Sustainable Rivers Program

In Progress Review

FY 2022

US Army Corps of Engineers

The Nature Conservancy

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Prepared for U.S. Army Corps of Engineers, The Nature Conservancy, and other organizations involved with Sustainable Rivers

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Overview

The Sustainable Rivers Program (SRP) is a national partnership between the U.S. Army Corps of Engineers (USACE) and The Nature Conservancy (TNC). The mission of SRP is to improve the health and life of rivers by changing dam operations to restore and protect ecosystems, while maintaining or enhancing authorized uses and other project benefits.

SRP began in 1998 with an initial collaboration to improve the ecological condition of Green River, Kentucky. The Program was formally established in 2002 and involved 8 river systems. At the end of FY 2022, SRP involved work in 23 USACE Districts and 7 Divisions. Individual projects affect 90+ USACE reservoirs in 44 river systems affecting approximately 12,069 river miles (Figure 1, Status of rivers engaged in the Sustainable Rivers Program at end of FY 2022). It is the largest scale and most comprehensive program for implementing environmental flows (e-flows) below USACE reservoirs and is growing. Five new rivers were engaged in FY 2022, including the Chattahoochee River, Gila River, Salt River, Trinity River, and Wabash River and several new "special projects" were engaged including the USACE Tribal Nations Technical Center of Expertise (TNTCX) Tule River Restoration Alliance and the USACE Engineering Research Development Center's (ERDC) test application of Climate Informed Reservoir Operations (CIRO) at Lewisville and Ray Roberts dams on the Trinity River, Texas.

Figure 1. Status of rivers engaged in the Sustainable Rivers Program at end of FY 2022.

E-flows are defined as the quantity, timing, and quality of water flows required to sustain ecosystems. For reservoir operators, e-flows manifest as management decisions that manipulate water and land-water interactions to achieve ecological or environmental goals.

SRP multi-step process for e-flows has three key phases: "advance, implement and incorporate" *(Figure 2, Sustainable Rivers Program Location-based Process).* Advancing e-flows involves engaging stakeholders in a science-based process to define the flow needs of riverine ecosystems. Implementation involves testing the effectiveness and feasibility of the defined flows. Incorporation involves including e-flow strategies in reservoir operations policy such as water control manuals.

Searching for e-flow opportunities at General multiple purpose reservoirs with storage space for flood risk management and other conservation purposes was the founding objective of SRP and remains the key focus. In recent years, the Program began exploring other reservoir-oriented actions with potential to produce environmental benefits. SRP initiatives have expanded to explore opportunities for pool level management and related environmental improvements strategies at lock and dam projects, and for actions to modify the land/water interface at dry dam projects to provide environmental benefits.

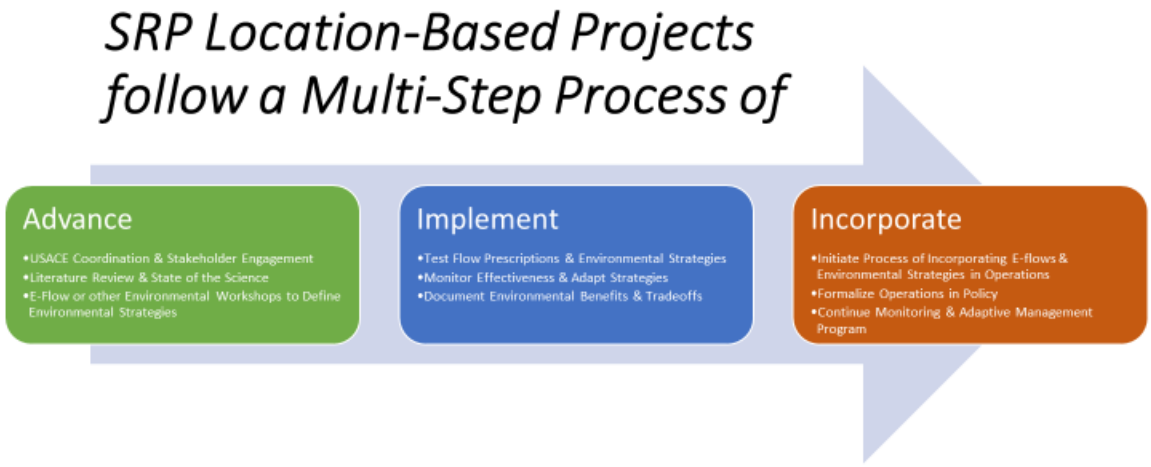

Figure 2. Sustainable Rivers Program Location-based Process.

As in previous years, SRP funds will be used to accomplish a combination of programmatic and site work in accordance with the following principles: 1) build capacity within the water management community to implement environmental strategies with little or no direct funding from SRP; 2) engage partners to focus on sustainability and avoid conflict; and 3) advance innovative efforts to implement environmental strategies.

In broad terms, programmatic work focuses on how best to generate more environmental benefits from water resources infrastructure and location-based work focuses on advancing, implementing, and incorporating environmental strategies at specific facilities. The two are complementary with each generating new ideas, honing SRP methods, and demonstrating the benefits of environmental actions. Individual pieces of programmatic and location-based work are characterized by the leads for those efforts per the task categories described above for organizational and communications purposes.

Ideas for programmatic work originate from and are shaped by several influences; Regional and National SRP meetings, other USACE programs, strategic directions of SRP's governmental and non-governmental partners, and especially interactions with and commonalities amongst location-based teams are all important sources. Ideas are refined by staff involved with SRP programmatic support and initiated as Program capacity allows.

This document details the status of SRP programmatic and location-based work and provides short backgrounds, FY 2022 progress, proposed FY 2023 work, and future visions of active SRP projects. In addition, in this report you will find that the four projects are highlighted as a distinct category of SRP Programmatic Work as "SRP-Science" in the following section. Project updates herein were compiled through meetings with district SRP Teams in November 2022 and supporting information can be found in the Deliverables and Milestones Spreadsheet (Appendix A) and SRP Tasks and Status Spreadsheet

(publicly available; "Sustainable Rivers - Tasks - 2022-12-14.xlsx"). Appendix B provides a summary of funding and expenditures for FY 2022. Other information and publications are available on the SRP HEC and TNC websites at: https://www.hec.usace.army.mil/sustainablerivers/ and https://www.nature.org/en-us/what-we-do/our-priorities/protect-water-and-land/land-and-water-stories/sustainable-rivers-project/.

SRP Highlights FY 2022

The last few years have been exciting for SRP with rapid growth due to the increase in budget from $500K to $5 Million and making it into the President's budget for $5 Million in FY 2023. Figure 3, SRP Highlights FY 2022, helps to visualize the broad efforts this year, while details of accomplishments are discussed in the location-based summaries.

More funding allowed for changes at the program level and the ability of SRP to fund larger multi-year location-based efforts. The SRP program team expanded to include leads for the locks and dams from the Mississippi Valley Division (MVD) and a new Science lead from TNC.

SRP has increased exposure with USACE Headquarters (HQ) and the public and it became important for the program team to communicate more regularly with HQ and Institute of Water Resources (IWR) leadership on program specifics. As part of this collaboration, SRP was invited to present at the Water Management Implementation Support Team meeting in December 2022. Wilmington District also presented on successful SRP efforts for the Cape Fear and Roanoke Rivers. Cape Fear work included operations for fish passage, ongoing sturgeon eDNA studies, and stakeholder engagement to many organizations in 2022.

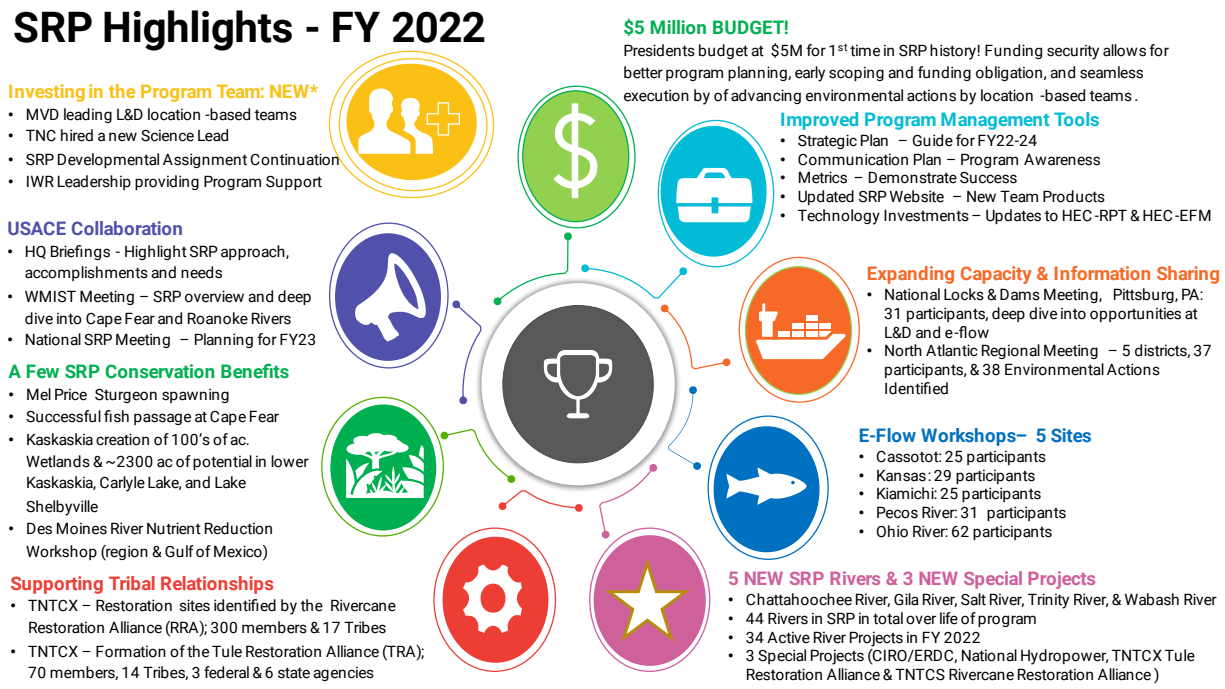

Figure 3. FY 2022 Sustainable River Program Highlights.

Some of the most exciting aspects of the program in 2022 came from the location-based teams and are described later in this document by river in detail. As you read, notice that many teams executed e-flow and stakeholder workshops that are used to identify environmental actions, which are the engine of SRP growth. Some examples of these accomplishments include the team for the Atchafalaya River in Louisiana identified Bayou Courtableau as having opportunities for reoperation to improve the downstream Lake Henderson areas in the basin and will be moving forward with necessary research with SRP funding in FY 2023. The Bois de Sioux River team completed all the tasks needed to implement summer drawdowns in FY 2023 to improve habitat for shorebirds, waterfowl and native vegetation. Multiple test pulses from Jordan Lake were completed for the Cape Fear River which allowed sturgeon to advance over several structures and provided an opportunity to study and propose changes for FY 2023 pulses. Des Moines hosted a Watershed Resilience and Nutrient Reduction Workshop as well as a spring pulse from Red Rock Dam supporting fish spawning and mussel recruitment as well as continued videography used to educate the public. The Gila River team identified opportunities to create seasonal and permanent wetlands utilizing abandoned wells and are at 30% design phase with likely construction in FY 2023. Several successful drawdowns at the Kaskaskia River pool and Lake Shelbyville were used to showcase success of the approach on restoring vegetation and increasing support of shorebirds and fishes. The Upper Mississippi River basin effort initiated four new focused studies for the lake sturgeon, macroinvertebrates, shorebirds, and vegetation to test operability of supporting environmental improvements for all targets with lake sturgeon being the top priority setting bounds on the other flow opportunities.

