as of May 1, 2023. This marks the largest obligation in program history, exceeding the previously authorized level of $33 million with five months left in the fiscal year. Plumley said he has no concerns about the program's ability to obligate its available funds this year, noting that execution rate is an important metric for the program. Consistent execution reflects the partnership's effectiveness and commitment to the program.

FY 2024 Budget Outlook

Plumley reported that the President's FY 2024 budget was released on March 9, 2023, and includes $55 million for UMRR. The President's FY 2024 budget includes funding exceeding $50 million for only two other ecosystem restoration programs through the Corps of Engineers: $415 million for South Florida Ecosystem Restoration (Everglades) and $67 million for Columbia River Fish Mitigation.

The draft FY 2024 plan of work for UMRR at $55 million is as follows:

- Regional Administration and Program Efforts – $1,675,000
  - Regional management – $1,260,000
  - Program database – $100,000
  - Program Support Contract – $140,000
  - Public Outreach – $50,000
  - Regional Project Sequencing – $125,000
- Regional Science and Monitoring – 15,325,000
  - Long term resource monitoring – 5,500,000
  - Regional science in support of restoration – $8,350,000

- Regional science staff support – $200,000
- Habitat evaluation (split across three districts) – $1,275,000

— Habitat Restoration – $38,000,000

- Rock Island District – $11,150,000
- St. Louis District – $13,700,000
- St. Paul District – $13,050,000
- Model certification – $100,000

Plumley said the FY 2024 workplan is largely consistent with the FY 2023 workplan with the addition of the next HREP selection process. In response to a question from Mark Gaikowski, Plumley said he is unsure of the execution rates of the Corps' other ecosystem restoration programs but is not aware of another program that executes as well as UMRR. UMRR has executed between 95 percent and 98 percent over the last decade. Chewning said the Louisiana Coastal Area Ecosystem Restoration project executes well but is focused only on the beneficial use of dredged material. According to Chewning, support from Congressional support for UMRR is partly due to effective and efficient execution of the program by the partnership.

WRDA 2022

Plumley reported that the enactment of WRDA 2022 on December 15, 2022 increased the annual authorized appropriation for UMRR to $90 million, with $75 million for HREP and $15 million for LTRM. Plumley said FY 2025 will be the first year that the District could include planning scenarios of up to $90 million for UMRR in its annual budget proposal.

UMRR Ten-Year Plan

Plumley said the UMRR 10-year plan illustrates the implementation schedules for 22 projects, including 10 projects in feasibility and 12 projects in design or construction. It was updated to reflect small changes to project timelines for McGregor Lake, Lower Pool 4, and Big Lake in St. Paul District, Pool 12 Forestry in Rock Island District, and Clarence Cannon, Crains Islands, Harlow Island, and Gilead Slough in St. Louis Districts. Plumley said the colors on the 10-year plan were changed to reflect the UMRR logo colors.

Assistant Secretary of the Army (Civil Works) Site Visit at the Beaver Island HREP

Plumley reported that, on April 10, 2023, the UMRR partnership hosted the ASA(CW) Mr. Michael L. Connor on a tour of the UMRR Beaver Island HREP. Plumley facilitated a discussion emphasizing UMRR's unique role in improving the Upper Mississippi River System ecosystem and the UMRR program's knowledge of it. Key messages included:

— The UMRR program is the nation's first large river ecosystem restoration and scientific monitoring program in the nation.

— The UMRR program consistently leads the nation in execution of dollars and makes significant contributions to USACE delivery of acres restored. During the past 37 years this program has restored 119,720 acres and completed 62 projects on the Upper Mississippi River System.

— UMRR, informed by the best available science, has pioneered many new and innovative engineering and planning techniques for ecosystem restoration in large river systems.

Plumley thanked Iowa DNR, which demonstrated electrofishing for Mr. Connor. Initial feedback from the visit was very positive. The partnership's support and value of the program was evident. Plumley expressed appreciation for everyone's involvement.

Environmental Justice

Plumley provided an overview of the UMRR Coordinating Committees discussions on environmental justice over the last year. The UMRR Coordinating Committee convened an initial discussion in May 2022, made a commitment to integrating environmental justice into habitat project planning, design, construction, operations, and management in August 2022, and established an *ad hoc* environmental justice committee in November 2022. Plumley reported that on January 25, 2023, the *ad hoc* committee met to share perspectives on approaches, best practices, methods, and tools related to environmental justice in participants' respective agency's work. Participants included agency personnel specializing in diversity, equity, and inclusion with limited priority experience with UMRR. The *ad hoc* committee also discussed how UMRR currently approaches environmental justice through HREPs.

Marshall Plumley introduced the new "UMRR HREP and Environmental Justice Dashboard" that shows completed and in-progress projects in relation to census tracts identified as disadvantaged communities. In response to a question from Lauren Salvato, Plumley said the outreach mechanisms are in place at the project level, but the tool may help highlight areas where work has not been done or where outreach methods may need to be modified. Vanessa Perry applauded the tool and expressed support for incorporating it into the HREP selection process. Plumley said the tool builds on the program's long term investment in data management and the database and will be available to river teams during the next UMRR HREP selection process. The tool is available at: https://usace-mvr.maps.arcgis.com/apps/instant/portfolio/index.html?appid=5b089a1373b744b697c73014c3ad3c3b.

Strategic Plan Review

Plumley reported that, on February 21, 2023, a revised draft 2015-2025 UMRR Strategic Plan Review Report was submitted via email to the UMRR Coordinating Committee with a request to provide any comments or suggested edits by March 20, 2023. On March 27, 2023, the UMRR Coordinating Committee met to review comments on the report and unanimously approved the draft report. The final report is anticipated to be distributed in the coming weeks. The report describes important partner insights.

The UMRR Coordinating Committee intends to use the report's findings to inform its priorities for UMRR in the near and long term, particularly as the Committee develops the program's next strategic plan. Plumley reflected on progress to advance priority actions since the survey was distributed. Efforts to advance Goals 1, 2, and 4 include aquatic vegetation planting at Huron Island, evaluating project performance, and the creation of HREP storymaps. Plumley said that additional efforts are underway to address other priorities, such as developing a platform for pre-and post-construction monitoring data to be incorporated into the HREP database by December 2023, specific hypothesis testing and monitoring through the Lower Pool 13 HREP associated research project, and standardizing consistent monitoring among HREPs.

Implementation Issues Assessment

Plumley reported that, on November 11, 2022, final implementation issue papers were sent to the UMRR Coordinating Committee. A survey to advance or resolve a suite of options associated with each paper was sent via email on September 21, 2022. The UMRR Coordinating Committee will meet on May 24, 2023 following the conclusion of the quarterly meeting to review consensus actions identified through the survey, prioritize implementation issues, identify agencies to lead on actions, and lay out recommended steps to implement the actions.

2022 Report to Congress

Plumley said that ASA(CW) Michael Connor is reviewing the 2022 UMRR Report to Congress prior to transmitting it to Congress. The Corps is drafting a press release and four-page flyer that was sent to the UMRR Communications and Outreach Team (COT) for review. Case studies on construction, science, and monitoring activities were developed for the report and can serve as a basis for future outreach efforts.

LTRM Program Manager Position

Plumley said the Corps intends to post the LTRM Program Manager position at the end of May 2023. The position is open to current federal employees and the public and can be located in any of the three UMRS Corps Districts. Plumley hopes to fill the position before the end of July. Plumley asked the partnership to share the position widely.

Outyear Funding Scenarios

Plumley said that, in response to a request from UMRR Coordinating Committee members during its March 1, 2023 meeting, a meeting will be convened this summer to discuss outyear funding scenarios for UMRR. Scenarios may include stable funding at $55 million, up to the authorized amount of $90 million, less than current funding levels, or variable funding in outyears. In response to a question from Kirsten Wallace, Plumley said topics to frame the discussion include the existing portfolio of HREPs and LTRM, the pace of additional HREPs initiating feasibility, partner capacity, additional WRDA changes, and inflation. Plumley said scenarios are anticipated to be drafted in June and a meeting is expected to be scheduled between July and November. Jim Fischer expressed appreciation for the conversation and consideration of partner capacity. Fischer said Wisconsin DNR has three to five staff working on UMRR, NESP, and Channels and Operations that were stretched under a $33 million program. Fischer stated that Wisconsin DNR does not want to be a bottleneck for UMRR execution at an increased $55 million appropriation.

UMRR HREP Workshop

Plumley said the last UMRR HREP workshop was held in 2019. A UMRR workshop for both HREP and LTRM personnel is anticipated for winter 2023 or spring 2024. A planning committee kickoff meeting is anticipated to be held in July. Potential workshop topics include monitoring and adaptive management, HREP/LTRM integration, HREP design handbook updates, and HREP lessons learned among others. Andrew Stephenson suggested UMRR Coordinating Committee members serve as POCs for an availability request in February to April of 2024. Kirk Hansen suggested coordinating the workshop with NESP. Plumley said workshops are great opportunities for new staff across all agencies to collaborate and learn about the program. He noted there are many staff across all agencies working on both NESP and UMRR and would leave it up to agencies to determine who should attend the UMRR workshop.

HREP Selection Process

Plumley recalled that the UMRR Coordinating Committee has set a recurring schedule for an HREP selection process to be implemented every five years. The last HREP selection process was completed in 2020. Plumley said the Program Planning Team, consisting of the UMRR Coordinating Committee, District HREP managers, and District River Team chairs, will convene in June 2023 to discuss a timeline for the next project selection process to have endorsed projects by the third quarter of FY 2025. Plumley said the request to river teams will align with the NESP Coordinating Committee's project selection planning process request also to being in June 2023. Stephenson expressed appreciation for the alignment of the two programs' requests to river teams in light of partner capacity considerations.

UMRR Strategic Planning

Plumley said UMRR's next strategic planning process is scheduled to occur in FY 2024. He noted the process for developing the last strategic plan took over two years. Plumley said that scoping the 2026-2036 strategic plan effort is anticipated to begin in fall 2023.

Desired Future Conditions

Plumley said the development of the Habitat Needs Assessment II (HNA-II) in 2017 was an initial step toward defining desired future conditions for the river. A summary of HNA-II and past planning efforts was included in the 2022 UMRR Report to Congress. Specific next steps to further define desired future conditions were outlined in the HNA-II document. Plumley said the development of desired future conditions could be a standalone effort or incorporated into the next strategic planning effort.

Program Priorities Table

Plumley presented a new table to overview programmatic efforts such as the next HREP selection process or UMRR strategic planning that will occur over multiple years. This table helps to visualize UMRR activities and aid partners in capacity planning. Jeff Houser said the next UMRR LTRM Science Meeting is anticipated to occur in January 2024.

Communications

Status and Trends Flyers

Andrew Stephenson reported that flyers are complete that describe the condition and trends of the UMRS fisheries, floodplain forests, sedimentation, water quality, and aquatic vegetation developed from the 2022 LTRM status and trends report. Two coordinated releases of the flyers are being planned. The first will celebrate 2023 as the 30th year of LTRM monitoring through partnership and feature flyers on fisheries, aquatic vegetation, and water quality. The second release will acknowledge the high water in 2023 and how flooding impacts floodplain forests and sediment. The UMRR Communications and Outreach Team (COT) will discuss the two coordinated releases at its June 7 meeting.

Stephenson reported that Big River Magazine shared the links to the flyers in a recent digital newsletter. Mark Gaikowski suggested considering developing K-12 criteria based on the Ecological Status and Trends Report. Stephenson recalled the Our Mississippi publication was developed for grades K-5. Karen Hagerty said NESP previously developed a teacher's guide that was popular. Jim Fischer agreed and supported a similar effort based on the LTRM status and trends report. Fischer added that environmental justice should consider science outreach efforts as well. Additional science outreach efforts now may influence future generations who work on the river. Diversity of applicants during a hiring process is important for recruiting diverse staff, noting that it will benefit the region to expand the diversity of our partnership.

Communication and Outreach Team Update

Marshall Plumley reported that, this spring, the UMRR Communications and Outreach Team will focus on developing a team framework to assist with successful communication, coordination, and collaboration. The framework addresses activities that are self-initiated by the team, directed by the regional program manager, or directed by the UMRR Coordinating Committee. The team is also reviewing the draft press release and flyer for the 2022 UMRR Report to Congress, supporting the rollout of the status and trends flyers communications toolkit, and supporting the 100th anniversary of the UMR National Wildlife and Fish Refuge in 2024. Plumley said the communication and outreach team will also hold future discussions on environmental justice communication.

Plumley said Jill Bathke has accepted a position as NESP Senior Plan Formulator and that Anne Wurtenberger (Anne.C.Wurtenberger@usace.army.mil), in Rock Island District, will serve as of co-coordinator for the COT with Rachel Perrine. In response to a question from Stephenson, Plumley said he would report back on progress on the video series the COT is currently developing.

External Communications and Outreach

Communication and outreach activities in the second quarter of FY 2023 include the following:

— Sabrina Chandler said the national level Izaak Walton League is engaging in activities to help celebrate the 100th anniversary of the Upper Mississippi River National Wildlife and Fish Refuge to occur in 2024. Will Dilg and the Izaak Walton League were instrumental in the founding of the Refuge. Chandler said she briefed Rep. Van Orden on the refuge and UMRR program and will attend Audubon's legislative tour next week to brief state legislators and congressional offices. Chandler also said that, during the transfer of HREP projects in St. Paul, she had the opportunity to brief the USFWS Action Midwest Regional Director Chuck Traxler as well Assistant Secretary of the Interior for Fish and Wildlife and Parks Shannon Estenoz on the program. Chandler said both were impressed with the partnership.

— Kirsten Wallace said UMRBA staff met with industry and NGO partners to advocate for UMRR. Rep. LaHood submitted a letter supporting FY 2024 appropriations for UMRR. UMRBA continues to engage Congressional offices regarding resolving the project partnership agreements (PPA) and have been asked to identify the merits of projects that have not been implemented due to PPA issues.

— Lauren Salvato said UMRBA's Water Quality Executive Committee and Task Force discussed a joint UMRR and NESP meeting in 2009 on the Clean Water Act and opportunities to collaborate across monitoring activities on the river.

— Brian Markert said MVS held an island naming contest with grade schoolers for features of the Piasa and Eagles NESP HREP. Staff from the local Corps project office as well as Chad Craycraft, Illinois DNR, visited two schools with over 2500 students to provide information on UMRR and the project.

— Jim Fischer said Wisconsin DNR staff hosted a visit for Wisconsin DNR Secretary Adam N. Payne. The visit included discussions of UMRR and LTRM during a road tour of the Spring Lake HREP, a visit to Buena Vista Park in Alma to discuss dredge material management, and a groundbreaking for the Section 1122 Pierce County Islands project. Governor Tony Evers also attended the groundbreaking.

— Mark Gaikowski said MICRA was planning a visit for Congressional Staffers to lock and dam 19 on May 16, 2023, but that high water may delay the visit until August. Gaikowski said he was able to conduct courtesy visits to several congressional offices in March 2023, including Representatives Omar, Craig, Johnson, Pocan, Van Orden and others.

— Plumley said he was invited by faculty at the University of Pennsylvania to participate in a symposium on the Idaho Power and Snake River. Plumley was asked to explain UMRR's background and history of collaboration. He anticipates meeting with them virtually the week of May 29, 2023.

— Brian Chewning said the Mississippi River Commission and Mississippi Valley Division will conduct their low water inspection tour on August 14-28, 2023. The tour will start in the Upper Mississippi and work south. Col. Curry said a public meeting in Burlington, IA is scheduled for August 16.

UMRR Showcase Presentations

HREP Storymaps

Kevin Hanson reported on the development of storymaps for UMRR HREPs. Hanson said storymaps incorporate interactive maps, videos, photos, and text in a modern web interface. A basic template was developed for consistency among HREPs, but it remains flexible to allow for additional pieces and information to be incorporated. Hanson demonstrated the Indian Slough HREP storymap. Storymaps are being developed for each HREP and can be found on the project page accessible through the "find an HREP" tool on the UMRR website linked here: https://www.mvr.usace.army.mil/Missions/Environmental-Stewardship/Upper-Mississippi-River-Restoration/Habitat-Restoration/Find-an-HREP-Project/.

Hanson said that, of the 56 completed and 30 active HREPs, storymaps have been published for 25 completed and 18 active HREPs. All three districts have a plan to complete storymaps for all HREPs by the end of FY 2024. Angela Deen said MVP began creating storymaps for older, completed HREPs, but pivoted to current HREPs as they are also helpful for explaining projects during public meetings. In response to a question from Brian Chewning, Hanson said storymaps can be drafted in a few days, but are reviewed extensively by biologists, planners, and public affairs before publishing. Content generation and accessing materials is typically the most time consuming aspect. Dave Potter recalled that previous storymaps incorporated a slider map to show pre- and post- project construction. Hanson said slider maps can be created, but are not currently part of the template.

Challenges and opportunities for HREP construction

John Henderson provided an overview of adaptive and innovative construction methods employed on HREPs in the St. Paul District. Henderson said MVP's current workload for UMRR from 2023-2030 totals $177.2 million with an additional $91.2 million in work under other authorities such as NESP, CAP 204, and Section 1122. The district workload may increase with potential additional investments in UMRR and NESP. Henderson said construction schedules are dependent upon weather and appropriate water levels. High water can exacerbate erosion issues and low water can limit access to project locations. Henderson overviewed environmental challenges to project construction such as wildlife grazing, beetles and mites, and invasive species. He outlined opportunities for cost savings by using available resources on site such as downed trees, the need for careful consideration of alternative species for projects to avoid pests, and potential use of natural regeneration processes in areas. Henderson said increasing project costs necessitate new methods as well, such as beneficial use of dredge material. On average, 900,000 CY of granular material is removed form the main channel of the Mississippi River annually. In the last three years, 1,100,000 CY of dredge material has been beneficially used in habitat restoration projects. The beneficial use of clean river sand creates opportunities to expand the scope of restoration projects. Beneficial use reduces costs because material is ideal for constructing island bases, can be offset by Channels and Harbors funding, and may allow more funds for other targeted project features, such as bank protection, flow control structures, and timber stand improvement.

Henderson provided a scenario for if Conway Lake HREP had incorporated beneficial use, with $878,562 of project costs being offset by Channel and Harbors contributions. Kirk Hansen expressed support for beneficial use, but noted some environmental benefits would not be realized by using dredge material from the main channel instead of backwaters. Sabrina Chandler said there are opportunities where granular material is needed that dredging may not support and said McGregor Lake HREP was a positive process. Jim Fischer echoed Hansen and Chandler's comments and said it is necessary to balance the needs of the river. Fischer said that dredging 3 million cubic yards from the main channel means that 3 million cubic yards of material settling in backwaters may not be addressed. He added that the GREAT studies prioritized moving main channel sand to upland areas. Fischer noted that beneficial use is fiscally responsible but stated Wisconsin DNR's position that backwater dredging be prioritized first. Chandler said that, when channel maintenance material can be used beneficially there is not a need for a placement site that may not be readily available. David Minge said sediment is largely from upstream drainage eroding banks and bluffs and the most effective thing that can be done is to retain water on land. Minge asked if there has been any effort to determine whether the cost of retaining water by restoring wetlands in upland areas would be less expensive than the cost of building islands and utilizing materials when it gets into the river. Lauren Salvato said the Lower Minnesota River Watershed Board requested the Minnesota legislature provide $2.5 million for a $5 million dollar project to stabilize a 1,000 yard bank on the Minnesota River in Eden Prairie. She noted the difficulty of working in the upper watershed and justifying the costs to stabilize the banks in the lower river. Salvato said the One Watershed One Planning effort should help them collectively look at the most chronic areas e.g., Le Seur county to address sedimentation coming from the Minnesota River.

Henderson said cost effective decision making is essential for projects. Human hours, hourly rates for different equipment types, and accounting for risk are the main drivers of project costs, not materials. Exclusion zones can help minimize project uncertainty related to eagles, mussels and other wildlife. Adaptive and innovative methods can also minimize project costs. Henderson said mud waves, due to soft soils, can protect structures, limit the need for rock, and improve vegetation diversity in an area quickly. Henderson overviewed dig and drop methods used at Beaver Island as well as thin layer placement and suggested that less refined features could reduce project costs while still achieving benefits. Henderson said ongoing needs include effectively transferring institutional knowledge prior to retirements, updating the UMRR Handbook to capture lessons learned, knowledge sharing and transparency in coordination and planning, as well as compromise. Henderson said UMRR can serve as a source of knowledge for many and still learn from others. Vanessa Perry asked about the potential to use island features as an experimental treatment option. Henderson said there are ongoing efforts to understand impacts to floodplain vegetation from different material depth and consistency in constructed island soils. In response to a question from Perry, Henderson said teams are looking at new ways to utilize dead trees considering their abundance at some projects such as Reno Bottoms. In response to a question from Minge, Henderson said early establishment of vegetation is key to reducing sediment movement.

Recognizing Karen Hagerty

Col. Jesse Curry presented Karen Hagerty with a Civilian Service Commendation Medal for outstanding performance and dedicated service to the Rock Island District for over 25 years. Hagerty led UMRR's LTRM element for 12 years and made critical contributions to its success. Hagerty said it was an honor and pleasure to work with the partnership. She received a standing ovation from the UMRR Coordinating Committee and attendees.

Habitat Restoration

Angela Deen reported that MVP's planning priorities include Big Lake – Pool 4, Reno Bottoms, and Robinson Lake. A public meeting for Robinson Lake was held on May 17, 2023 in Wabasha and a site visit is scheduled for May 25, 2023. The Big Lake – Pool 4 tentatively selected plan is complete and a milestone meeting is anticipated soon. Reno Bottoms has entered the design phase. As early as this week, MVP anticipates awarding one contract for stages 1, 2, and 3 for the Lower Pool 10 HREP. McGregor Lake HREP construction is 95 percent complete. Bass Ponds and Conway Lake have been officially turned over to the project sponsors and the Harper's Slough HREP O&M Manual is complete. Harper's Slough will be turned over late this year. Deen said the Trempealeau Lake HREP is being evaluated to improve performance where harmful algal blooms have been problematic. The goal is to have recommendations on how to address by the end of FY 2023 and to discuss options in early FY 2024. Lauren Salvato asked if the USACE HAB Demonstration program could help address issues at Trempealeau Lake HREP. Deen said that Shawn Giblin and Aaron McFarlane are looking into it and that ongoing hydraulics and hydrology modeling will provide valuable information. In response to a question from Andrew Stephenson, Deen said forestry work at Reno Bottoms is extensive and may cost between $5 million and $10 million. Kirk Hansen asked if area nurseries have the capacity to provide enough trees. Deen said the Corps is working with industry and small businesses to assess capacity and that the Corps anticipates it will require multiple contractors and for the work to be spread out over time.

Julie Millhollin reported that MVR's planning priorities include Lower Pool 12 Forestry, Lower Pool 13 Phases I and II, Green Island, and Quincy Bay HREPs. The Green Island tentatively selected plan milestone was completed on April 3, 2023 and a Lower Pool 13 Phase II water level management workshop was held on May 19, 2023. Steamboat Island Stage II remains in design with 100 percent review anticipated in July 2023. Millhollin said MVR has four projects in construction: Beaver Island, Steamboat Island Stage I, Keithsburg Division Stages I and II, and Huron Island Stage III. Construction at Huron Island is complete and ERDC is surveying vegetation in June 2023 and will conduct additional plantings this summer and assessment in September 2023. Due to the extensive forestry work across projects, Julie Millhollin said they are using a multiple award task order contract (MATOC) to have a set of three to six contractors do small test orders of under $800 thousand. This contract mechanism allows a multi-year contract for up to five years and over $9 million. Millhollin noted there is a lot of forestry work to do along the UMRS and the MATOC may be applicable to both UMRR and NESP. The district has three project evaluation site visits planned for Spring Lake, Huron Island, and Pool 11 HREPs. Millhollin said that a college-level environmental science class from Bettendorf High School toured the Keithsburg Division HREP on May 5, 2023. Students had a hands-on experience observing the spillway, eagle nest, old infrastructure, new infrastructure, and active construction. Stephenson asked Millhollin to describe the process for coordinating with partners to determine which HREP to start next. Millhollin said she convenes partners to review the prioritized list of projects endorsed by the river teams and Coordinating Committee to determine if the prioritization is still relevant and implementable given current needs and capacity. Plumley said that typically, once projects are endorsed by the Coordinating Committee and approved by MVD, they are available to the District Program managers to implement in consideration of administrative factors. Plumley said that the extra coordination recently was to ensure any partner capacity concerns were considered appropriately. Chad Craycraft commended the Quincy Bay PDT for a smooth process with the first NGO sponsored HREP.

Brian Markert reported that MVS's planning priorities include West Alton Islands and Yorkinut Slough. Markert said Gilead Slough and Reds Landing are anticipated to begin feasibility in the first quarter of FY 2024. MVS's design priorities include Harlow Island, Oakwood Bottoms, Swan Lake, and Crains Island HREPs. Harlow Island is completing the 65 percent review and scoping of the Swan Lake HREP flood damage rehabilitation is underway. Markert said MVS has three projects in construction: Crains Island Stage I, Piasa and Eagles Nest Stage II, and Clarence Cannon Refuge. Markert said the contractor is on site at Piasa and Eagles Nest to survey and place pipe. Markert reported that an island naming contest was held with local grade schools for an island forming upstream of the Piasa and Eagles Nest island features. Names were submitted to USGS. USACE real estate and operations helped select the name Powrie Island to honor a family that settled in the area in the 1800s and was paid to maintain a safety light on an island. Markert said reforestation work at Clarence Cannon Refuge is anticipated to occur in fall 2023. Markert described the newly developed Meredosia Island fact sheet and requested the Coordinating Committee endorse the fact sheet. The project is located on the Illinois River and the project sponsor is USFWS. Matt Vitello moved and Chad Craycraft seconded a motion to endorse the Meredosia Island fact sheet. The motion passed unanimously. Sabrina Chandler expressed appreciation for endorsement of the fact sheet and said the project will be critical for that area.

All three districts updated their maps of projects in planning, design, and construction for consistency across districts.

Long Term Resource Monitoring and Science

FY 2023 2nd Quarter Report

Jeff Houser reported that accomplishments of the second quarter of FY 2023 include publication of the following manuscripts:

- *22 Years of Aquatic Plant Spatiotemporal Dynamics in the Upper Mississippi River*
- *Aquatic Vegetation Types Identified During Early and Late Phases of Vegetation Recovery in the Upper Mississippi River*
- *Diverse Portfolios: Investing in Tributaries for Restoration of Large River Fishes in the Anthropocene*

Houser said a hard copy publication of *Molecular Ecology* includes a cover design created by Andy Bartels highlighting the manuscript *Gene flow influences the genomic architecture of local adaptation in six riverine fish species*.

Houser reported that an LTRM all-hands meeting was held April 11-13, 2023 in Muscatine. The LTRM Fisheries component held a field meeting on May 8-11 at the Kibbe Field Station in Pool 19. The field component meetings help to ensure standardized field methods across field stations. The vegetation component will hold a similar meeting in June 2023.

Houser reported that all 2022 LTRM data are available online and that graphical browsers have been updated. Data can be accessed at the following link: https://umesc.usgs.gov/ltrm-home.html.

Houser reported the Mississippi River Research Consortium annual meeting was held on April 19-21 in La Crosse, Wisconsin. He said LTRM staff and data were featured in many presentations.

Houser reported the Water Quality Lab anticipates moving back to UMESC by September 30. In response to a question from Marshall Plumley, Gaikowski said commercial properties and others were considered for temporarily relocating the Water Quality Lab, but the University of Wisconsin-La Crosse was the first option due to an existing cooperative space agreement. Gaikowski said the University building is scheduled for demolition and the Water Quality Lab is looking forward to moving back to UMESC. In response to a question from Andrew Stephenson, Mark Gaikowski said they have many photos throughout the lab renovation and could create a communication tool to highlight the Water Quality Lab renovation.

USACE LTRM Report

Karen Hagerty said UMRR's LTRM FY 2023 budget allocation is $7 million ($5.5 million for base monitoring and $1.5 million for analysis under base) with an additional $6.85 million available for "science in support of restoration and management."

Hagerty reviewed high priority funding items for science in support of restoration totaling $2,502,149 that were previously endorsed by the UMRR Coordinating Committee including:

- LTRM balance: $331,508
- Ecohydrology: $469,973
- LC processing (last year): $335,238
- Vital Rates consolidated report: $52,788
- Establishing an herbarium: $21,649
- Macroinvertebrate contaminants: $77,483
- Future landscape modeling: $600,136
- Equipment (FS, UMESC): $659,268
- Proposal adjustments: ($45,894)

Hagerty presented four priority proposals from the 2022 Science Meeting totaling $1,626,797 for the Coordinating Committee's consideration:

— Scoping and vetting new technology and methods for use in future hydrographic and topographic surveys

— Avian associations with management in the UMRS: filling knowledge gaps for habitat management

— Filling in the gaps with FLAMe: Spatial patterns in water quality and cyanobacteria across connectivity gradients and flow regimes in the Lower Impounded Reach of the UMR

— Substrate stability as an indicator of abiotic habitat for the UMR benthic community

Jim Fischer moved and Matt Vitello seconded a motion to fund the four proposals. The motion passed unanimously.

Hagerty said that items to utilize the remaining FY 2023 science in support funds totaling $2,844,108 will be presented to the Coordinating Committee at its August 9, 2023 quarterly meeting. Potential items include funding the Pool 13 HREP associated research project (HARP), updating topobathy, and initiating work on selected LTRM information needs. In response to a question from Vitello, Hagerty said initial cost estimates for updating topobathy systemically were between $30 million and $35 million with bathymetry being the largest cost. Vitello asked if topobathy would be an ongoing process over multiple years to update. Houser said that a plan was developed to update topobathy opportunistically over time, but that with the potential for NESP to contribute funds as well, the hope was to update most of the system in a short period of time. Because NESP funds are no longer available, a new plan is being developed. Plumley said he does not expect LTRM to cover all of the costs because the dataset is also incredibly useful for HREP planning and feasibility. Fischer asked if the "scoping and vetting new technology and methods for use in future hydrographic and topographic surveys" science proposal would inform next steps and be important to fund and complete first. Houser explained the project is largely focused on sediment transects in Pools 4, 8, and 13 and would use different methods than systemic methods for backwaters.

A-Team Report

Matt O'Hara introduced himself as the new Chair of the A-Team. O'Hara has 32 years of large river experience, has been involved with the LTRM and A-team in some capacity for over 20 years, and has served as the Illinois A-team representative for the last three years. He said he worked for the Illinois River Biological Station for 19 years before joining the Illinois DNR in 2010. O'Hara reported that the A-Team met on April 19, 2023. The agenda covered the following items:

— Chloride levels on the Upper Mississippi River presented by Kathi Jo Jankowski

— Lower Pool 13 HREP associated research project: understanding wind dynamics and contributing factors of water clarity, aquatic vegetation, and native freshwater mussels presented by Kristen Bouska

— UMRR program updates and LTRM science highlights presented by Marshall Plumley, Karen Hagerty, and Jeff Houser.