A few interesting new projects have broader-scale regional and national impacts. For example, the USACE TNTCX Rivercane Restoration Alliance has expanded to 300 partners and 17 tribes and has identified a site-specific restoration project funded by SRP in 2023; and the new Tule Restoration Alliance, which currently has 70 members and 14 tribes, is evaluating restoration potential in California. Both rivercane and tule are critically endangered ecosystems and cultural keystone species.

Programmatic Work

Programmatic work planned for FY 2021-2024 is comprised mainly of program support, technologies, and validation of environmental strategies. Between 4 and 5 new or continuations of ongoing programmatic efforts per year are expected (e.g., national informational resources, regional meetings, national meetings, technologies, and validation).

Program Support

Program support includes costs to administer the Program, engage partners, building capacity, and assistance for location-based efforts (outreach, implementation, and innovation). Program support is key to understanding and communicating the portfolio of structures involved (distribution and relevant characteristics of structures) and the spectrum of possible environmental actions (enabling setting and other considerations). Programmatic work includes organizing regional Operations and Water Management Meetings as well as the following type-specific activities (see pages 6-7 in PMP). In FY 2022 SRP executed one regional meeting, the North Atlantic Regional Operations and Water Management Meeting, held in October 2021 to support 5 USACE Districts in identifying potential environmental opportunities that could be pursued through SRP, the USACE Planning and Environmental Program, or another federal program. This regional meeting resulted in 38 actionable environmental ideas that may lead to future SRP funded efforts. In addition, the National Locks and Dams Meeting was held in Pittsburg, PA in May 2022 where 31 participants discussed the role of SRP in

environmental operations at Locks and Dams and outlined strategies for expansion. These reports are available on the USACE SRP website.

Technologies

Technologies includes investments in ecological and water resource software applied broadly within Sustainable Rivers as well as technical support for software applications led by location-based teams. Software enhancements benefit SRP modelers and others using the tools for ecological applications. Ongoing technologies efforts include software development related to formulation of ecosystem management alternatives, ecological time series analyses, and spatial habitat mapping.

Formulation of river management alternatives

Environmental strategies promoted by SRP generate environmental benefits by changing the operation of water resource infrastructure. The "advance, implement and incorporate" process described above is the plan that guides SRP work. As part of the advance phase, groups of scientists, engineers, water managers, operators, and stakeholders work together to formulate alternative ways to manage the infrastructure and associated aquatic systems.

Several software is used during alternative formulation, including the Regime Prescription Tool (HEC-RPT). RPT is a communications tool and contributes to the early stages of planning by formalizing ideas and expert knowledge into alternatives that are easily visualized and considered in more detailed modeling tools. Contributions of RPT to the formulation process include simple navigation and visualization of hydrologic data, tracking of hydrologic condition, electronic creation and shaping of alternatives, documentation of justifications and uncertainties associated with alternatives, simple comparisons of alternatives from different management perspectives, and assistance with integrating different perspectives into a single unified alternative.

HEC-RPT is used by SRP location-based teams during definition of environmental flows and is a key facilitation software for environmental flows workshops. Recent applications have generated development ideas for the software, including more user-control of ordering spatial locations and focal ecosystem aspects, added user-control of hydrologic time series display, custom displays of alternatives per location and hydrologic condition, allowing alternative formulation in terms of elevations and stages in addition to flows, and allowing alternative formulation in user-specified data types and units. These enhancements are being supported by SRP to improve program capabilities during alternative formulation and are expected to be ready for use in 2023.

Ecological time series analyses

Time series analyses are a fundamental part of technical support for a wide range of ecological and engineering projects. Time series analyses are used throughout the SRP process. During the advance phase, time series analyses are used to assess hydrological and ecological status and trends. During implementation, time series analyses are used to explore alternatives that are not easily done and monitored in real-world operations. During incorporation, time series analyses are used to measure the degree of adherence to operational alternatives and, ultimately, to reassess status and trends of new ecological trajectories.

Two software that are commonly used by SRP teams to perform time series analyses are the Indicators of Hydrologic Alteration (IHA) and the Ecosystem Functions Model (HEC-EFM). Both statistically assess time series to gain insights about an array of ecosystem dynamics with the fundamental goal of supporting restoration and stewardship of managed aquatic systems. HEC-EFM applications in support

of SRP are diverse, ranging from statistical assessments of historical hydrologic conditions to modeling ecosystem responses to ecologically designed outflows from reservoirs.

SRP is supporting HEC-EFM enhancements that enable use of multiple variables to assess ecological conditions. This multivariate approach, where condition can be based on constellations of variables such as water depths, velocities, and temperatures, will allow for more complex time series analyses investigating connections between operational decisions and ecosystem responses. Multivariate features are expected to be ready for use in 2023.

Spatial habitat mapping

Habitat mapping is performed in support of ecosystem restoration projects, habitat conservation plans, and investigations related to species of interest. It is also an effective platform for communications, producing visual displays of habitat distributions, connectivity, and sometimes functionality across landscapes or within aquatic systems. Habitat mapping is less common than and often lags time series analyses and alternative formulation in the SRP process, but the approach has excellent potential as an information source for ecosystem restoration and management and to further inform development of alternatives and communication of expected benefits.

As a spatial endeavor, habitat mapping is underpinned by geographic information systems (GIS) and there are many GIS software options. The Environmental Systems Research Institute, Inc. (ESRI) produces several GIS software options as part of the Arc suite of tools. GeoEFM, which is a spatial accessory for HEC-EFM, is programmed to work with Arc software and offers several features related to management of spatial data sets, computation and comparisons of habitat areas, and assessment of habitat functionality.

SRP is supporting GeoEFM enhancements for features that allow users to generate habitat suitability maps, display spatial statistics, and assess habitat functionality in terms of how much habitat and the configurations of habitat that members of ecological communities need to survive and reproduce. These habitat mapping features are expected to be ready for use in 2023.

Science (Validation)

The success of SRP is a function of ecological improvements in river health which are of key importance to gage. The health of a natural system is very difficult to measure due to uncertainties in understanding ecological concepts, changing influences of water management, and time required for ecological responses to become measurable. Through SRP-Science, SRP seeks to cultivate scientific understanding of the connections between reservoir operations and ecosystem responses for select rivers in unique ecoregions around the United States. Development of scientific knowledge is leveraged through implementation of e-flow prescriptions at reservoirs, which alters land-water interactions thereby stimulating ecosystem responses that can be studied and quantified using field monitoring protocols and analysis. If operational changes are studied, resulting knowledge can be used to improve prescriptions and perpetuate a culture of adaptive management. Monitoring does not need to be exhaustive to be effective and requires constructive, informative, and timely guidance from science practitioners to dam operators.

The SRP-Science Initiative began in FY 2020 and continues with annual funding of four regional efforts, including the Des Moines River, North Carolina Rivers (Cape Fear and Roanoke), Upper Ohio River Basin (Allegheny River), and Willamette River. These current study and adaptive management efforts are intended to promote implementation of environmental strategies across at reservoirs across USACE

by 1) reducing uncertainties about flow-ecology responses and 2) quantifying and communicating benefits of e-flows. Additional rivers may be included in the SRP-Science Initiative in the future as they enter the Incorporate Phase of the SRP Process and demonstrate transferability to other rivers.

Des Moines River, IA – (SRP-Science)

SRP-Science activities on the Des Moines River and Lake Red Rock include agreements with the USGS Cooperative Research Unit at Iowa State University and partnerships with the Iowa DNR fisheries, MVR Operations, the MVR Water Control Center, Engineer Research and Development Center (ERDC), Ecosystem Management and Restoration Research Program, and USACE Engineering with Nature program. Field work began in 2021 to evaluate how dam operations can influence fish recruitment below the Red Rock Dam. The effort created momentum with partnering agencies and resulted in the Iowa Department of Natural Resources (IDNR) to also conduct fish recruitment studies on the lower Des Moines River that focus largely on sturgeon spawning. Shovelnose Sturgeon are long-lived, slow-growing fish; do not spawn annually, but are especially susceptible to population declines due to overharvest and habitat modifications. Hydrologic conditions were favorable for a spring pulse in May 2021. Two pulses were passed through the dam resulting in larval sturgeon and other fishes being captured later. The "normal," run of the river mode during the unusually dry period otherwise would not prompt fish to spawn. Laboratory analysis will continue into winter months and a report of findings anticipated.

Waterbird surveys and vegetation sampling were initially conducted during the summer 2021 by Iowa State University researchers at the Lake Red Rock delta region. The 2022 effort repeated the 2021 outstanding research, where waterbird species were documented along with the diversity and relative abundance of the plant species. Results of this SRP-funded research has inspired next steps to survey interstate migration of shorebirds via satellite https://usace1.webex.com/meet/michelle.l.mattson in future FYs.

SRP-Science efforts for the Des Moines River also focuses on better understanding the effects of e-flows on fish and mussel dynamics. The most recent work includes a two-year field study on mussel assemblages and impacts from the dam. Since the MVR's involvement in the SRP started, a concerted effort has been made to operate the Red Rock Lake and Dam to realize more environmental benefits. These efforts are detailed in the Des Moines River Adaptive Management & Monitoring Plan (AMMP), a product of a workshop attended by scientists, biologists and experts regarding reservoir operations, fisheries, riverine ecology, etc.

North Carolina Rivers, VA and NC – (SRP-Science)

The Wilmington District (SAW) in North Carolina has two rivers in the SRP, the Roanoke and the Cape Fear Rivers. The Roanoke River is one of the original 8 rivers in SRP and is in the "incorporate" phase of the process. In 2016, the water control manual was amended to allow for quasi-run-of-river when USACE enters flood operations. Building on the momentum of the Roanoke, the Cape Fear River was added to SRP in 2016/17. The Cape Fear is in the "implement" phase of the SRP process, actively conducting e-flow releases.

Being in different stages of the SRP process and with semblance to other Atlantic coastal plain rivers make the Roanoke and Cape Fear compelling candidates for scientific attention. SRP-Science in these two rivers entails formal work with the USGS across four topics: (1) creating a long-term adaptive management plan for both rivers, (2) learning about bank stability after high flows on the Roanoke to learn how to reduce the stress on the system with the new operational flexibility, (3) studying algal blooms and water quality in relation to flows using advanced technologies and techniques, and (4) investigating how climate change is influencing the timing and magnitude of inflows into reservoirs. The adaptive management plan was initiated in 2020 with a structured decision-making analysis. Field work for water quality started in 2020 with USGS adding new sensors to their existing gages as well as running the autonomous underwater vehicle (AUV). The water quality work was expanded in the spring/summer of 2021 to include additional water quality sensors and 5 additional runs of the AUV in varying flow and pulse conditions. The Cape Fear was in a drought in the summer of 2022 with documented algal scum in multiple places within the river. The USGS was able to run the AUV 8 more times which included times during USACE pulses out of Jordan and at locations with documented algal scum. USGS, TNC, and US Fish and Wildlife Service (USFWS) created a plan to study bank stability that included a Light Detection and Ranging (LIDAR) analysis complemented by field work utilizing “structure for motion”, which is planned for January 2023.

As part of the adaptive management work, TNC, USGS, and the USACE embarked on an effort to study how inflows are changing into reservoirs using the period of record data. Early results show that the spring is getting wetter, which is a critical time for the fish spawn, tree sapling establishment on riverbanks, agricultural planting, and more. The group is pursuing work in 2023 to run climate models that extend to 2100 to look at the future potential risk of different climate and inflows at reservoirs. The 2023 efforts will continue the adaptive management framework, the bank stability, the water quality, and analysis of climate change.

Upper Ohio River, PA – (SRP-Science)

SRP support for e-flow efforts in the Upper Ohio River basin began in 2014. After flow targets were defined for various watersheds, focus shifted to translating basin-wide e-flow recommendations into operating recommendations at reservoirs across the region.

In September 2020, the SRP team held the Kinzua Dam provisional ecosystem flow recommendations workshop that was attended by forty river scientists and USACE staff. The SRP team prepared an Adaptative Management and Monitoring Plan (AMMP) for implementation of e-flows at Kinzua Dam, including summaries of the biological surveys conducted in the Allegheny River and knowledge gaps that limit implementation.

SRP-Science in the Upper Ohio River (Allegheny River) for FY 2023 will continue formal work by USGS and focus on summarizing findings of a pilot study (2021-2023) in a USGS Open-File Report (OFR) to characterize stage fluctuations, river velocity, and water temperatures within mussel beds, as well as understand water quality variation at the nearest USGS stream gage and link these river conditions to reservoir management. USGS would also develop a survey method and modeling approach for aquatic biota and their required habitat. The goal of which is to develop a survey methodology and modeling approach for the upper Allegheny River and an implementation monitoring program for testing implementation of operational changes through the target reach downstream of Kinzua Dam. This approach would be detailed in a statement of work for FY 2024 SRP support.

In FY 2023 the SRP-Science team will continue to provide information that will refine the environmental prescriptions on the Allegheny River and transfer lessons learned to other basins within the Upper Ohio River system. Additionally, LRP will initiate investigation of impacts of climate change on the system and how it may influence the ability to implement e-flow changes at the Allegheny and other basins in the Upper Ohio.

Willamette River, OR – (SRP-Science)

Through SRP, the USACE and TNC have worked together since 2006 to determine e-flow requirements downstream of USACE dams in the Willamette River Basin and identified opportunities to restore key aspects of the natural flow regime. The work reached a pivotal milestone in July 2015 when a Memorandum for the Record (MFR) was signed thereby incorporating e-flows into the operational guidance (i.e., water control manuals) for several basin reservoirs.

In 2020, SRP-Science efforts were initiated to assess implementation of e-flow targets in the Willamette River Basin, evaluate ecological implications of flow objectives and develop communication products that can support the implementation and adaptive refinement of prescriptions for the basin and other watersheds. Results of this SRP-Science work will eventually be used by USACE water management and natural resources management staff, in conjunction with other co-managers and stakeholders, to determine if e-flow prescriptions can or should be adjusted to meet ecological requirements.

SRP-Science efforts focused on development of a simple, streamlined process for annually reporting SRP implementation, describing which targets were met, the context for those targets, ecological benefits, lessons learned and recommendations for future monitoring and adaptive management. The district partners with USGS to conduct scientific monitoring, data analysis and reporting. USGS began acoustical monitoring and sediment collection in FY 2021 with installation of hydrophones the North Santiam River near Mehama, OR and McKenzie River near Bellinger, OR. The goal of the study is to identify streamflow rates which mobilize sediment. In FY 2022, the sediment study continued along with initiating a pilot macroinvertebrate monitoring effort to help develop models for taxa within the basin, assess variability of model performance, and evaluate operation scenarios. USGS drafted a summary report of monitoring efforts to date that is being reviewed by the district and will be finalized and shared on the SRP website in FY 2023.

Location-based Work

The program budget held at $5M in FY 2022 and was included at that level in the President's Budget for FY 2023. In FY 2022, three SRP location-based Requests for Proposals (RFPs) were announced: General, Locks and Dams, and Dry Dams and received and reviewed 56 proposals on behalf of 28 rivers, including 13 new rivers.

SRP identifies and executes location-based work via the following process: 1) evaluate program objectives and topics of interest to determine if adjustments are needed, 2) highlight objectives and topics as part of a RFP, 3) compile and prioritize responses, 4) scope priority tasks, 5) arrange funding and other logistics, and 6) perform work. The annual In-Progress Review (IPR) reports summarize status, including work completed in each FY and anticipated work in the coming FY for those funded projects. IPR reports are available at https://www.hec.usace.army.mil/sustainablerivers/publications/.

This section is organized alphabetically by river as shown in Table 1. New SRP efforts are indicated by an asterisk (*) after the river or project name. Infrastructure type(s) - "Gen" for general multi-purpose

reservoirs, “LD” for locks and dams, and “DD” for dry dams - and pertinent state abbreviations are acknowledged as part of the section header for each river.

Table 1. FY 2022 Location-Based Efforts

SRP Supported Rivers (Structures) - FY 2022	District Name
Atchafalaya River (Old River Control Complex)	New Orleans District (MVN)
Bois de Sioux River (Lake Traverse and Mud Lake)	St. Paul District (MVP)
Brazos River (Whitney)	Fort Worth District (SWF)
Cape Fear River (Jordan Dam)	Wilmington District (SAW)
Chattahoochee River*	Mobile District (SAM)
Des Moines River (Saylorville and Lake Red Rock)	Rock Island District (MVR)
Farm Creek (Farmdale Reservoir)	Rock Island District (MVR)
Gila River *	Los Angeles District (SPL)
Iowa River (Coralville Lake)	Rock Island District (MVR)
Kaskaskia River (Carlyle, Shelbyville and Kaskaskia Lock & Dam)	St. Louis District (MVS)
Mississippi River	St. Louis District (MVS) St. Paul District (MVP) Rock Island (MVR)
Neches River (Sam Rayburn and Town Bluff)	Fort Worth District (SWF)
Ohio River (multiple Locks & Dams)	Huntington District (LRH) Pittsburgh District (LRP) Louisville District (LRL)
Osage River (multiple reservoirs)	Kansas District (NWK)
Potomac River (Jennings Randolph Lake)	Baltimore District (NAB)
Roanoke River (John H. Kerr Dam)	Wilmington District (SAW)
Salt River*	St. Louis District (MVS)
Trinity River*	Fort Worth District (SWF)
Trinity River Climate Informed Reservoir Operations (CIRO)*	ERDC & Fort Worth District (SWF)
Upper Allegheny River (Navigation System), NY & PA	Pittsburg District (LRP)
Wabash River*	Chicago District (LRC)
National Hydropower Program (NHP)*	USACE Headquarters (HQ)
TNTCX Rivercane Restoration Alliance	Multiple Districts
TNTCX Tule Restoration Alliance*	Multiple Districts

*New location-based effort in FY 2022

Atchafalaya River (Old River Control Complex), Louisiana – MVN (Gen)

The Atchafalaya River Basin is the nation's largest river swamp, containing almost 750,000 acres of bottomland hardwoods, cypress swamps, bayous and backwater lakes plus a quarter million acres of similar habitats disconnected by levees and other structures. The basin stretches 140 miles southward to the Gulf of Mexico and is currently bound by natural ridges and levees formed by the Mississippi River. Historically, the Mississippi and Red Rivers migrated across the floodplain periodically intersecting. Through this intersection, a distributary channel formed from the Red River, named the Atchafalaya River. By the mid 1900’s concern grew that the Mississippi River would change course to

the Atchafalaya River channel, leaving the ports of the lower Mississippi River inaccessible. The Old River Control Complex (ORCC) was constructed in 1963 to maintain a 70/30 flow split where 30% of the combined flows at latitude of the structure goes to the Atchafalaya and 70% goes to the Mississippi River.

Cypress swamps and aquatic species historically evolved to seasonal variability of river flows and water levels but managing flows through ORCC shifted that seasonal dynamic. Through SRP, river scientists and the Corps are attempting to identify and evaluate options for managing the 70/30 split to restore some seasonal variability and support cypress swamp regeneration.

FY 2020 was the first SRP support at Atchafalaya River basin. The effort consisted of developing alternatives and understanding operational flexibility for the Atchafalaya River Basin by first identification of stakeholders, evaluating a sound process for stakeholder engagement, and identifying hydrology models and other tools that could be utilized for preliminary evaluation of ecological opportunities. Additional work was funded in FY 2022 to review science and assess current operations and authorizations and determine e-flow recommendations.

Status of FY 2022 work

The Atchafalaya River SRP team continued coordination among USACE, TNC, GOCA, and CPRA through three teams: Core Management Team, Science Team, and Stakeholder Team. Due to litigation and sensitive issues, the SRP Atchafalaya team recognizes the need to work in less controversial parts of the basin to get basin stakeholders familiar with e-flow concepts, modeling, and changes to management. The Core Management Team met approximately monthly from May through September. The Science Team met in June and in September. Through this engagement, the team looked at multiple existing water control structures in the Atchafalaya Basin to identify opportunities to modify current flows, within the structures' existing authorizations, to improve downstream ecological conditions in areas that could serve as a learning ground for other control structures in the Atchafalaya. The team identified Bayou Courtableau as a potential structure that could be studied and re-operated to improve the downstream Henderson Lake. The Stakeholder Team drafted an initial stakeholder engagement plan and stakeholder list and will continue to refine stakeholders with the narrowed focus of the Bayou Courtableau and Lake Henderson areas of the Basin. The Core Management Team confirmed with Office of Council that there are no concerns with focusing on bayou Courtableau.

Anticipated Work in 2023

The MVN team will focus new work on Bayou Courtableau and Henderson Lake within the Atchafalaya River basin through improving investigating opportunities to improve water conveyance utilizing an existing model developed by a contractor and adding additional data as needed. The goal of this work within the current authorizations of water control structures in the Atchafalaya Basin Floodway to perform and monitor experimental environmental flow(s) within three years that aims to test a potential water management change to the structures to benefit the environment. The proposed flow will incorporate considerations for navigation and flood risk reduction, in alignment with existing authorizations.

Future Vision

Strategically build a coalition of scientists, stakeholders, local and state government support for identifying, implementing, and monitoring environmental beneficial actions for the Atchafalaya River over the long-term.

Bois de Sioux River (Traverse and Mud Lakes), MN and SD - MVP (Gen)

The primary purposes for the Lake Traverse Flood Control are for flood control benefits along the Bois de Sioux River and lower Red River valley, as well as water conservation. White Rock Dam, which forms Mud Lake, is located at the extreme north end of the site and controls water flowing north on the Bois de Sioux River.

The purpose of the SRP effort is to identify if late summer drawdowns and minimum releases at Mud Lake are possible to improve environmental conditions in the Bois De Sioux River. In 2020, the SRP team engaged partner agencies, developing potential alternatives, and engaging the affected public to gage acceptability and potential adverse effects. Partner agencies had requested that minimum releases be provided from Mud Lake to the Bois de Sioux River. Mud Lake provides low quality habitat now, as it is very shallow, windswept, and nearly devoid of vegetation. A growing season drawdown in the early 2000s resulted in a vegetation response and a high number of shorebirds used the area, but the response was short-lived due to holding floodwaters.

The team spent FY 2021 focused on outreach, developing, and engaging an interagency team to assist in developing a plan, and engaging the public and downstream communities to identify potential adverse effects and ways to mitigate them. Agency partners included the Minnesota Department of Natural Resources, the South Dakota Game, Fish and Parks, and the U.S. Fish and Wildlife Service (USFWS).

Status of 2022 work

The team completed scoping opportunities and considerations for spring and early summer drawdowns, minimum releases, and fall flooding at Mud Lake. The team has evaluated the hydrology, drafted and evaluated preliminary operating rules, and has begun drafting an environmental assessment (EA) and determined that potential for shorebird habitat, waterfowl habitat, and native vegetation establishment is substantial enough to warrant summer drawdowns.

Anticipated 2023 work

The team plans to present preliminary findings to agency partners in early 2023 to gather feedback and make refinements prior to finishing the EA and circulating for public comment. It is anticipated that the first drawdown would occur in summer of 2023 through a deviation to the 1994 Lake Traverse Water Control Manual, pending approval by MVD, and then included in the next version of the manual.