— Two-page flyers communicating the major findings from the 2022 UMRR LTRM status and trends report presented by Andrew Stephenson

— Preliminary outputs from the LTRM Implementation Planning Team presented by Jeff Houser

— Updating field stations descriptions

— Rotation of the chairpersonship

- — Acknowledgement of Karen Hagerty's service to the A-Team
- — Introduction of new staff, including field station leaders and USGS staff
- — Overview of Bellevue Field Station staff

O'Hara expressed appreciation for Hagerty and Scott Gritters involvement in the A-Team. During Gritters' chairmanship, he emphasized the importance of people in the program and introduced a field station in focus agenda item during each A-Team meeting. O'Hara said the status and trends flyers will be critical informational pieces to share with the public. O'Hara summarized findings from the chloride presentation noting an increasing trend in the data and a need to look more at where and what is the source of chloride. The A-Team voted to continue chloride monitoring under the water quality component.

O'Hara said the Lower Pool 13 HREP associated research project (HARP) will pilot a radar wave monitoring system to better understanding wave conditions in Lower Pool 13 and evaluate relationships between wind dynamics, waves, turbidity, and relative contributions of upstream sources and local resuspension on turbidity in the project area. The Lower Pool 13 HARP proposal and budget will be discussed again at the next A-Team meeting.

O'Hara reported that macroinvertebrate sampling was reinstated at LTRM field stations and shared pictures of ongoing sampling. He said it is good to collect data that has been sorely missed in recent years and noted mayflies have been found in La Grange and Pool 26 samples.

O'Hara said the next A-Team meeting is scheduled to be held virtually on July 24, 2023.

LTRM Implementation Planning

Jeff Houser reported that over the past several months, the *ad hoc* LTRM implementation planning team drafted objective statements and identified and prioritized information needs using a structured decision-making process. The team considered the relevance of information needs to both ecosystem understanding and assessment as well as management and restoration along with the depth of current knowledge, cost, opportunity to learn, urgency, and unique capacity of LTRM to address the information need. The *ad hoc* LTRM implementation planning team identified 11 information needs from an initial list of 29 and presented its tentative selection of information needs recommended for further development. The tentative list of information needs includes:

- — System-scale assessments of changes in floodplain vegetation
- — Spatial and temporal distribution of higher trophic levels on the UMRS floodplain (reptiles and amphibians)
- — Where and how the geomorphology of the river and floodplain changing and can be expected to change over planning horizons of decades to centuries
- — Ecological condition of the transitional portion of the UMRS between Navigation Pools 13 and 26.
- — Abundance, distribution, and status of zooplankton and phytoplankton
- — Aquatic plant distribution
- — Status and trends of mussel species within the Upper Mississippi River and Illinois Rivers
- — Community composition, abundance, and distribution of native and non-native macroinvertebrates in the UMRS
- — Assessing long term changes and spatial patterns in macroinvertebrates through standardized long-term monitoring
- — Learning from restoration and management actions
    - o Floodplain vegetation change at restoration project scales
    - o Effects of restoration on habitat conditions

Houser said the team will work to refine cost estimates and create an in-depth FY 2024 to FY 2026 work plan for these information needs for consideration and endorsement at the August 9, 2023 Coordinating Committee meeting. Houser said there may be available FY 2023 funds to begin one or two information needs and that the *ad hoc* team would also provide a recommendation to that effect for consideration at the August meeting. Lauren Salvato said UMRBA interstate water quality monitoring has a spatial sampling design completed for portions of the area between Pools 13 and 26 and asked how that effort could be complementary to the proposed information need. Houser invited Salvato to future discussions on that information need to ensure that information is incorporated.

Other Business

Upcoming quarterly meetings are as follows:

August 2023 – La Crosse

- UMRBA quarterly meeting – August 8
- UMRR Coordinating Committee quarterly meeting – August 9

October 2023 – St. Louis

- UMRBA quarterly meeting – October 24
- UMRR Coordinating Committee quarterly meeting – October 25

February 2024 – Virtual

- UMRBA quarterly meeting – February 27
- UMRR Coordinating Committee quarterly meeting – February 28

With no further business, Chad Craycraft moved and Vanessa Perry seconded a motion to adjourn the meeting. The motion carried unanimously. The meeting adjourned at 2:28 p.m.

UMRR Coordinating Committee Attendance List
May 24, 2022
[Note: this includes in-person and virtual attendees]

UMRR Coordinating Committee Members

Brian Chewning	U.S. Army Corps of Engineers
Sabrina Chandler	U.S. Fish and Wildlife Service
Mark Gaikowski	U.S. Geological Survey, UMESC
Chad Craycraft	Illinois Department of Natural Resources
Randy Schultz	Iowa Department of Natural Resources
Vanessa Perry	Minnesota Department of Natural Resources
Matt Vitello	Missouri Department of Conservation
Jim Fischer	Wisconsin Department of Natural Resources
Rich Vaughn	Natural Resources Conservation Service

Others In Attendance

Jim Cole	U.S. Army Corps of Engineers, MVD
Thatch Shepard	U.S. Army Corps of Engineers, MVD
Samantha Thompson	U.S. Army Corps of Engineers, MVD
Jeff Varisco	U.S. Army Corps of Engineers, MVD
Terry Birkenstock	U.S. Army Corps of Engineers, MVP
Nathan Wallerstedt	U.S. Army Corps of Engineers, MVP
Angela Deen	U.S. Army Corps of Engineers, MVP
John Henderson	U.S. Army Corps of Engineers, MVP
Dan Reburn	U.S. Army Corps of Engineers, MVP
Col. Jesse Curry	U.S. Army Corps of Engineers, MVR
Marshall Plumley	U.S. Army Corps of Engineers, MVR
Karen Hagerty	U.S. Army Corps of Engineers, MVR
Ken Barr	U.S. Army Corps of Engineers, MVR
Julie Millhollin	U.S. Army Corps of Engineers, MVR
Jesse Dunton	U.S. Army Corps of Engineers, MVR
Davi Michl	U.S. Army Corps of Engineers, MVR
Dan Meden	U.S. Army Corps of Engineers, MVR
Brian Markert	U.S. Army Corps of Engineers, MVS
Kraig McPeek	U.S. Fish and Wildlife Service, IIFO
Sara Schmuecker	U.S. Fish and Wildlife Service, IIFO
Lauren Larson	U.S. Fish and Wildlife Service, IIFO
Greg Conover	U.S. Fish and Wildlife Service
Laura Muzal	U.S. Fish and Wildlife Service
Jeff Houser	U.S. Geological Survey, UMESC
Jennifer Dieck	U.S. Geological Survey, UMESC
JC Nelson	U.S. Geological Survey
Rick Pohlman	Illinois Department of Natural Resources
Matt O'Hara	Illinois Department of Natural Resources
Kirk Hansen	Iowa Department of Natural Resources
Bob Bacon	Missouri Department of Natural Resources
Brent Newman	Audubon
David Minge	Izaak Walton League
Rick Stoff	Stoff Communications
Kirsten Wallace	Upper Mississippi River Basin Association
Andrew Stephenson	Upper Mississippi River Basin Association
Mark Ellis	Upper Mississippi River Basin Association
Lauren Salvato	Upper Mississippi River Basin Association
Natalie Lenzen	Upper Mississippi River Basin Association
Erin Spry	Upper Mississippi River Basin Association

ATTACHMENT B

UMRR Quarterly Budget Reports (7/12/2023)

(B-1 to B-4)

UMRR Quarterly Budget Report: St. Paul District

FY2023 Q3; Report Date: Wed Jul 12 2023

Habitat Projects

Project Name	Cost Estimates			FY2023 Financials			
	Non-Federal	Federal	Total	Carry In	Allocation	Funds Available	Actual Obligations
Bass Ponds, Marsh, and Wetland	-	$6,300,000	$6,300,000	-	-	-	$127,786
Conway Lake	-	$7,413,000	$7,413,000	-	-	-	$13,007
Harpers Slough	-	$13,675,000	$13,675,000	-	-	-	-$153,762
Lower Pool 10 Island and Backwater Complex	-	$17,000,000	$17,000,000	-	$3,248,000	$3,248,000	$1,865,898
Lower Pool 4, Big Lake	-	$18,000,000	$18,000,000	-	$550,000	$550,000	$357,517
McGregor Lake	-	$23,550,000	$23,550,000	$183,743	$6,600,000	$6,783,743	$7,465,815
Reno Bottoms	-	$10,000,000	$10,000,000	$59,603	$200,000	$259,603	$217,404
Robinson Lake, MN	-	$12,000,000	$12,000,000	-	$550,000	$550,000	$182,989
Total	-	$107,938,000	$107,938,000	$243,346	$11,148,000	$11,391,346	$10,076,654

Habitat Rehabilitation

Subcategory	FY2023 Financials			
	Carry In	Allocation	Funds Available	Obligations
District Program Management	-	-	-	$494,283
Total	-	-	-	$494,283

Regional Program Administration

Subcategory	FY2023 Financials			
	Carry In	Allocation	Funds Available	Obligations
Habitat Eval/Monitoring	-	-	-	$279,831
Total	-	-	-	$279,831

	Carry In	Allocation	Funds Available	Actual Obligations
St. Paul Total	$243,346	$11,148,000	$11,391,346	$10,850,768

UMRR Quarterly Budget Report: Rock Island District

FY2023 Q3; Report Date: Wed Jul 12 2023

Habitat Projects

Project Name	Cost Estimates			FY2023 Financials			
	Non-Federal	Federal	Total	Carry In	Allocation	Funds Available	Actual Obligations
Beaver Island	-	$25,288,000	$25,288,000	-	$300,000	$300,000	$118,521
Green Island, IA	-	$16,600,000	$16,600,000	$23,581	$400,000	$423,581	$533,372
Huron Island	-	$15,773,000	$15,773,000	$65,698	-	$65,698	$34,188
Keithsburg Division	-	$29,643,000	$29,643,000	-	$6,600,000	$6,600,000	$568,432
Lower Pool 13	-	$25,288,000	$25,288,000	$48,000	$400,000	$448,000	$323,994
Lower Pool 13 Phase II	-	-	-	$21,336	$600,000	$621,336	$226,981
Pool 12 (Forestry)	-	-	-	$53,705	$600,000	$653,705	$380,128
Pool 12 Overwintering	-	$20,870,822	$20,870,822	$1,598	-	$1,598	$1,598
Quincy Bay, IL	-	-	-	$12,312	$600,000	$612,312	$465,587
Rice Lake, IL	$7,280,000	$13,459,763	$20,739,763	$115,525	-	$115,525	-
Steamboat Island	-	$41,977,000	$41,977,000	-	$3,952,000	$3,952,000	$6,120,857
TBD	-	-	-	-	$50,000	$50,000	$3,001
Total	$7,280,000	$188,899,585	$196,179,585	$341,755	$13,502,000	$13,843,755	$8,776,659

Habitat Rehabilitation

Subcategory	FY2023 Financials			
	Carry In	Allocation	Funds Available	Obligations
District Program Management	-	-	-	$468,497
Total	-	-	-	$468,497

Regional Program Administration

Subcategory	FY2023 Financials			
	Carry In	Allocation	Funds Available	Obligations
Adaptive Management	-	$200,000	$200,000	$148,687
Habitat Eval/Monitoring	$450	$1,275,000	$1,275,450	$168,242
Model Certification/Regional HREP	-	$100,000	$100,000	$27,062
Public Outreach	-	$50,000	$50,000	$8,009
Regional Program Management	$2,993	$1,500,000	$1,502,993	$938,393
Regional Project Sequencing	-	$125,000	$125,000	$72,212
Total	$3,443	$3,250,000	$3,253,443	$1,362,605

Regional Science and Monitoring

Subcategory	FY2023 Financials			
	Carry In	Allocation	Funds Available	Obligations
Long Term Resource Monitoring	-	$5,500,000	$5,500,000	$3,187,392
Science in Support of Restoration/Management	-	$8,350,000	$8,350,000	$5,918,281
Total	-	$13,850,000	$13,850,000	$9,105,673

	Carry In	Allocation	Funds Available	Actual Obligations
Rock Island Total	$345,198	$30,602,000	$30,947,198	$19,713,434

UMRR Quarterly Budget Report: St. Louis District

FY2023 Q3; Report Date: Wed Jul 12 2023

Habitat Projects

Project Name	Cost Estimates			FY2023 Financials			
	Non-Federal	Federal	Total	Carry In	Allocation	Funds Available	Actual Obligations
Clarence Cannon	-	$29,800,000	$29,800,000	-	$950,000	$950,000	$453,935
Crains Island	-	$36,562,000	$36,562,000	-	$1,900,000	$1,900,000	$95,687
Gilead Slough	-	$11,000,000	$11,000,000	-	$350,000	$350,000	$79,020
Harlow Island	-	$37,971,000	$37,971,000	-	$325,000	$325,000	$134,068
Oakwood Bottoms	-	$29,000,000	$29,000,000	-	$575,000	$575,000	$787,599
Piasa - Eagle's Nest Islands	-	$26,746,000	$26,746,000	$31,151	$8,300,000	$8,331,151	$7,851,523
West Alton Missouri Islands	-	-	-	$21,510	$425,000	$446,510	$254,343
Yorkinut Slough, IL	-	$8,500,000	$8,500,000	$13,681	$375,000	$388,681	$622,637
Total	-	$179,579,000	$179,579,000	$66,342	$13,250,000	$13,316,342	$10,278,812

Habitat Rehabilitation

Subcategory	FY2023 Financials			
	Carry In	Allocation	Funds Available	Obligations
District Program Management	-	-	-	$544,907
Total	-	-	-	$544,907

Regional Program Administration

Subcategory	FY2023 Financials			
	Carry In	Allocation	Funds Available	Obligations
Habitat Eval/Monitoring	-	-	-	$338,684
Total	-	-	-	$338,684

	Carry In	Allocation	Funds Available	Actual Obligations
St. Louis Total	$66,342	$13,250,000	$13,316,342	$11,162,403

ATTACHMENT C

UMRR Status and Trends Snapshot Summaries Communication Tool Kit

(C-1 to C-21)

UMRR Status and Trends Snapshot Summaries Communication Tool Kit

Introduction

The Upper Mississippi River Restoration (UMRR) program is a unique, collaborative, science-based restoration program that uses state-of-the-art research and monitoring to understand changing environmental conditions of the river. UMRR is implemented through a partnership of federal and state agencies, nongovernmental organizations, and individuals. Long Term Resource Monitoring, an element under UMRR, provides scientific knowledge of the complex dynamics and interactions among various ecosystem characteristics and watershed drivers, including the influence of habitat projects on the Upper Mississippi River System. By collecting and evaluating data over decades, scientists can assess the health of the river and target habitat restoration projects for the greatest benefit of the river ecosystem.

A concise summary of the program is available in this UMRR program flyer.

With 30 years of monitoring, UMRR has extensive knowledge of ecological processes, function, structure, and composition on the Upper Mississippi River System and can assess and detect changes in the key components of the Upper Mississippi River ecosystem.

UMRR has published three reports of the river's ecological status and trends using Long Term Monitoring Data. The latest report was published in June 2022 and provides a clear and quantitative assessment of our understanding of how the Upper Mississippi River ecosystem is doing, how we know that, and why it matters. This new report presents the most complete understanding of any large river ecosystem in the world. The full report is available here: https://pubs.er.usgs.gov/publication/ofr20221039

The Communication Toolkit for Sharing the Snapshot Summaries based on the Ecological Status and Trends Report:

The UMRR program has developed snapshot summaries highlighting the most important observations about the river's ecological health and how long-term monitoring can inform how the river's ecological resources can be sustained and restored. They focus on **fisheries, floodplain forest loss, sedimentation, water quality, and aquatic vegetation**. The five snapshot summaries are available here: https://www.mvr.usace.army.mil/Missions/Environmental-Stewardship/Upper-Mississippi-River-Restoration/

This communication toolkit was developed to assist UMRR partners in disseminating these snapshot summaries and information to their respective stakeholders. Two announcement templates to deliver snapshot summaries in discrete events are provided recognizing 2023 as a year of high water and the 30th year of annual monitoring for the UMRR partnership.

Below each snapshot summary subject, sample messages are listed for communication with various audiences. If publishing a social media post, please include the hashtag #UMRR.

The Message:

The Upper Mississippi River System is complex; state and federal agencies use science to inform restoration actions. Thanks to long term monitoring, periodical aerial surveys, and continued analysis, we know more about the rivers' ecosystem than ever before. Continued monitoring will help us assess the impacts of management actions on these resources in the future to help us build a healthier river ecosystem.

The UMRR partnership has been monitoring the health of the Upper Mississippi River System for 30 years, creating the most complete understanding of any large river in the world. UMRR monitors fish communities, water quality, and aquatic vegetation annually – here are three stories from the biggest dataset on one of the world's largest river ecosystem in the world:

- Upper Mississippi and Illinois River Experience Widespread and Regional Changes in Fish Communities
- Aquatic Plants Expand and Water Clarity Improves in Portions of the Upper Mississippi River
- Water Quality has Improved in the Upper Mississippi and Illinois River but Challenges Remain

In 2023, much of the river system experienced major to moderate flooding with some areas recording top five records for high water. Here are two stories on the impacts of increased flooding in the Upper Mississippi River System:

- Upper Mississippi and Illinois Rivers Floodplains Experience Widespread Loss of Forested Areas
- Sediment Changes the Depth and Shape of the Upper Mississippi River

This communication toolkit contains resources on the following:

- Fisheries
- Water Quality
- Aquatic Plants
- Floodplain Forests
- Sediment

For More Information

Science details and S&T Report findings:

Contact Randy Hines at rkhines@usgs.gov or Jeff Houser at jhouser@usgs.gov.

Print questions and photos:

Contact Andrew Stephenson at astephenson@umrba.org or Erin Spry at espry@umrba.org.

Potential Audiences

- Policymakers – Legislators (state and federal)
- Agency Leadership (state and federal)
- General public (recreation, anglers, students, farmers, landowners)
- Conservation / Environmental groups
- Media, particularly key publications (developing media list)
- Resource managers and scientists
- Navigation industry
- Agriculture community
- Levee districts
- Academia
- Landscape-focused NGOs
- Local communities (e.g., Mississippi River Cities and Towns Initiative)
- Groups that have been previously marginalized such as people from racial and ethnic minority groups and low-income communities

Photos

Thumbnail photos relevant to each snapshot summary are included below. Higher resolution photos can be provided upon request. Please contact Andrew Stephenson at astephenson@umrba.org or Erin Spry at espry@umrba.org for high resolution photos.

Pitch Templates

Use these pitch templates to send the status and trends snapshot summaries to internal and external audiences.

INTERNAL PARTNERSHIP AUDIENCES (natural resource, pollution, transportation, agriculture departments)

Subject: Complex Science Made Simple – Share these Mississippi River Snapshot Summaries

Dear [Name of the recipient],

The Upper Mississippi River System (UMRS) is an incredibly important natural resource, home to hundreds of species of fish and wildlife. It is a nationally significant ecosystem and a nationally significant transportation system.

Your government, your agency, and your community members care about the River. Everyone wants to understand the River better, so they can help take action to make the River better. The Upper Mississippi River Restoration (UMRR) program was the first federal program to combine habitat restoration with scientific monitoring and research on a large river system, improving our understanding of how large rivers function and ensuring a healthier and more resilient UMRS.

The UMRR partnership has created a set of "Snapshot Summaries" that tell the story of fish populations, aquatic plants, water quality, floodplain forests, and sediment in the River. These snapshot summaries are based on nearly 30 years of data compiled in the recent UMRR 2022 Ecological Status and Trends Report.

Your state helped to produce the science and the report. Now you can help deliver the insights.

Take a look. See what you think.

Here are links to the Snapshot Summaries and brief targeted messages to accompany their release:

Fisheries Snapshot Aquatic Plants Snapshot Water Quality Snapshot	TARGETED MESSAGE 1: This summer marks the 30th year of Long Term Resource Monitoring through the UMRR Program partnership on the Upper Mississippi and Illinois Rivers. Every year, we monitor aquatic plants, water quality, and fisheries. As we publish these snapshot summaries, we are celebrating expanding upon the most complete understanding of any large river ecosystem in the world and the cooperative monitoring that led us here.
Sediment Snapshot Floodplain Forests Snapshot	TARGETED MESSAGE 2: This spring, many parts of the Upper Mississippi and Illinois Rivers were again impacted by flooding. As we publish these snapshot summaries, we are reflecting on increasing flood severity and occurrence and the significant impacts volatile conditions can have on ecological communities.

Thanks for all the good work you and your colleagues are doing.

[Your name]

[Your contact information]

EXTERNAL AUDIENCES (media)

Subject: Complex Science Made Simple – Share these Mississippi River Snapshot Summaries

Dear [Name of the recipient],

The Upper Mississippi River Restoration (UMRR) program, a partnership between state and federal agencies that monitors and rehabilitates the ecosystem of the Upper Mississippi and Illinois Rivers, has published five snapshot summaries based on the results of almost 30 years of monitoring compiled in the recent UMRR 2022 Ecological Status and Trends Report. These summaries highlight the most important observations about the river's ecological health and how long-term monitoring can inform sustainable and restorative management of the river's ecological resources.

Here are links to the Snapshot Summaries and brief targeted messages to accompany their release:

Fisheries Snapshot Aquatic Plants Snapshot Water Quality Snapshot	TARGETED MESSAGE 1: This summer marks the 30th year of Long Term Resource Monitoring through the UMRR Program partnership on the Upper Mississippi and Illinois Rivers. Every year, we monitor aquatic plants, water quality, and fisheries. As we publish these snapshot summaries, we are celebrating expanding upon the most complete understanding of any large river ecosystem in the world and the cooperative monitoring that led us here.
Sediment Snapshot Floodplain Forests Snapshot	TARGETED MESSAGE 2: This spring, many parts of the Upper Mississippi and Illinois Rivers were again impacted by flooding. As we publish these snapshot summaries, we are reflecting on increasing flood severity and occurrence and the significant impacts volatile conditions can have on ecological communities.

The goal of these snapshot summaries is to provide you and other interested parties with valuable information on the Upper Mississippi River System (UMRS), allowing greater reach of the latest research to more community members. The summaries tell stories on trends in fish communities, recovery of some aquatic plant populations, decreased nutrient and sediment pollution in the rivers.

We hope [intended media outlet] can use these summaries to discuss complex interdisciplinary issues on the UMRS. We ask that you share these summaries and the stories within with your audience and your partners to increase awareness of what's happening on the UMRS.

We are happy to provide the contact information of several experts involved in the collection and analysis of long-term monitoring data on the UMRS.

Thank you for considering use of these products.

[Your name]

[Your contact information]

Announcement sample:

Celebrating the most complete understanding of any large river ecosystem in the world and the cooperative monitoring that led us here

The Upper Mississippi River Restoration (UMRR) program, implemented through a partnership of federal and state agencies, nongovernmental organizations and individuals, has released five snapshot summaries on the ecological status and trends of the Upper Mississippi River System. Three of these summaries outline important findings from long term annual monitoring of water quality, aquatic plants, and fisheries across Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The UMRR partnership has been monitoring the river system for three decades, building the most complete understanding of any large river ecosystem in the world. Here are three stories from the largest dataset for a large river ecosystem:

- Upper Mississippi and Illinois River Experience Widespread and Regional Changes in Fish Communities
- Aquatic Plants Expand and Water Clarity Improves in Portions of the Upper Mississippi River
- Water Quality has Improved in the Upper Mississippi and Illinois River but Challenges Remain

Continued annual monitoring will inform river management and investments in the coming years and help develop new tools and models to better understand and manage the ecosystem in the face of a changing river.

(Use banner photos F1, AP1, WQ1)

Acknowledging high water in 2023 and its impacts on the UMRS:

The Upper Mississippi River Restoration (UMRR) program, implemented through a partnership of federal and state agencies, nongovernmental organizations and individuals, has released five snapshot summaries on the ecological status and trends of the Upper Mississippi River System. Two of these summaries outline important findings on the impacts of high water on floodplain forests and sediment across Illinois, Iowa, Minnesota, Missouri, and Wisconsin. This year, much of the river system experienced major to moderate flooding with some areas recording top five records for high water. Here are two stories on the impacts of increased flooding in the Upper Mississippi River System:

- Upper Mississippi and Illinois Rivers Floodplains Experience Widespread Loss of Forested Areas
- Sediment Changes the Depth and Shape of the Upper Mississippi River

Long-term monitoring of sediment dynamics and floodplain forests helps to predict future habitat availability for aquatic and floodplain plants and animals and allows resource managers to address the most vital restoration projects for the health of the river ecosystem.

(Use banner photos FL1, S1)

Supplemental text on UMRR program

The Upper Mississippi River Restoration (UMRR) program is a unique, collaborative, science-based restoration program made up of state and federal agencies that uses research and monitoring to understand changing environmental conditions of the river. UMRR is implemented through a partnership of federal and state agencies, nongovernmental organizations, and individuals. Long Term Resource Monitoring under UMRR provides scientific knowledge of the complex dynamics and interactions among various ecosystem characteristics and watershed drivers, including the influence of habitat projects on the Upper Mississippi River System. By collecting and evaluating data over decades, scientists can assess the health of the river and target habitat restoration projects for the greatest benefit of the river and the public.

A concise summary of the program is available in this UMRR program flyer.

UMRR has published three reports of the river's ecological status and trends using Long Term Monitoring data. The latest report was published in June 2022 and provides a clear and quantitative assessment of our understanding of how the Upper Mississippi River ecosystem is doing, how we know that, and why it matters. This new report presents the most complete understanding of any large river ecosystem in the world. The full report is available here.

General takeaways from S&T report

Key findings

- Thirty years of Long-Term Resource Monitoring data illustrates the fundamental role of science and management of large floodplain river systems. By collecting and evaluating LTRM water, fish, land use, and vegetation data over decades, scientists can assess the health of the river and target habitat restoration projects and management actions for the greatest benefit of the river ecosystem.
- The river is changing, and now experiences higher flows more often. The most widespread long-term trend was the **increase in discharge** (the flow rate of water through a given area) observed throughout the Upper Mississippi River System. Discharge is a fundamental characteristic of river systems, and this change has broad implications for habitat conditions and riverine biota.
- The Upper Mississippi River System is a large and diverse ecosystem with many regional differences. Long term monitoring has captured changes occurring differently and at different rates within the river system.

Sample talking points

- The Upper Mississippi River Restoration (UMRR) program manages the Upper Mississippi River System by using long-term monitoring and science to understand the changes to and diversity of ecosystems. These snapshot summaries document some of the changes the river system has experienced and how ecosystems respond to those changes. #UMRR
- The Upper Mississippi River Restoration (UMRR) program combines long term resource monitoring, research, and modeling to provide a solid scientific foundation upon which many agencies base their management actions. These snapshot summaries give snapshots of this monumental effort to understand the river system and explore some of the changes that have taken place in the last 30 years of monitoring.
- The Upper Mississippi River System has experienced more water in the river more of the time with high flows lasting longer and occurring more frequently. What does that mean for the rivers' ecosystem?
- UMRR program has the most robust river ecosystem datasets of any river in the world. This datasets are available for use and exploration on the website here. (link varies for subject)
- US Geological Survey, US Army Corps of Engineers, and the five Upper Mississippi River Basin states have partnered to monitor the river's health, creating the largest dataset of any large river in the world. These snapshot summaries tell us about the results of this monitoring and what is happening in the river system. #UMRR
- Why monitor the Upper Mississippi River System? By collecting and evaluating LTRM water, fish, land use, and vegetation data over decades, scientists can assess the health of the river and target habitat restoration projects and management actions for the greatest benefit of the river ecosystem.

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Topic-specific takeaways from S&T report

Photos

Thumbnail photos relevant to each snapshot summary are included below. Higher resolution photos can be provided upon request. Please contact Andrew Stephenson at astephenson@umrba.org or Erin Spry at espry@umrba.org for high resolution photos.

Fisheries

Key findings

- Native fish populations have increased in some pools partially due to improved water clarity and increased aquatic plant life.
- Recreational fish populations have increased in some pools despite changes in fishing methods and technology as well as species targeted by anglers.
- Invasive bigheaded carps now dominate the fish community in the lower reaches of the river system, contributing to declines in native fish.
- Forage fish, a vital food source for larger fish and wildlife of the Upper Mississippi River System, are declining throughout much of the river network.

Sample talking points

- The Upper Mississippi River Restoration (UMRR) program has produced the most extensive fisheries dataset for a great river in the world. Because of this effort, we now know forage fish, a vital food source for larger fish and wildlife of the Upper Mississippi River System, are declining in some areas. (Use Photo F3)
- Portions of the Upper Mississippi River System are experiencing an increase in native fish thanks in part to improved water clarity and more aquatic plant life. (Use Photo F2)
- Anglers' fishing technology has improved but that hasn't hurt the recreational fish population. In fact, in some parts of the Upper Mississippi River System that population is on the rise. (Use Photo F1 or F5)
- How does the spread of invasive bigheaded carp affect the Upper Mississippi River System? As bigheaded carp move to new areas in the river system, native filter feeding fishes like paddlefish decline in number. (Use Photo F2 or F4)
- For thirty years, field crews all along the Upper Mississippi River System have monitored fish populations. Thanks to their work, trends in fish populations are available for six pools. (Use Photos F1-F4)

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Photos Available:

F1

F2

F3

F4

F5

<u>Photo credits:</u>

F1: Jason DeBoer

F2: Nick Schlesser

F3: University of Illinois

F4: Prairie Research Institute

F5: Illinois Natural History Survey

Aquatic plants

Key findings

- The diversity of native aquatic plants and their abundance has increased in the northern half of the Upper Mississippi River, but in other areas, they remain scarce.
- More aquatic plants help to improve water clarity, and improved water clarity helps more aquatic plants to grow. Aquatic plants are important food and habitat for fish, wildlife, and other aquatic organisms.
- Floating plants are scarce in many areas of the river but can present problems in certain backwaters where they overgrow.
- Water level management in the lower reaches of the Upper Mississippi River System resulted in an increase in native emergent plants. Many agencies are working together to implement this effective management practice in other parts of the river.