Future Vision

Changing operations would require both informal and formal consultation with state, federal, and Tribal agencies, as appropriate. If successful in identifying appropriate e-flow prescriptions, the MVP team would request a deviation from the current water control manual to allow a drawdown at Mud Lake.

Brazos River, TX – SWF (Gen)

The headwaters of the Brazos River start near the Texas-New Mexico border north and west of Lubbock, Texas and flow 1,280 miles to the Gulf of Mexico near the city of Freeport. The Brazos River basin

encompasses approximately 16-percent of the land area of Texas, including all or part of 70 counties, stretching across more than 42,000 square miles. The Brazos River proper begins at the confluence of the Salt Fork and Double Mountain Fork and major tributaries include the Clear Fork of the Brazos, the Paluxy River, the Bosque River, the Little River, Yegua Creek, the Nolan River, the Leon River, the San Gabriel River, the Lampasas River, and the Navasota River.

Twelve reservoirs are located within the Brazos River basin, three of which are located on the main stem of the river: Possum Kingdom, Lake Granbury, and Lake Whitney. The multipurpose uses of the reservoirs include flood control, water supply, and recreation. Each reservoir is guided by project specific Water Control Manuals to ensure project compliance with congressionally approved operating purposes. The Brazos River also supports many endangered and threatened species fishes, salamanders, and mussels and a robust recreational fishery.

Near the Gulf of Mexico, the river passes through bottomland hardwood systems in the San Bernard National Wildlife Refuge (NWR), the MidCoast NWR Complex, Justin Hurst Wildlife Management Area (WMA), the Nannie M. Stringfellow WMA, and Brazos Bend State Park. Potential SRP actions could benefit these areas as well as aquatic, floodplain, and riparian habitats throughout the basin.

In 2021, SWF and TNC coordinated a workshop with the Brazos River Authority, natural resource agencies, academia, and other scientific experts and environmental practitioners to identify ecosystem problems and opportunities. The workshop, on 8 September 2021, identified data, data gaps, flow-related elements of resources in basin, environmental opportunities, and the challenges of changes in the system. A report was prepared, and an e-flows workshop planned for 2023.

Status of 2022 work

The team wrapped 2021 work (workshop report), prepared a new SRP proposal for an e-flows workshop in 2023, and began coordination with the stakeholders. FY 2022 funding was not distributed until August 2022, so no additional work was completed during the FY.

Anticipated 2023 work

The Brazos River SRP Team submitted two proposals for SRP consideration in FY 2022: a proposal for data collection and a Brazos River system analysis. These proposals have multi-agency support, a clear path forward, and in-kind and financial support to augment the funding of the SRP actions. The e-flows workshop is planned for early 2023 calendar year and the operational model for the Brazos basin is planned for spring or summer depending on workshop results.

Future Vision

The benefits of this workshop reached beyond its original intent and the Brazos SRP team plans to continue to meet on SRP and other related issues into the future.

Cape Fear River (Jordan Dam), NC – SAW (Gen and LD)

In North Carolina, the Cape Fear River serves people and wildlife, making its water quality and water quantity of utmost importance to the region. USACE management on the Cape Fear River includes B. Everett Jordan Dam and Lake, three locks and dams and dredging operations. These facilities are collectively managed for a diverse set of purposes including water supply, flood risk management, water quality, navigation, recreation and fish and wildlife conservation. These same structures are barriers to

diadromous fish; and NOAA estimates that commercial fish landings have decreased 87% in two centuries.

SRP work on the Cape Fear River began in FY 2017 by engaging and convening stakeholder groups to develop a conceptual framework of environmental opportunities to improve habitat for diadromous fish and potentially managing water quality issues. Eager partners worked together to develop the State of the Science Report on the ecology and hydrology of the Cape Fear system in preparation of the e-flows workshop held in Fall 2019. Together the USACE and regional river experts developed flow regimes for consideration at Cape Fear River dams to improve conditions for diadromous fishes and potentially diffuse algal blooms before they become hazardous. Summer flow demonstrations began in 2020 and will provide the initial glimpse into the value of changes for fish and water quality. These demonstrations and extensive monitoring will continue for all the seasonal flow components to refine the e-flow prescriptions for the Cape Fear River.

Hydrology models were run to determine the spring conditions that enable pulses of 20,000 cfs at the downstream locks and dams, with the goal to better support spawning by shad, sturgeon and other diadromous fish. SAW and TNC analyzed the enabling hydrological conditions for late summer flow pulses that reduced the chances for algal blooms. In FY 2021 SRP funds arrived late (April 2021), after the spawn in North Carolina was underway. TNC organized the NC Division of Marine Fisheries, NC Wildlife Resources Commission, and Clemson University to conduct telemetry, collect eDNA, tag shad and some sturgeon. The weather was conducive to accomplish one large pulse out of Jordan Dam in March 2021 to assist the fish over the locks and dams, but it was determined that fish were not able to migrate the 50 river miles to clear all three locks and dams. The fish often made it over one barrier but not all three. This was an important observation for proposed FY 2022 work. In late March 2021, the basin went into abnormally dry or moderate drought conditions and no more fish pulses could be implemented, but data collection continued as well as observations of “natural pulses” during rain events.

Status of 2022 work

During 2021-2022, multiple test pulse releases happened to assist fish migration to their upstream spawning habitat and to improve water quality. Innovative monitoring techniques were used in 2021-2022 to evaluate these pulses which included tagging fish, monitored diadromous fish over the locks and dams via advanced telemetry, eDNA to study the sturgeon young of year and watch for a fall sturgeon spawn, satellite imagery of water quality and direct sampling and additional locations, an autonomous underwater vehicle for water quality, continuous thermistors throughout the water column and began RAS modeling of LD2 and LD3.

Learning how to do the pulses, as well as the effects on the ecology is dependent on the seasonal weather. The 2020 season was one of the wettest on record. The 2021 season started wet and then became dry. The 2022 season was dry for the entirety of the season. Even in a dry season, the USACE conducted pulses that had positive results on the downstream system. This season demonstrated that the USACE needs the state of North Carolina (who owns the water in Jordan Lake below guide curve) to potentially issue deviations to maximize the benefits to the downstream communities.

SAW also completed several administrative tasks to get contracts in place with Clemson and NC WRC. In addition, there were multiple stakeholder efforts throughout the year with formal presentations to the Middle Cape Fear River Basin Association, the Cape Fear River Assembly, the Cape Fear River Partnership, to over 40 staff from NC Dept of Environmental Quality, and more. SRP was written about

in the North Carolina TNC newsletter that reaches 25,000+ people and our SRP Cape Fear video was released on TNC's website.

Anticipated Work in 2023

New work funded by SRP in 2023 spans three FYs with final products being delivered December 2024 (FY 2025). Work will be completed by the USACE, CESU and WRC contracts, USGS (gaging) and TNC. Previous work showed that under certain conditions, the State of North Carolina needs to provide deviations in operations to allow for pulse flows and fish passage. SAW will conduct two additional years of research, data collection, and pulse flows to strengthen the science and better predict the balance of water across all user needs. The goal is to incorporate pulse flows depending on fish passage and water quality data collected during the pulses.

In 2023, the team will build on current science by assessing how long fish will wait behind a lock and dam, assess flow velocities suitable for fish to swim upstream, and utilize this data to further refine spring pulses. This requires tagging additional fish and tracking new and existing tags for a longer duration. The team would continue efforts around sturgeon since they were recorded at the first lock and dam in 2021. Efforts would include monitoring sturgeon movement and eDNA sampling and analysis. With respect to water quality, deviations from USACE operating procedures would be implemented if an algal bloom occurs during a drought. Additional water quality data is essential for demonstrating that pulses and mixing water reduces the likelihood of algal blooms. T

The USACE and TNC will reconvene basin stakeholders to review pulses, evaluate lessons learned, and identify any needed information to move Cape Fear River into the “incorporate” stage of the SRP process. Within the next year, the team plans to identify the necessary steps to get effective e-flow prescriptions incorporated into the USACE operating principles.

Future Vision

The USACE operates four dams in the system and plans to continue implementation of the Cape Fear e-flow prescription. Assessment and adaption of these flows will focus on the movement of diadromous fish, connection of river flows with off-channel floodplain habitat, and summer flow conditions that support juvenile fish movement and potential dispersal of algal blooms. Additional environmental actions will be based on outcomes associated with testing e-flows. The team’s overarching goal is to incorporate effective e-flows into the USACE operating principles. Cape Fear River is in the SRP-Science program and is on mark to collect and share important data on e-flows, fish eDNA, vegetation/water level interactions, water quality and more with teams across the enterprise.

Chattahoochee River (Buford Dam), GA – SAM (Gen)

The Chattahoochee River is within the Apalachicola-Chattahoochee-Flint (ACF) River basin which encompasses a 19,600 mi^2 watershed among Georgia, Alabama, and Florida. The headwaters of the Chattahoochee River begin as a convergence of small spring-fed tributaries in the Chattahoochee National Forest in northeast Georgia (Union County) and flows southwesterly for approximately 42 miles to Lake Sidney Lanier in Hall County. Lake Lanier is a 38,000-acre reservoir within the United States Geological Survey (USGS) Hydrologic Unit Code (HUC-8) 0313001 (Upper Chattahoochee River), and the Lake Lanier watershed has a total drainage area of 1,040 mi^2. The Chattahoochee River is impounded by Buford Dam, which straddles Gwinnett and Forsyth counties just north of the city of Buford. The Chattahoochee River resumes flow from Buford Dam’s penstocks as a cold-water river (annual average

temperature = 11.0 °C) owing to the deep, hypolimnetic release from Buford Dam. This section of the Chattahoochee River, often referred to as Lanier tailwater, continues a southwesterly flow for approximately 35 miles until reaching Morgan Falls Dam.

Prior to its convergence with the Flint River at Lake Seminole in the far southwest corner of Georgia, the Chattahoochee River encounters a series of active hydropower infrastructure, and inactive hydropower facilities and historic milldams. The USACE Water Management Section of the SAM operates five federal reservoir projects: Buford Dam (Lake Lanier), West Point Dam, Walter F. George Lock and Dam, George W. Andrews Lock and Dam, and Jim Woodruff Lock and Dam (Lake Seminole) as components of the ACF system. The multipurpose uses of the USACE reservoirs include flood control, water supply, water quality, navigation, hydropower, recreation, and fish and wildlife management (environmental stewardship). Each USACE reservoir is guided by a project specific WCM to ensure project compliance with congressionally approved operating purposes.

The Chattahoochee River in the Upper Chattahoochee watershed supports an abundance of rare aquatic species including several species of shiner; the state-threatened Halloween Darter (*Percina crypta*) and Chattahoochee Crayfish (*Cambarus howardi*); and the federally endangered Shineyrayed Pocketbook (*Hamiota subangulata*). The Chattahoochee River and its reservoirs also support robust and economically important recreational fisheries for various species of black bass, walleye, and a unique cold-water fishery for wild Brown (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*). The Georgia Department of Natural Resources' Wildlife Resources Division supports trout fishing opportunities in the Lanier tailwater through annual stockings of up to 180,000 catchable rainbow trout. Lake Lanier and the Chattahoochee River are also critical water resources for drinking water and wastewater assimilation for local municipalities, including metropolitan Atlanta's five million residents that obtain approximately 70% of their drinking water from the Chattahoochee River.

The Chattahoochee River, from Buford Dam to Morgan Falls Dam, suffers from poor water quality in autumn because of Lake Lanier's seasonal stratification process. It FY 2022, the SAM team proposed to identify potential environmental actions that could be implemented to improve water quality and benefit aquatic ecology.