Sample talking points

- The Upper Mississippi River Restoration (UMRR) partnership has monitored the Upper Mississippi River System for 30 years, establishing the most complete dataset for any large river system in the world. During this time, monitoring has tracked aquatic plants rebounding in some areas of the river and struggling to re-establish in other locations. Could changes to water clarity impact aquatic plant success? #UMRR (Use Photos AP1-4)
- The Upper Mississippi River Restoration (UMRR) program has produced the largest aquatic vegetation dataset in the world. Because of this extensive knowledge on the river, we now know native emergent plants have increased in parts of the lower reaches of the Upper Mississippi River and water level management practices have contributed to native plant success. (Use Photo AP2)
- Did you know that aquatic plants help to improve water clarity and that water clarity helps aquatic plants grow? Most of the Upper Mississippi River System has seen an increase in the diversity and abundance of aquatic plants, a vital part of our ecosystem. (Use Photo AP5)
- Millions of birds migrate through the Upper Mississippi River System every year. These birds - as well as fish and other wildlife – depend on aquatic plants as a vital food source and habitat. Our understanding of where aquatic plants can grow and where plant restoration is likely to succeed is vital to supporting those populations. We've been monitoring this for more than 30 years. (Use Photo AP1)
- The Illinois River, vitally important waterfowl habitat, is facing a lack of aquatic plant life. This is likely due to a combination of large water level fluctuations, herbivory, and a lack of water clarity. (Use any photo)

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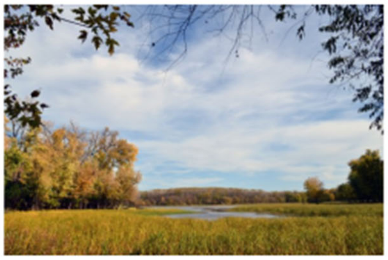
Photos Available:

AP1



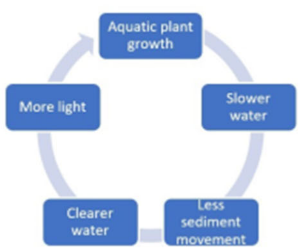
AP2

Photo credits:
AP1: U.S. Fish and Wildlife Service
AP2: Alicia Carhart
AP3: Andrew Stephenson
AP4: Eric Lund

AP3

AP4

AP5



Water clarity sustains plants and plants sustain water clarity.

Water quality

Key findings

- Water quality has improved in the Upper Mississippi River System.
- Though phosphorus and nitrogen levels remain higher than the EPA water quality criteria, progress has been made to improve water quality in the Upper Mississippi River System.
- An important indicator of water quality, Total Suspended Solids (TSS) have decreased in most parts of the river but are still too high in the southern portion to sustain aquatic plants.
- Improved watershed practices are making an impact on water quality, but climate change (high flow events) may diminish these benefits.

Sample talking points

- Long term monitoring of the Upper Mississippi River System shows that nitrogen concentrations have increased in three of six studied pools. Restoration projects and improvements to agricultural best management practices can help to reduce these levels.
- Water quality is improving on the Upper Mississippi River System, but more work is needed to reduce nutrient input to the river. In many areas of the river system, concentrations of nutrients, notably nitrogen and phosphorus, remain high, exceeding U.S. Environmental Protection Agency benchmarks. However, total phosphorus concentrations have declined in many of the studied river areas.
- What do phosphorus, nitrogen, and total suspended solids have in common? They are all important indicators of water quality in the Upper Mississippi River System. Data from over 30-years of monitoring shows that we are making progress in reducing these indicators and improving the health of our river. #UMRR
- Improved watershed practices are having a positive impact on the water quality of the Upper Mississippi River System. But is it enough to curb the impacts of climate change and human activity? [Insert agency name] and others are collaborating to improve and implement watershed practices, reduce sediment and nutrient inputs, and improve water quality.
- Nitrogen and phosphorus are key nutrients for plant growth. Excess nutrients have caused nuisance blooms of algae, overabundance of plant life, and loss of animal life in rivers. Algal blooms can interfere with river recreation and reduce oxygen availability, which threatens the survival of aquatic organisms. Under certain conditions, algal blooms resulting from excess nutrients have harmed human health.

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Photos Available: WQ1

Photo credit:
Kathi Jo Jankowski

Floodplain forests

Key findings

- Floodplain forests are declining due to longer and more frequent periods of flooding, human modifications to the river, and other environmental changes.
- More water means greater stress on floodplain forests which will likely result in additional floodplain forest decline in the coming years.
- Management practices and restoration efforts will ensure the river system continues to provide habitat for wildlife and connect human communities to the river.

Sample talking points

- Aerial imagery collected by Long Term Resource Monitoring allows the UMRR partnership, made up of several federal and state agencies and NGOs, to understand the changes to floodplain forests on the Upper Mississippi River System. (Use Photo FL2)
- The Upper Mississippi River Restoration (UMRR) program's systemic monitoring effort of the Upper Mississippi River System helps forest managers understand changing hydrologic conditions threatening floodplain forests, a landscape already in decline. #UMRR
- Floodplain forests, vital habitat for wildlife, are declining due to pressures from invasive species and changes in hydrology on the Upper Mississippi River System. (Use Photos FL1 or FL3)
- What will all this flooding mean for the Upper Mississippi River System? Floodplain forests are damaged when floods occur too often or when trees are under water for too long. (Use Photo FL3)
- What can be done to protect the floodplain forests of the Upper Mississippi River? Multiple agencies have worked together to manage and restore forests which will not only benefit wildlife but also enjoyment of recreational opportunities on the river. (Use Photo FL2)
- Floodplain forests store carbon and improve water quality. Why are these vital forests on the decline in the Upper Mississippi River System? Flooding, human modifications to the river and environmental changes are the biggest culprits. (Use Photo FL1)

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Photos Available:

FL1

FL2

FL3

Photo credits:

FL1: U.S. Fish and Wildlife Service Midwest Region

FL2: Stephen Winter

FL3: Andrew Stephenson

Sediment

Key findings

- More sediment is entering the river system, likely due to both climate impacts and human activity, such as a change from forested landcover to agricultural landcover.
- Increased sediment deposition in the river can reduce depth of and water flow to backwater lakes, impacting suitable habitat for some fish species, which concerns resource managers.
- Sediment deposited on banks is creating critical habitat for shorebirds and waterbirds and provides ideal growing conditions for some trees.
- Sediment suspended in the water can affect water clarity, impacting aquatic plant communities.
- The Upper Mississippi River System has experienced localized changes in both size and shape.

Sample talking points

- The Upper Mississippi River System is experiencing more water, more of the time. In some locations, sediment is moving to backwater lakes and reducing vital habitat for overwintering fish. In other locations, sediment is being deposited on riverbanks, which increases habitat for willow, cottonwood, and some shorebirds. Long-term monitoring of sediment dynamics in the Upper Mississippi River System allows resource managers to address the most vital restoration projects for the health of the river ecosystem. #UMRR (Use Photo S4)

- The Upper Mississippi River Restoration program monitors the dynamics of erosion and sedimentation on the Upper Mississippi River, which helps to predict future habitat availability for aquatic and floodplain plants and animals. (Use Photos S1 or S4)

- Did you know sediment can reduce depth of and water flow to backwater lakes, impacting habitat for some fish species? It's happening in the Upper Mississippi River. (Use Photo S1)

- Multiple agencies have been monitoring changes to the size and shape of the Upper Mississippi River, including the movement of sediment. These studies will help predict the future health and function of the river ecosystem. (Use Photo S2)

- Where is all the sediment in the Upper Mississippi River System coming from? Many human activities can introduce sediment to the river. Rates of erosion and sedimentation may also be impacted by increased annual rainfall, increased variability in flood severity from year to year, and increases in upland sources of sediment from many tributaries. (Use Photo S5)

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Photos Available:

S1

S2

S3

S4

S5

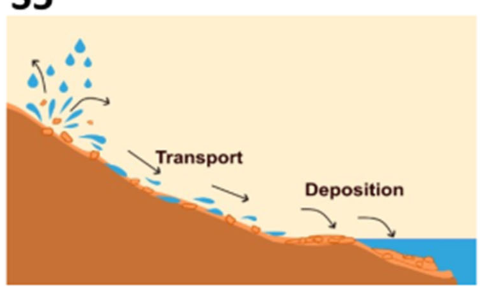


Photo credits:

S1: Andrew Stephenson
S2: Minnesota Pollution Control Agency
S3: U.S. Fish and Wildlife Service
S4: Larry Reis
S5: Erin Spry

ATTACHMENT D

UMRR Communications & Outreach Team Framework (2023)

(D-1 to D-9)

Upper Mississippi River Restoration
Communication & Outreach Team Framework

Background and Purpose

Authorized by Congress in 1986, the Upper Mississippi River Restoration (UMRR) program was the first program to undertake restoration and monitoring on a large river system in the United States. UMRR is a highly successful environmental restoration program known for its revolutionary methodologies in long-term resource monitoring and habitat rehabilitation, restoration, and enhancement. These state-of-the-art research and resource monitoring methods have been adopted and used as a model for other major river systems around the globe. UMRR provides a better understanding of the ecological needs of the Upper Mississippi River System (UMRS) and is now recognized as the single most important effort committed to ensuring the viability and vitality of wildlife in the UMRS. Since its authorization, UMRR has restored approximately 120,000 acres of aquatic and floodplain habitat and is a leader of large river restoration.

Standing by the program's tagline "Leading – Innovating – Partnering," the UMRR Communication and Outreach Team (COT) has developed this framework, utilizing the strong partnership for successful communication and outreach of the UMRR program. Partnership is a fundamental component to implementing the UMRR program and each partner plays a critical and unique role in the success of the program. As multiple agencies have a vested interest in this program, regular and effective communication and coordination amongst UMRR partners is critical. This Communication and Outreach Team Framework was developed to assist the COT with successful communication, coordination and collaboration. The following objectives, strategies, and actions will focus on various methods and actions partners will be expected to follow to communicate key information with UMRR and target audiences. Through UMRR Coordinating Committee oversight, the COT works to coordinate and implement communication-related objectives.

Objectives and actions 3.1-3.3 were developed for Goal 3 of the 2015-2025 UMRR program's Strategic Plan and Implementation Plan (https://dvidshub.net/r/3ylwp2) and guides communication and outreach objectives for the COT. A fourth additional objective (AO) was identified.

Objectives and Actions

- **3.1:** Work with key organizations and individuals in the Upper Mississippi River (UMR) watershed.
- **3.2:** Provide information to organizations and individuals whose actions and decisions affect the UMR ecosystem.
- **3.3:** Exchange knowledge with other organizations and individuals nationally and internationally.
- **AO:** Continuously work to ensure all aspects of the UMRR program are being shared amongst the UMRR Coordinating Committee and their agency's key leadership and produce efficient and effective continuity for future partners.

Roles and Responsibilities:

Partnership is a fundamental component to implementing the UMRR program and each partner plays a critical and unique role in the success of the program. In order to successfully execute this COT Framework, the partners of the UMRR program will continuously work together to accomplish objectives outlined above.

Each UMRR program partner will provide at least one representative to serve on the UMRR COT who will be tasked with the following:

- Attending regular COT meetings. Meetings are typically scheduled monthly.
- Provide feedback and discussion on COT efforts or activities; timeline is provided per topic.
- Communicate and coordinate important outreach and engagement information to appropriate contact(s) within reasonable or suggested timeframe; work with organizational public affairs personnel to post UMRR articles and social media content.
- Seek opportunity to lead COT efforts and act as an Agency champion to further the program's reach and impact within their agency and stakeholder groups.

The partners have a shared responsibility for advancing Environmental Justice (EJ) for the UMRR program through collaboration with or consideration of District-level EJ Strategic Plans, UMRR programmatic EJ initiatives, and Habitat Rehabilitation and Enhancement Project Management Plans.

Communication & Outreach Team Framework

Current UMRR Communication and Outreach Team Partners:

Federal Partners

- U.S. Army Corps of Engineers:
  St. Paul, Rock Island, St. Louis Districts
- U.S. Fish and Wildlife Service:
  Illinois/Iowa Ecological Services Field Office
- U.S. Fish and Wildlife Service:
  Upper Mississippi River National Wildlife and Fish Refuge
- U.S. Geological Survey
  Upper Midwest Environmental Sciences Center
- U.S. Department of Agriculture:
  Natural Resources Conservation Service

State Partners

- Illinois Department of Natural Resources
- Illinois Natural History Survey
- Iowa Department of Natural Resources
- Minnesota Department of Natural Resources
- Missouri Department of Conservation
- Wisconsin Department of Natural Resources

Non-Governmental Organizations

- Upper Mississippi River Basin Association
- The Nature Conservancy
- American Rivers
- 1 Mississippi

Target Audiences

UMRR program partners are responsible for communication and outreach to the following two main target audiences:

1. **Interested Public and Affected Stakeholders:** People, organizations, and communities that are within UMRR's authorized geographic area who have either frequent or occasional contact with the river. This would include cities, civic organizations, colleges, recreational clubs, media outlets, NGO's, businesses (marinas, utilities, outdoor recreation, etc.), and schools. This would also include new partners who are working within the UMRS or communities with EJ concerns.

2. **Decision Makers and Other Key Advocates:** Communication with state and federal agencies, regional organizations, and congressional staff is critical so that awareness of the UMRR program and its contributions to the UMRS are more widely known, understood, and supported.

Process for COT Efforts

Monitoring and Evaluation

Evaluation of the success and effectiveness of current UMRR communication is a critical part of the UMRR COT Framework. The COT will assess the effectiveness of communication and outreach efforts and determine those efforts are following framework and objectives. The following measures of success and methods of evaluation may be used, but the COT will need to determine metrics and methods for each individual effort.

Measures of Success

- Number of attendees at activities/meetings/events
- Participation by both key partners and a wide range of members of the public, including communities with EJ concern
- Number of public responses to surveys/requests for public comment
- Number of people receiving emails/communication notes
- Website visits, clicks, interactions
- Number of media stories

Methods of Evaluation

- Survey event host(s) and attendees regarding activity or event successes, failures, ways to improve. *Survey should be sent within two weeks of activity or event.*
- Debrief meetings after activities and events. Discuss successes, failures, ways to improve. *Debrief should occur within one month of activity or event.*
- Individual or group interviews with members of the public
- Informal conversations
- Website analytics

Actions Timeframe:

This COT Framework outlines a recommended timeline for review and discussion of key items. For UMRR COT meeting scheduling, the table below provides a simple and quick overview to guarantee timely discussion and execution of topics or actions.

Monthly

- Discussion of current and upcoming efforts, initiatives, events, and activities by COT.
  - Discussion of UMRR media content initiatives.
    - What can be created or published?
    - What are the media needs?
    - Which agency/individuals are responsible?
  - Hosting or participation.
  - Discussion of collaboration with other national or international large aquatic ecosystem/water resources efforts.
  - Monthly status updates.
  - Virtual collaboration tools needed?
  - What are the unique timelines for actions relating this event or activity? (See Ad Hoc below.)

Ad Hoc

- Discussion of the four core objectives and current communication effectiveness. Surveys may be utilized.
  - What is working well? Any issues? What can be improved?
- Agency input regarding featured projects, best business practices, and lessons learned. Surveys may be utilized.
- Incorporate insights gained from other national and international programs/efforts as applicable to enhance program implementation, increase knowledge, and create cost-efficiencies, etc.
- Review content.
  - Create new social media content for UMRR and partner use (project highlights, upcoming events, conferences, etc.).
  - Revise suite of UMRR promotional outreach material (brochures, visual aids, information papers, print media, business cards, etc.).
  - Coordination with publishing districts or agency Communications contact(s) for future social media posts.

Per Event: Debrief meetings after activities and events. Discuss successes, failures, ways to improve. Surveys may be utilized in addition to debrief.

Annually

- Development of the following year's strategy and anticipated efforts (November)
- Discussion of Communication and Outreach Team Framework effectiveness over last year.
  - Does it need updates or adjustments?
- Refine UMRR messaging and common language.
- Review way pictures/videos are captured, labeled, and stored.

Every Five Years

- Creation of a new professional UMRR PowerPoint template for partner use.
- Consider recommendation to Coordinating Committee for branding assessment to more efficiently communicate the UMRR mission/story.

Communication and Outreach Strategy

This Communication and Outreach Team Framework was developed to assist UMRR partners with successful communication, coordination and collaboration guidance across the Coordinating Committee and beyond. The following objectives, strategies, and actions will focus on various methods and actions partners will be expected to follow to communicate key information with UMRR and target audiences.

Objectives and Actions

Objectives and strategies were developed for Goal 3 of the 2015-2025 Strategic Plan and Implementation Plan (https://dvidshub.net/r/3ylwp2) which drives partners to "Engage and Collaborate with Other Organizations and Individuals to Help Accomplish the UMRR Vision". Actions were developed to support the guiding objectives and strategies. The following objectives are taken directly from Goal 3 of the Strategic Plan:

- **3.1:** Work with key organizations and individuals in the Upper Mississippi River watershed.
- **3.2:** Provide information to organizations and individuals whose actions and decisions affect the Upper Mississippi River ecosystem.
- **3.3:** Exchange knowledge with other organizations and individuals nationally and internationally.

A fourth additional objective (AO) was identified:

- **AO:** Continuously work to ensure all aspects of the UMRR program are being shared amongst the UMRR Coordinating Committee and their agency's key leadership and produce efficient and effective continuity for future partners.

Detailed Communication and Outreach Framework

Objective 3.1: Work with key organizations and individuals in the Upper Mississippi River watershed.

- **Strategy 3.1.1:** Ensure rich collaboration with key organizations and individuals in the Upper Mississippi River watershed in advancing complementary visions, missions, and goals.
  - **Action 3.1.1.1:** Continue defining key partnerships and restoration efforts. *Review annually.*
    - Review and Update this Communication and Outreach Team Framework as needed. *Review and discuss annually.*
  - **Action 3.1.1.2:** Advocate standardization of messaging, materials, and formats for external communication. *Review per recommendation.*
    - Refine UMRR messaging and common language. *Review annually.*
    - Creation of a UMRR PowerPoint template for partner use. *Review every five years.*
    - Revise suite of UMRR promotional outreach material, including the need for translated materials (brochures, visual aids, information papers, print media, business cards, etc.) *Review as needed.*
- **Strategy 3.1.2:** With key watershed programs and projects, jointly develop and communicate common messages about the restoration and knowledge needs of the Upper Mississippi River.
  - **Action 3.1.2.1:** Advocate standardization of messaging, materials, and formats for external communication. *Review per recommendation.*
    - Refine UMRR messaging and common language. *Review annually.*
    - Creation of a UMRR PowerPoint template for partner use. *Review every five years.*
    - Revise and create a suite of UMRR promotional outreach material, including translated materials (brochures, visual aids, information papers, print media, business cards, videos, etc.). *Review as needed.*
- **Strategy 3.1.3:** Seek knowledge from other organizations and individuals for the purposes of being aware of activities that may influence UMRR's work and enhancing programmatic efforts.
  - **Action 3.1.3.1:** Increase communication between partners to strengthen UMRR partner knowledge. Equal discussion of all agency work. *Review and discuss monthly.*

- **Strategy 3.1.4:** Directly engage relevant organizations or individuals in implementing UMRR's efforts, as appropriate
  - **Action 3.1.4.1:** Increase general awareness of the UMRR program through use of social media and other web-based platforms. *Review and discuss per recommendation.*
    - Development of UMRR media. Led by USACE. *Coordinate in advance with publishing District or agency Communications contact.*
    - Online media kit with key program information. *Update as needed with new content for posts.*
  - **Action 3.1.4.2:** Utilize traditional media to communicate UMRR mission and projects. Seek input from communities with EJ concern on preferred media and methods, utilizing their recommendations. *Review per recommendation.*
    - Provide media to Tower Times (MVR), Crosscurrents (MVP), and other agency publications. *Coordinate in advance with publishing District or agency Communications contact.*
    - Development of public education signs for HREP projects and LTRM field stations. *Review per project/location.*
    - UMRR HREP site exploration trail development for public use of sites. *Coordination with Great River Road and National Geographic Tourism.*
  - **Action 3.1.4.3:** Leverage opportunities at existing venues to educate and inform key organizations and individuals about UMRR. *Discuss per recommendation.*
    - Prioritize external engagements and collaboration. Host and participate in events (groundbreaking, ribbon cutting, conferences, fishing tournaments, etc.) *Discuss as needed.*
    - Survey attendees' regarding event successes, failures, ways to improve. *Survey should be sent within two weeks of activity or event.*
    - Debrief meetings after activities and events. *Debrief should occur within one month of activity or event.*
    - Connect with other national and international organizations to share UMRR story and build relationship. *Review monthly.*

Objective 3.2: Provide information to organizations and individuals whose actions and decisions affect the Upper Mississippi River ecosystem.

- **Strategy 3.2.1:** Enhance the delivery and utility of UMRR's knowledge in order to increase understanding of the Upper Mississippi River's ecosystem drivers and means to achieve the UMRR vision.
  - **Action 3.2.1.1:** Facilitate dialogue to solicit public input for implementation of habitat project planning, resilience concepts. *Review and discuss per recommendation.*
    - Use UMRR key messages and media content developed in Objective 3.1 of this framework. *Review and plan prior to public outreach events.*
    - Use innovative technologies like virtual collaboration tools to solicit feedback from the general public. *Discuss three months prior to each public outreach event. Review one month prior to event.*
  - **Action 3.2.1.2:** Enhance the delivery and utility of UMRR's knowledge in order to increase understanding of the Upper Mississippi River System ecosystem drivers and means to achieve the UMRR vision.
    - Utilize UMRR media. *Review as needed.*
    - Utilize agency publications. *Review as needed. If contributing, coordinate in advance with publishing coordinator.*
- **Strategy 3.2.2:** Provide decision makers with timely, relevant, understandable, and usable knowledge about the needs and tools available to advance the UMRR's vision.
  - **Action 3.2.2.1:** Utilize key messages and media developed in Objective 3.1 of this plan. *Review and plan annually.*
  - **Action 3.2.2.2:** Be consistent and regular with engagement.

Objective 3.3: Exchange knowledge with other organizations and individuals nationally and internationally.

- **Strategy 3.3.1:** Serve as a resource for similar programs nationally and internationally
  - **Action 3.3.1.1:** Promote Program's significance. *Review per recommendation.*
    - Use UMRR key messages and social media developed in Objective 3.1 of this plan. *Review and plan as needed.*

- **Action 3.3.1.2:** Collaborate with other related large aquatic ecosystem/water resources efforts both nationally and internationally. *Review and plan as needed.*

- **Strategy 3.3.2:** Seek knowledge from other organizations and individuals nationally and internationally to enhance UMRR's efforts in advancing its vision.
  - **Action 3.3.2.1:** Incorporate insights gained from other national and international programs/efforts as applicable to enhance program implementation, increase knowledge, and create cost-efficiencies, etc. Review and d*iscuss as needed.*

Additional Objective (AO): Continuously work to ensure all aspects of the UMRR program are being shared amongst the UMRR Coordinating Committee and their agency's key leadership.

- **Strategy AO.1:** Share UMRR featured projects, best business practices, lessons learned, and upcoming events (i.e. ground breakings, ribbon cutting, etc.). *Review and plan as needed.*
  - **Action AO.1.1:** Host webinars aimed at increasing communication and coordination across the partnership. *Review and plan as needed.*
  - **Action AO.1.2:** Continually educate and inform UMRR partners about UMRR and the value it brings to each of their agencies. *Review and plan as needed.*
- **Strategy AO.2:** Ensure efficient organization and assessment of the UMRR program.
  - **Action AO.2.1:** Consider branding assessment to more efficiently communicate the UMRR mission and story. *Discuss every five years.*
  - **Action AO.2.2:** Improve way pictures/videos are captured, labeled, and stored. Assess diversity of communities represented in photo and videos. *Review annually*.

UMRR Key Messaging – Attachment 2

Key Messaging

In 2016 the UMRR Coordinating Committee concurred on making the UMRR program's tagline: "Leading – Innovating – Partnering". Below are established talking points for each tagline components.

"Leading – Innovating – Partnering"

1. **Leading:** For more than 30 years, the UMRR Program has been leading the way in large river ecosystem restoration, both nationally and internationally.
    a. Talking Point: The UMRR Program is recognized as the first large river ecosystem restoration and scientific monitoring program in the nation.
    b. Talking Point: Despite of being a national leader in ecosystem restoration, the program is critically sustaining the UMRS ecosystem because it is still degrading at a faster rate than it is being restored.
    c. Talking Point: The UMRR Program uses long term resource monitoring, research, modeling, and data management to provide critical knowledge about the ecological health and resilience of the Upper Mississippi River System.
    d. Talking Point: The UMRR Program's large river standardized monitoring protocols are being incorporated into other river systems, providing a database to compare status and trends information of ecological health and resilience.
2. **Innovating:** The UMRR Program has a long history of using innovative techniques and sustainable solutions to restore and rehabilitate complex fish and wildlife habitat.
    a. Talking Point: The UMRR Program has created a formalized method for future restoration that incorporates the understanding of how management interventions affect habitat and ecosystems on a larger scale.
    b. Talking Point: Standardized monitoring provides valuable information over the wide range of habitats that exist in the Upper Mississippi River ecosystem.
    c. Talking Point: With long term data collected for nearly three decades, UMRR's database is one of the most extensive and comprehensive on any large river system in the world.
    d. Talking Point: Implementation of the 10-year Strategic Plan takes the program to the next level of effectiveness. Steps include operationalizing metrics of ecosystem health and resilience for project identification and formulation, development of new tools and models to design and construct habitat projects, use of systemic and project data to measure the success of restoration efforts, and use of cutting-edge research to understand complex relationships between stressors on the river and what needs to be done to counteract those stressors.
3. **Partnering:** The strong partnership between the states, federal agencies, non-governmental organizations, as well as citizens who contribute to the UMRR Program, are the foundation of the program's success.
    a. Talking Point: Over the past 35 years, UMRR Program, with its partners, has restored approximately 120,000 acres of riverine and floodplain habitats on the Upper Mississippi River System.
    b. Talking Point: The program has been recognized as the single most important effort committed to ensuring the ecological viability and vitality of the Upper Mississippi River System since the establishment of national wildlife refuges in the 1920s.
    c. Talking Point: Collaborative efforts of the UMRR Program partners provides a solid foundation for the creation of restoration methods, management actions and government policy.
    d. Talking Point: Each year, UMRR Program partners commit substantial time and resources (more than $1,000,000) to the program.

Best Practices: UMRR-Focused Press Releases

Updated October 2022

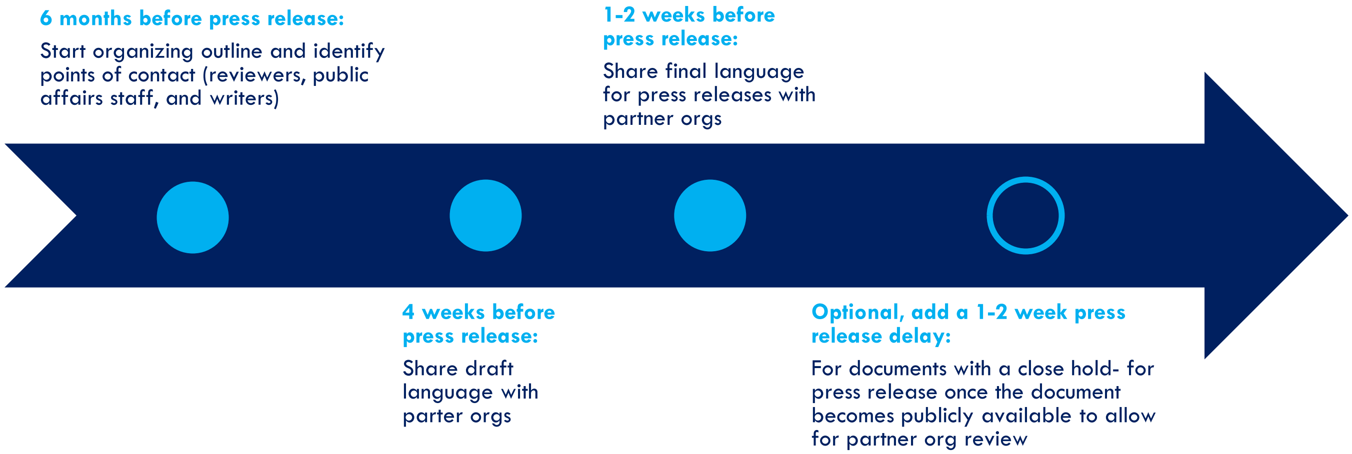
Purpose of Document

Document best practices related to press releases intended to be shared by more than one UMRR partner to communicate UMRR purpose, program updates, or restoration and science news.