Status of 2022 work

The SRP funds were provided to the SAM team in mid-May 2022. The team held a pre-workshop webinar on 29 June 2022 to discuss on water quality trends and potential impacts on aquatic species with regional scientists, see if they could identify any data gaps, and initiate outreach for a water quality workshop in January 2023. The team deployed dissolved oxygen (DO) sensors throughout the reach and data collection is on-going. Planning for the workshop has begun with the goal of identification of seasonally environmental water quality stressors, data gaps, potential mitigation strategies, and a plan for future outreach in the watershed. Currently the team expects that there will be data gaps on heavy metals and macroinvertebrates.

Anticipated Work in 2023

Execute the water quality workshop and prepare a workshop report that summarizes existing conditions of the Chattahoochee River within the study area, data gaps, and monitoring strategies and associated costs to fill critical data gaps to inform decisions regarding possible mitigation measures. Mitigation

measures that have been discussed theoretically include environmental flows, hypolimnetic aeration, landowner education campaign(s), tailwater labyrinth weirs, turbine venting, and sluicing/mixing.

Future Vision

Broad understanding of water quality issues in the system and a coalition of involved stakeholders helping to identify and implement realistic mitigation measures, that may include modifying USACE dam operations, to improve water quality and fisheries.

Des Moines River (Saylorville and Lake Red Rock), IA – MVR (Gen and Science)

The Des Moines River watershed drains about 1,350 square miles (3,496 km^2) of agricultural land that once was glaciated prairies in Minnesota and Iowa. Along the river, Saylorville Dam and Reservoir operationalized in 1977 is located upstream from the City of Des Moines and Lake Red Rock Reservoir operationalized in 1969 is located approximately 50 miles downstream of the City of Des Moines. The USACE dams are operated for flood risk management as well as recreation, water supply, drought management, and fish and wildlife.

Des Moines River dam operations altered river flow by increasing summer flows, lowering spring flows, reducing peak flows, and substantially reducing connectivity to floodplain features like oxbow lakes. River scientists documented the changes to the river from impoundments and were looking for options to improve conditions for fish and wildlife habitat. Around 2015, the MVR began the process of updating the Water Control Manual (WCM) at both dams, which provided the opportunity to evaluate and add environmental considerations. SRP helped support the USACE and stakeholders include improved e-flows in the WCM update. At the same time, SRP supported the development of the Des Moines River Adaptive Management and Monitoring Plan (AMMP). This is a product of the e-flows workshop that was held in 2016, resulting in a summary report that identified eight river flows and reservoir level management practices to improve conditions for aquatic biota, terrestrial habitats, and water quality. The reservoir WCM now includes seasonal conservation bands for the reservoir that will support aspects of the natural flow regime to benefit several ancient river fishes, such as paddlefish, shovelnose, and lake sturgeon, as well as floodplain plant communities and terrestrial wildlife.

Since SRP partnered with MVR, the team completed the Agricultural Conservation Planning Framework for all 33 HUC 12 watersheds surrounding Saylorville Lake and Lake Red Rock. The goal of that effort was to identify ideal locations to construct soil conservation structures or agricultural practices to help reduce sedimentation to the reservoir.

In 2020, SRP-Science invested in efforts that gauge the effectiveness of e-flows for fish and water level management strategies to improve waterbird habitat and denitrification potential. In addition, The Des Moines River SRP continues to pursue collaborative efforts with NRCS and others, to reduce nutrient inputs to the Des Moines River system. See https://www.mvr.usace.army.mil/Missions/Environmental-Stewardship/Sustainable-Rivers/Des-Moines-River-SRP/Watershed-Resilience/

The team continued work in FY 2021 partnering under a 2-year Cooperative Ecosystem Studies Unit (CESU) contract with Iowa State University to evaluate waterbird use, feeding and resting in the reservoir delta. Concurrently, the team partnered with the Iowa Geological Survey/University of Iowa and the USACE Engineering with Nature to characterize the geomorphology of the delta with the goal of gaining knowledge to help reduce the nitrate load in the reservoirs, rivers, and eventually to the hypoxia zone of the Gulf of Mexico.

Status of 2022 work

Des Moines River SRP efforts began in 2015 and has completed the process to advance, implement, and incorporate e-flows. Work now includes location-based work and SRP Science efforts to better understand ecological responses to operations, including outflows and pool level management for ecological benefits. Guided by the SRP supported Des Moines River Adaptive Management and Monitoring Plan, efforts are focused on achieving understanding and solutions for the eight identified flow or lake pool recommendations.

The SRP team planned and hosted a Watershed Resilience and Nutrient Reduction Workshop. The interagency stakeholder event was held on 30 March 2022 at the Neal Smith National Wildlife Refuge. This workshop was targeted for managers of USACE owned land in the reservoir watersheds, although interest from other land managers and biologists also attended. Twenty-four participants from ten agencies or departments took part in the interactive program. The workshop was focused on the evaluation of best management practices for reservoir watersheds with presenters on Agricultural Conservation Planning Framework and soil health. "Soil health" is a new emphasis on agricultural land use that is friendlier to the environment, enhances soil organic community and potentially reduces nutrient losses to rivers and streams.

The team also continued to coordinate multiple activities between researchers, ERDC, USACE staff and other agencies to implement e-flow prescriptions through dam releases or environmental water level management within the lake. FY 2022 included the second year of multiple contracts and partnerships with Iowa State University and USACE Engineering with Nature. Efforts on-going evaluate waterbird use, feeding, and resting in the vast reservoir delta as water levels are slowly lowered during peak migration; evaluating geomorphology and sediment sampling for nutrients; and photography and videography to educate the public on the importance of the system and the science behind the SRP efforts.

Birding surveys initially occurred in 2021 on fourteen occasions at Lake Red Rock during the summer pool drawdown. The field biologist also conducted vegetation sampling of the delta to document the diversity and relative abundance of the plant species, which can be useful food sources for the migrating shorebirds, as well as later waterfowl migration when the pool is raised, and vegetation is flooded. The 2022 effort repeated the 2021 research where 44 waterbird species was documented on 13 surveys. In addition, the vegetation transects that were surveyed in 2021 were repeated in 2022, with an average of 9 plant species per survey, albeit low diversity, yet important wildlife food sources. Data entry for both seasons is complete and stopover ecology analysis will begin in FY 2023.

Iowa State University completed the literature review on nutrients in the reservoir delta area and collected the first year of sediment and water quality samples. Early research on the denitrification ability of Lake Red Rock from 1974-2019 has concluded that the reservoir has reduced nitrates 12% from incoming flow to its release through the dam. A second phase sediment samples and cores were funded by the USACE Engineering with Nature. The team is drafting a report that characterizes the delta geomorphology and biochemistry. This report will be completed in FY 2023.

SRP funded the coordination of a "spring pulse," an intentional pulse of flow from the Red Rock Dam to stimulate fish spawning and freshwater mussel recruitment. This coordination included USACE staff from Des Moines River reservoirs, the Rock Island District Water Control and other offices, the Iowa DNR Fisheries Bureau, Iowa State University, and the University of Iowa. The planning was timed to coincide with ideal water temperature, river flow, flood risk management and season.

ISU mussel researchers completed quadrat sampling and visual/tactile searches at 26 sites along the Des Moines River during 52 sampling occasions. Thirteen sites were located above Red Rock Dam and thirteen were located below Red Rock Dam. At each site, 25 random quadrats were excavated for live mussels and recorded a suite of environmental data including flow, depth, temperature, and dissolved oxygen. During these searches, 1,439 live mussels of 21 different species were collected. In addition, the researchers conducted 190.6 hours of visual/tactile searches to assess reproductive success in relation to river discharge. Select species will be evaluated for age analysis. No endangered species or species of special concern were found. They also collected relict shells of 28 different species.
ISU fisheries research continued sampling efforts to assess the effects of experimental flow for fish reproduction on the Des Moines River, downstream from the Red Rock Dam. This included two events for larval fishes, zooplankton, and juvenile fishes below the dam, at two downstream locations, and at three locations on the Iowa River (reference system). During the first event, larval fishes and zooplankton were sampled fifteen times. Researchers captured 14,520 larval fishes comprised of nine taxa. Samples were processed for zooplankton, analyzed larval fish diets, factors affecting growth rates, and estimate hatch dates. During the summer, the second sampling occurred during two events for age-0 fishes via seining in the Des Moines (224 seine hauls) and Iowa rivers (142 seine hauls). The goal was to collect fish that may have hatched during the experimental pulse period. Once results are assessed, fish recruitment associated with river discharge characteristics can be incorporated in an adaptive management framework to manipulate flows from Red Rock Dam to benefit fish reproductive success.

Videography initiated in FY 2020 continues and is being used to study environmental responses related to pool drawdowns to support growth of wetland vegetation, waterbird use, and habitat and forage provision for shorebirds.

Anticipated 2023 work

The accomplishments of 2021 and 2022 generated excitement and enthusiasm for the SRP in the Rock Island District. FY 2023 will continue the multi-year efforts on mussels, fishes, and nutrients. An exciting scope is being developed to study the interstate migration of shorebirds at three COE structures in Minnesota, Lake Red Rock and a lock and dam in Missouri. The team will also continue water level management initiatives funded by the Ecosystem Management and Restoration Research Program (EMRRP) to study reptiles and further implement objectives in the 2020 Des Moines River Adaptive Management & Monitoring Plan. The primary SRP funding tasks for FY 2023 will include continuation of the communications and outreach component to advance scientific understanding of ecological processes in conjunction with reservoir operations and continue shorebird and vegetation work to document environmental response to e-flows and environmental water level management. Iowa DNR and MVR-Red Rock will co-present about SRP at a biologist symposium in March 2023 and the district anticipates 2 or more articles highlighting the work of SRP in Iowa. The work at Des Moines River is invaluable and wouldn't be possible without SRP support. The science initiative alone will continue to transfer knowledge to other reservoirs, locks and dams and promote exploring e-flows and water level management across the enterprise.

Future Vision

The Rock Island District SRP program was initially concerned with how dam and reservoir operations can be managed to minimize negative ecological consequences and maximize positive flow and pool benefits. The product of an E-Flows workshop with scientific experts and resource professionals provided the flexible framework for a versatile Adaptive Management and Monitoring Plan. This alignment of academics, field personnel, reservoir operators and hydrologists has already yielded

outstanding environmental benefits and scientific knowledge. This collaboration has not occurred to this extent before on the Des Moines River. The Des Moines River team seeks to continue the dialogue between agencies and scientists to affect the most benefit from operations. As we learn, more questions arise. By seeing the waters of Iowa as a life sustaining resource, rather than simply landscape overflow and drainage, we find the riverine ecology responding in-kind.

Farm Creek (Farmdale Reservoir), IL – MVR (DD)

Farm Creek has two impoundments within the Rock Island District (MVR); Fondulac Reservoir completed in 1949 and Farmdale Reservoir completed in 1951. Farmdale Reservoir is a dry reservoir where normally the land behind the impoundment is empty of standing water. When the flow in the creek exceeds the capacity of the culvert, water is retained in the reservoir area owned by the USACE. The stored water naturally releases at a rate dependent on the size of the culvert without the use of gates. The USACE owns a total of 973 acres of land in the Farm Creek Projects, most of which is available for low-impact recreation use by the public.

In 2020, Farmdale Reservoir became the first dry dam in the SRP. Since the land is owned by the USACE, resource managers determined that improvements may be possible including constructing intermittent wetlands, conducting invasive species management, restructuring Farm Creek to the original channel, and encouraging more ephemeral ponds across the landscape. MVR proposed to collaborate with state and federal partners and stakeholders including technical experts from Illinois DNR, USFWS, and TNC to develop specific guidance for implementing physical habitat improvements for a range of hydrologic conditions. The team had access to data sources and tools that to support this initiative including LiDAR imagery and HEC-RAS 2D modeling.