Participation

- Identify key partners in press release and identify their needs, process, and review periods early on
- Identify best dissemination and communication methods for non-UMRR river groups

Timing



Messaging

- Time devoted on key message development, including accessibility and accuracy, is well-spent; plan to spend one to three months prior to release date on message development
- Keep language plain and clear, avoiding jargon
- Identify and confirm technical and/or communication experts for each partner prior to distribution of press release
- Develop a FAQ document before press release, if possible
- Tie key messages to areas of effect; for example, identify state-specific examples for a regional report, which allows state agencies to use and share that information for other river groups or disseminate data that is meaningful to their organization or stakeholders
- Focus on findings (e.g. "more flooding more of the time") vs. statements (e.g. "report is available") to increase chance of media developing a story
- Consider use of a social media toolkit/copy for use by river groups to share with their members and stakeholders/audiences

Press Relationships

- Continue to build relationships with the Mississippi River Basin Ag & Water Desk
- Continue to use and update established organization lists for press releases, which have worked well and provides UMRR with networking and promotion opportunities

Press Release or Public Affairs Contacts

Name and Organization	Name	Email
USACE- MVR	Sam Heilig	samantha.a.heilig@usace.army.mil
USACE- MVP	Melanie Peterson	melanie.m.peterson@usace.army.mil
USACE- MVS	George Stringham	George.E.Stringham@usace.army.mil
USGS- Region	Vacant	-
USGS- UMESC	Randy Hines	rkhines@usgs.gov
Illinois River Biological Station (LTRM)	Kris Maxson	kmaxs87@illinois.edu
USFWS- Region		
USFWS- Refuge	Sabrina Chandler	sabrina_chandler@fws.gov
MN DNR	Greg Husak	greg.husak@state.mn.us
WI DNR	Susan Tesarik	Susan.Tesarik@wisconsin.gov
IA DNR	Shannon Hafner	shannon.hafner@dnr.iowa.gov
MO DOC	Dave Herzog	Dave.Herzog@mdc.mo.gov
IL DNR	Jayette Bolinski	jayette.bolinski@Illinois.gov
USDA-NRCS	Vacant	-
UMRBA	Andrew Stephenson	astephenson@umrba.org
American Rivers		
1 Mississippi	Michael Anderson	manderson@1mississippi.org

Partner Press Release Process Notes

Organization	Unique Process Notes
USACE- MVR	
USACE- MVP	
USACE- MVS	
USGS	The USGS cannot release “close-hold” reports/science in advance of release. USGS HQ press release review requires 2-3 weeks.
USFWS- Region	
USFWS- Refuge	
MN DNR	
WI DNR	
IA DNR	
MO DOC	
IL DNR	
USDA-NRCS	
UMRBA	
American Rivers	
1 Mississippi	

ATTACHMENT E

Program Reports

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
Developing and Applying Indicators of Ecosystem Resilience to the UMRS						
2023R1	Updates provided at quarterly UMRR CC meeting and A team meeting as appropriate	Various				Bouska, Houser
2023R2	Develop collaborative research proposal and work plan to empirically test resilience hypotheses related to Lower Pool 13 HREP	30-May-2023		15-Jun-2023		Bouska
On-Going						
2021R3	Submit resilience assessment synthesis manuscript for peer review publication	30-Mar-2021	30-Sep-2023		Delayed due to change in priorities	Bouska
2021R4	Submit resilience assessment synthesis fact sheet for USGS peer review	30-Sep-2021	30-Sep-2023		Delayed due to change in priorities	Bouska
2022R2	Submit manuscript that investigates associations between general and specified resilience for peer review publication	30-Sep-2022	30-Sep-2023		Changed from manuscript that investigates associations between general and specified resilience in FY21	Bouska

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
Landscape Pattern Research and Application						
2023LP1	Draft Report: 2020 Land Cover Change	30-Sep-2023				Rohweder and De Jager
2023LP2	Data Analysis: Thresholds analysis of Reed canary grass habitat suitability.	30-Sep-2023				Delaney and Rohweder
2023LP3	Draft Report: Thresholds analysis of Reed canary grass habitat suitability	30-Sep-2023				Delaney, De Jager, Van Appledorn, Bouska, Rohweder
2023 LP4	Data Analysis: Detecting decadal changes in RCG dominance in wet meadows	30-Sep-2023				Delaney, De Jager, Van Appledorn, Bouska, Rohweder
2023LP5	Map Set: UMRS forest communities	30-Sep-2023				Rohweder and De Jager
2023LP6	Map Set: Aquatic Areas	30-Sep-2023				Rusher, Rohweder, De Jager
On-Going						
Manuscript: Review of Landscape Ecology on the UMR 2016L3; in draft						
Intended for distribution						
Manuscript: Delaney, J.T., Van Appledorn, M., De Jager, N.R., Bouska, K.L., Rohweder, J.J. In Prep. Predicting *Phalaris arundinacea* (reed canarygrass) invasion in forest understories of the Upper Mississippi River floodplain. 2022LP3						

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
Eco-hydrologic Research						
2023EH1	Draft report of backwater sedimentation patterns through time to support vulnerability modeling effort	30-Sep-2023				Van Appledorn, Rohweder, DeJager, Kalas
2023EH2	Draft manuscript of reed canary grass, wood nettle, and silver maple seedling distributions and persistence in the UMR floodplain across environmental gradients	30-Sep-2023				Van Appledorn, Kirsch
On-Going						
2020EH02	Submit manuscript of temporal patterns in UMRS inundation regimes for peer review	30-Sep-2021	30-Sep-2023		Delayed due to change in priorities	Van Appledorn, De Jager, Rohweder
2021EH01	Draft manuscript of temporal and spatial trends of large wood in the UMRS and potential eco-hydrologic drivers	30-Sep-2021	30-Sep-2023		Delayed due to change in priorities	Van Appledorn, Jankowski
2021EH02	Draft manuscript of UMRS floodplain forest classification	30-Sep-2021	30-Sep-2023		Delayed due to change in priorities	Van Appledorn, De Jager
Intended for distribution						
Development of UMRS inundation model query tool; Van Appledorn, Fox, Rohweder, De Jager; 2019EH03						
Manuscript: Modeling and mapping inundation regimes for ecological and management applications: a case study of the Upper Mississippi River floodplain, USA; Van Appledorn, De Jager, Rohweder, Jason. (In revision with J Hydrology; IP-102710)						

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
Acquisition and Interpretation of Imagery for Production of 2020 UMRS Land Cover/Land Use Data and Pool-Based Orthomosaics						
2023LCU3	Image processing, stereo model development, orthorectification, pool-based mosaicking, image interpretation, automation, QA/QC, and serving of 2020 LCU datasets for Pools 1-3, 7, 11, and 50% of Pool 10, the St. Croix and lower Minnesota Rivers, and the Alton Pool of the Illinois River	30-Sep-2023				Dieck, Strassman
Aquatic Vegetation, Fisheries, and Water Quality Research, Statistical Evaluation						
Intended for Distribution						
Manuscript: Annual summer submersed macrophyte standing stocks estimated from long-term monitoring data in the Upper Mississippi River. (Completed; 2020A8; https://doi.org/10.3996/JFWM-21-063)						
On-Going						
Manuscript: Evidence of functionally defined non-random fish community responses over 25 years in a large river system (Ickes; 2019B13 replacing 2015B17 and 2016B17; Resubmitted to Hydrobiologia, IP-118040)						
Manuscript: A synthesis on river floodplain connectivity and lateral fish passage in the Upper Mississippi River, (Ickes; Submitted River Research and Applications, IP-123678)						
Statistical Evaluation						
Intended for distribution						
Manuscript: Inferring decreases in among-backwater heterogeneity in large rivers using among-backwater variation in limnological variables (2010E1; IP-027392; Gray; in journal review)						
Manuscript: How well do trends in LTRM percent frequency of occurrence SAV statistics track trends in true occurrence? (2016E2; IP-123221; Gray; in journal review)						
Manuscript: Model selection for ecological community data using tree shrinkage priors; Gray, Hefley, Zhang, Bouska; (2017FA2; IP-111931; in revision with Ecological Applications; https://arxiv.org/abs/2005.14303)						
Pool 12 Overwintering HREP Adaptive Management Fisheries Response Monitoring						
2023P13d	Age determination of bluegills	1-Feb-2023		1-Feb-2023		Kueter
2023P13e	In-house project databases updated	31-Mar-2023		31-Mar-2023		Kueter
2023P13f	Made available to program partners via Iowa Fish Mgmt. State report	30-Jun-2023				Kueter
Pool 4 - Peterson Lake HREP Water Quality Monitoring – Pre and Post-Adaptive Management Evaluation						
2022PL1	Summary letter: Describing 2022 monitoring and future work	30-Dec-2022				Burdis, Lund

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
FY18 Funded Science in Support of Restoration and Management Proposals						
Conceptual Model and Hierarchical Classification of Hydrogeomorphic Settings in the UMRS						
2019CM6	Submit Final LTRM Completion report on hydrogeomorphic conceptual model and hierarchical classification system	30-Jun-2020	30-Dec-2022			Fitzpatrick, Hendrickson, Sawyer, Strange
Water Exchange Rates and Change in UMRS Channels and Backwaters, 1980 to Present						
2019WE4	Submit Final LTRM Completion Report	30-Mar-2020	30-Dec-2023			Hendrickson
Intrinsic and extrinsic regulation of water clarity over a 950-km longitudinal gradient of the UMRS						
2019IE3	Submit Draft manuscript	30-Mar-2020	30-Sep-23	PIs determined that to move forward biomass information as needed. Will continue work once biomass model complete. Original Lead author (Drake) resigned from WDNR. Update 5/5/23: Currently undergoing final co-author review. Update 6.22.23--submitted to Ecosystems		Carhart and others
Systemic analysis of hydrogeomorphic influences on native freshwater mussels						
2019FM9	Final LTRM completion report (changed to manuscript)	30-Jan-2023	23-Dec-2023	the lead PI took a different job in Sep 2022 without completing the MS		Teresa Newton
Using dendrochronology to understand historical forest growth, stand development, and gap dynamics						
2022DD1	Draft manuscript: Floodplain forest structure and the recent decline of Carya illinoinensis (Wangenh.) K. Koch (northern pecan); Part 2	30-May-2022	TBD			Grant Harley (U Idaho), Ben Van der Myde (USACE contact)
Forest canopy gap dynamics: quantifying forest gaps and understanding gap – level forest regeneration						
2019FG5	Draft Manuscript: Forest canopy gap dynamics: quantifying forest gaps and understanding gap - level forest regeneration in Upper Mississippi River floodplain forests	30-Sep-20	30-Sep-23			Guyon, Thomsen, Meier, Strassman

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
Investigating vital rate drivers of UMRS fishes to support management and restoration						
2019VR8	Data set complete (data delivered to Ben Schlifer, physical structures delivered to BRWFS)	30-Sep-2021	31-Dec-23	Mean length at age across all species, years, and field station complete. However, not applied to all fishes yet. Some species have been completed and shared. We have refined code to accomplish this fully now. Catch curves, measures of mortality, recruitment and growth expected to be complete for rest of species by end of year.		Quinton Phelps
On-Going						
2019VR10	Submit draft manuscript (Drivers of vital rates)	31-Dec-2021	30-Sep-23			Quinton Phelps, Kristen Bouska
2019VR11	Submit draft manuscript (Microchemistry)	31-Dec-2021	31-Dec-22	1/15/2023	Delayed by having to make several repairs to mass spectrometer; instrument down-time slowed our progress. In June completed analysis of otolith samples from all LTRM fish to be used in the project. The remaining steps data analysis and writing.	Greg Whitledge
Intended for distribution						
Manuscript: vital rates of Channel Catfish, led by Colby Gainer (MS student) (in review with the North American Journal of Fisheries Management; 2019VR9; Bouska, IP-121915)						
FY19 Funded Science in Support of Restoration and Management						
Reforesting UMRS forest canopy openings occupied by invasive species						
2019ref3	Draft LTRM Completion	30-Apr-2021	30-Jun-23			Guyon and Cosgriff
2019ref4	Final LTRM Completion	30-Sep-2021	30-Jun-23			Guyon and Cosgriff

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
A year of zooplankton community data from the habitats and pools of the UMR						
2019zoo2	Draft LTRM Completion report on utility of zooplankton community monitoring for HREP assessment	30-Dec-2020	22-Dec-2023		Sample collection delayed because of Covid-19 state protocols; zooplankton ID delayed; Fulgoni took new position	Sobotka
2019zoo3	Final LTRM Completion report on utility of zooplankton community monitoring for HREP assessment	30-Jun-2021	30-Jun-2023			Sobotka
2019zoo4	Draft LTRM Completion report on detailing differences between pools and habitats. Report will also investigate the potential investigate the potential impacts of Asian carp on the zooplankton community.	30-Dec-2020	22-Dec-2023			Sobotka
2019zoo5	Final LTRM Completion report on on detailing differences between pools and habitats. Report will also investigate the potential investigate the potential impacts of Asian carp on the zooplankton community.	30-Jun-2021	30-Jun-2023			Sobotka
FY19 Funded Illinois Waterway 2020 Lock Closure						
Pre- and Post-Maintenance Aerial Imagery for Illinois River's Alton through Brandon Lock and Dams, 2019-2021.						
2023IWW	Final LTRM Completion Report (2022IWW)	30-Apr-2023		1-Dec-2022		Strassman
Fish Community Response to the 2020 Illinois Waterway Lock Closure						
2022FSH1	Draft Manuscript: Fisheries and WQ	31-Dec-22	30-Sep-23		Data analysis was more complicated and time intensive than anticipated.	Lamer

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
FY20 Funded Science in Support of Restoration and Management						
Mapping Potential Sensitivity to Hydrogeomorphic Change in the UMRS Riverscape and Development of Supporting GIS Database and Query Tool						
2021HG6	Submit draft LTRM Completion report on hydrogeomorphic change GIS database and query system	31-Dec-2021	30-Sep-2022	07-Oct-2022		Vaughan, Strange, Fitzpatrick, Van Appledorn, USACE core team
2021HG7	Submit Final LTRM Completion report on hydrogeomorphic change GIS database and query tool.	30-Mar-2022	30-Jun-2023		Update 5/5/23: Reconciling peer review comments	Vaughan, Strange, Fitzpatrick, Van Appledorn, USACE core team
Improving our understanding of historic, contemporary, and future UMRS hydrology by improving workflows, reducing redundancies, and setting a blueprint for modelling potential future						
2021HH1	Historic and Contemporary Hydrologic Database Release and Documentation	30-Sep-2021	31-Jul-2023	Delayed due to issues of data acquisition from USACE; expected submission of data and metadata to USGS Fundamental Science Practices 31-Dec-2022		M. Van Appledorn, L. Sawyer
2021HH2	Draft LTRM Completion Report: document database and documentation development steps, database capabilities, and quantitative summaries of the hydrologic regime through time.	30-Dec-2021	31-Jul-2023	Dependent on data acquisition from USACE		M. Van Appledorn, L. Sawyer
2021HH3	Final LTRM Completion Report: document database and documentation development steps, database capabilities, and quantitative summaries of the hydrologic regime through time	31-Mar-2022	30-Sep-2023			M. Van Appledorn, L. Sawyer
2021HH6	Final LTRM Completion Report (Scenarios): This report will serve as the blueprint for modeling future hydrology to be undertaken with future funding opportunities.	30-Jun-2022	30-March-2023	29-Mar-23		M. Van Appledorn, L. Sawyer

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
Understanding physical and ecological differences among side channels of the Upper Mississippi River System						
2021SC4	Final report on UMRR management implications submitted for USGS review	30-Sep-2022	30-Mar-2023		Delayed with McCain moving to new position	Sobotka & McCain
2021SC5	Manuscript on benthic invertebrate associations with side channel characteristics submitted for USGS and peer review	30-May-2023				Sobotka & Vander Vorste
Refining our Upper Mississippi River's ecosystem states framework						
Intended for Distribution						
Manuscript: Integrating machine learning and ecosystem state concepts: Modeling submersed plant resilience and vulnerability to ecosystem state transitions. (2021SS10; in USGS review, Delaney and Larson, IP-141445)						
Tool: Submersed aquatic vegetation vulnerability evaluation application (SAVVEA); (Completed, 2021SS10; Delaney and Larson, IP-142969)						
Augmenting the UMRR fish vital rates project with greater species representation for genetics and otolith microchemistry						
2021VR3	Submit draft manuscript (genetics)	31-Dec-2022				Davis, Tan, Lamer
2021VR4	Submit draft manuscript (genetics - mimic/channel)	31-Dec-2022				Davis, Tan, Lamer
2021VR5	Submit draft manuscript (constructing management units)	31-Dec-2022				Bartels, Bouska, Davis, Lamer, Larson, Phelps, Tan, Whitledge
Functional UMRS fish community responses and their environmental associations in the face of a changing river: hydrologic variability, biological invasions, and habitat						
2021FF2	Draft manuscript: "Has large scale ecosystem rehabilitation altered functional fish community expressions in the Upper Mississippi River System?"	30-Sep-2021	30-Mar-2023		Delayed with other priorities such as S&T Report writing and Gatto moving to other agency	Ickes and Gatto
2021FF3	Draft Manuscript: "Why aren't bigheaded carps (*Hypophthalmichthys* sp.) everywhere in the Upper Mississippi River System?"	30-Sep-2021	30-Mar-2023			Ickes and Gatto

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
Understanding landscape-scale patterns in winter conditions in the Upper Mississippi River System						
2021WL1	System wide spatial layers of habitat conditions	30-Sep-2022	30-Dec-2023		Lead author on family leave and in a new job	Mooney, Dugan, Magee
2021WL2	Draft manuscript: Landscape scale controls on overwintering habitat in a large river	30-Sep-2022	30-Dec-2023		Lead author on family leave and in a new job	Mooney, Dugan, Jankowski, Magee
2021WL3	Draft manuscript: Response of oxygen dynamics to ice and snow phenology in backwater lakes	30-Sep-2023				Jankowski, Dugan, Burdis, Kalas, Kueter
2021WL4	Draft Manuscript: Patterns in sediment characteristics and oxygen demand across a winter riverine landscape	30-Sep-2023				Perner, Kreiling, Jankowski, Giblin
Forest Response to Multiple Large-Scale Inundation Events						
2021FR3	Technical Report	1-Jun-2022	30-Sep-23		Delayed due to staffing shortages, hiring of new staff at NGREEC	Cosgriff, Guyon, De Jager
FY22 Funded Science in Support of Restoration and Management						
Assessing Forest Development Processes and Pathways in Floodplain Forests along the Upper Mississippi River using Dendrochronology						
2023dendro1	Finalize the scanning of 1,100 tree cores uploaded into DendroElevator	30-Nov-2023				Windmuller-Campione
2023dendro2	Annual summary	31-Dec-2023				Windmuller-Campione and Van Appledorn
2023dendro3	Coordination and scheduling for three to five virtual meetings; Meetings will address current objectives outlined in Activity 3 and future directions	1 March – 31 May 2024				Windmuller-Campione and Van Appledorn
2023dendro4	Draft manuscript – Age data of floodplain forests of the Upper Mississippi River	30-May-2024				Windmuller-Campione and Van Appledorn
2023dendro5	Draft Manuscript – Growth dynamics of silver maple of the Upper Mississippi River	30-Sep-2024				Windmuller-Campione and Van Appledorn

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
2023dendro6	Final report writing, edits on manuscript, and completion of all data storage	30-Nov-2024				Windmuller-Campione and Van Appledorn
Evaluating the LOCA-VIC-mizuRoute hydrology data products for scientific and management applications in the UMRS						
2023Hydro1	LOCA-VIC-mizuRoute data product evaluation	31 June 2023				Sawyer and Van Appledorn
2023Hydro2	LTRM project management team update on evaluation results	31 June 2023				Sawyer and Van Appledorn
2023Hydro3	ECB 2018-14 compliance completion	30-Sep-2023				Sawyer and Van Appledorn
2023Hydro4	Annual update: Year 1	31-Dec-2023				Sawyer and Van Appledorn
2023Hydro5	UMRS projected hydrology data and documentation release	30-Sep-2024				Sawyer and Van Appledorn
2023Hydro6	UMRR webinar on UMRS projected hydrology data release	31-Dec-2024				Sawyer and Van Appledorn
2023Hydro7	Virtual workshop or LTRM project team update for red pathway outcomes	31-Mar-2024				Sawyer and Van Appledorn
2023Hydro8	Draft LTRM completion report	30-Sep-2024				Sawyer and Van Appledorn
2023Hydro9	Final LTRM completion report	30-Dec-2025				Sawyer and Van Appledorn
Putting LTRM's long-term phytoplankton archive to work to understand ecosystem transitions and improve methodological approaches						
2023Phyto1	System-wide phytoplankton community dataset	30-Sep-2023				Jankowski
2023Phyto2	Draft Manuscript: Phytoplankton community composition over the past 20 years in the Upper Mississippi River: distribution of harmful taxa and relationships with environmental trends	30-May-2024				Jankowski and others
2023Phyto3	Draft Manuscript: Relating phytoplankton communities to distinct vegetation recovery trajectories in Pools 4 and 13	30-May-2024				Jankowski and others

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
2023Phyto4	Report: Assessment of FloCam for use on archived and fresh phytoplankton samples for LTRM sampling	30-Mar-2024				Larson, James
2023Phyto5	Draft Manuscript: Comparison of trends captured by microscopy and FlowCam phytoplankton community analysis	30-May-2024				Larson, James
Assessing long term changes and spatial patterns in macroinvertebrates through standardized long-term monitoring						
2023inv1	Field collection of macroinvertebrates	14-Jun-2023				State field station staff
2023inv2	Laboratory identification of macroinvertebrates	30-Aug-2023				TBD
2023inv3	Screening level mayfly tissue analysis	30-Sep-2023				Giblin
2023inv4	Annual summary	31-Dec-2023				Lamer
2023inv5	Complete data entry and QA/QC of 2023 data; 1250 observations.					
	a. Data entry completed and submission of data to USGS (Includes contaminant data)	31-Jan-2024				State field station staff, Giblin
	b. Data loaded on level 2 browsers; QA/QC scripts run and data corrections sent to Field Stations	15-Feb-2024				Lamer, Schlifer
	c. Field Station and contaminant QA/QC with corrections to USGS	15-Mar-2024				State field station staff, Giblin
	d. Corrections made and data moved to public Web Browser	30-Mar-2024				Lamer, Schlifer
2023inv6	Field collection of macroinvertebrates	14-Jun-2024				State field station staff
2023inv7	Laboratory identification of macroinvertebrates	30-Aug-2024				TBD
2023inv8	Screening level mayfly tissue analysis	30-Sep-2024				Giblin
2023inv9	Annual summary	31-Dec-2024				Lamer

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
2023inv10						
	a. Data entry completed and submission of data to USGS (Includes contaminant data)	31-Jan-2025				State field station staff, Giblin
	b. Data loaded on level 2 browsers; QA/QC scripts run and data corrections sent to Field Stations	15-Feb-2025				Lamer, Schlifer
	c. Field Station and contaminant QA/QC with corrections to USGS	15-Mar-2025				State field station staff, Giblin
	d. Corrections made and data moved to public Web Browser	30-Mar-2025				Lamer, Schlifer
2023inv11	Draft LTRM Completion report or manuscript on contaminant sampling	30-Sep-2025				Giblin
2023inv12	Field collection of macroinvertebrates	14-Jun-2025				State field station staff
2023inv13	Laboratory identification of macroinvertebrates	30-Aug-2025				TBD
2023inv14	Annual summary	31-Dec-2025				Lamer
2023inv15						
	a. Data entry completed and submission of data to USGS (Includes contaminant data)	31-Jan-2026				State field station staff, Giblin
	b. Data loaded on level 2 browsers; QA/QC scripts run and data corrections sent to Field Stations	15-Feb-2026				Lamer, Schlifer
	c. Field Station and contaminant QA/QC with corrections to USGS	15-Mar-2026				State field station staff, Giblin
	d. Corrections made and data moved to public Web Browser	30-Mar-2026				Lamer, Schlifer
2023inv16	Draft LTRM Completion report or manuscript on macroinvertebrate sampling, trends, etc.	30-Sep-2026				Lamer

UMRR Science in Support of Restoration and Management
FY2014 and FY2015 Scopes of Work
August 2023 Status

Tracking number	Milestone	Original Target Date	Modified Target Date	Date Completed	Comments	Lead
Plankton community dynamics in Lake Pepin						
2015LPP1	Phytoplankton processing; species composition, biovolume	30-Dec-15		22-Oct-15		Burdis
2015LPP2	draft manuscript: Plankton community dynamics in Lake Pepin	30-Sep-16	31-Dec-23		Revisions are in progress following reviews	Burdis, Manier
Predictive Aquative Cover Type Model - Phase 2						
2015AQ1	Develop 2-D hydraulic model of upper Pool 4	30-Sep-15		30-Sep-15		Libbey (MVP H&H)
2015AQ2	Apply model to Pool 4 and resolve discrepancies	31-Dec-15	31-Mar-16	31-Mar-16		Yin, Rogala
2015AQ3	Detailed summary of work for Phases I & II	31-Dec-15		NA	Work terminated with resignation of Dr. Yin. Danelle Larson will re-evaluate vegetation modeling in a future time frame	Sauer (for Yin), Rogala, Ingvalson

FY2023 UMRR Science Proposal

The following is a proposal that was initiated with a brainstorm discussion at the 2022 UMRR Science Meeting. Because this proposal is tied to an HREP in the feasibility planning stage, the development of the proposal was delayed until after a tentatively selected plan was identified. An in-person meeting among project collaborators occurred mid-January 2023 with a similar format and purpose of a UMRR Science Meeting. A presentation describing the proposal was shared with the A-Team at the April 19, 2023 meeting after which the proposal was sent out for comment. Response to comments and revisions to the proposal were shared back with the A-Team on June 27, 2023.

The final proposal will be discussed at the July 24, 2023 A-Team meeting after which the LTRM Management Team and A-Team chair will determine a final recommendation for the UMRR Coordinating Committee's consideration.

Upper Mississippi River Restoration (UMRR) Science in Support of Restoration and Management Proposal

Title of Project: Lower Pool 13 HARP[1]: Understanding wind dynamics and contributing factors of water clarity, aquatic vegetation, and native freshwater mussels

Previous LTRM project:
This project complements and builds upon two proposed UMRR Science in Support of Restoration projects – *Filling in the gaps with FLAMe: Spatial patterns in water quality and cyanobacteria across connectivity gradients and flow regimes in the Lower Impounded Reach of the Upper Mississippi River* and *Substrate stability as an indicator of abiotic habitat for the UMR benthic community*.

Name of Principal Investigator(s):
Kristen Bouska, USGS UMESC, 608-781-6344, kbouska@usgs.gov; role: overall project coordination and management, co-lead on water clarity objectives, mentor new hire, co-develop mussel models, draft final products.
Teresa Newton, USGS UMESC, 608-781-6217, tnewton@usgs.gov; role: oversight on mussel objective, synthesize mussel data, co-develop ecological models assessing relationships between substrate stability and mussel density, species richness, and species associations, draft data summaries, completion report, and journal article.
Jesse McNinch, USACE Detroit District, Jesse.E.Mcninch@usace.army.mil; role: lead PI on radar wave monitoring objective, deployment of X-band radar infrastructure, processing of radar signals, mentor Rock Island District staff on methods, and draft completion report.
Kathi Jo Jankowski, USGS UMESC, 608-781-6242, kjankowski@usgs.gov; role: co-lead on water clarity objectives, water quality expertise for study design and analysis, mentor new hire, assist with drafting final products.
Danelle Larson, USGS UMESC, 608-783-6350, dmlarson@usgs.gov; role: aquatic vegetation expertise for study design; oversee LTRM vegetation sampling; co-analyze plant data and disseminate findings at conferences and reports

Collaborators (Who else is involved in completing the project):
Dave Bierman, IA DNR, 563-872-5495, dave.bierman@dnr.iowa.gov: coordination with Bellevue field station
Elizabeth Bruns, Steve Gustafson, Dillan Laaker, Kara Mitvalsky, USACE MVR; role: coordination with Lower Pool 13 HREP construction and adaptive management
Seth Fopma, IA DNR, 563-590-1347, seth.fopma@dnr.iowa.gov; role: conduct vegetation sampling; co-analyze plant data
Jeff Houser, USGS UMESC, 608-781-6262, jhouser@usgs.gov; role: project planning; project planning, contribute to writing, editing and review of reports and publications, coordination with LTRM management team and Lower Pool 13 PDT
Ashley Johnson, IA DNR, 563-872-5495, ashley.johnson@dnr.iowa.gov; role: assist with sensor deployment and maintenance; assist with FLAMe collections
Luke Loken, USGS UMWSC, 608-821-3801 , lloken@usgs.gov; role: FLAMe expertise and assistance

[1] HREP-associated research project

Rachel Malburg, USACE Detroit District, rachel.m.malburg@usace.army.mil; role: assist with radar wave monitoring objective

Anton Stork, USACE MVR, 309-794-5470, Anton.J.Stork@usace.army.mil; role: generate hydraulic model output for relative substrate stability calculations

Angus Vaughan, USGS, UMESC, 608-781-6152, aavaughan@usgs.gov; role: generate values for complex hydraulics needed to estimate relative substrate stability, co-author journal articles.

Stephen Winter, USFWS, 507-494-6214, stephen_winter@fws.gov; role: coordination with USFWS refuge

Introduction/Background:

What's the issue or question? Prevalence of submersed aquatic vegetation, especially wild celery (*Vallisneria americana*), increased from 1998 to 2008 but has since declined in Pool 13 (Larson et al. 2022). Long Term Resource Monitoring (LTRM) indicates that water clarity in Pool 13 has exceeded criteria established for sustaining submersed aquatic vegetation in 54% of years since 1994 (Jankowski 2022). Water clarity in Spring is particularly important for survival and growth of wild celery winterbuds (Doyle and Smart 2001). In the impounded portion of Pool 13, LTRM indicates water clarity during Spring exceeds the criteria in 79% of years since 1994. Both upstream sources of suspended materials and local sediment resuspension likely contribute to reduced water clarity, but it is uncertain to what degree each of these sources, as well as other aspects (for example, wake-producing vessel traffic, depth, substrate composition, or distribution of vegetation) contribute. Concern regarding further loss of wild celery prompted natural resource managers to propose a Habitat Rehabilitation and Enhancement Project (HREP) to improve conditions for submersed aquatic vegetation. Secondarily to aquatic vegetation, resource managers recognized the opportunity to diversify flow and substrate in the project area to benefit mussels. The research proposed herein seeks to advance our understanding of how abiotic factors (i.e., velocity, waves, water clarity, substrate composition and stability) influence water clarity, the distribution and density of aquatic vegetation, and native freshwater mussels that will inform future HREP selection, planning and design.

What do we already know about it? Of particular concern in Lower Pool 13 is the loss of wild celery, a distinct vegetation type that responds differently to the environment compared to other submersed species (Larson et al. 2023). The presence, growth, and biomass of wild celery responds to water clarity (Donnermeyer and Smart 1985, Kimber 1995, Kreiling et al. 2007), nutrients and substrate type (Larson et al. 2023); however, neither 'thresholds' nor quantitative targets for restoring wild celery with HREP features are known. Further, it is well recognized that when submersed aquatic vegetation is present at certain densities, it can slow water velocities and reduce wave energy in ways that facilitate the persistence of vegetation and increase seasonal water clarity; however, these feedbacks can weaken when vegetation declines to a point at which it can be difficult for vegetation to re-establish (Moore 2004; Gruber and Kemp 2010).

Pool 13 contains a diverse, dense, and actively recruiting population of native freshwater mussels (hereafter mussels) (Newton unpublished data). Models of physical habitat have consistently shown that substrate stability explains a substantial amount of variation in the presence, density, and survival of mussels in the UMR (Zigler et al. 2008, Newton et al. 2020). Morales et al. (2006) developed a dimensionless parameter to estimate substrate stability (relative substrate stability, RSS) that combined shear force and substrate type. When applied in the UMR, specifically in Pool 16, areas that remained stable (RSS <1) during medium (2039 m^3/s) to high (3965 m^3/s) flows were spatially coincident with dense and diverse mussel beds (Morales et al. 2006). Research in Texas rivers generated similar results whereby low values of RSS during high flow conditions were associated with high mussel density and species richness (hereafter, richness) (Randklev et al. 2019).

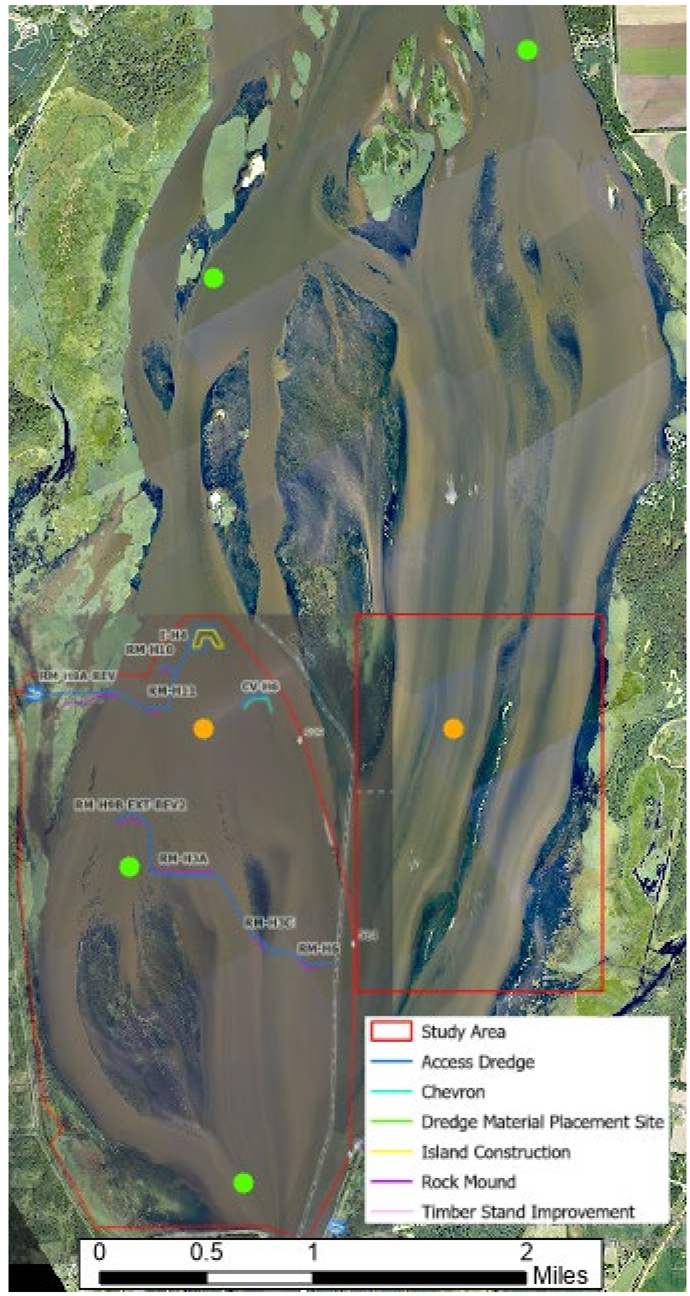
How will the proposed work improve our understanding of the UMRS?
The proposed work will address the following objectives:
(1) Pilot a radar wave monitoring system to measure existing (pre-project) wave conditions in Lower Pool 13;
(2) Evaluate relationships between wind, waves, and turbidity, and assess the relative contributions of upstream sources and local resuspension on turbidity in the project area;
(3) Assess spatial patterns and quantify relationships among wild celery, turbidity, and wave dynamics through additional pre-project water clarity and aquatic vegetation field collections;
(4) Estimate substrate stability and population size, density, and species richness of mussels pre-project and determine if areas with stable substrates (RSS<1) have more robust mussel assemblages relative to areas with unstable substrates (RSS>1).

Our objective to pilot a technique to spatially characterize wave dynamics has utility across the UMRS for understanding how these abiotic factors influence water clarity and for measuring how HREP measures affect wave dynamics. Methods to parse out the role of background turbidity (upstream input) from that of resuspended sediments on local turbidity (Objective 2) can be applied in other areas where contributions to local environments is uncertain. More generally, understanding the abiotic factors (e.g., turbidity, velocity, substrate stability) that support dense and diverse biological resources (Objectives 3 and 4) can inform future HREP selection and design. The proposed research will provide a baseline of pre-construction physical conditions, biological resources, and their interactions in the HREP project area. Post-project monitoring is not included in this proposal due to extensive HREP planning and construction timelines. However, our sampling was designed to answer specific questions (outlined herein) in the short-term and to provide baseline, pre-project information for post-construction assessments of the effects of specific project features (e.g., rock mounds, islands, chevrons) on wave dynamics, velocity, substrate, water clarity, aquatic vegetation, and mussels. All pre-project data will be available for use in HREP monitoring and adaptive management, which will include monitoring of velocity and aquatic vegetation post-construction.

Relevance of research to UMRR:
How will the results inform river restoration and management? The information generated from this research will be useful on multiple fronts. Radar wave monitoring could be a cost-effective and spatially-explicit approach to characterize wave dynamics and generally assess how HREP features influence wave energy. For this HREP, several features within the tentatively selected plan were developed to minimize resuspension in areas identified by the project development team. Wave monitoring across the project area may be useful to assess if there are additional areas vulnerable to resuspension. Furthermore, a clearer understanding of wave energy patterns and the contributions to local turbidity via sediment resuspension will be informative for understanding whether additional features may be needed in the project area and the relative contributions of sediment resuspension and upstream sources of suspended sediment to turbidity in the project area . We currently do not have a habitat suitability model for wild celery, but supplementing the annual LTRM stratified random sampling with additional aquatic plant and abiotic data (such as wave dynamics) can lead to greater understanding of the current constraints and restoration potential for this key aquatic plant species.

Mussels are a priority resource of concern for the Upper Mississippi River National Fish and Wildlife Refuge (USFWS 2019) and several features within the Lower Pool 13 HREP are expected to be beneficial to mussels; thus, an improved understanding of linkages between the effects of HREP measures on substrate stability and mussel assemblages could provide managers a useful metric to quantify mussel habitat and to prioritize mussel relocation sites and other conservation measures to enhance survival and recovery.

How will the proposed work contribute to, or improve, the selection or design of HREPs? HREPs represent important learning opportunities because they manipulate fundamental ecosystem drivers such as depth, connectivity, wave dynamics, current velocity, and substrate characteristics. Many of these abiotic conditions influence substrate stability and potential for sediment resuspension. Resource managers are often challenged with designing HREPs to achieve a wide range of goals and objectives, while utilizing the best available science to avoid and minimize adverse effects. Improved assessments of abiotic-biotic relationships can be beneficial for HREP planning. For example, if substrate stability is strongly associated with mussel assemblages, then these data could be used to evaluate which project features or project alternatives might enhance substrate stability and benefit mussels. Furthermore, observing the degree to which HREP measures reduce sediment resuspension could inform the design of such measures in future HREP projects. We will also create habitat suitability models of wild celery to help resource managers identify current constraints, thresholds as restoration targets, as well as the places of greatest restoration potential. These models will build off of previous work (Carhart et al. 2021; Delaney and Larson, 2023).



Linkages to 2022 Focal Areas. The proposed work is directly related to the UMRR 2022 Theme 2 “Understanding how geomorphology, hydrology, and biotic interactions affect the distribution and abundance of biota in the river and on the floodplain”. Although this proposal is focused on pre-construction monitoring, there is intention to develop future proposals to use the data sets collected herein to directly relate to Focal area 2.9 – “HREP’s as learning opportunities: Lower Pool 13.”

Methods:

Study area:

Our study area includes the defined Lower Pool 13 HREP boundary (approximately 2200 acres), a control area directly east of the project boundary, and two locations directly upstream of the project and control areas where turbidity sensors will be deployed (Figure 1).

Figure 1. Red polygons outline the project area (left) and approximate area of the control area (right) within Lower Pool 13. Approximate locations of turbidity sensors are identifed with the green and orange circles. Orange circles indicate where wave sensors would be coupled with turbidty sensors. The Bulger's Hollow boat landing is located in the northwestern corner of the project area, represented by the blue boat landing icon.

Objective 1 – Wave monitoring pilot

To assess spatial variation in wave characteristics of the project area, we propose to pilot a radar wave monitoring system. Radar wave monitoring systems have been primarily developed for coastal applications (McNinch and Humberston 2019), but were recently piloted successfully in the St. Clair River in Michigan. In collaboration with the USACE Detroit District, we propose to deploy x-band radar infrastructure near the Bulger's Hollow boat landing during the summers of 2024 and 2025. Existing analytical programs within the MATLAB (MATrix LABoratory) computing environment have been developed and will be used to process radar signals and estimate wave energy attributes and wave shadowing. Wave attributes derived from radar signals will be related to observed wave characteristics at stationary wave sensor locations (see objective 2). Methods, analysis, and results of the wave monitoring pilot will be integrated into manuscript #3 described in the products section below.

Objective 2 – Contributions to water clarity

To meet this objective, we propose to deploy an array of six multiparameter sondes outfitted with continuous turbidity and chlorophyll sensors (YSI EXO3 sondes) upstream of and throughout the project area as well as a control area located adjacent to the project area on the east side of the navigation channel (Figure 1). Additionally, there is a USGS gage (#05420400) located directly downstream of Lock and Dam 13 outfitted with a turbidity sensor. Sensors will be deployed at representative water depths for vegetation growth to monitor turbidity throughout the growing season (May – October) of 2024 and 2025. Sensors will be visited regularly for maintenance. At one location each within the project and control areas, the turbidity sensor will be paired with a continuous wave sensor (RBRsolo|wave 16). At the location in the project area where turbidity and waves will be measured with instrumentation, an acoustic doppler velocity meter (Nortek Vector, hereafter ADV) will also be deployed at to measure near-bed velocity.

To understand the relationships between wind and waves, wind data (wind speed, gust, and direction) from two nearby weather stations (Lock and Dam 13 and Tri-Township Airport) will be paired with concurrent wave data (wave height and period) processed from stationary wave sensors. Nonlinear models will be used to evaluate wind direction-specific relationships between wind speed and wave characteristics. Spatial and temporal patterns in turbidity will be described and compared at each location in regard to frequency and duration of high turbidity events, variability at different temporal scales, and correspondence across locations.

Through the collection of high-resolution field data, an assessment of the contributions of upstream sources and resuspension to local turbidity will be estimated using methods similar to Valipour et al. (2017) and Waite et al. (in review). We will pair high-frequency turbidity data with discharge and ADV measurements during events to help disentangle local vs upstream sources of turbidity. Because vessel traffic in this area can also generate substantial wave energy, and tend to produce different wave properties from wind waves (Hofmann et al. 2008), we propose to investigate whether we can discern vessel wave-induced resuspension from wind wave-induced resuspension through the use of the Automated Identification System that is used to track vessels. From the

ADV, we will quantify instantaneous maximum current velocities for each sampling interval and backscatter attributes will be used to estimate resuspension occurrences (Li et al. 2019; Fleit and Baranya 2021). Correlations between ADV estimates of resuspension and turbidity measurements will be assessed. Quantile plots of turbidity and maximum current velocity will be used to determine velocity thresholds for resuspension. We will also evaluate nonlinear relationships between turbidity and wave height characteristics for thresholds of wave height or period that may indicative of resuspension. These thresholds will be applied to the time series data to estimate the relative contribution of resuspension to high turbidity events during the period of study.

Objective 3 – Spatial correspondence among wild celery, turbidity, and waves

Fast Limnological Automated Methods for turbidity and chlorophyll: We propose to use the Fast Limnological Automated Methods (FLAMe) platform (under consideration for funding under separate FY23 UMRR Science Proposal) to survey both the project area and control area across a range of discharges for a total of six surveys encompassing the growing season of both 2024 and 2025. If conditions allow, a survey will be targeted for the early or late growing season prior to vegetative growth or after senescence each year. The FLAMe platform enables the development of spatially continuous measurements of turbidity and chlorophyll from which contrasts discharge conditions can be estimated. Additionally, turbidity can be spatially summarized across discharge conditions to estimate predominant turbidity patterns in the study area.

Sampling Aquatic Vegetation: To be able to detect differences in the frequency of occurrence of submersed aquatic vegetation in the project area, power analyses using existing LTRM data indicated a minimum of 175 sites would be needed in the pre-project phase (i.e., 60 sites annually). Three zones were identified in the study area to better understand spatial changes: 1) an upstream, currently non-vegetated zone with an expected increase in SAV frequency of occurrence of 20% (estimated from HREP feasibility study), 2) a currently vegetated zone with an expected increase in SAV prevalence of 20%, and 3) a downstream, currently non-vegetated zone where SAV frequency of occurrence is expected to increase by 10%. Sites will be randomly selected within each zone from an evenly spaced grid over the project area (Madsen 1999) and collections will follow LTRM aquatic vegetation sampling protocols with the addition of a velocity measurement at each site. Unsampled areas between the points will be spatially interpolated as 'surface maps.'

We will use this augmented vegetation sampling to quantify the relationships among wild celery, bathymetry (from topobathy), velocity, water clarity and chlorophyll (derived from FLAMe), and other pre-existing LTRM variables of interest, like substrate type. Further, if the piloted radar wave monitoring successfully characterizes wave dynamics, this data source may also be used to assess relationships with wild celery distributions. We will use all the newly acquired data to create a habitat suitability model for wild celery that can inform our understanding at multiple spatial scales (site-, HREP-, and pool wide-scales).

Objective 4 – Mussels and substrate stability

We propose to conduct systematic, quantitative sampling for mussels at ~300 sites across the HREP project area during the summer of 2024. These sites will be ~50 m apart in non-feature areas and ~10 m apart in the proposed footprint of each of the nine features where conditions are most likely to change post-construction. At each site, divers will place two 0.25 m^2 quadrat frames on the river bottom, excavate substrates to a depth of ~15 cm, and place material into a 6 mm mesh bag. Mussels will be identified to species, aged via external annuli, measured for shell length, and sexed (in species with external sexual dimorphism). Divers will estimate the percent substrate composition based on tactile methods. Resistance of the substrate surface will be measured at each site by pushing the tip of a pocket penetrometer into the substrate to a depth of 6 mm (Geist and Auerswald 2007). Divers will also obtain a sediment sample at each site with a dredge. In the laboratory, sediments will be processed for particle size (Plumb 1981); a needed component to estimate RSS. RSS is the ratio of the bed shear stress at a given flow (τ_0) to the critical shear stress at which substrate movement begins (τ_c): $\text{RSS} = {}^{\tau_0}/_{\tau_c}$. Estimates of τ_0 will be obtained from existing 2D hydrodynamic models; these models will be run at flow exceedance probabilities of 5, 50, and 95 to evaluate τ_0 (and hence RSS) across a range of flow conditions. Estimates of τ_c will be obtained from particle size analysis of site-specific sediment samples and information from the hydrodynamic model. Calculation of τ_c involves computing the particle Reynolds number (Re_*), which is a function of particle size and τ_0. Next, Re_* is used to estimate critical shear stress (Shields number, τ_c^*). For relatively uniform, unimodal particle size distributions, a single value of τ_c^* can be estimated (Shields 1936, Miller et al. 1997). If particle sizes are more complex, τ_c^* can be estimated for each component (Wilcock 1993, Wilcock and Kenworthy 2002). Finally, τ_c is calculated from τ_c^* from $\tau_c^* = \frac{\tau_c}{(\rho_p - \rho_w) g D}$, where ρ_p and ρ_w are the density of sediment and water, respectively, g is the gravitational acceleration, and D is a representative particle size of the sample (e.g., the median, D_{50}). Response variables at each site will include particle size distribution, RSS, substrate compaction, water depth, mussel species richness, and mussel density. We will use ecological models (e.g., generalized linear mixed effect models, non-metric multidimensional scaling) to regress mussel density and richness against RSS and to assess the effects of substrate movement on species associations. These analyses will provide baseline estimates of the robustness of the mussel assemblage in the Pool 13 HREP project area and will be used to derive pre-project linakges between mussels and RSS.

Data management procedures

All data generated in this study will be recorded in bound laboratory notebooks, electronic files, or kept in file folders on UMESC servers that are routinely backed up. An electronic study file will be created on the UMESC server in consultation with IT and data management personnel. Data will be proofed against original data for accuracy. Proofed data will promptly be shared through a USGS GitLab Repository where all PIs may access and use the data synthetically (e.g., plant data can be merged with turbidity and substrate data). Data analyses will be conducted by individual investigators and compiled into synthetic reports, with input from all investigators. Upon project completion, raw data, field notebooks, and electronic files will be stored in the UMESC archives. A Federal Geographic Data Committee compliant metadata file will be created as part of the online USGS documentation process for information products. Data and metadata will be approved for release following the USGS Fundamental Sciences Practices and made publicly available through USGS ScienceBase.

FLAMe data will be georeferenced and collected in real-time on a Campbell datalogger. Following each sampling campaign, raw data will be uploaded to a cloud directory and processed using the R program language and git repositories developed for other projects (https://github.com/lukeloken/SuperFlamer). This workflow includes several functions that provide initial QA/QC, compile data in consistent and machine-readable formats, and plots of timeseries and maps. Once data have been reviewed and approved, data will be stored as comma separated values (csv) and shapefiles for archival in USGS ScienceBase in a similar fashion to other FLAMe projects (Loken, Crawford, & Stanley, 2018; Loken, Crawford, Stanley, et al., 2018)

Special needs/considerations, if any: To ensure the onboarding of a new hire at UMESC ahead of the 2024 field season, we are requesting funding in FY23.

Expected milestones and products:

Outcomes of this project will include a minimum of four manuscripts on the topics of:

1. Wind, wave, turbidity interactions (estimated Spring 2026)
2. Contributions of resuspension and upstream delivery to local turbidity (estimated Summer 2026)
3. Spatial patterns and correspondence among wave dynamics, turbidity, and aquatic vegetation (estimated Spring 2026)
4. Linkages between native freshwater mussel assemblages and substrate stability (estimated Spring 2026)

Annual updates will be provided at the end of each fiscal year.

Timeline:

Objective 1 Tasks - ***Wave monitoring pilot***	**Date**	**Task Leads**
Conduct site visit to test radar coverage	Winter 2023/2024	McNinch, Malburg
Deploy radar system	Summer 2024	McNinch, Malburg
Wind and wave analysis (radar-measured)	Winter 2024	McNinch, Malburg
Redeployment to capture undersampled events	Summer 2025	McNinch, Malburg
Radar-measured wave analysis with other metrics	Winter 2025	McNinch, Malburg
Provide input to draft manuscript 3 (see below)	Spring 2026	McNinch, Malburg
Objective 2 Tasks - ***Contributions to water clarity***	**Date**	**Task Leads**
Acquire wave and turbidity sensors and ADV	Fall 2023	Bouska
Deploy and maintain sensor array	Summer 2024/2025	New hire, Bouska, Johnson
Wind, wave, and turbidity analyses	Spring 2026	New hire, Bouska
ADV processing	Fall 2024/Winter 2025	New hire
Turbidity contributions analyses	Fall 2024/Winter 2025	New hire, Bouska, Jankowski
Submit draft manuscript 1 - Wind, wave, turbidity interactions	Spring 2026	New hire, Bouska, Jankowski
Submit draft manuscript 2 - Contributions of resuspension and upstream delivery to local turbidity	Summer 2026	New hire, Bouska, Jankowski
Objective 3 Tasks - ***Spatial correspondence of wild celery, turbidity, and waves***	**Date**	**Task Leads**
Augmentation of LTRM Aquatic Vegetation sampling	Summer 2023/2025	Larson, Fopma
FLAMe sampling campaign	Summer 2024/2025	Jankowski, Loken, New hire
Processing of FLAMe data	Fall 2024/Winter 2025	New hire, Jankowski, Loken
Spatial analyses of FLAMe and vegetation data	Winter 2024/2025	New hire, Jankowski, Larson
Submit draft manuscript 3 - Spatial patterns and correspondence among wave dynamics, turbidity, and aquatic vegetation	Spring 2026	New hire, Jankowski, Loken, Larson
Objective 4 Tasks - ***Mussels and substrate stability***	**Date**	**Task Leads**
Hydraulic model outputs for existing conditions	Summer 2024	Stork
Mussel survey and sediment sampling	Summer/Fall 2024	Contract (Ecological Services)
Mussel population estimates	Winter 2025	Newton, statistician
Laboratory processing: particle size analyses	Fall 2024/Spring 2025	Newton, technician, new hire
Relative substrate stability analyses	Spring/Summer 2025	Vaughan, Newton

Ecological response model of mussels and relative substrate stability	Summer 2025	Bouska, Newton
Submit draft manuscript 4 - Linkages between native freshwater mussel assemblages and substrate stability	Spring 2026	Newton, Vaughan, Bouska

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Estimated Budget

Objective	Principal investigators	USGS	USACE	States	Total Estimated Budget
1 – Pilot a radar wave monitoring system to measure existing (pre-project) wave conditions in Lower Pool 13	Jesse McNinch, USACE Detroit District		$133,840		$133,840
2 – Evaluate relationships between wind, waves, and turbidity, and assess the relative contributions of upstream sources and local resuspension on turbidity in the project area	Kristen Bouska, USGS UMESC; Kathi Jo Jankowski, USGS UMESC	$354,877		$882	$355,759
3 - Assess spatial patterns and quantify relationships among wild celery, turbidity, and wave dynamics through additional pre-project water clarity and aquatic vegetation field collections	Kathi Jo Jankowski, USGS UMESC, Danelle Larson, USGS UMESC; Kristen Bouska, USGS UMESC	$189,077		$1,578	$190,655
4 - Estimate substrate stability and population size, density, and species richness of mussels pre-project and determine if areas with stable substrates (RSS<1) have more robust mussel assemblages relative to areas with unstable substrates (RSS>1)	Teresa Newton, USGS UMESC	$281,472	$99,000		$380,472
USACE Coordination	Support for Kara Mitvalsky, Steve Gustafson, Dillan Laaker, Elizabeth Bruns, and Anton Stork, USACE Rock Island District		$25,000		$25,000
Total (all objectives)		$825,426	$257,840	$2,460	$1,085,726

UMRR LTRM Implementation Planning

Recommended Information Needs

July 26, 2023

Beginning in March 2022, a core team representing the UMRR LTRM Partnership has been meeting as part of an implementation planning process to prepare for a potential increase in funds made possible by the Water Resources Development Act of 2020. If additional funds continue to be appropriated, this would present an opportunity to expand our understanding of the UMRS and better inform restoration and management.

The LTRM Implementation Planning Team (IPT) initially identified 29 information needs for evaluation using several optimization approaches. These 29 information needs were provided in the UMRR Coordinating Committee's read ahead material for the November 16, 2022 and March 1, 2023 quarterly meetings. The optimization process developed by the IPT was described at the March 1, 2023 UMRR Coordinating Committee's quarterly meeting. At the May 25, 2023 UMRR Coordinating Committee meeting, the IPT provided a description of how 11 information needs were tentatively selected for further development and consideration.

The IPT has finalized our recommendations for information needs to address during FY2024 – FY2026 if sufficient funds are appropriated. Several of the 11 information needs described during the May 25, 2023 quarterly meeting were combined resulting in a total of nine information needs recommended for funding through FY 2026. The following document describes the nine recommended information needs. There are enough FY 2023 funds remaining to initiate work on parts of two of these information needs.

During the August 9, 2023 UMRR CC meeting, the IPT will present for endorsement by the Coordinating Committee these two recommendations:

1. The nine information needs described in this read ahead should be addressed during FY2024 to FY2026 if sufficient funds are appropriated
2. Two information needs should be partially funded with remaining FY 23 funds as follows:
    a. 2.1 (Hydrogeomorphic change: Geomorphic Trends)
    b. 3.12 (Aquatic ecology: river gradients from pool 14 to pool 25).

Recommended information needs that are described in the following document:

Floodplain Ecology: Vegetation change across the system

Floodplain ecology: terrestrial and aquatic herpetofauna

Hydrogeomorphic change: Geomorphic trends

Aquatic ecology: Aquatic Vegetation Distribution and Changes Across the System

Aquatic ecology: native freshwater mussel distribution

Community composition, abundance, and distribution of macroinvertebrates (see Appendix 1)

Aquatic ecology: lower trophic contribution

Aquatic ecology: river gradients – pools 14-25

Restoration applications

1.1 Floodplain Ecology: Vegetation Change Across the System

Approach

The general approach to monitoring system-level vegetation change will be to utilize existing data sets and tools to better understand and quantify long-term changes in plant communities, particularly floodplain forests, which make up approximately 75% of the non-developed, non-agricultural floodplain land cover of the UMRS (De Jager and Rohweder 2017). However, herbaceous communities (e.g., wet and sedge meadows) are also of interest because they are often heavily invaded by non-native grasses (e.g., *Phalaris arundinacea*) and relative to floodplain forests, may represent an alternative stable vegetation type (Bouska et al 2022).

The UMRR program currently supports collection and analysis of LTRM's decadal land cover data, which is useful for documenting system level changes in coarse scale vegetation classes, such as: wet meadows, grasslands, shrub, willow, cottonwood communities, and floodplain forests (Dieck et al. 2014). Additionally, although it is not a part of LTRM's base monitoring program, LTRM has collected plot-level forestry data in various parts of the river following large floods in 1993 and 2019 (Yin et al. 1993; Weiss et al. 2023). The 1993 data were valuable in evaluating the impacts of a single large magnitude flood (Yin et al. 1993, 2009) and for developing flood tolerance models used in forest simulation modelling (De Jager et al. 2019). The 2019 data is currently being analyzed to determine tree mortality rates and changes in forest structure across approximately 20 years and at least two large magnitude floods (Weiss et al. 2023). UMRR also invests in integrative eco-hydrology research and intends to continue to support the development of flood inundation models and tools that clarify the role flooding plays in structuring floodplain vegetation communities (Van Appledorn et al. 2021).

Beyond LTRM's investments, the US Army Corps of Engineers (USACE) has been collecting UMRS system-level forest inventory data since at least as far back as the early 2000's. This extensive dataset has been integrated into a system-wide Forest Management Geodatabase and used to guide stand-level forest restoration and management activities, develop relationships between patterns of flood inundation and forest species composition (De Jager et al. 2012), as well as to populate initial forest conditions in simulation modelling (De Jager et al. 2019). In addition, as more restoration projects are carried out by USACE that incorporate forest management actions (e.g., timber harvest, planting, invasive species control), opportunities to collect and/or utilize local-scale plant community data to evaluate impacts of management actions will increase. Finally, historical data also exist for the UMRS in the form of data collected by the US General Land Office in the late 1800's.

Despite the availability of several different floodplain vegetation data sets, along with models and tools that can be used to characterize and simulate the impacts of flood inundation, LTRM lacks a quantitative understanding of how the vegetation of the entire UMRS has changed since historical conditions (pre-lock and dam) as well as over the past 30 to 40 years. How is the abundance of different species and age-classes changing across the system? What are the main drivers of changes in floodplain vegetation communities? How do different disturbances (e.g., flood-related mortality, invasive plant species, emerald ash borer, Dutch elm disease, climate change, and management actions (e.g., timber harvest, planting, and invasive species control) influence floodplain communities? What are the long-term consequences of forest mortality on forest ecosystem resilience and landscape-scale diversity and are certain drivers (e.g., climate change and invasive species) accelerating mortality rates and shifts in community composition? To address questions such as these, a dedicated funding mechanism is needed to support a principal investigator for floodplain plant ecology within LTRM.

Geographic extent

The geographic extent of floodplain vegetation monitoring is the entire UMRS and possibly extending to areas south, given the potential for species range expansion.

Monitoring/measurement endpoint(s) (description of data to be collected):

This component will utilize existing data sets and potentially seek additional funding from other sources (e.g., NESP, Corps operations, UMRR additional funding as available) to gather additional data if needed. Such efforts are generally done on a decadal basis given the timescales over which most vegetation communities change. Existing data sets include:

1) LTRM's decadal land cover data
2) LTRM's flood mortality data 1993/2019 (every 10-20 years).
3) USACE forest inventory data sets (~decadal, rotating plot).
4) Existing GLO data for historical conditions.
5) Possible local-scale HREP monitoring of floodplain vegetation at specific sites (see information need 4.3).

Design (when and how frequent will the data be collected)

See above

Analysis (general description of how data will be assessed [e.g., status and trends])

The focus of this monitoring effort will be to analyze status and trends in existing forest inventory data (#2, #3 above), as well as conduct data analysis of newly collected vegetation data in areas of recent forest mortality (identified from #1 above) and conduct analyses of site-level data collected around HREP's as available (#5 above). This component will compliment ongoing data analyses related to land cover change conducted under the Spatial Data component (#1 above). It will also compliment ongoing eco-hydrology data analyses. The primary aim of this area of research is a more 'plant-ecology based' examination of forest stand dynamics and changes over time as they are impacted by multiple interacting disturbances.

Personnel needs (general description of expertise needed and location(s) [e.g., UMESC, FS])

The personnel needs are a single Principal Investigator at UMESC or elsewhere within the UMRR community to focus on floodplain plant ecological dynamics using existing data. This person would collaborate with existing personnel tasked with land cover analyses and forest succession modelling, and integrative eco-hydrology data analyses. This person would also be expected to coordinate research activities related to floodplain forests conducted by other entities (e.g., Universities) and local-scale data collection efforts conducted around HREP's (as funding and opportunities arise). The PI would lead the analysis of existing data, outline proposals and secure funding as needed for additional data, serve as an advisor to restoration projects, and serve as a coordinator for additional floodplain vegetation research done with collaborators.

Equipment needs (include even if redundant with existing FS/UMESC equipment)

Computer and office space

Houser estimated costs based on above—need confirmed:

	Net
Research Ecologist (GS 0408/12/4)	$133,005
Computer travel etc	$8,000
Total (net)	$141,005
Total (gross)	$221,456
3 yr cost:	$664,369

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1.4 Floodplain ecology: terrestrial and aquatic herpetofauna

Approach –

Clear purpose (what is the purpose? how will information be used?)

Amphibian and reptile populations have been declining in many locations around the world. These populations have intrinsic ecological value and are sensitive to environmental changes. Various environmental changes underlie their declines and further environmental changes could cause further declines. The environmental changes responsible for these declines may have broader effects on ecosystem function, overall biodiversity, ecological services, and human health. Thus, understanding the statuses of amphibian and reptile populations in relation to changing environmental conditions is important for many reasons.

Investment in short- and long-term projects and monitoring efforts can help address many questions including:

- What is the abundance, distribution, and status of reptile and amphibian species within the Upper Mississippi River and Illinois Rivers? Better understand the spatial and temporal distribution of terrestrial and aquatic herpetofauna (i.e., reptiles and amphibians) that depend on the floodplain during different life cycle phases. What, where, and how many non-native herpetofauna are present in the UMRS? Determine habitat use by focal communities through long-term monitoring.

- What drives reptile and amphibian abundances and distribution throughout the UMRS and individual reaches? Develop habitat suitability models and map spatial prioritization of habitat throughout the UMRS.
- Assessing ecosystem health by documenting herpetofauna abundance/use of the floodplain, improving management and restoration by identifying project futures that could improve habitat use, and preparing for emerging issues by identifying drivers of herpetofauna use and potential changes in them. Develop a management guide discussing results and management suggestions for reptiles and amphibians. Coupled with current forest inventory datasets and forest-flood interaction findings.

Existing data and expertise (what data collection approaches and opportunities currently exist?)

- Amphibians
    - ARMI has recorded amphibian acoustics at 10 sites along the Upper Mississippi River National Wildlife and Fish Refuge.
- Reptiles
    - Turtle bycatch data from fish monitoring.
        - Beginning in 1992, fisheries component specialists at each of six field stations began to systematically record data on turtles collected as a by-product of fisheries monitoring. Summary of 1992-1995 data available here. Turtle data now resides in a special project database - same format and sampling methods as our core fisheries data with all relevant sampling site measurements as for fish. LTRM fish teams record ID, carapace length, and sex of all turtles captured by all sampling gears in all time periods. Some additional analyses of this data have been completed for the Middle Mississippi River (Barko and Briggler, 2006; Braun and Phelps, 2016).