In the first year, the Farmdale team implemented several habitat improvements that included wetland creation, saddle dam installation, creek reroute, and vernal pool creation within the flood control reservoir. These projects focused on a goal of attracting reptiles and amphibians.

Status of 2022 work

The Farmdale SRP team planned to continue construction and restoration of additional small-scale habitat improvements like those from 2020. However, those actions were paused in FY 2021 and 2022 pending update of the project Operational Management Plan (OMP), including completion of environmental clearances needed for further implementation. Some site monitoring was conducted these past two years at the restoration sites and activities implemented in FY 2020. The ramped wetlands are showing some plant diversity, especially the circular one in Muddy Meadow. Multiple flowering plants were recorded as well as reed canary grass. Ramp wetlands in the sunny area have been filled with sediment from flooding and are overgrown with reed canary grass and need maintenance. Neither wetland areas show much evidence of holding water, probably due to the soil type. In addition, the 1-foot-high gravel dam has been almost entirely washed out by high water flows and is a lesson learned in gravel/rip rap sizing. The rip rap dam installed is still in place and ponding and could be used as a template for future small-scale projects.

Anticipated Work in 2023

The team will continue to monitor the new restoration projects (including involvement of local schools in environmental education programs) and incorporating lessons learned. In addition, the team would

continue to evaluate whether other habitat enhancement projects are feasible within the reservoir while waiting on the OMP update.

Future Vision

As the first dry dam project to implement restoration actions under SRP, efforts at Farmdale have proven helpful in generating interest for environmental enhancements at other USACE dry dams. The Farmdale team would like to maximize the use of seasonal water to support ecological resources and continue to study the effectiveness of projects within the limitations of the land owned in fee title by the USACE within the dry reservoir. Potential future actions within the project area include restoring upland oak savannah habitat in a former organized camp and restoring an historic cutoff oxbow of Farm Creek.

Gila River (Painted Rock Dam), AZ – SPL (DD)

Painted Rock Flood Control Project is located on the Gila River, in the southwest part of Maricopa County in the State of Arizona about 20 miles northwest of Gila Bend, Arizona. Gila Bend is a town located on the U.S. Highway No. 80 approximately 78 miles southwest of Phoenix, Arizona. The dam site is in a gap between the Painted Rock Mountains and the Gila Bend Mountains where the river is confined to a relatively narrow channel. It is the last dam on the Gila River before its confluence with the Colorado River.

The regulated inflow coming from the upstream projects includes: (1) releases made by the Salt River Project System which is comprised of seven reservoirs on the Salt and Verde Rivers; (2) releases made by the Coolidge Dam on the upper Gila River operated by the San Carlos Indian Project; and (3) releases made by the New Waddell Dam on the Agua Fria River operated by the Central Arizona Project. The current downstream channel capacity is limited to approximately 10,000 cfs. Painted Rock Dam has a drainage area of 50,800 square miles.

FY 2022 was the first year of SRP support for environmental activities at Gila River to include physical restoration of wetland habitats. Additional wetlands in this region would improve migratory bird foraging, provide additional habitat for resident bird populations that utilize riparian and riparian scrub habitat, and provide ancillary benefits to resident wildlife populations.

Status of 2022 work

The team completed an assessment of the USACE property and discovered four abandoned wells in the upstream flood pool area adjacent to the Gila River. Based on a reconnaissance by the USBR well drilling team, the well looks like it could be rehabilitated to provide hydrology to new wetland habitats. USBR will gather additional information on the well in November 2022 to ascertain if a pilot wetland of ¼ to ½ acre in size could be supported. Conceptually, the well would run on a solar powered pump to support a mosaic of constructed perennial and ephemeral wetlands. If successful, the team believes USFWS would be amenable to populating the wetlands with ESA listed species.

Internally, the USACE SRP team has initiated environmental analysis, including NEPA compliance work and engineering (30% design phase). The team has compiled a list of stakeholders and collaboration has been initiated with Arizona Game and Fish Department and an adjacent landowner. Contact with additional stakeholders is on hold until engineering and feasibility work is further along.

Anticipated 2023 work

In FY 2023, the team anticipates completing the remaining environmental work, including NEPA documentation, engineering, and P&S. The team anticipates awarding a contract or MIPR to USBR to repair the existing well, purchase and install a solar pump, purchase a liner and planting material. Once the contract is awarded, the team plans to develop a draft Monitoring and Adaptive Management Plan and initiate discussions with USFWS on using the constructed wetland as habitat for ESA listed species.

Future Vision

The team views Painted Rock Dam as having the potential to serve as important habitat linkage between up and downstream islands of habitat on the Gila River in this extremely arid climate. In addition, the remoteness of the site reduces the USACE risk of trespass and vandalism on constructed restoration sites and associated facilities. Therefore, if the FY 2022 work is successful, the team would seek to develop a more comprehensive ecosystem restoration plan for the area to include perennial and ephemeral wetlands where suitable sources of hydrology and other conditions are present. For example, four wells were identified upstream of the dam and have the potential to support construction of perennial and/or ephemeral wetlands. Other sites were identified downstream of the dam as has having potential for ephemeral wetlands. The dam is remote and does not support recreational activities, providing an ideal setting for wildlife refugia in an otherwise urban region.

Iowa River (Coralville Lake), IA – MVR (Gen)

The Iowa River originates in north-central Iowa and flows 323 river miles until joining the Cedar River and ultimately the Mississippi River. Coralville Lake is a multi-purpose project providing primary benefits in flood control and low flow augmentation, and secondary benefits in recreation, fish and wildlife management, and forest management.

The Iowa River and management of Coralville Dam was a new project to SRP in 2020. Patterned after the work on the Des Moines River, the USACE and River stakeholders are considered e-flows and reservoir management during the update of the Water Control Plan to incorporate flexibilities that accommodate future adaptive management strategies. During FY 2021, the Iowa River Team identified partners to include the TNC, IDNR Fisheries/Mussels, academic, regional and district experts. The team completed the Iowa River State of the Science Report in July 2021 and planned to hold an e-flows workshop. The workshop was postponed due to COVID hesitancy, cancelations, and agency restrictions, and later determined to not be needed. Comments from the Iowa River stakeholder meetings were instead used in collaboration with TNC to build recommendations based on those developed for the Des Moines River.

Status of 2022 work

The Iowa River SRP team completed an "Iowa River Environmental Flows Summary Report" using the information received from participants of the e-flows workshop for the Des Moines River; scaled to the Iowa River; and includes information provided by the Iowa River Stakeholders. The product defined the pre and post release metrics related to the timing and quantities of e-flows. The team has been collaborating with federal and state partners and other stakeholders to plan a question-and-answer forum for early FY 2023 and to kick off the development of the Adaptive Management and Monitoring Plan (AMMP).

Anticipated 2023 work

The SRP team will host a virtual question and answer forum November 2023 on the Iowa River Environmental Flows Summary Report and finalize the report after addressing stakeholder input. The team plans to move forward with drafting Iowa River AMMP, with a goal of having that accomplished in mid-FY 2023.

Future Vision

As stated, the Iowa River SRP project is modeled after the extensive work completed and on-going on the Des Moines River. If as successful, this project will expand to include flow prescriptions, implementation and monitoring, and adaptive management.

Kaskaskia River (Carlyle, Shelbyville, and Kaskaskia Lock & Dam), IL – MVS (Gen and LD)

The Kaskaskia River Basin covers 10% of the State of Illinois, encompassing parts or all of 22 counties, with 30 main tributaries and 5,840 square miles of drainage. It is a tributary of the Mississippi River, with headwaters just west of Champaign, and flows southwesterly across the state for approximately 325 miles to its confluence with the Mississippi River, about eight miles north of Chester at river mile 117.

Carlyle Lake Dam was completed 1967 and Lake Shelbyville Dam was completed in 1970; both were built primarily for flood risk management. Kaskaskia Lock and Dam (RM 28) was completed in 1974 to provide a nine-foot navigation channel for a narrower tow/barge configuration than those that transit the Mississippi River locks and dams. Flexibility of dam operations offers potential to manage water levels lower during summer growing season to enhance aquatic plant growth.

The Kaskaskia River was identified as a high priority work area for SRP action at the 2019 Midwest Operations and Water Management Meeting. All three dams on the Kaskaskia River were proposed for SRP by the St. Louis District (MVS) in 2020. In FY 2020, the team analyzed daily flows for the previous 10 years at Kaskaskia River Lock and Dam and upstream releases at Carlyle Lake to determine feasibility of implementing water level management to expose shoreline substrate upstream of Kaskaskia Lock and Dam. Water control managers and other stakeholders held meetings with a small group of stakeholders to propose a 0.5’ water level reduction at the dams to expose river edge for at least 30 days during the summer. The exposed substrate has viable native seeds that will regenerate and provide fish and wildlife habitat, capture suspended sediment and stabilize the riverbanks. FY 2021 work included public outreach, qualitative vegetation monitoring, approximately half of the desired aerial imagery analysis, and photo documentation of the plant response at Carlyle Lake and Kaskaskia River.

Status of 2022 work

A key aspect of the work continued to be public outreach to inform and educate the public on plans for water level management implementation at the two reservoirs and the one lock and dam and the successes realized from these operational changes. Data and imagery from monitoring vegetation during implementation of successful drawdowns at the Kaskaskia River pool and Lake Shelbyville was used to showcase successes. Seedhead sampling and satellite imagery was used to evaluate implementation and delineate acres of habitat exposed. A successful public outreach meeting occurred for the Shelbyville in December 2021 and a joint public outreach meeting for Carlyle Lake and the Lower Kaskaskia River was planned for December 2022.

Satellite imagery was acquired and used to delineate Lake Shelbyville, Carlyle Lake, and the lower Kaskaskia River pools. The geospatial team recently completed quality control of delineation data and is

packaging layers, example images, and acreage tables for the project team to utilize for outreach in early FY 2023.

Vegetation was assessed at Lake Shelbyville and on the Lower Kaskaskia River utilizing both IWMM and Illinois Natural History Survey transect protocols. Local field office teams deployed game cameras to document plant response over the drawdown period, and the district drone team gathered imagery from the lower Kaskaskia River and at Lake Shelbyville. Seedhead samples were gathered at the lower Kaskaskia River and Lake Shelbyville but could not be sampled at Carlyle Lake. The Lake Shelbyville drawdown occurred later in the season, and as a result the plants had less time to mature and develop seed compared to the lower Kaskaskia River pool. Seedhead analysis was attempted for both locations but could only be completed in the Kaskaskia River pool due to constraints of already developed species models.

At Carlyle Lake a mid-summer drawdown started to produce outstanding results, but several large rain events in July forced an increase in reservoir water elevation. The establishing emergent vegetation was overtopped for an extended period and did not survive.

Summary reports for both the public meetings and vegetation surveys are anticipated in early FY 2023. The district continues to share information about e-flow attempts over the past summer and plans for e-flows in 2023 at all public meetings.

Anticipated 2023 work

A joint public outreach meeting for Carlyle Lake and the Lower Kaskaskia River is scheduled for December 2022. The team proposes to build on the FY 2021 and 2022 work that included successfully completing water level management efforts at Kaskaskia lock and dams during both years, in 2021 at Carlyle Lake, and in 2022 at Lake Shelbyville. The team proposes additional public outreach and meetings to inform and educate the public on the 2022 successes. Also proposed is a continuation of quantitative vegetation monitoring efforts during implementation to document plant response and biological impact, showcase success and use for future public outreach. The team is adapting environmental drawdown attempts to refine e-flows strategy based on past lessons.