        - John Tucker at INHS and Jim Lamer trapped and marked close to 40,000 turtles in backwaters of the lower Illinois River and parts of the Mississippi River – assigned unique codes to each turtle captured using a power drill. Recorded any deformities, extra scutes or missing scutes, injuries, sex and took several measurements, carapace length, width, height, plastron length, and mass (on snappers, we also measured distance from cloaca to tail base, and posterior scute for sex validation).

        - Chad Dolan at Iowa DNR has adopted above protocols for work across Iowa – with Bellevue and Fairport Fisheries Management Units drill-marking turtles along Mississippi River. Have transitioned to pit tags in southeast Iowa.

    - HerpMapper (HerpMapper is a 501(c)(3) nonprofit organization designed to gather and share information about reptile and amphibian observations across the planet. HerpMapper (HM) is a relatively new global herp atlas and data hub project that receives “catch and release” data from the general public, herpers, other citizen scientists, and professionals. HM data are only viewable to county-level to the public, but HerpMapper does make these data freely available to HM Partners – groups that use these recorded observations for research, conservation, and preservation purposes.)

  - There are 7,297 reptile and amphibian entries in HerpMapper within the UMRS floodplain.

Geographic extent (general location(s) of work)

- Reach/UMRS scale. It would be beneficial to implement a systematic approach across the entire UMRS to account for regional variation in occurrence due to differences in the forest ecosystems by reach and variations in species ranges. Reference reaches could be identified using existing forestry spatial data and known or proposed forest inventory locations. Information from HerpMapper may help identify some preferred locations for sampling.

Monitoring/measurement endpoint(s) (description of data to be collected)

- Quantify the status of amphibian populations (presence/absence, spatial occupancy, and habitat selection at LTRM study reach scale) and communities and identify relations with various other ecological attributes (e.g., habitat).
  - Amphibian acoustic monitoring: A long-term acoustic monitoring component would establish a robust infrastructure for assessing trends and changes in amphibian abundances, distributions, and resilience (including species of concern) as well as infrastructure for targeted studies. Use automated recording units (ARUs) to monitor large scale soundscapes of the UMRS with specific focus on amphibians.

  - Active camera traps with optical triggers can help estimate occupancy and abundance of amphibians and reptiles especially for rare, threatened, and endangered species. The Hobbs Active Light Trigger (HALT) system is applicable to small animal studies designed to detect species presence, spatial occupancy, relative activity, habitat selection. Mark recapture methods are often necessary to estimate abundance; however, identification of individuals by spot patterns, particularly with image-recognition software has been shown to be successful for many amphibian and reptile species.

- Identify non-native species and potential/existing invasive status. Data on herpetofauna distribution and use of the floodplain and aquatic areas.

- Robust application of acoustic and active camera traps for long term monitoring may also help identify opportunities for before-after-control-impact study designs to determine community shifts across management strategies and habitats, fine-scale reptile/amphibian suitability models, and a comprehensive model of herpetofauna spatial prioritization as it pertains to the UMRS. This would allow managers to relate habitat decisions to impacts on herpetofauna.

Design (when and how frequent will the data be collected)

- Acoustic Amphibian monitoring: April to October field season. ARUs will sample five minutes at the top of every hour each day while sampling in stereo at 16000 Hz (2008 and early 2009) or 22050 Hz (2009–2012).
    - Data Collection at 8 key pools sited on forest inventory point or within 100 M of a forest inventory point. 10 ARUs at each pool total of 80 ARUs.

    NOTE: Can consider purchasing recording units with multiple microphones to detect amphibians and birds, as well as bats.

- Turtle bycatch: Recommend modifications to fish monitoring protocols when turtles are caught include:
    - Notching scutes
    - Photos and GPS locations for harder to identify species (could enter data into existing database HerpMapper.)
    - Guidance on recovering lethargic or non-responsive turtles

    NOTE: Fisheries component field crews will discuss these issues during the May 8-11 field practicum and Brian Ickes will report back. Also, consider if USGS can serve as central repository for various turtle marking codes for the region?
- Drift fence with active camera trap box could be deployed during breeding seasons of specific target species. Cameras can be active for 24 hours. This would be consistent with automated recording units for acoustic recording. Assuming they are placed in the same locations, it is plausible that camera traps and acoustic detectors could be serviced at the same time. 5 arrays may be needed per acoustic site to adequately detect a similar distance area of 0.2 km2– with some species calls detectable up to 1 km and others to only 200 m. If 2-camera trap arrays were put out at 40 of the 80 acoustic sites, that would mean an increased initial equipment cost of $210,000.
    - This additional cost has not been reviewed by the small group that helped refine the acoustic costs. There is a need to develop a better assessment of necessary sampling effort across the floodplain for reptiles and amphibians to better refine estimated costs, but this should help us understand the potential scope better.
    - Estimate of effort required for camera traps:
        - Based on evaluation of 18 cameras (9 fences) deployed along 63 m of drift fences distributed along 3.5 km of coastline. Total time invested in building the array and retrieving the images was 50 hr. Time required to download photos from each fence averaged 20 min/fence. Ours would be considerably higher once a sampling frame is determined, but we can use this as a basis.
        - Image processing required 1 hr/camera/month and was facilitated by "camtrapR" software, which reduced observer error while sorting data (Niedballa et al. 2016)
        - The webinar PDF identified five field visits during the season – construction of arrays between March and April, activating cameras, servicing arrays (batteries/memory cards) twice, and deconstructing arrays. Both the article and webinar PDF indicate much fewer person hours for this form of

monitoring and therefore this work is likely a good candidate for pairing with other monitoring needs for efficiency.

Analysis (general description of how data will be assessed [e.g., status and trends])

- Analyze data for status, trends, and factors associated with different outcomes
- Acoustic recordings will be analyzed using kaleidoscope or similar software to determine species presence, absence, and relative abundance.
  Note: Data would be available for birds during certain times, but analysis of bird and bat data is not being accounted for at this time.

Personnel needs (general description of expertise needed and location(s) [e.g., UMESC, FS])

- 1 PI - New Hire GS12/13 - USGS
- 2 field staff to help deploy ARUs - 1 New Hire GS09/11, 1 New Hire GS07/09

- **<u>Option to consider using field staff for deployment</u>**
    - 1 with PI and field station at .25 fte

Equipment needs (include even if redundant with existing FS/UMESC equipment)

- $150K will cover ~80 units and associated equipment
- $210 will cover 5 camera trap arrays at each of 40 sites (half of the ARU sites)
- $25K - Boat – 16ft johnboat – with trailer – can be $25K on high end (brand new).
    NOTE: Potential for boat use to deploy acoustic monitors not to overlap existing field crew needs – will need to further describe when a boat would be needed and how much time it would be used. Anticipate primary use in April, July, and October.

Opportunities for overlap with other information needs

- Acoustic monitors will collect data at the top of each hour during all 24 hours of the day. Location of ARUs may not be entirely appropriate for all desired bird species – would assume this would be a subset of bird species in the forest with preference to wetter areas. Point counts could be conducted at ARU sites to help advance science regarding how ARUs can be used to assess robust density or abundance of birds.
    - If field station staff are used to help deploy ARUs, could increase FTE to .75-1 to do point counts as well as acoustic monitors.

- Option – Consider purchasing recording units with multiple microphones to detect amphibians and birds, as well as bats. Could consider doing this for a portion of the total ARUs to also assess audio quality across unit types. Questions remain on whether an acoustic ecologist hired for amphibian calls would also be able to analyze bird or bat calls.

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- Additional references related to camera traps are available from Andrew Stephenson upon request

2.1 Hydrogeomorphic change: Geomorphic trends

Draft: 24 June 2023

Hydrogeomorphology is the study of the interactions of water and channel-floodplain topography (geomorphology). One of the most important facets of hydrogeomorphology is its strong control over the spatial and temporal distributions of riverine habitats. Hydrogeomorphology changes over time on two overlapping time scales. The hydrodynamics timescale refers to variation in hydraulics and habitat metrics that results from changes in water discharge in the absence of significant change in channel-floodplain geomorphology. Hydrodynamic variation is dominated by seasonal hydrology, punctuated by rare events. With climate change, however, hydrodynamic variation may also become non-stationary and involve multi-decadal trends.

The morphodynamics timescale refers to variation attributed to changes in geomorphology as sediment is redistributed in a river corridor or watershed as a result of adjustments to factors like dams, channel engineering, land-use patterns, and climate change. Morphodynamic timescales tend to be longer than hydrodynamics timescales (typically multi-decadal to millennial) although geomorphic change can be rapid in areas where erosional energy is concentrated or where sediment accumulates. Geomorphic adjustments in the river corridor or propagated through drainage basins can create long-term and lagged responses as sediment and energy are redistributed. Hence, geomorphic trajectories can be complex and challenging to predict. In the Upper Mississippi River System, geomorphic changes fundamentally alter the mosaic of riverine habitats, for example in infilling backwaters or in areas of channel incision and bank erosion downstream from dams.

Prediction of the changes in hydrogeomorphology – that is, the integrated effects of changes in hydrology and changes in geomorphology – is fundamental to understanding long-term resilience of the Upper Mississippi River System and for planning sustainable restoration projects. The following describes the first phase in understanding hydrogeomorphic change: detection of geomorphic trends through change detection. Predictive understanding of geomorphic change may be considered in a subsequent phase; predictive understanding depends on and should be considered after robust evaluation of empirical data.

Assumptions

This information need is based on several assumptions.

- Most of the data needed to accomplish a systemic evaluation of geomorphic change – including bathymetric and terrestrial lidar data – will be available through coordinating agencies and the cost of acquiring those data are therefore not included in this information need. The number, timing, extent, and resolution of the available data will likely be dictated by other project needs.

- Limited new geomorphic data collection may be necessary in places of exceptional importance, such as HREP projects, habitats of concern, or areas experiencing rapid change, where systemic datasets are not adequate. However, collection of those data will be through coordinated efforts with existing survey crews and will not require additional equipment investments for this information need.
- Future scenarios of hydrologic variation will be provided by coordinated activities by the proposed LOCA-VIC-mizuRoute project, or something similar.
- This document outlines the information needs as recognized presently (2023) and which are likely to persist for the next 3-5 years, but as information is developed and assimilated, we anticipate that information needs related to hydrogeomorphic trends will evolve. Reprioritization at ~5-year intervals is expected.

Hydrogeomorphic change: Geomorphic trends

Purpose

This information need is motivated by benefits of having a predictive understanding of how the mosaic of habitats of the Upper Mississippi River will change over time. The first phase is analysis from empirical data and includes addressing these questions:

1. Where, how, and to what degree is the geomorphology of the river and floodplain changing and expected to change over planning horizons of decades to centuries?
2. How do these geomorphic changes relate to long-term changes in discharge and episodic weather events?
3. How are geomorphic changes affected by ongoing navigation channel operations, e.g., dredging and placement site operations, wing dikes, closing structures, revetments, etc.?
4. What are the implications for the future spatial and temporal distributions of habitat metrics such as water depth, inundation frequency/depth/duration, water residence time, and physical, biological, and chemical properties of the system?

Approach, design, analysis

Several components are envisioned for this research effort, but we also recognize that new components may emerge, and some components may be dropped as priorities may evolve depending on results of analyses and data availability. Some notes on sequencing and logistics are also included. The hydrogeomorphic change information need encompasses nested scales of analysis and a lot of work at finer scales can be programmed while waiting for larger, systemic datasets to be compiled.

1. Evaluation of existing and new datasets for change detection. This component will compile existing data and new datasets as they are planned and deployed. The compilation will provide the critical understanding of data availability in time and in space, where data gaps exists, and importantly, how data specifications vary among datasets.
    a. This fundamental first step will be addressed in the first few months of the project.
2. Evaluation of limits of change detection. This component follows on the first and involves a robust, quantitative assessment of how much geomorphic change can be detected with the existing and new datasets. This involves understanding the x, y, and z positioning errors associated with each dataset and, for bathymetric data, understanding inherent limits on detection based on daily to seasonal variation in bedform dimensions and effects of sediment compaction on change calculations.

    a. This component can be addressed before new, system-wide datasets are available. There will be a need to spend – potentially -- a couple of years on methods development, including understanding sources of error and developing processing and analysis protocols. Some strategic, small-footprint data collection would be advisable during this period to shake out details of how the broader datasets can be processed.
    b. For example: what are the limits of quantification of change in different environments where different sensors are used to evaluate topography and bathymetry?
3. Assessment of geomorphic change at system and pool scales. Within the constraints of detectability, these assessments will show spatial extent, direction, and rates of geomorphic change, although rate calculations may be limited by number and time distribution of datasets.
4. Assessment of geomorphic change in changing and important habitats. Based on results of component 3, sites of accelerated geomorphic change or changes in important habitats will be targeted for additional analyses. Such analyses may require additional data collection and/or applications of additional, existing data.
    a. If additional time is needed before the broader datasets are available, it would be valuable to collect small footprint data sets within HREPs to document rates and processes and relate to adaptive management of the HREPs.
5. Integration with hydrology, including future hydrologic conditions. This component will address the interaction of present and future hydrology (flow regime) with changes in geomorphology. As a first step, areas of greatest geomorphic change will be assessed for sensitivity to changing hydrology. If sufficient sensitivity exists, this component may include compilation of hydrodynamic models that will quantify the integrated effects of hydrologic and geomorphic change.

Geographic extent

We envision nested scales for these analyses. Some analyses will provide useful information at the UMRS (system) scale whereas other will require increased analysis and/or additional data collection at a reach/pool scale. Systemic assessment may be more easily justified for some kinds of data, for example, lidar data for which economies of scale can be achieved in a regular schedule of flights. Because of the time and cost investments required for bathymetric data collection at scales applicable to a range of project needs, bathymetric data may be amenable to targeted, sequential collections. An example might be the prioritization of backwater sedimentation rate monitoring in select areas.

Note that this information need may benefit from understanding and tools developed through a new (2023) USGS Powell Center working group on National Topographic Change (A National Topographic Change Mapping and Monitoring System | U.S. Geological Survey (usgs.gov)),

Endpoints

The general objective of this effort will be a predictive understanding of hydrogeomorphic change in time and space. Several endpoints can be defined leading up to that objective:

- Multiple updates of gridded topo-bathymetric digital elevation models (DEMs) at appropriate resolutions. These data are also fundamental to hydrodynamic modeling and therefore will also support updated surface-water models.
- Raster-based datasets of differences of topo-bathymetric DEMs collected over multiple periods to calculate rates, magnitudes, and locations of recent change.

- Evaluations of expected rates, magnitudes, and locations of future change based on trends evident in repeated topo-bathymetric DEMs
- Statistical models relating geomorphic change and rates of change to covariates including emergent and submergent vegetation communities, factors in contributing watershed areas, channel geometry variables, channel-training structures, restoration projects, and distance to dams.

Project staffing and costs

The project will be headed by a **principal investigator with a strong background in quantitative geomorphology (research hydrologist, physical scientist, or geographer) at GS-12 level**. The PI will be supported by a **GS-7 technician with strong data-processing and GIS skills**.

NOTE: *these costs are obsolete. See summary spreadsheet for current estimates.* Additional annual costs (based on 2023 rates) are estimated as:

Salaries	$	178,900
Contracts	$	45,000
Travel	$	12,424
Training	$	-
Equipment	$	6,400
Supplies	$	-
Reports	$	6,400
Net Total	$	249,124

Estimated Gross $249.124 * 1.57 = $391,124 / year

The Contracts line includes anticipated new data collection at targeted sites. Travel includes professional meetings and local/regional coordination meetings with partner agencies. Equipment for the first year includes computer resources; this cost may be decreased in subsequent years. Reports costs are based on 1-2 journal articles per year, open-source options.

3.1 Aquatic ecology: Aquatic Vegetation Distribution and Changes Across the System

Information need (IN):

IN 3.1.1. What are the factors which limit aquatic plant distribution and (re)establishment throughout the UMRS, especially the unsampled portions of the lower impounded reach (P14-25) and Illinois River?

IN 3.1.2. What, if any, inputs from the tributaries in this reach contribute to the lack of aquatic plants?

IN 3.1.3. How does the hydrologic regime affect aquatic plant community dynamics? What are the implications of shifting seasonality and magnitude of hydrologic extremes?

Geographic extent: UMRS, with emphasis on increasing information in currently unsampled but potentially suitable habitats for aquatic plants like Pool 19 (on lower impounded reach) and Peoria Pool (on the Illinois River).

How the information will be used: All three IN will contribute to assessing status and trends, assessing ecosystem health and resilience, improving management and restoration.

Measurements or endpoints: same endpoints as in LTRM aquatic vegetation sampling protocol (Yin et al. 2000; plant abundance, plant density, species composition, diversity, substrate, water depth); select parameters from LTRM's water quality protocol that are known to be key predictors of aquatic plants in the upper impounded reach (substrate, velocity, and turbidity) (Bouska et al., 2022; Carhart et al., 2021; Delaney & Larson, 2022, 2023); bathymetry (water depth maps); water level fluctuations (Carhart et al. 2021); available water quality data from above and below tributary confluences (SPARROW).

Approach

Purpose (what is the purpose? how will information be used?)

We currently lack sufficient data to address this IN, particularly in the lower impounded reach (Pools 14–26) and the Illinois River. Models showed thousands of hectares of potentially suitable habitat for submersed plants in Pool 19 and in Peoria Pool (Carhart et al., 2021), and LTRM-associated field crews report there have been submersed plants in these pools. More data collection and analyses are needed in these sections of river to understand the current limitations of submersed plants and other life forms (e.g., emergents and floating leaved plants), which can guide appropriate actions for restorations if needed.

The existing LTRM data and in-house expertise has effectively synthesized the status and long-term trends (over 25 years) of aquatic plants in the upper study reaches of the UMRS (J Houser et al., 2022; Larson et al., 2022). The status and trends data have provided tremendous learning that continually impacts policy, restoration, and management. The LTRM data and expertise address specific, applied research questions, for example but not limited to: (Bouska et al., 2022; Burdis et al., 2020; Carhart et al., 2021; Carhart & De Jager, 2019; Larson et al., 2023; Moore et al., 2010). The existing LTRM data and predictive modeling was able to effectively disentangle the key factors affecting submersed aquatic vegetation in the upper reach, and this information was presented in ways to reduce vulnerability to loss, increase resilience, and prioritize restoration (Carhart et al., 2021; Delaney & Larson, 2022, 2023). Similar kinds of information can address this IN if we routinely sample a study reach within the lower impounded river and Illinois River.

Adaptive management is a top objective of the UMRR Strategic Plan (U.S. Army Corps of Engineers, 2015), and this IN can guide ongoing adaptive management initiatives. For example, water level management (Heglund et al., 2022) planning on the Lower Pool 13 HREP (Iowa/Illinois), on the Emiquon National Preserve (Illinois), and Hennepin and Hopper Lakes (Illinois) would benefit from plant data and the hydrologic analyses proposed here.

Existing data and expertise (what data collection approaches and opportunities currently exist?)

For IN 3.1.1. (limiting factors), no new data collection procedures are required. The existing aquatic vegetation sampling protocol (Yin et al., 2000) will be transferred in these new study reaches and the data will be directly comparable to the other study reaches. We will field sample key water quality variables (water depth, substrate, velocity, and turbidity; Delaney and Larson 2022, 2023) at every plant sampling site following LTRM protocols (Soballe & Fischer, 2004). Our predictive models can also include Upper Mississippi River Conservation Committee (UMRCC) Vegetation Data (usgs.gov) and data from 'IN 3.12 River Gradients' herein if funded. The LTRM Aquatic Vegetation Component PI (Danelle Larson, UMESC) will lead the data analyses and disseminations, in collaboration with other LTRM experts, to address this IN.

For IN 3.1.2 (tributary sourcing), the major tributaries in the UMRS have existing water quality data for nutrients, suspended solids, and select contaminants to determine where the source problems for plants originate (SPARROW). We are very limited by the plant data to associate with tributary sourcing but propose in IN 3.1.2 to collect plant data. We currently lack professional staff with time to collate, analyze, and interpret these complex water quality data. A new hire would work with guidance from LTRM PIs and the new Research Ecologist hired through IN 3.12 river gradients. If existing water quality data are found not sufficient to fully inform plant distribution and dynamics, we can follow up with future research experiments and proposals that target other possible drivers of plants, like herbicides or herbivory.

For IN 3.1.3. (hydrology influences and dynamics), we have sufficient hydrologic data spanning the LTRM vegetation record (1998–current) in the upper river reach to address this IF (National Water Information System database, https://doi.org/10.5066/F7P55KJN; Van Appledorn et al. 2021). We are very limited by the plant data in lower river reaches to associate with hydrology but propose in IN 3.1.2 to collect plant data. We currently lack professional staff to collate, analyze, and interpret that data. A new hire would work with guidance from LTRM PIs Van Appledorn, Jankowski, Carhart, De Jager, and Larson to address this IN. The new hire would document all data processing and modeling procedures so Larson can update the model as the LTRM vegetation data becomes available in Pool 19 and Peoria Pool.

Geographic extent

We will use the existing data throughout the UMRS to inform all IN. We propose to collect new aquatic plant data in currently unsampled but suitable study reaches (Carhart et al., 2021), like Pool 19 and Peoria Pool. The new data in these river reaches are required for monitoring status and trends and identifying the factors affecting plant distribution and dynamics. New personnel for IN 3.1.1. will be permanently stationed at the IRBS with other LTRM staff. The new post-doc for IN 3.1.2 and 3.1.3 will be at UMESC for a 3-year term.

This IN differs from the IN 3.12 river gradients by having unique goals and geographic extent. This IN will assess the status and trends of aquatic plants in a 'study pool' in the lower impounded reach (likely Pool 19). In contrast, the IN 3.12 aims to assess status in pool(s) that are representative of the entire lower impounded reach and may employ a roving sampling regime. This IN will also focus on understanding and managing aquatic plants in the Illinois River, whereas IN 3.12 aims to focus on the main stem Mississippi River only.

Monitoring/measurement endpoint(s) (description of data to be collected)

See above

Design (when and how frequent will the data be collected)

For IN 3.1.1. (limiting factors), we will implement the LTRM's stratified random sampling regime in Pool 19 and Peoria where the most suitable habitats exist for plants (Carhart et al., 2021). The vegetation and select water quality sampling will be done annually in summer, following the existing protocols (Soballe & Fischer, 2004; Yin et al., 2000). We propose that this is a perpetual annual sampling like that of the other LTRM study reaches to assess status and trends and guide further research if needed. Our predictive models can also include Upper Mississippi River Conservation Committee (UMRCC) Vegetation Data (usgs.gov) and data from 'IN 3.12 River Gradients' herein if funded.

We leave flexibility in defining the 'study reaches' within the first years of study. Changes may be made as more information is learned about the plant life and whether these pools are representative of the larger reaches (Pool 19 represents the lower impounded reach, and whether Peoria represents the Illinois River). We can run power analysis after year 3 of data collection to determine the number of sampling sites needed to assess status and trends and predictive modeling. If power analysis suggests that 450 sites are NOT needed to address the IF, we could expand the study reach to include 450 sites spread out across Pools 18, 19 and 20 and Peoria and La Grange. Lastly, we could restrict the sampling frame of each study reach to only areas within each pool that have a suitable hydrogeomorphic template for plants, like shallow areas, to improve learning and sampling efficiency.

For IN 3.1.2 (tributary sourcing) and IN 3.1.3. (hydrologic influences and dynamics), the new post-doc hire will collate and evaluate the quality of all data sources spanning 1998–current, for which we have existing LTRM plant data in the upper study reaches (Pools 4, 8 and 13). We will rely on existing data like updated versions of inundation maps (Van Appledorn et al., 2021), a UMRS water surface elevation database (Sawyer and Van Appledorn, in review), projected inundation maps under future climates (Van Appledorn, in progress), photosynthesis zones (Carhart et al., 2021), and summarized hypothesized hydrologic variables from the National Water Information System database (https://doi.org/10.5066/F7P55KJN).

Analysis (general description of how data will be assessed [e.g., status and trends])

For IN 3.1.1. (limiting factors), Larson will lead two primary analyses: (1) status and trends and (2) predictive modeling. The status and trends data will be available annually on the LTRM graphical browser (https://umesc.usgs.gov/data_library/vegetation/graphical/veg_front.html) and summarized in the reports like (J Houser et al., 2022; Larson et al., 2022). Larson will include the new data from Pool 19, Peoria, and possibly Upper Mississippi River Conservation Committee (UMRCC) Vegetation Data (usgs.gov) and data from 'IN 3.12 River Gradients' into predictive modeling, similar to (Carhart et al., 2021; Delaney & Larson, 2022, 2023). The hypotheses and predictive model will be informed by data (new and existing) and existing knowledge, like (U.S. Army Corps of Engineers, 2007).

For IN 3.1.1. (limiting factors), the LTRM aquatic vegetation specialists will be doing field collections for ~2 months each year. During the other ~10 months they will work on other LTRM activities like data analysis, report writing, presentations, and technical assistance for HREPs. The specialists will need diverse and technical skill set, including boat safety and experience but also data analysis and writing skills. These positions will be under the direction of the supervisor (IRBS Lead, Dr. Lamer) and in collaboration with the rest of LTRM vegetation Component (Larson, Lund, Carhart and Fopma).

For IN 3.1.2. and 3.1.3 (water quality and hydrology associations), the post-doc hire will work collaboratively with LTRM PIs to determine the most appropriate modeling approach given the state of the data and specific hypotheses. The post-doc will require prior experience with dynamics modeling, given the nature of the IN, complexity of the river system, and difficulty with modeling dynamics of hydrology and plants. The analyses will build off prior work and a variety of analysis approaches, like (Bino et al., 2015; Bouska et al., 2022; Carhart et al., 2021; De Jager et al., 2016; De Jager & Rohweder, 2017; Delaney & Larson, 2023). We will address the specific IN and may also address other key questions about the role of flooding on aquatic plant functional traits and diversity, similar to that of LTRM floodplain forest work (Van Appledorn & Baker, 2023). We will include simulation models of hypothetical hydrologic regimes to gain understanding of plant vulnerability to loss or resilience, similar to (De Jager et al., 2019).

Personnel needs (general description of expertise needed and location(s) [e.g., UMESC, FS])

(2) permanent aquatic vegetation specialists, who would be hired through and permanently stationed with the IRBS led by Dr. Jim Lamer. The specialists would be officed at either the Havana IRBS (which is ~1.5 hours from Pool 19 or Peoria) or the Macomb satellite IRBS and University (which is ~45 minutes from Pool 19 or Peoria) and would work jointly on study reaches on the Illinois and Mississippi Rivers. The specialists need the ability to lead, train, and oversee aquatic plant field surveys conducted annually. We require the specialist to have an advanced degree (either a Masters or PhD) so they can be expected to lead some data analyses and dissemination when not in field season. The specialist will require flexibility to work on a variety of LTRM projects as directed by the IRBS Supervisor.

$65,000 (PhD-level salary) + 27,500 (FICA at 42.32%) + $8,000 (computer, travel) = $100,500 * 1.15 (indirect IRBS) = $116,000 per year per specialist * 2 specialists =
$232,000 per year for two permanent vegetation specialists

(1), 3-year post-doctoral researcher through UMESC to lead data collation, analysis, and dissemination for IN 3.1.2 and 3.1.3. This person would require expertise with eco-hydrology dynamics modeling and would work collaboratively with LTRM experts. They could be hired at the GS-11 or GS-12.

$133,000 (Research Ecologist, UMESC, GS-12; salary and FICA) + $8,000 (computer, travel) = $141,000 per year (net) * 1.57 (indirect USGS) * 3 years =
$664,000 total (for three-year term position)

Equipment needs (include even if redundant with existing FS/UMESC equipment)

(2) Velocity meters: $12,000
(2) Turbidity meters: $4,000
(1) Outboard boat at IRBS for vegetation specialists: $40,000
(1) Microscope at UMESC (for plant identification by Larson): $3,000

Annual, recurring costs:

Motels (Peoria, IL) overnights: 10 nights *$98 gov't rate = $980 per year
Kibbe Field Station (Keokuk, IA; Pool 19) overnights: no charge per year
(1) truck at IRBS for vegetation specialists: $6,000 per year

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3.3 Aquatic ecology: native freshwater mussel distribution

Information need: Resource managers wish to understand the spatial (and ultimately temporal) patterns in the distribution, abundance, and assemblage structure of native freshwater mussels in the UMRS. Obtaining a systemic baseline assessment of the status of UMRS mussel resources will allow resource managers to (1) assess the health and resiliency of the UMR ecosystem, (2) predict how mussel assemblages may respond to changing environmental conditions such as climate change and increased navigation traffic, (3) quantify the ecosystem services that mussels provide to the UMR ecosystem, (4) identify hotspots for abundance and diversity that will facilitate prioritization of areas for restoration efforts and avoidance of areas for HREPs, and (5) track changes in species richness, including T&E and species of greatest conservation need.

Our objective is to quantify the distribution, abundance, and assemblage structure of native freshwater mussels throughout the UMRS ecosystem. Multiple federal and state agencies, including the UMRR, have funded poolwide mussel surveys, where entire navigation pools are systemically sampled (~300–400 sites per pool) to quantify estimates of abundance (no/m^2) and population size (number of mussels per pool). To date, poolwide surveys have been completed in Pools 3 (2013), 5 (2006 and 2022), 6 (2007), 8 (2019), 13 (2019), and 18 (2007). However, many pools remain unsampled, especially in the lower reaches. We propose to repeat existing surveys in Pools 3, 5, 6, 8, 13, and/or 18, and add additional pools, particularly within the lower reaches of the UMR (i.e., Pools 11, 22, 24). The pool(s) to be sampled will be chosen to maximize and leverage learning opportunities with the Navigation and Ecosystem Sustainability Program and water level management projects. With this systemic baseline, future studies could explore the suite of physical, hydrological, and hydraulic features that drive mussel distribution and abundance within the UMRS. For example, the baseline data on mussels would have strong linkages with focal area 2.1 (hydrogeomorphic change). Additionally, linkages with this effort could help select pools for mussel surveys and help refine geomorphic variables that drive mussel distribution and abundance.

If future poolwide mussel surveys were done in pools with H&H models, hydrophysical models could be developed to estimate simple and complex hydraulic variables (i.e., shear stress, Froude number, substrate stability)—habitat features that have been shown to be more predictive of mussel distribution and abundances relative to physical variables such as depth and flow (Steuer et al. 2008, Zigler et al. 2008, 2012). With additional spatial coverage in poolwide data, a future study (perhaps the 2024 LTRM science meeting) could develop habitat suitability model(s) to provide guidance on best practices for designing HREPs to have co-benefits for mussels.

The proposed approach supports research and management needs identified in the UMRCC Conservation Plan for Freshwater Mussels of the Upper Mississippi River (UMRCC 2004), the UMRR Scientific Framework for Research on Unionid Mussels in the UMRS (Newton et al. 2010), and the Freshwater Mollusk Conservation Society National Strategy for the Conservation of Native Freshwater Mollusks (FMCS 2016). This effort also contributes towards the recovery of three federally endangered mussel species and numerous State-listed species by assessing the status of the mussel assemblages and its associated habitat through surveys and monitoring.

Approach: Our approach would be to leverage the existing poolwide surveys with additional poolwide surveys in unsampled pools and/or resample existing pools with poolwide data. The number of pools to be sampled per year would depend on the level of funding and the needs of federal and state managers. However, given the high start-up costs, a minimum of four pools is recommended. Given that mussels are long-lived (30–100 y), we recommend re-sampling pools on a 5-year cycle. Each survey would consist of quantitative, whole substrate samples at 300–500 sites per pool; sites are distributed across the entire pool using a systematic survey design. From past experiences, each pool will require ~12 days to sample using two 4-person dive crews. Because of potentially high-water levels in the spring, we recommend sampling be done in late summer to early fall. All data would be stored in the USACE mussel database and potentially in the USFWS regional mussel database. Below, we provide an example budget for a total of six poolwide surveys conducted over 3 years. This budget estimate, assuming contract divers with their own boat and dive gear, is ~$303K per pool.

Budget item	Cost
Contract divers: 150K/pool; 2 pools/y*3y	900 K
GS-11 biologist: 165K/y*3 y [FY24 salary, fringe, 57.055% indirect]	495K
GS-7 biologist: 110K/y*3 y [FY24 salary, fringe, 57.055% indirect]	330K
Misc: 2 computers, travel to regional and national meetings, supplies – 30K/y	90K
Total: 605K/y	1,815,000

Geographic extent: The geographic extent of the poolwide mussel surveys is the entire UMRS.

Assessment endpoints: The poolwide surveys will generate the following raw biotic data in sampled pools: number of sites with and without mussels, species identification, number live and dead (fresh dead, weathered dead), shell length, external age, sex in dimorphic species, gravidity, and the number of zebra mussels per unionid. It will also generate raw data on abiotic features including water depth, substrate type, and resistance of the substrate surface (assessed with a penetrometer). With these raw biotic data, the following estimates will be derived *a posteriori*: site occupancy, species richness, percent listed species, species composition, total, adult, and juvenile density and associated confidence limits, density frequency distributions, estimate of population size and associated confidence limits, estimate of recent mortality, mortality of common species via catch curves, demographic data on length and age, strength of recent recruitment, species diversity, species evenness, partial dominance plots, and rank-abundance plots. If the poolwide survey was conducted in a pool with H&H models, the following derived abiotic features will be estimated: bed roughness, Froude number, Boundary Reynolds number, Reynolds number, shear velocity, shear stress, and substrate stability (may also need ADCP data here). These additional metrics will be used to quantify and predict suitable habitat for mussels that could be used to inform future habitat modelling by providing guidance on how to create habitat for mussels.

Analysis: Statistical analyses will be used to generate species-specific total, adult, and juvenile densities and population estimates and associated confidence limits. The percentage of fresh dead mussels will be used as an index of recent mortality (Dunn et al. 2020). Recruitment of new individuals will be estimated as the percentage of juveniles (defined as individuals less than the species-specific age at sexual maturity) in the population and as the percentage of the number of sampled species that are represented by juveniles. The relative health of the UMRS mussel assemblages will be assessed as the proportion of juveniles, estimates of recent mortality, and as length and age frequency distributions. Data on ecosystem services (e.g., biofiltration capacity) will be analyzed as in Newton et al. (2011). With these baseline data, future efforts could explore spatial patterns of mussels within and across pools using methods in Ries et al. (2016, 2019) and DeJager et al. (2018). Spatial patterns within pools could identify hotspots where the most dense and diverse mussel assemblages exist and would allow resource managers to identify areas that should be protected. Spatial patterns across pools would identify which pools have similar/dissimilar distribution, abundance, and assemblage structure and would allow hypotheses about the mechanisms driving these patterns to be developed.

Personnel needs: We anticipate hiring a GS-11/12 malacologist (~200K/year) to oversee sampling and conduct statistical analyses and a GS-7/9 (~110K/year) to enter and summarize data. Diving could be conducted by an external contract or by the state field stations hiring dive staff. Prior poolwide surveys have taken 2 boat crews ~12 days to sample; each boat has a 4-person crew consisting of 1 boat driver, 2 divers, and 1 dive tender. Sampling costs typically range from 100–200K per pool.

Equipment needs: Assuming this effort uses contract divers with their own boat and dive gear, equipment needs include (1) two computers, (2) spatial analysis and modelling software, (3) travel funds for field work and to attend local, regional, and national meetings and (4) miscellaneous supplies.

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3.9 Aquatic ecology: lower trophic contribution

Information need: What is the abundance, distribution, and status of lower trophic organisms (zooplankton and phytoplankton)? What is the lower trophic base contribution and response to ecosystem health and resilience? What, where, and how many non-native or harmful plankton are present in the UMR?

> Geographic extent: Reach/UMRS scale. Use existing phytoplankton samples from field stations. and consider specific outpool samples in the future that may have connections to other LT monitoring efforts (e.g., LTEF) or expansion of LTRM. Zooplankton and other lower trophic (e.g. microbes) investigations would require additional sample collection.
> How the information will be used: Assessing ecosystem health and resilience.
> Measurement or endpoint: Establish baseline abundance, community composition and spatiotemporal change for lower trophic base and investigate relationships with environmental conditions. Identify non-native or harmful species and potential for or existing invasive status.

Implementation Summary: The proposed implementation of this information need begins with the hiring of a principal investigator (PI). We envision this position to be filled by a community ecologist with strong quantitative skills to lead design and analysis of plankton community data, and expertise in plankton communities. The primary activity of the first year would be to develop a robust design for phytoplankton monitoring by assessing the effort required to adequately characterize and quantify plankton assemblage structure and trends based on existing data. Funds were also included to contract the processing of 600 samples from the phytoplankton backlog to support this effort (e.g., increase processed samples from reaches where there has been less data analysis). During the first year, the PI would also be tasked with synthesizing existing studies on phytoplankton in the UMRS (Table 1) and other large rivers.

During the second year, the LTRM water quality specialists would collect phytoplankton samples under the new monitoring design. Funds were included to contract the processing of 500 samples. The PI would focus efforts on synthesizing existing studies about zooplankton, coordinating with state-level zooplankton specialists, assessing the effort needed to adequately characterize and quantify zooplankton based on existing data sources, and develop a robust design for zooplankton monitoring.

In the third year, a plankton biologist and biological technician are to be hired at each of the LTRM field stations to implement zooplankton monitoring. Both of these positions would be full-time to support in-house processing of zooplankton samples. The PI will be charged with coordinating, designing and teaching a standardized zooplankton processing approach and developing an identification key. The PI will also be tasked with analyzing processed phytoplankton and zooplankton data for status, trends, spatial patterns, and associations with environmental conditions.

Cost estimation:

Personnel	First year	Second year	Third year
Personal investigator + computer + travel + sample processing	$375,569	$348,840	$357,504
Field Specialists			$477,600
Technicians			$252,720
Total	$375,569	$348,840	$1,087,824

Table 1. Past or ongoing projects focused on lower trophic components that have occurred in the UMRS that may be useful resources to help guide a lower trophic contribution component.

Project	Agency	River	River mile	Pools	Dates	Taxa	Ref
EMAP-GRE	EPA	Mississippi	0 (Ohio R. confluence) – 853.3 (St. Paul)		2004-2006	Phytoplankton; zooplankton	Reavie et al. 2010; Chick et al. 2010
LTER – Large Rivers project	NSF	Mississippi		Pool 19, 26	mid 1980s	Zooplankton	
Zebra Mussel veliger project	INHS-IRBS	Illinois		Illinois River	1994-1995	zooplankton, though only processed for veligers and D. lumholtzi? Data only available for Havana fixed site.	Stoeckel et al. 1996
GLRI Zooplankton indicators of Bigheaded carps management	INHS – IRBS/KBS	Illinois		Illinois River	2010-2023	zooplankton	Sass et al. 2010; DeBoer et al. 2018; Chara-Serna et al. 2020
USFWS zooplankton gear comparison	USFWS & UWL	Mississippi		Pool 8	2017	zooplankton	Appel et al. 2019
LTRM – Manier thesis	LTRM - USGS	Mississippi		Pools 8, 13, and 26	2006-2009	phytoplankton	Manier et al. 2021
WI DNR – drivers of cyanobacteria	WIDNR & USGS	Mississippi		Pools 5 - 8	2019	phytoplankton	Giblin & Gerrish 2020; Giblin et al. 2022
LTRM	MN DNR	Mississippi	796.9 – 752.8	Pool 4	2006-2007	Zooplankton (crustacean and rotifers)	Burdis and Hoxmeier 2011
LTRM	MN DNR	Mississippi	786-764 (L. Pepin)	Pool 4	1995-2012	Zooplankton (crustacean)	Burdis and Hirsch 2017
LTRM	MN DNR	Mississippi	786-764 (L. Pepin)	Pool 4	2012-2015	Zooplankton (rotifers)	Dawald and Burdis 2018

LTRM	MN DNR	Mississippi	786-764 (L. Pepin)	Pool 4	2012-2014	Phytoplankton	Burdis et al. 2023 Manuscript in prep
LTRM	MN DNR	Mississippi	786-764 (L. Pepin)	Pool 4	1993-2003	Zooplankton (crustacean)	Burdis and Hirsch 2005
LTRM	MDC	Mississippi and Illinois Rivers		LTRM study reaches	2019-2020	Zooplankton	Sobotka and Fulgoni ongoing
LTRM	USGS, WI DNR, MN DNR, IA DNR	Mississippi		LTRM study reaches	2005-2020	Phytoplankton	Larson et al. Ongoing
LTRM/NGWOS	USGS, INHS	Illinois River		La Grange reach and tributaries	2010-2020	Phytoplankton	Jankowski et al. ongoing
LTRM	USGS, MDC	Mississippi and Illinois Rivers		LTRM study reaches	1996-2014	Phytoplankton	Fulgoni and Jankowski
PhD thesis		Mississippi	Lawrence Lake and other sites	Pool 8	1999-2004	Phytoplankton	Decker

3.12 Aquatic ecology: river gradients – pools 14-25

The stretch of the UMR between LTRM key pools 13 and 26 is the longest un-monitored reach within the program and an area encompassing multiple large tributary inputs and the largest dam on the system (L&D 19). Several agencies are currently collecting data using LTRM fishing protocols within this extent and a variety of other data collection efforts are ongoing. It seems likely that establishing a field station focused on a single pool will not meet all the interests of program members. We propose an initial hire to explore hybrid sampling across multiple agencies and/or distributed effort for different components.

Approach – Hire a scientist to expand upon initial description of the information need to assess current data needs and design sampling plans:

1. **Clear purpose**
    a. The scientist will identify spatial and/or component gaps in current data collection over the river extent between Pool 14 to Pool 25. Doing so will involve reviewing existing reports and publications and consulting broadly across the partnership to develop a detailed plan for filling in the p13 to 26 "gap". These results will be used to identify LTRM component-based study reaches. Project results expected within approximately 2 years. Existing data on aquatic vegetation distribution may be more sparse than other components and initial field surveys to verify arial imagery/land cover surveys and identify sampling sites may be necessary.
    b. Scientist will work with current LTRM PIs, field station staff, and consult additional statistical expertise as needed to design a sampling regime for each component. Sampling locations will be identified that allow inferences across the geographic extent. Components may not necessarily cover the same spatial areas. Components may be additive to other ongoing efforts (e.g. LTEF) or roving across a subset of pools within the geographic extent.
2. **Existing data and expertise**
    a. A great deal of data is available already and data sets that are unknown to this group may exist. Individuals previously involved with planning and establishing the LTRM design may have input on historical monitoring goals that are not met with the current form of the program. The Implementation planning sub-group and other experts (e.g. current LTRM component leads) will be available to the scientist to provide access and contact information.
    b. The scientist will be expected to coordinate with agencies currently collecting data to explore opportunities to enhance current LTRM-style data collection in multiple pools and support commitments to long term data collection.
    c. HREP planning could guide study locations. Pools with a large number of HREPS planned or the potential for many HREPS could benefit the most from additional data collection.
    d. Collaboration with new hire addressing IN 3.1 Vegetation Distribution in analyzing existing vegetation data.
    e. See list at end of document.
3. **Geographic extent**
    a. UMRS Pools 14 - 25
4. **Monitoring/measurement endpoint(s)** List of existing datasets, identification of gaps in data collection, monitoring plan.
    a. Gaps in spatial/temporal coverage for LTEF fish community collection as well as availability of other fish community datasets.
    b. Availability of long-term water quality data (ex: USGS river gage superstations).
    c. Identification of areas where water quality conditions have changed or are changing significantly.

   d. Gaps/areas of high importance for water quality trends (tributary inputs causing major shifts in water quality or nutrient concentrations for example).
   e. Trends in aquatic vegetation distributions based off aerial imagery and other data sources.
   f. Hydrogeomorphic trends particular to the reach if appropriate data sources are available.
   g. **Final outcomes**: monitoring plans to evaluate fish, veg, water quality, macroinvertebrates. Methods will be pulled from LTRM manuals or equivalent.
5. **Design**
   a. Only data sets which are ongoing or can be compared to current LTRM methods will be used to design component sampling.
6. **Analyses to be completed by the scientist or considered as part of the decision-making process.**
   a. Spatial and temporal trends in the extent using LTEF fish community data and or genetic data. Like the outpool comparisons done by Chick et al 2006, these analyses will allow us to understand how data collected in one pool could allow inferences across other pools.
   b. Current status of fish community compared to other LTRM reaches.
   c. Trends in location, density, and total coverage of aquatic vegetation using non-LTRM surveys and aerial imagery.
   d. Water quality longitudinal trends and comparisons to other reaches. Some of these analyses may be completed as components of other projects (e.g., FLAMe data collection and analyses are planned under UMR Science in Support funding).
7. **Personnel needs**
   a. One LTE. PHD preferable, applied experience required. Hired through UMESC but location is preferably somewhere within pools 14 to 25 to facilitate connections with other researchers in the area and an on-the-ground understanding of travel distances, accesses, and river conditions. Location would be flexible.
      i. Estimated salary: $98,200 (Example from Illinois including 15% indirect)
      ii. Estimated salary FY23: $ 151,427 (Example from UMESC - GS11 including 57.055% indirect)
   b. This position will assist in establishing the field station (or equivalent) and could be well suited to either administer the field and science unit that develops from this effort or lead the science focused effort after unit lead has been hired.
8. **Equipment needs**
   a. Computer and office. Sporadic use of truck, trailer, and boat.

List of known data collections and field stations to be assessed by planner

1. Illinois LTEF; P25, 16-21
   a. Only in MC-B, no other methods
      i. Site WQ chemistry
2. Kibbe – 2013/14 electrofishing.
3. Iowa DNR: fish SRS (EF and Hoops) pool 16 (and 18).
4. MDC office Hannibal, MO – species based.
5. LACMRERS, IA Pool 16.
6. UMRBA CWA pilot 2021 LTRM electrofishing methods in MC Pools 18-21 – one year only
7. ACOE Lock and Dam TSS monitoring data.
8. UMRR FLAME proposal – WQ, longitudinal and across strata.
9. UMRCC veg collection (sporadic).
10. Landcover aquatic veg estimates/arial imagery. Allows some guild identification but not species specific.
11. Vital rates genetic analysis from targeted collection.
12. EMAP GRE dataset.

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4.5 (now also includes 4.1 and 4.3) Restoration Applications (revised)

NOTE: The scope information need 4.5 ("Hypothesis Testing") has been revised to build programmatic capacity to address several of the information needs contained within the section '4 – Restoration Applications'. With this revision, information needs 4.1 and 4.3 that were next up in the priority listing have been incorporated in the revised information need.

The intended purpose of this information need is to build capacity to learn from HREPs across the UMRS, resolve uncertainties regarding the ecological role of management actions (e.g., HREP features, Biological Opinion activities, NESP restoration projects, etc.) and enhance LTRM capacity to provide technical expertise as part of HREP Project Development Teams (PDT) through improved integration of LTRM and HREP expertise. To build a participatory and collaborative approach for prioritizing which hypotheses are pursued across UMRR program elements, it is envisioned that River Teams (FWWG, FWIC, RRAT), the Analysis Team, and LTRM components and field stations be actively engaged. Given the range of potential hypotheses, it is anticipated that approaches may include before-after control-impact designs, retroactive assessment of multiple actions with similar objectives, as well as investigating habitat requirements for priority species, guilds, communities, and habitat types (Table 1). The latter would likely occur outside of the footprint of any single HREP or management action to serve the purpose of expanding UMRR's capacity to design HREPs to meet specific habitat objectives not currently under consideration due to limited understanding of habitat requirements.

Table 1. Examples of different approaches that could be used to assess specific information needs and improve our understanding of controlling variables and ecological processes.

Type of approach	Example of existing information needs
Before-after control-impact	Assess how submerged features influence wave energy to enhance water clarity and improve conditions for aquatic vegetation
	Assess the effects of timber stand improvements on forest health
Retroactive assessment across projects and districts	Evaluate relative effectiveness of different measures (for example, thin layer placement, ridge swale features, burying reed canary grass, manipulation of soil composition) and other abiotic factors (for example, soil types, elevations, inundation periods) on tree survival to inform management actions in areas of forest mortality
	Assess broader fish community habitat associations in restored overwintering sites to improve understanding of how such measures influence a broader array of species beyond Centrarchid fishes.
Species-habitat relationships	Establish habitat requirements (i.e., controlling variables and thresholds) for species/guilds/habitats in greatest conservation need, such as lotic mussels, lentic fish, birds, and bats, to inform habitat design criteria

The primary cost of this information need will be personnel needs. Given the strong degree of collaboration and interaction among LTRM and HREP elements to effectively build capacity to learn from HREPs within the UMRR Program, a joint funding model with support from both LTRM and HREP is proposed. At a minimum, it is envisioned that personnel will be hired at UMESC and each of the six LTRM field stations. The primary role of the UMESC hire would be akin to existing LTRM principal investigators by providing scientific leadership in the development of robust sampling designs and analyses to test hypotheses and answer research questions. The UMESC hire would be expected to collaborate with LTRM principal investigators in this pursuit. The primary role of the field station hires would be to lead and coordinate data collection efforts within a reasonable distance from the field station. Additionally, UMESC and field stations personnel would be expected to provide technical expertise to PDTs regarding LTRM data and resources and develop a firm understanding of HREP planning processes, tools, and resources. It may be beneficial to diversify the expertise of these positions to reflect the diversity of valued resources of the UMRR partnership (for example, backgrounds in forestry, fisheries, water quality, malacology, migratory birds, ecohydrology). To further enhance capacity, it may be beneficial to consider establishing a support mechanism for USACE technical experts to provide input on science gaps that could inform HREP design, increase support for LTRM technical representatives, and/or establish support for USFWS to hire an individual within the National Wildlife Refuge System or Ecological Services Programs. The roles, responsibilities, and funding need for these positions will require further development and are not included in our cost estimation. Equipment needs likely will include boats and base LTRM equipment, some of which currently exist within field stations and other state management agency offices. Computers and office space will be required for each new hire. There will likely be additional field equipment needs; thus, an annual equipment fund could be established or equipment needs could be assessed as specific projects are developed.

Cost estimation and assumptions: The associated excel file includes a cost estimate that would need to be run through each state agency to revise and fine-tune. In this budget, it is assumed that the principal investigator would start in the first year, followed by the six field specialists in the second year. The federal position is based on step 1 salaries, 40% fringe, and 7% annual salary increase. Field station specialists, equipment, travel, and operational expenses are based on average rates and existing budgets with a 5% annual salary increase. UMESC indirect rate of 57.3% is applied and an average of 30% indirect rates for field stations is applied. Costs for new computers ($5000 each) are included for each new hire as are $5000 in travel funds. It is assumed that boats and basic sampling gear are available, but funds are included to support vehicle/boat/motor use. Specialized equipment may be needed in the future for which funding mechanisms would be needed.

Personnel	First year	Second year	Third year
Principal investigator + computer + travel	$210,404	$211,203	$219,866
Field specialists + computers + travel		$513,600	$493,200
Total	$210,404	$724,803	$713,066

Appendix 1. Macroinvertebrate proposal funded as part of the 2022 Science meeting. The work described therein is ongoing. A continuation of this work is being planned as on of the Information needs selected for funding during FY 24 – FY 26 pending sufficient funds appropriated to UMRR.

Assessing long term changes and spatial patterns in macroinvertebrates through standardized long-term monitoring

Previous LTRM project:

This is a systemic project that builds on and refines the LTRM macroinvertebrate component that was discontinued in 2004. The macroinvertebrate component sampled all six LTRM sampling pools for various periods of time from 1992-2004. The proposed project is adapted from the historic design to preserve the ability to make comparisons with historic data and improve precision around abundance estimates through strata-specific effort reallocations. Beyond inferences made through historic sampling, this proposed framework will also allow us to target additional important, but poorly characterized macroinvertebrate communities and establish baseline contaminant levels in mayflies across the program.

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Collaborators (Who else is involved in completing the project):

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Introduction/Background:

Macroinvertebrates are a key component of aquatic ecosystems, providing the predominant trophic base for a wide variety of fish and waterfowl species (Hoopes 1960, Thompson 1973). Through nutrient cycling and transfer of organic material, macroinvertebrates are a substantial driver of river ecosystem change and structure and constitute the primary consumer biomass of the UMR (Reice and Wohlenberg 1992). Recognizing the ecological significance of this group of organisms, the UMRR LTRM program conducted benthic macroinvertebrate sampling, beginning in 1991, across main channel, backwater, side channel, and impounded geomorphic strata in Pool 4, Pool 8, Pool 13, Pool 26, and Open River Reach of the Mississippi River and La Grange Reach of the Illinois River. Mayflies, midges, and fingernail clams were the primary benthic taxa quantified, although zebra mussels and Asiatic clams were added to the component soon after its start. The component was discontinued for the Open River reach in 2001 due to the lack of suitable soft-substrate habitats and despite its importance in river food web dynamics, it was discontinued for the remaining reaches after 2004 due to funding restrictions. Although the component was discontinued, its importance for answering questions regarding our river resources remains.

Changes in spatial and temporal trends in macroinvertebrate abundance reflected in the LTRM historic sampling and the mechanisms responsible not only inform macroinvertebrate abundance from this span of time, but also offers a baseline to make future comparisons in response to system-wide stressors. Despite LTRM macroinvertebrate sampling ending in 2004, the need for macroinvertebrate trend data remains to understand the impact of not only drivers of fish functional diversity and nutrient cycling, but past and new biotic and abiotic changes to the system. For instance, invasive carp began reaching high densities in the Illinois River, and portions of the UMR in the mid 2000's and some evidence suggests their high densities and resulting egestion can enrich the benthos and promote increases in benthic macroinvertebrate abundances (Yallaly et al. 2015, Collins et al. 2017). Inferences made from continued benthic sampling can help explain historic and future waterfowl use and abundance. Furthermore, in order to address a growing concern over *Hexagenia* spp. decline in response to pesticide compounds such as neonicotinoids and pyrethroids, comparison of new and historic samples will help determine the extent of decline (Bartlett et al. 2018, Moran et al. 2017, Stepanian et al. 2020). Additionally, reinstatement of the systemic macroinvertebrate component will further provide the infrastructure to conduct targeted contaminant water, sediment and tissue analysis, and genus-level tolerance values as indicators of resilience and environmental change (Steingraber and Wiener 1995, Sauer 2004), and species-level resolution for comprehensive taxonomic assessment. The LTRM benthic macroinvertebrate component was a powerful program to detect spatial and temporal trends in macroinvertebrate abundance, but continuation of the component allows us to revisit and reevaluate sampling design and component objectives for the betterment of the component while still preserving the ability to make comparisons to historic samples. One limitation of the previous LTRM protocol was the sole focus on soft-substrate and benthic taxa, which was limiting or difficult to sample in the Open River Reach compared to the other reaches. This prevented system-wide comparisons, and although benthic communities are important, have limited mobility, and react quickly to environmental change, other macroinvertebrate communities are also important and can be assessed system-wide. The EPT (Ephemeropterans, Plecopterans, Trichopterans) and amphipod taxa are adapted for life in deep, fast-moving turbid rivers (McCain et al. 2015), critical prey sources for aquatic organisms and integral to aquatic food webs and trophic structure but are poorly understood and inadequately captured in historic sampling. The addition of rock bag samplers to the LTRM framework (main channel) would allow for the detection of systemic changes in this unique community type across all 6 LTRM study reaches. Additionally, since the historic LTRM macroinvertebrate sampling design relied only on the best estimated sampling size and strata allocations in the absence of previously collected long-term macroinvertebrate data in the system, a need to understand the power to detect changes as related to sample size and design was needed (Bartsch et al. 1998). This proposal is meant to adaptively apply what we have learned and modify historic protocols to make sampling more efficient, systemic, capable of serving as a baseline to address more targeted research questions, all while still allowing direct comparisons to historic data.

This proposal's suggested baseline infrastructure accomplishes this the following ways:

1. <u>Power analysis</u> - Power analysis was conducted (Ickes unpublished) to identify sample sizes required to detect <25% annual change in abundance for the three major benthic macroinvertebrate taxa groups (mayfly nymphs, fingernail clams, midge larvae; in that order) and identify and eliminate pool-specific strata (mainly non-soft substrates) where sampling effort required to detect significant change would exceed what would feasible for sampling crews (i.e., would far exceed historic levels of sampling). This allows for re-allocation of those sites in non-informative strata to increase precision on abundance estimates in other strata while still maintaining a similar level of historic sampling effort.

2. <u>Systematism</u> – To overcome omission of the Open River reach from benthic sampling due to lack of suitable or sampleable substrates and allow for project-wide data comparisons on an important, but poorly quantified community of macroinvertebrate taxa, this proposal adds rock bag samplers. The samplers can be deployed in main-channel habitats throughout all LTRM reaches to make temporal and spatial comparisons possible program-wide. Many of the organisms that will colonize rock bag samplers serve diverse functional roles in the UMR to complement those served by those living in the soft-substrate benthos.

3. <u>Project coordination</u> - The infrastructure to support the historic project coordination is no longer in place so this proposal would fund personnel to not only coordinate system-wide sampling efforts, but also provide field and lab support to all LTRM macroinvertebrate field crews. A postdoctoral researcher or equivalent would be responsible for coordinating sampling site allocation, logistical support for data entry and curation, coordinating specimen preservation and archiving, source for to coordinate targeted research objectives among various researchers (e.g., finer taxonomic resolution, contaminant analysis, genetic analysis, diet analysis), coordinate laboratory identification, continual adaptive management, data analysis and writing to synthesize and evaluate historic and new data. This proposal also would have technicians dedicated to the project to assist all field crews with benthic and rock bag sampling as needed, assist with sample transport and laboratory coordination and sample processing.

This continuation of historic data collection and modifications to add efficiency, additional important macroinvertebrate communities, and systematism will be an important source of long-term macroinvertebrate data to further our understanding of environmental stressors and functional processes that have occurred in the Mississippi River system over the past 30+ years and into the future.
Primary objectives include:

1. LTRM macroinvertebrate sampling to detect spatial and temporal changes in macroinvertebrate abundance and allow for strata-specific comparisons to historic LTRM macroinvertebrate (1991 – 2004) trend data. This would be a 3-year initial trial with possibility of continuation after the initial evaluation period to extend into at least a 5-year program to evaluate trends. Macroinvertebrate sampling protocols and data will be assessed annually to adaptively improve design and implementation. Additionally, this component structure and sampling design can serve to address current and future research objectives and questions, such as *Hexagenia* radar validation, effects of invasive carp benthic enrichment, waterfowl trends in abundance, macroinvertebrate response to climate change, improving water quality, geomorphic changes and sedimentation, and effects of pesticides on benthic macroinvertebrate communities.

2. Add a systemic component (rock bag samplers/plate samplers) to sample main-channel colonizer communities (predominantly EPT and amphipods) allowing for data collection on this important but poorly characterized community and to allow for program-wide comparisons to complement the historic benthic sampling.

3. Provide systemic species-level taxonomic resolution for the first year of the study to develop macroinvertebrate biological indices that can be beneficial to characterize the community and its current status and resilience to system degradation.

4. Determine contaminant levels of polycyclic aromatic hydrocarbons (PAHs), neonicotinoids, pyrethroids and other current-use pesticides in burrowing mayfly tissue during years one and two of the study.

Relevance of research to UMRR:

The proposed work would support multiple goals and objectives of the UMRR and partnering agencies including:
This is a systemic program including all 6 LTRM reaches and partially fills a critical gap in our understanding of Mississippi River ecology.

1. This project will fill information gaps identified in the Focal Areas document under subarea 5.2: *Better understand the mechanisms behind observed changes in fish populations and implications for UMRS ecosystem and management.* This project also supports overall LTRM goals to "*Develop a better understanding of the Upper Mississippi River System and its resource problems*" and to "*Monitor resource change*" (e.g., comparison of 1992-2000 data to 2019-2021 data). As part of the ongoing UMRR resilience assessment, a draft manuscript has been developed as part of the resilience assessment that describes alternative regimes that are thought to occur in the UMRS. One set of regimes describes transitions between a diverse, native fish community and an invasive-dominated fish community (Bouska et al. *in prep*). Further, feedbacks that are thought to maintain the regimes are described. One of the types of feedback that is hypothesized to maintain an invasive-dominant fish community involves the role of bigheaded carp in altering trophic pathways. Based on observations from experimental studies, it is hypothesized that a bigheaded carp dominance may have resulted in a shift in the abundance of benthic invertebrates in the lower Illinois River consistent with results outlined by Yallaly et al. (2015) and Collins and Wahl (2017). Results provided by this proposed work will help inform whether the mechanisms observed in experimental studies play out in a complex and dynamic river system. Specifically, this project aims to answer the question: have bigheaded carp led to a shift from pelagic planktonic food resources to benthic food resources resulting in the potential benefit of benthic macroinvertebrates? As conceptual models concerning ecosystem resilience and regime shifts are developed, having scientifically valid data to support and validate ecological mechanisms is of vital importance.

2. Provide critical information needed to better understand the functional diversity of the system by including a critical, but largely absent trophic base (i.e. benthic and colonizing macroinvertebrates) and their resulting ecological impact that would be beneficial for a multitude of agencies (including but not limited to: INHS, IL DNR, MDC, IA DNR, MN DNR, WI DNR, USGS, FWS, USACE) to help make informed decisions about our river resources.