Future Vision

The team is learning more about the capabilities and plant response at each of three locations identified for drawdowns on the Kaskaskia River. Lessons learned from each year's attempts will be utilized to inform and refine the future management strategies. Opportunities may exist to implement drawdowns and capture additional ancillary benefits at adjacent state-managed sites, so continued coordination with partners and the public will be necessary to maintain support for the project. Diverse stakeholders, particularly at the reservoirs underline the importance of continued outreach and communication to ensure the public is informed and that any concerns that arise are addressed promptly. The overarching goal is to identify ecologically beneficial management practices that can be incorporated in the WCP.

Mississippi River (Upper River Basin), IL and MO – MVP, MVR & MVS (LD)

The Upper Mississippi River has been modified for navigation and other purposes for over 100 years through a series of locks and dams constructed in the 1930s and 1940s. The primary purpose of these projects was to construct the Nine-Foot Channel Navigation Project. Each lock and dam create a navigation pool to provide relatively stable water levels during non-flood periods.

The high and relatively stable water levels created by the locks and dams subjected islands in the lower portion of the pools to wave erosion. Many islands disappeared along with the aquatic plant beds adapted to the shallow water. A river restoration program was secured through Congressional action and although critical river restoration has occurred, seasonal variability in flow and water levels has not.

The 3 Districts of the Upper Mississippi River have experimented with modifying operations of the locks and dams to restore some seasonal variability. The districts have reduced water levels during the growing season in some pools to expose mudflats and prompt native seed germination. The St. Louis District (MVS) has been successful in using operational flexibility to keep water levels slightly lower in the summer while maintaining the navigation channel. Between 2015 and 2018, SRP supported MVS in monitoring adaptive management activities to demonstrate responses to these lower water levels at specific locations. This SRP funding is supporting improving the management of the entire system, including more than 30 locks and dams on the Upper Mississippi and Illinois Rivers.

The Upper Mississippi River team continued developing an implementation strategy for operationalizing water level management within the system. They acquired hourly flow and gage data from locks and dams for years 2016-2018 during the growing season and performed analysis of data to determine operational capability for small-scale water level management. The focus was to identify specific operating bands for each lock and dam on the Upper Mississippi River totaling over 500 river miles. The team quantified acres exposed through implementing pool by pool operations in 14 pools in Rock Island District (MVR) and 9 pools in St. Paul District (MVP) with additional success rate calculations for water level management. The objective of the PAS is to implement systemic water level management on the Upper Mississippi River.

In FY 2021, the Upper Mississippi River SRP team proposed to investigate, compile, and document Upper Mississippi River goals and objectives. In FY 2021 the team completed a report of FY 2020 accomplishments and expanded work by holding remote regional operational workshops for a small group of Water Control Managers. The workshops consisted of six meetings totaling 21 working hours between March and July 2021. The members considered programmatic implementation of water level management in the Upper Mississippi River. Participants represented the following agencies: USACE, USFWS, USGS, UMRBA, TNC, ILDNR, IADNR, MNDNR, WIDNR, and USEPA. The facilitator used SDM processes and an adaptive management framework to guide the discussions. Input was organized into a detailed report capturing the steps and decisions made during the workshops, and recommendations for characterizing the ecological conditions of pools to aid selecting and prioritizing pools for water level management.

In FY 2022, the Upper Mississippi River SRP team transitioned from overall water level management study to specific scientific efforts to assess habitat and species-specific. These efforts are the Vegetation Study, Lake Sturgeon Spawning, Shorebird Habitat, and Evaluation of Operational Requirements, as described below.

Vegetation Study, MO - MVS

The 3 Districts of the Upper Mississippi River have experimented with modifying operations of the locks and dams to restore some seasonal variability as described in the 2021 IPR. In FY 2022, MVS collected Arrowhead samples in August, September, and October 2022 to evaluate arrowhead distribution, density, and tuber growth and density. Arrowhead data were gathered along 10 random transects at the Mile 210 area along to allow assessment of aboveground cover and spread. Additionally, the district drone team gathered aerial imagery at the Mile 210 area to document extent of arrowhead for communication and outreach. Arrowhead tuber samples are being processed and then the team will

coordinate with HEC to update ecological parameters in the model. Completion of the project summary report and model verification will follow.

Lake Sturgeon Spawning, MO - MVS

The lake sturgeon (LKSN) is a charismatic fish species that is unique due to its longevity and sheer size. Lake sturgeon, also known as "rubbernose" sturgeon can reach 8 feet long, weigh over 200 pounds and live over 100 years. LKSN are designated as state endangered species in Illinois and Missouri. In 2015, LKSN was observed spawning in the tailwater of the Melvin Price Lock and Dam (Mel Price), a dam and two locks at river mile 200.78 on the Upper Mississippi River, about 17 miles north of St. Louis, Missouri. This site became the first confirmed sturgeon spawning location in Missouri, however some of the specifics around this event aren't fully understood. It is known that water temperature, time of year, flow velocity, and substrate are critical to spawning. Ongoing work seeks to collect data necessary to operationalize e-flows for lake sturgeon through targeted operations, collaboratively monitoring lake sturgeon activity/response in the area and conduct agency coordination and public outreach.

MVS completed baseline flow conditions of prior use years in HEC-RAS 2D modeling, sturgeon sampling, tracking and spawn monitoring, as well as development and implementation of an SRP lake sturgeon conservation outreach plan. HEC-RAS was used to simulate existing channel conditions and study velocities affected by gate bay gate settings on the April 2015 spawning zone and two similar events from 2016 and 2018. The tailwater averages for the 2018 and 2016 events were 405.3 and 405.1. The approximate tailwater elevation relationships between events simulated seem to indicate that tailwater might be the most functional parameter in establishing a relationship between the hydraulics and Lake Sturgeon spawn. These functional relationships can be used as a determining factor for decisions on ideal gate 9 and/or gate 8 settings. For a tailwater ranging from 403.0 feet to 406.5 ft, the current recommended settings for gate 8 is 4 to 5 feet, and gate 9 of 2 to 4 feet. A gate 8 and gate 9 opening of 5 feet and 4 feet would coincide with the lowest total gate openings within this tailwater range. Lake sturgeon monitoring around Mel Price will be initiated in FY 2023 to capture and radio tag fish, track passively and actively via VR2 receiver and homing transects via boat to reaffirm a pre-spawn staging area located along the Illinois shoreline below Mel Price.

Modeling outputs were used as a starting point for generating recommended gate settings to achieve target flows in the suitable spawning substrate area. Shoreline velocity measurements taken in the field each morning was used to verify suitable flows or used to inform further gate management. Target velocities were maintained and documented for nearly four weeks and resulted in a very successful Lake Sturgeon spawning season. Active monitoring during the field season identified that the location of suitable spawning velocities shifts on the bankline with various gate settings and suggests that a range of gate settings may achieve target velocities needed to encourage Lake Sturgeon spawn at the site. The news of the second successful Lake Sturgeon spawn in the state in modern Missouri history generated several wide-reaching news articles and shared media products on the project.

Shorebird Habitat Enhancement, MO - MVS

The Upper Mississippi River System is located at the center of one of the primary migratory pathways in North America and is historically significant for migratory shorebirds. Many of the species that utilize migratory stopover habitat in our region depend on mudflat habitats scattered across hundreds to thousands of miles apart between breeding and overwintering areas. Shorebirds depend on shallowly flooded and recently flooded mudflats and sandbars to access invertebrate prey. When mudflats are exposed, extensive shorebird use near Mel Price L&D declines quickly due to surface drying. Ongoing work seeks to provide shorebird habitat for migrants more consistently across their spring and fall migratory period (March-Jun and mid-July-September).

The team implemented experimental short duration water elevation pulses between 0 and 1.2 miles upstream to rehydrate exposed sandbars and mudflats during spring 2022. Pulses were isolated to once a week to fine tune our pulse strategy without modifying flow conditions below the dam repeatedly. This cautious approach was due to experimental trials of ideal flow conditions occurring for Lake Sturgeon as described above. These trials helped raise new, helpful insights and questions about how gate management may be used achieve multiple environmental benefits in the project area (Lake Sturgeon and Shorebird habitat).

Macroinvertebrate samples were gathered during each pulse attempt along with an assessment of shorebird use over the migration season, but additional data will be needed in subsequent years.

Game cameras were placed in locations that limited threat of theft in areas thought to be good evaluation locations, but woody growth and disturbance impacted use of the resulting photos. Alternative sites that are located closer to suitable habitat have been identified for monitoring in subsequent years.

Evaluation of Operational Requirements, MO - MVS

In 2021, through a USACE PAS effort, navigation pools on the Mississippi River in MVR and MVP were evaluated for the operational costs and likelihood of success for a prolonged WLM event. MVS pools were not included in that assessment. This effort seeks to apply a similar methodology to the 3 MVS pools, with the intent of evaluating the dredge timing and requirements in each pool to allow a maximum within band drawdown to occur, evaluating a 20 year hydrologic period of time (when WLM was attempted in MVS) to determine in which years successful implementation of WLM was impacted by low channel depths, and to complete an AAHU habitat assessment to determine the ecological benefit (vs additional cost) of dredging to ensure maximum WLM success. Results would be used to recommend a large-scale ecosystem restoration project in these pools under USACE UMRR or NESP authorities. Analyses of the 20-year hydrologic period and ecological benefit for Pools 24-26 will occur in FY 2023.

Anticipated Work in 2023

Summary reports are being prepared for the work described above and additional proposals were submitted to focus on operationalizing gate settings at Mel Price to achieve desirable tail water velocities for the Lake Sturgeon, establish a frequency of rehydration needed to maintain suitable habitat for shorebirds, and improve game cam monitoring strategy. The team will also further analyze and refine the model to inform draft operational plan development for eventual incorporation into the water control manual update and continue to partner with the Missouri Department of Conservation to capture, tag, and track lake sturgeon in the Mel Price tailwater.

Future Vision

Managing the entire Upper Mississippi River, over which there are 27 locks and dams spanning several hundred river miles to maximize beneficial spawning habitat the Lake Sturgeon, migratory shorebirds while maintaining navigation. Apply lessons learned other pools along the Upper Mississippi, Illinois River, and others.

Neches River, TX – SWF (Gen)

The Neches River is in east Texas with the headwaters located near Colfax, Texas in the Fort Worth District (SWF). The Neches River flows approximately 416 miles into a coastal estuary, Sabine Lake, and ultimately into the Gulf of Mexico. The watershed of the Neches River and its tributaries encompass approximately 10,300 square miles. Town Bluff Reservoir is located on the mainstem of the Neches River while the Sam Rayburn Reservoir is located on the Angelina River just above Town Bluff and the confluence with the Neches River. Reservoir purposes include flood control, water supply, hydropower, and recreation.

The Lower Neches River supports some of the highest diversity of aquatic life in Texas, including the most diverse mussel community in the state. The rich fish and wildlife communities are evidenced by the Big Thicket National Preserve, the Sabine National Wildlife Refuge (NWR), The McFaddin NWR, the Texas Point NWR, the Lower Neches Wildlife Management Area (WMA), the Big Hill WMA, and the J.D. Murphree WMA all located downstream of Sam Rayburn and B. A. Steinhagen reservoirs.

SRP work on the Neches began in FY 2021 and seeks to optimize reservoir releases and river flows to benefit river ecology while continuing to operate for project purposes. Maintaining e-flows that benefit native species and ecological systems would provide year-round river water levels suitable for the behavioral, reproductive, and habitat needs of river and floodplain flora and fauna.