Methods:

Benthic sampling:

The LTRM macroinvertebrate component protocols outlined by Thiel and Sauer (1999) would be introduced on the La Grange Reach from May 1 – June 14 for upper three reaches and April 1 – June 1 for Pool 26 and La Grange) from 2023-2025 (three-year initial trial with annual evaluation and adjustment as needed). The protocol would be modified to include only pool-specific, soft-substrate strata that are capable of detecting a <25% annual change based on reasonable and similar sampling effort that was conducted in 2004 (~120+ sites). These strata vary between reaches, consisting of backwater and impounded strata in the upper three reaches, main-channel and backwater in the La Grange Reach, and impounded and side channel in Pool 26 (Table 1). Alternative sampling strategies for Open River reach will be explored. All other methods outlined in Thiel and Sauer (1999) will followed to maintain consistency with historic LTRM sampling. The number and allocation of benthic samples would vary between reach and strata (Table 1). Using a Ponar Grab sampler, benthic samples would be collected from the substrate, excess substrate and debris cleared and macroinvertebrates then picked from the sample and jugged in the field with no identification or enumeration conducted in the field, but all other data recorded following methods outlined by Theil and Sauer (1999). This is a deviation from methods used in historic LTRM macroinvertebrate collections as all sample picking and enumeration was conducted in the field during that component. This modification would alleviate excessive field processing but should have no impact on comparisons to historic sampling.

Table 1. Benthic and rock bag sampler effort across RTA and strata. Sample sizes established to detect <25% annual change in mayfly abundance.

	BW	IMP	SC	MC	Total sites	MC (rock bags/paired Hester Dendy)
Pool 4	57	64	0	0	121	25
Pool 8	43	66	0	0	109	25
Pool 13	72	46	0	0	118	25
Pool 26	0	60	51	0	111	25
Open River	0	0	0	0	0	25
La Grange	69	0	0	50	119	25

New macroinvertebrate collections would allow for direct comparisons between existing LTRM data (1992-2002) and newly collected data (2023-2025) to assess long-term spatial and temporal trends in macroinvertebrate abundance. The benthic samples will primarily focus on changes in burrowing mayfly nymphs, fingernail clams, and midge larvae abundance. Results will better inform UMRR Resilience efforts.

Rock bag samplers:

Rock bag/paired plate samplers (see McCain et al. 2015) will be deployed at randomly generated sites (n=25 per pool) in main-channel border strata of all 6 RTAs. Samplers will be deployed according to McCain et al. (2015) in the month of May and will remain submerged at each site for approximately 6 weeks. Upon retrieval of the samples, all organisms will be rinsed from rocks on sieve and sluice table using methods similar to Theil and Sauer (1999). All organisms will be preserved in 70% ethanol unless other downstream research objectives require special collection (e.g., genomic or contaminant analysis) and returned to the Illinois River Biological Station for further processing. The first two years, species-level taxonomic resolution will be pursued to develop a comprehensive species assessment of the UMR macroinvertebrate biological index to assess system health and resiliency. Sample identification and enumeration will be performed by Rithron Associates, Inc. and/or UW-La Crosse ($50,000 per year) during first year. After initial one year of species-level resolution, abundances will be sorted by coarser informational taxonomic groups Family/Genus) and be conducted by dedicated Illinois River Biological Station technicians.

Screening level mayfly tissue analysis:

Upon the conclusion of the benthic sampling effort of the first study year, the five sites with the greatest abundance of burrowing mayflies will be identified. The most abundant mayfly sites will be chosen to optimize capture efficiency and collect sufficient numbers of mayflies required for contaminant analysis. Among these five sites, three sites will be selected to represent the largest geographic distribution within each pool for tissue analysis. A suction dredge will be utilized at these three sites per pool to collect burrowing mayflies (25-30 g) for screening level mayfly tissue contaminant analysis. Mayflies will be frozen until delivery for laboratory analysis. Mayfly tissue will be analyzed to quantify body burden of PAHs, current use pesticides and neonicotinoid insecticides at SGS AXYS Analytical Services Ltd. ($45,414 in year one). Post-extraction tissue samples will be split at SGS AXYS and 0.5 of the extract will be sent to US EPA (Athens, GA) for quantification of additional analytes. Following year one screening level analysis, more focused mayfly tissue analysis, for compounds of interest, will be conducted in year two based on the screening level analysis conducted in year one ($20,000 in year two).

Data management procedures

All SRS sampling locations will be generated by USGS-UMESC (Jason Rohweder), and field data will be collected through the macroinvertebrate database app produced USGS-UMESC (Ben Schlifer). All field stations will send data through exported database app to project coordinator at the Illinois River Biological Station. Database app entries will be completed at the Illinois River Biological Station after all samples have been processed. Data and associated metadata will be preserved in the Illinois River Biological Station database and be archived and made available directly to field stations involved in the collection. After internal and external QA of data, data will be archived and made publicly available through UMESC LTRM server.

Special needs/considerations, if any:

Funding for annual salary and benefits of one postdoctoral researcher and two-technicians will be required for field and laboratory processing of samples, analysis of data, project coordination, and writing. Funding would also be needed for laboratory supplies outlined by Theil and Sauer (1999), travel expenses, publication costs and consulting fees for species-level identification during the first year of the project. Contracted work through Rithron or UW-La Crosse can be established through purchase order or subaward through University of Illinois. (See attached budget for details)

Field station in-kind commitments:

MNDNR – 2 people at 200 hours each
WIDNR – 1 person at 200 hours
IADNR – 2 people at 200 hours each
INHS GRFS – 2 people at 200 hours each
INHS IRBS – 3 people at 200 hours each
MDC – 2 people at 200 hours each

Timeline:

April 1- June 14, 2023-2025: Field collection of macroinvertebrates following established protocols outlined by Theil and Sauer (1999) and McCain et al. (2015).

July 1- April 30, 2023-2025: Laboratory identification of any macroinvertebrates. This would include sending specimens for expert identification and verification.

July 2023-September 26, 2025: Data analysis and completion of, at minimum, draft LTRM completion report. Peer reviewed publication to be pursued at discretion of PI, collaborators, and UMRR personnel.

Expected milestones and products [with completion dates]:

A UMRR LTRM completion report is expected from data collected and analyzed by this project, and completion of a draft of this report is expected by September of 2026. In addition, results of this project will be presented at both state, local, and national conferences. Peer reviewed publications describing the differences in the macroinvertebrate community in response to environmental changes and those focusing on more targeted research objectives will be pursued from 2023-2025+. Data will also directly support the ongoing Resilience project by validating conceptual models developed and will be available to inform future resiliency efforts pursued by UMRR.

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ATTACHMENT F

Additional Items

- Future Meeting Schedule (*F-1)*
- Frequently Used Acronyms (4-29-2022) *(F-2 to F-8)*
- UMRR Authorization, As Amended (12/23/2022) *(F-9 to (F-12)*
- UMRR (EMP) Operating Approach (5/2006) *(F-13)*

QUARTERLY MEETINGS
FUTURE MEETING SCHEDULE

OCTOBER 2023	
St. Louis, MO	
October 24	UMRBA Quarterly Meeting
October 25	UMRR Coordinating Committee Quarterly Meeting

FEBRUARY 2024	
Virtual	
February 27	UMRBA Quarterly Meeting
February 28	UMRR Coordinating Committee Quarterly Meeting

Acronyms Frequently Used on the Upper Mississippi River System

AAR	After Action Report
A&E	Architecture and Engineering
ACRCC	Asian Carp Regional Coordinating Committee
AFB	Alternative Formulation Briefing
AHAG	Aquatic Habitat Appraisal Guide
AHRI	American Heritage Rivers Initiative
AIS	Aquatic Invasive Species
ALC	American Lands Conservancy
ALDU	Aquatic Life Designated Use(s)
AM	Adaptive Management
ANS	Aquatic Nuisance Species
AP	Advisory Panel
APE	Additional Program Element
ARRA	American Recovery and Reinvestment Act
ASA(CW)	Assistant Secretary of the Army for Civil Works
A-Team	Analysis Team
ATR	Agency Technical Review
AWI	America's Watershed Initiative
AWO	American Waterways Operators
AWQMN	Ambient Water Quality Monitoring Network
BA	Biological Assessment
BATIC	Build America Transportation Investment Center
BCOES	Bid-ability, Constructability, Operability, Environmental, Sustainability
BCR	Benefit-Cost Ratio
BMPs	Best Management Practices
BO	Biological Opinion
CAP	Continuing Authorities Program
CAWS	Chicago Area Waterways System
CCC	Commodity Credit Corporation
CCP	Comprehensive Conservation Plan
CEICA	Cost Effectiveness Incremental Cost Analysis
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CFS	Cubic Feet Per Second
CG	Construction General
CIA	Computerized Inventory and Analysis
CMMP	Channel Maintenance Management Plan
COE	Corps of Engineers
COPT	Captain of the Port
CPUE	Catch Per Unit Effort
CRA	Continuing Resolution Authority
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program

CSP	Conservation Security Program
CUA	Cooperative Use Agreement
CWA	Clean Water Act
CY	Cubic Yards
DALS	Department of Agriculture and Land Stewardship
DED	Department of Economic Development
DEM	Digital Elevation Model
DET	District Ecological Team
DEWS	Drought Early Warning System
DMMP	Dredged Material Management Plan
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DOA	Department of Agriculture
DOC	Department of Conservation
DOER	Dredging Operations and Environmental Research
DOT	Department of Transportation
DPR	Definite Project Report
DQC	District Quality Control/Quality Assurance
DSS	Decision Support System
EA	Environmental Assessment
ECC	Economics Coordinating Committee
EEC	Essential Ecosystem Characteristic
EIS	Environmental Impact Statement
EMAP	Environmental Monitoring and Assessment Program
EMAP-GRE	Environmental Monitoring and Assessment Program-Great Rivers Ecosystem
EMP	Environmental Management Program [Note: Former name of Upper Mississippi River Restoration Program.]
EMP-CC	Environmental Management Program Coordinating Committee
EO	Executive Order
EPA	Environmental Protection Agency
EPM	Environmental Pool Management
EPR	External Peer Review
EQIP	Environmental Quality Incentives Program
ER	Engineering Regulation
ERDC	Engineering Research & Development Center
ESA	Endangered Species Act
EWMN	Early Warning Monitoring Network
EWP	Emergency Watershed Protection Program
FACA	Federal Advisory Committee Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FDR	Flood Damage Reduction
FFS	Flow Frequency Study
FMG	Forest Management Geodatabase
FONSI	Finding of No Significant Impact
FRM	Flood Risk Management

FRST	Floodplain Restoration System Team
FSA	Farm Services Agency
FTE	Full Time Equivalent
FWCA	Fish & Wildlife Coordination Act
FWIC	Fish and Wildlife Interagency Committee
FWS	Fish and Wildlife Service
FWWG	Fish and Wildlife Work Group
FY	Fiscal Year
GAO	Government Accountability Office
GEIS	Generic Environmental Impact Statement
GI	General Investigations
GIS	Geographic Information System
GLC	Governors Liaison Committee
GLC	Great Lakes Commission
GLMRIS	Great Lakes and Mississippi River Interbasin Study
GPS	Global Positioning System
GREAT	Great River Environmental Action Team
GRP	Geographic Response Plan
H&H	Hydrology and Hydraulics
HAB	Harmful Algal Bloom
HEC-EFM	Hydrologic Engineering Center Ecosystems Function Model
HEC-RAS	Hydrologic Engineering Center River Analysis System
HEL	Highly Erodible Land
HEP	Habitat Evaluation Procedure
HNA	Habitat Needs Assessment
HPSF	HREP Planning and Sequencing Framework
HQUSACE	Headquarters, USACE
H.R.	House of Representatives
HREP	Habitat Rehabilitation and Enhancement Project
HSI	Habitat Suitability Index
HU	Habitat Unit
HUC	Hydrologic Unit Code
IBA	Important Bird Area
IBI	Index of Biological (Biotic) Integrity
IC	Incident Commander
ICS	Incident Command System
ICWP	Interstate Council on Water Policy
IDIQ	Indefinite Delivery/Indefinite Quantity
IEPR	Independent External Peer Review
IGE	Independent Government Estimate
IIA	Implementation Issues Assessment
IIFO	Illinois-Iowa Field Office (formerly RIFO - Rock Island Field Office)
ILP	Integrated License Process
IMTS	Inland Marine Transportation System
IPR	In-Progress Review
IRCC	Illinois River Coordinating Council

IRPT	Inland Rivers, Ports & Terminals
IRTC	Implementation Report to Congress
IRWG	Illinois River Work Group
ISA	Inland Sensitivity Atlas
IWR	Institute for Water Resources
IWRM	Integrated Water Resources Management
IWS	Integrated Water Science
IWTF	Inland Waterways Trust Fund
IWUB	Inland Waterways Users Board
IWW	Illinois Waterway
L&D	Lock(s) and Dam
LC/LU	Land Cover/Land Use
LDB	Left Descending Bank
LERRD	Lands, Easements, Rights-of-Way, Relocation of Utilities or Other Existing Structures, and Disposal Areas
LiDAR	Light Detection and Ranging
LMR	Lower Mississippi River
LMRCC	Lower Mississippi River Conservation Committee
LOI	Letter of Intent
LTRM	Long Term Resource Monitoring
M-35	Marine Highway 35
MAFC	Mid-America Freight Coalition
MARAD	U.S. Maritime Administration
MARC 2000	Midwest Area River Coalition 2000
MCAT	Mussel Community Assessment Tool
MICRA	Mississippi Interstate Cooperative Resource Association
MDM	Major subordinate command Decision Milestone
MIPR	Military Interdepartmental Purchase Request
MMR	Middle Mississippi River
MMRP	Middle Mississippi River Partnership
MNRG	Midwest Natural Resources Group
MOA	Memorandum of Agreement
MoRAST	Missouri River Association of States and Tribes
MOU	Memorandum of Understanding
MRAPS	Missouri River Authorized Purposes Study
MRBI	Mississippi River Basin (Healthy Watersheds) Initiative
MRC	Mississippi River Commission
MRCC	Mississippi River Connections Collaborative
MRCTI	Mississippi River Cities and Towns Initiative
MRRC	Mississippi River Research Consortium
MR&T	Mississippi River and Tributaries (project)
MSP	Minimum Sustainable Program
MVD	Mississippi Valley Division
MVP	St. Paul District
MVR	Rock Island District
MVS	St. Louis District

NAS	National Academies of Science
NAWQA	National Water Quality Assessment
NCP	National Contingency Plan
NIDIS	National Integrated Drought Information System (NOAA)
NEBA	Net Environmental Benefit Analysis
NECC	Navigation Environmental Coordination Committee
NED	National Economic Development
NEPA	National Environmental Policy Act
NESP	Navigation and Ecosystem Sustainability Program
NETS	Navigation Economic Technologies Program
NGO	Non-Governmental Organization
NGRREC	National Great Rivers Research and Education Center
NGWOS	Next Generation Water Observing System
NICC	Navigation Interests Coordinating Committee
NPDES	National Pollution Discharge Elimination System
NPS	Non-Point Source
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRDAR	Natural Resources Damage Assessment and Restoration
NRT	National Response Team
NSIP	National Streamflow Information Program
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O&M	Operation and Maintenance
OHWM	Ordinary High Water Mark
OMB	Office of Management and Budget
OMRR&R	Operation, Maintenance, Repair, Rehabilitation, and Replacement
OPA	Oil Pollution Act of 1990
ORSANCO	Ohio River Valley Water Sanitation Commission
OSC	On-Scene Coordinator
OSE	Other Social Effects
OSIT	On Site Inspection Team
P3	Public-Private Partnerships
PA	Programmatic Agreement
PAS	Planning Assistance to States
P&G	Principles and Guidelines
P&R	Principles and Requirements
P&S	Plans and Specifications
P&S	Principles and Standards
PCA	Pollution Control Agency
PCA	Project Cooperation Agreement
PCX	Planning Center of Expertise
PDT	Project Delivery Team
PED	Preconstruction Engineering and Design
PgMP	Program Management Plan

PILT	Payments In Lieu of Taxes
PIR	Project Implementation Report
PL	Public Law
PMP	Project Management Plan
PORT	Public Outreach Team
PPA	Project Partnership Agreement
PPT	Program Planning Team
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RCP	Regional Contingency Plan
RCPP	Regional Conservation Partnership Program
RDB	Right Descending Bank
RED	Regional Economic Development
RIFO	Rock Island Field Office (now IIFO - Illinois-Iowa Field Office)
RM	River Mile
RP	Responsible Party
RPEDN	Regional Planning and Environment Division North
RPT	Reach Planning Team
RRAT	River Resources Action Team
RRCT	River Resources Coordinating Team
RRF	River Resources Forum
RRT	Regional Response Team
RST	Regional Support Team
RTC	Report to Congress
S.	Senate
SAV	Submersed Aquatic Vegetation
SDWA	Safe Drinking Water Act
SEMA	State Emergency Management Agency
SET	System Ecological Team
SMART	Specific, Measurable, Attainable, Risk Informed, Timely
SONS	Spill of National Significance
SOW	Scope of Work
SRF	State Revolving Fund
SWCD	Soil and Water Conservation District
T&E	Threatened and Endangered
TEUs	twenty-foot equivalent units
TIGER	Transportation Investment Generating Economic Recovery
TLP	Traditional License Process
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TSP	Tentatively selected plan
TSS	Total Suspended Solids
TVA	Tennessee Valley Authority
TWG	Technical Work Group
UMESC	Upper Midwest Environmental Sciences Center

UMIMRA	Upper Mississippi, Illinois, and Missouri Rivers Association
UMR	Upper Mississippi River
UMRBA	Upper Mississippi River Basin Association
UMRBC	Upper Mississippi River Basin Commission
UMRCC	Upper Mississippi River Conservation Committee
UMRCP	Upper Mississippi River Comprehensive Plan
UMR-IWW	Upper Mississippi River-Illinois Waterway
UMRNWFR	Upper Mississippi River National Wildlife and Fish Refuge
UMRR	Upper Mississippi River Restoration Program [Note: Formerly known as Environmental Management Program.]
UMRR CC	Upper Mississippi River Restoration Program Coordinating Committee
UMRS	Upper Mississippi River System
UMWA	Upper Mississippi Waterway Association
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VTC	Video Teleconference
WCI	Waterways Council, Inc.
WES	Waterways Experiment Station (replaced by ERDC)
WHAG	Wildlife Habitat Appraisal Guide
WHIP	Wildlife Habitat Incentives Program
WIIN	Water Infrastructure Improvements for the Nation Act
WLM	Water Level Management
WLMTF	Water Level Management Task Force
WQ	Water Quality
WQEC	Water Quality Executive Committee
WQTF	Water Quality Task Force
WQS	Water Quality Standard
WRDA	Water Resources Development Act
WRP	Wetlands Reserve Program
WRRDA	Water Resources Reform and Development Act

Upper Mississippi River Restoration Program Authorization

Section 1103 of the Water Resources Development Act of 1986 (P.L. 99-662) as amended by
Section 405 of the Water Resources Development Act of 1990 (P.L. 101-640),
Section 107 of the Water Resources Development Act of 1992 (P.L. 102-580),
Section 509 of the Water Resources Development Act of 1999 (P.L. 106-53),
Section 2 of the Water Resources Development Technical Corrections of 1999 (P.L. 106-109),
Section 3177 of the Water Resources Development Act of 2007 (P.L. 110-114),
Section 307 of the Water Resources Development Act of 2020 (P.L. 116-260), and
Section 8345 of the Water Resources Development Act of 2022 (P.L. 117-263).

Additional Cost Sharing Provisions

Section 906(e) of the Water Resources Development Act of 1986 (P.L. 99-662) as amended by
Section 221 of the Water Resources Development Act of 1999 (P.L. 106-53).

SEC. 1103. UPPER MISSISSIPPI RIVER PLAN.

(a)(1) This section may be cited as the "Upper Mississippi River Management Act of 1986".

(2) To ensure the coordinated development and enhancement of the Upper Mississippi River system, it is hereby declared to be the intent of Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system. Congress further recognizes that the system provides a diversity of opportunities and experiences. The system shall be administered and regulated in recognition of its several purposes.

(b) For purposes of this section --

(1) the terms "Upper Mississippi River system" and "system" mean those river reaches having commercial navigation channels on the Mississippi River main stem north of Cairo, Illinois; the Minnesota River, Minnesota; Black River, Wisconsin; Saint Croix River, Minnesota and Wisconsin; Illinois River and Waterway, Illinois; and Kaskaskia River, Illinois;

(2) the term "Master Plan" means the comprehensive master plan for the management of the Upper Mississippi River system, dated January 1, 1982, prepared by the Upper Mississippi River Basin Commission and submitted to Congress pursuant to Public Law 95-502;

(3) the term "GREAT I, GREAT II, and GRRM studies" means the studies entitled "GREAT Environmental Action Team--GREAT I--A Study of the Upper Mississippi River", dated September 1980, "GREAT River Environmental Action Team--GREAT II--A Study of the Upper Mississippi River", dated December 1980, and "GREAT River Resource Management Study", dated September 1982; and

(4) the term "Upper Mississippi River Basin Association" means an association of the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, formed for the purposes of cooperative effort and united assistance in the comprehensive planning for the use, protection, growth, and development of the Upper Mississippi River System.

(c)(1) Congress hereby approves the Master Plan as a guide for future water policy on the Upper Mississippi River system. Such approval shall not constitute authorization of any recommendation contained in the Master Plan.

(2) Section 101 of Public Law 95-502 is amended by striking out the last two sentences of subsection (b), striking out subsection (i), striking out the final sentence of subsection (j), and redesignating subsection "(j)" as subsection "(i)".

(d)(1) The consent of the Congress is hereby given to the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, or any two or more of such States, to enter into negotiations for agreements, not in conflict with any law of the United States, for cooperative effort and mutual assistance in the comprehensive planning for the use, protection, growth, and development of the Upper Mississippi River system, and to establish such agencies, joint or otherwise, or designate an existing multi-State entity, as they may deem desirable for making effective such agreements. To the extent required by Article I, section 10 of the Constitution, such agreements shall become final only after ratification by an Act of Congress.

(2) The Secretary is authorized to enter into cooperative agreements with the Upper Mississippi River Basin Association or any other agency established under paragraph (1) of this subsection to promote and facilitate active State government participation in the river system management, development, and protection.

(3) For the purpose of ensuring the coordinated planning and implementation of programs authorized in subsections (e) and (h)(2) of this section, the Secretary shall enter into an interagency agreement with the Secretary of the Interior to provide for the direct participation of, and transfer of funds to, the Fish and Wildlife Service and any other agency or bureau of the Department of the Interior for the planning, design, implementation, and evaluation of such programs.

(4) The Upper Mississippi River Basin Association or any other agency established under paragraph (1) of this subsection is hereby designated by Congress as the caretaker of the master plan. Any changes to the master plan recommended by the Secretary shall be submitted to such association or agency for review. Such association or agency may make such comments with respect to such recommendations and offer other recommended changes to the master plan as such association or agency deems appropriate and shall transmit such comments and other recommended changes to the Secretary. The Secretary shall transmit such recommendations along with the comments and other recommended changes of such association or agency to the Congress for approval within 90 days of the receipt of such comments or recommended changes.

(e) Program Authority

(1) Authority

(A) In general. The Secretary, in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, may undertake, as identified in the master plan

(i) a program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement; and

(ii) implementation of a long-term resource monitoring, computerized data inventory and analysis, and applied research program, including research on water quality issues affecting the Mississippi River (including elevated nutrient levels) and the development of remediation strategies.

(B) Advisory committee. In carrying out subparagraph (A)(i), the Secretary shall establish an independent technical advisory committee to review projects, monitoring plans, and habitat and natural resource needs assessments.

(2) REPORTS. — Not later than December 31, 2004, and not later than December 31 of every sixth year thereafter, the Secretary, in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, shall submit to Congress a report that —

(A) contains an evaluation of the programs described in paragraph (1);

(B) describes the accomplishments of each of the programs;

(C) provides updates of a systemic habitat needs assessment; and

(D) identifies any needed adjustments in the authorization of the programs.

(3) For purposes of carrying out paragraph (1)(A)(i) of this subsection, there is authorized to be appropriated to the Secretary $75,000,000 for fiscal year 1999 and each fiscal year thereafter.

(4) For purposes of carrying out paragraph (1)(A)(ii) of this subsection, there is authorized to be appropriated to the Secretary $15,000,000 for fiscal year 1999 and each fiscal year thereafter.

(5) Authorization of appropriations.—There is authorized to be appropriated to carry out paragraph (1)(B) $350,000 for each of fiscal years 1999 through 2009.

(6) Transfer of amounts.—For fiscal year 1999 and each fiscal year thereafter, the Secretary, in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, may transfer not to exceed 20 percent of the amounts appropriated to carry out clause (i) or (ii) of paragraph (1)(A) to the amounts appropriated to carry out the other of those clauses.

(7)(A) Notwithstanding the provisions of subsection (a)(2) of this section, the costs of each project carried out pursuant to paragraph (1)(A)(i) of this subsection shall be allocated between the Secretary and the appropriate non-Federal sponsor in accordance with the provisions of section 906(e) of this Act; except that the costs of operation and maintenance of projects located on Federal lands or lands owned or operated by a State or local government shall be borne by the Federal, State, or local agency that is responsible for management activities for fish and wildlife on such lands and, in the case of any project requiring non-Federal cost sharing, the non-Federal share of the cost of the project shall be 35 percent.

(B) Notwithstanding the provisions of subsection (a)(2) of this section, the cost of implementing the activities authorized by paragraph (1)(A)(ii) of this subsection shall be allocated in accordance with the provisions of section 906 of this Act, as if such activity was required to mitigate losses to fish and wildlife.

(8) None of the funds appropriated pursuant to any authorization contained in this subsection shall be considered to be chargeable to navigation.

(f) (1) The Secretary, in consultation with any agency established under subsection (d)(1) of this section, is authorized to implement a program of recreational projects for the system substantially in accordance with the recommendations of the GREAT I, GREAT II, and GRRM studies and the master plan reports. In addition, the Secretary, in consultation with any such agency, shall, at Federal expense, conduct an assessment of the economic benefits generated by recreational activities in the system. The cost of each such project shall be allocated between the Secretary and the appropriate non-Federal sponsor in accordance with title I of this Act.

(2) For purposes of carrying out the program of recreational projects authorized in paragraph (1) of this subsection, there is authorized to be appropriated to the Secretary not to exceed $500,000 per fiscal year for each of the first 15 fiscal years beginning after the effective date of this section.

(g) The Secretary shall, in his budget request, identify those measures developed by the Secretary, in consultation with the Secretary of Transportation and any agency established under subsection (d)(1) of this section, to be undertaken to increase the capacity of specific locks throughout the system by employing nonstructural measures and making minor structural improvements.

(h)(1) The Secretary, in consultation with any agency established under subsection (d)(1) of this section, shall monitor traffic movements on the system for the purpose of verifying lock capacity, updating traffic projections, and refining the economic evaluation so as to verify the need for future capacity expansion of the system.

(2) Determination.

(A) In general. The Secretary in consultation with the Secretary of the Interior and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, shall determine the need for river rehabilitation and environmental enhancement and protection based on the condition of the environment, project developments, and projected environmental impacts from implementing any proposals resulting from recommendations made under subsection (g) and paragraph (1) of this subsection.

(B) Requirements. The Secretary shall

(i) complete the ongoing habitat needs assessment conducted under this paragraph not later than September 30, 2000; and

(ii) include in each report under subsection (e)(2) the most recent habitat needs assessment conducted under this paragraph.

(3) There is authorized to be appropriated to the Secretary such sums as may be necessary to carry out this subsection.

(i) (1) The Secretary shall, as he determines feasible, dispose of dredged material from the system pursuant to the recommendations of the GREAT I, GREAT II, and GRRM studies.

(2) The Secretary shall establish and request appropriate Federal funding for a program to facilitate productive uses of dredged material. The Secretary shall work with the States which have, within their boundaries, any part of the system to identify potential users of dredged material.

(j) The Secretary is authorized to provide for the engineering, design, and construction of a second lock at locks and dam 26, Mississippi River, Alton, Illinois and Missouri, at a total cost of $220,000,000, with a first Federal cost of $220,000,000. Such second lock shall be constructed at or in the vicinity of the location of the replacement lock authorized by section 102 of Public Law 95-502. Section 102 of this Act shall apply to the project authorized by this subsection.

SEC. 906(e). COST SHARING.

(e) In those cases when the Secretary, as part of any report to Congress, recommends activities to enhance fish and wildlife resources, the first costs of such enhancement shall be a Federal cost when--

(1) such enhancement provides benefits that are determined to be national, including benefits to species that are identified by the National Marine Fisheries Service as of national economic importance, species that are subject to treaties or international convention to which the United States is a party, and anadromous fish;

(2) such enhancement is designed to benefit species that have been listed as threatened or endangered by the Secretary of the Interior under the terms of the Endangered Species Act, as amended (16 U.S.C. 1531, et seq.), or

(3) such activities are located on lands managed as a national wildlife refuge.

When benefits of enhancement do not qualify under the preceding sentence, 25 percent of such first costs of enhancement shall be provided by non-Federal interests under a schedule of reimbursement determined by the Secretary. Not more than 80 percent of the non-Federal share of such first costs may be satisfied through in-kind contributions, including facilities, supplies, and services that are necessary to carry out the enhancement project. The non-Federal share of operation, maintenance, and rehabilitation of activities to enhance fish and wildlife resources shall be 25 percent.

EMP OPERATING APPROACH

2006 marks the 20th anniversary of the Environmental Management Program (EMP). During that time, the Program pioneered many new ideas to help deliver efficient and effective natural resource programs to the Upper Mississippi River System (UMRS). These included the creation of an effective partnership of five states, five federal agencies, and numerous NGOs; a network of six field stations monitoring the natural resources of the UMRS; and the administrative structure to encourage river managers to use both new and proven environmental restoration techniques.

EMP has a history of identifying and dealing with both natural resource and administrative challenges. The next several years represent new opportunities and challenges as Congress considers authorization of the Navigation and Environmental Sustainability Program (NESP), possible integration or merger of EMP with NESP, and changing standards for program management and execution.

We will continue to learn from both the history of EMP and experience of other programs. Charting a course for EMP over the next several years is important to the continued success of the Program. EMP will focus on the key elements of partnership, regional administration and coordination, LTRMP, and HREPs.

The fundamental focus of EMP will not change, however the way we deliver our services must change and adapt. This will include:

- further refinements in regional coordination and management,
- refinement of program goals and objectives,
- increased public outreach efforts,
- development and use of tools such as the regional HREP database and HREP Handbook,
- exploring new delivery mechanisms for contracting,
- continued refinement of the interface between LTRMP and the HREP program components, and
- scientific and management application of LTRMP information and data.

The focus of these efforts must benefit the resources of the UMRS through efficient and effective management.