In 2021, SWF and TNC coordinated a workshop with the Lower Neches Valley Authority (LNVA), natural resource agencies, academia, and other scientific experts and environmental practitioners. A summary report of the workshop includes stakeholders, ecosystem problems and opportunities, and a prioritized list of potential ecosystem projects or research needed to identify e-flow opportunities.

Status of 2022 work

The next phase of work received approval and funding from SRP in early September 2022.

Anticipated 2023 work

The SWF team will investigate environmental strategies for operational changes at Sam Rayburn and Town Bluff Reservoirs, data compilation and literature review and for assessing opportunities to benefit freshwater mussels and planning and execution of an e-flows workshop in early 2023. The goal is to finalize the development of e-flow recommendations in April 2023.

Future Vision

If possible, implementation of e-flows at the Sam Rayburn and Town Bluff Reservoirs.

Ohio River, IN, KY, OH, PA, and WV – LRP, LRH, and LRL (LD)

The Ohio River basin is of national ecological and socioeconomic significance, containing a diverse aquatic community (approximately 160 fish and 120 mussel species) and providing vital services (e.g., navigation, recreation, drinking water) to over five million people. Altered hydrology has been identified as an urgent threat to the ecological sustainability of the Ohio River by altering water quality, sediment transport and distribution, floodplain connectivity, and availability of/access to critical (e.g., spawning and rearing) habitats. The *overall goal* of the three participating USACE districts is to develop the science and tools needed to maximize ecological sustainability of the Ohio River mainstem through strategic operations of its 19 navigation dams and 68 contributing reservoirs while maintaining current mission goals (navigation, hydropower, flood risk management, etc.).

In 2021, the multi-district team set out to utilized SRP funding to inventory existing conditions within the Ohio River, identify environmental and operational constraints and considerations, and identify potential opportunities to maximize ecological sustainability through reservoir and navigation system operations. Due to the delay of funds, this work extended further into FY 2022 than originally scheduled.

Status of 2022 work

The initial inventory of baseline conditions focused on the mainstem of the Ohio River, with some consideration to high value tributaries or reservoirs was completed in March 2022. Using publicly available data, the PDT has documented water quality trends, invasive species distributions, high quality habitats (i.e., islands, wildlife refuges, etc.), fish and mussel community characteristics, presence of threatened and endangered species, substrate types, ORSANCO ORFIN and macroinvertebrate assessment scores, and known water quality issues to the extent feasible. H&H Engineers, in coordination with Operations, documented physical characteristics and constraints of the navigation system, including presence and characteristics of hydropower; number and characteristics of gates, locks, and weirs; ordinary high-water marks; upper pool elevation; length of pool; drainage area; and travel times, among others. H&H Engineers have also evaluated the potential to use the Ohio River Community Model to assess future conditions of selected pools should e-flows be implemented.

In February 2022, the districts identified and prioritized 10 environmental opportunities to increase the ecological quality and sustainability of the Ohio River based on the inventory of physical and ecological conditions. These include: 1) temporarily raise pool elevation; 2) temporarily lower pool elevation; 3) flow manipulation for habitat improvement; 4) selective withdrawal retrofits for flood risk management structures; 5) structural changes; 6) island restoration; 7) invasive species control; 8) modification of hydropower operating agreements; 9) rapid watershed assessment for tributaries; and 10) conservation lockages on tributaries. Environmental professionals from each district researched potential benefits, drawbacks, and considerations of these opportunities to develop broad recommendations for implementation. H&H Engineers modeled potential impacts of temporarily lowering pool elevation (opportunity 2) on navigability in three selected pools, one in each district. Geospatial sections summarized land use in the riparian corridors and assessed the acreage of habitat that could be generated through temporarily raising (opportunity 1) and lowering (opportunity 2) the pool elevation. Information compiled from each discipline was used to generate recommendations for further study. The report and all associated deliverables are available online at the Pittsburgh District's website.

The overall goal of the FY 2022 effort is to prepare and advance a stakeholder engagement campaign to present and refine the environmental opportunities identified by the Districts in FY 2021. Funding for the FY 2022 SRP effort was received in May 2022 and pushed planned work to late in the FY and into FY 2023. Between May and September, the Districts identified a list of regional stakeholders, including academic institutions, nonprofit organizations, and state and federal government agencies and planned a kick-off meeting for October 2022.

Anticipated work in 2023

The multi-district team executed a series of in-person stakeholder meetings planned in early FY 2023 at the Pittsburgh, Huntington, and Louisville District offices concurrently. The individual meetings were connected via webex to provide a basin-wide perspective while maximizing stakeholder attendance and participation. A total of 62 participants, including USACE personnel, attended the 4 October stakeholder meeting. The districts are working to develop focus working groups to identify specific opportunities for

ecological restoration or enhancement in collaboration with the stakeholders. The districts anticipate completion of the implementation plan and the overall FY 2022 SRP effort in May 2023.

Future Vision

Outcomes of the SRP funded work will culminate in a thorough assessment of opportunities within the Ohio River Basin, across 19 navigation dams and 68 contributing reservoirs, and affect a suite of flora and fauna. The overarching goal is to incorporate operations across the USACE facilities that benefit the environment while maintaining current mission goals (navigation, hydropower, and flood risk management).

Osage River, KS and MO – NWK (Gen)

The Osage River was identified as a potential SRP project at the 2019 Upper Midwest Regional Meeting as a logical expansion of efforts on the Kansas and was funded by SRP in FY 2020 as a "general" reservoir. The proposal included evaluation of three geographic areas: 1) headwaters of the Osage River, extending from Kansas to Truman Reservoir in Missouri, 2) the Sac River from Stockton Reservoir to the Osage River, and 3) the Pomme De Terre River from Pomme De Terre Reservoir to the Osage River. Initial work was slated to explore current and historic operating conditions and identification of both regulated and unregulated flow to the Osage. In 2020, the team executed an IPA with Oklahoma State and held a project kick-off meeting. The work on Osage River in FY 2021 was delayed due to staffing limitations and Covid 19 restrictions. Funds were carried over to FY 2022.

Status of 2022 work

The Osage River team completed a kickoff meeting followed by a series of 4 Science Team meetings with good participation from stakeholders including the USACE, USFWS, USGS Missouri Cooperative Fish and Wildlife Research Unit, Missouri Department of Conservation, Kansas Department of Wildlife and Parks, Kansas Water Office, SWPA, Oaklahoma State University, and Kansas State University. Discussions focused primarily on mussels. A Draft Ecological Resources Report focusing on fish and mussels in the Osage River is in process and will be finalized in early 2023. The report integrates fish data from the Marais de Cygnes section of the Osage River compiled from historical surveys (1950's) with repeated data collections from the KDWP, including in-depth reproductive strategies for several species. Comprehensive fish data and presence/absence mussel data are outlined with literature review as basis for e-flow planning like the Kansas River Science report.

The USFWS discovered a new endangered species Spectaclecase mussel in Pomme de Terre River during the WCM Update. Missouri has committed to provide all mussel and fish data from the MDC Integrated Aquatic Database for the Osage River at a HUC 12 resolution and the Science Team agrees that mimicking natural flows as best possible is ideal for the mussel species. HEC-RPT period of record data for Osage River basin was completed, a test flow was completed, and some products are being incorporated into Ecological Report. HEC-RPT capacity building sessions with trial runs to prep for workshop agenda are in process.

Anticipated 2023 work

The NWK SRP team will finalize the Ecological Resources Report prepare for an e-flows workshop in 2023.

Future Vision

The current vision of the project is to implement meaningful long-term e-flow prescriptions within the 3 river reaches included in the Osage River SRP. If successful in testing prescriptions in 2023 and 2024, incorporating e-flow operational changes into the WCM is the ultimate goal to support sensitive mussels and fishes.

Potomac River North Branch (Jennings Randolph Lake), MD and WV - NAB (Gen)

Jennings Randolph Lake (JRL) is located on the North Branch Potomac River and spans across Garrett County, Maryland, and Mineral County, West Virginia. The dam is located 58 miles upstream of the confluence of the North Branch and South Branch Potomac Rivers. Jennings Randolph Lake is operated by the U.S. Army Corps of Engineers, Baltimore District (NAB) and is often operated in conjunction with Savage River Dam, a State-owned project on the Savage River. Jennings Randolph Lake was originally authorized for the purposes of flood control (now flood risk management), domestic and industrial water supply, water quality control, and recreation. Whitewater recreation was added as a project purpose in 1988.

Storage within Jennings Randolph Lake at its summer pool is specifically allocated for both water quality and water supply. Originally, regulating Jennings Randolph Lake for water quality concerns centered around acid mine drainage and industrial pollutants in the watershed. The lake was devoid of fish, and it was deemed that there never could or would be a fishery in the lake. At that time reservoir regulation strategies included utilizing the selective withdraw capability of the outlet works to regulate the quality of the releases for pH, conductance, and dissolved oxygen. In addition, the release plan included maximizing the use of the water quality storage within the reservoir to help dilute downstream pollution. During the late summer and fall, when there were extended periods of low flows, sediment and precipitates from industrial effluent and acid mine drainage would settle out in the downstream river channel creating a smothering effect.

To help minimize these adverse effects during extended low flow periods, Artificially Varied Flow (AVF) releases were initiated - AVF releases are pulse flows for removing accumulated organic sediments, thus improving the downstream aquatic environment.

As various remediation efforts were implemented such as treatment of acid mine drainage and stricter limits on industrial effluents, the overall condition of the North Branch Potomac River watershed improved. Fisheries both in-lake and downstream began to thrive. A thriving cold-water fishery developed downstream of Jennings Randolph which led to a significant increase in fishing interests and growing recreation businesses. Over the years, the main water quality concern began to shift to the downstream fishery and the ability of Jennings Randolph to maintain cold water releases for that cold water fishery. Release strategies shifted away from releasing as much as possible to utilizing the water quality storage more conservatively to conserve cold water storage to maintain downstream temperatures and desired flows for the downstream fishery.

FY 2021 was the first year of SRP involvement in the North Branch Potomac River. Initial efforts were focused on internal coordination with Operations, Engineering (Water Management) and Planning regarding the evolution of the regulation of Jennings Randolph Lake to date, gaining a better understanding of e-flows, and assessing the potential for considering e-flows for Jennings Randolph and the North Potomac.

Status of 2022 work

The continuation of the North Branch Potomac SRP in FY 2022 focused on the development of the State of the Science report and stakeholder collaboration. Team meetings were held from June through September to discuss literature review, data gathering and development of the report. A literature search was conducted to accumulate and categorize existing data already "in hand". Coordination and meetings with other agencies including Interstate Commission on the Potomac River Basin (ICPRB), Maryland Department of the Environment (MDE), Maryland Department of Natural Resources (MDDNR), and Maryland Bureau of Mines were completed. Data from these agencies was collected and used in preparing the draft State of the Science Report (75% complete).

Anticipated FY 2023 Work

The team will finalize the State of the Science Report and host an e-flows workshop planned for May 2023 to evaluate and identify environmental opportunities sustain or improve the ecosystem health for the North Branch Potomac River below Jennings Randolph. An issue report will be prepared documenting primary concerns identified by partners and stakeholders and will include an initial draft of ecological flow needs.

Future Vision

The team anticipates that the e-flow workshop will identify actions to environmental actions to implement and ultimately incorporate into the Jennings Randolph Lake Reservoir Regulation Manual (RRM) to improve environmental conditions downstream.

Roanoke River (John H. Kerr Dam), VA and NC – SAW (Gen)

The Roanoke River flows over 400 miles from the Blue Ridge Mountains to the Albemarle Sound, encompassing a drainage area of about 9,600 square miles. The Upper and Middle Roanoke Basins are highly regulated, with multiple private and USACE-owned reservoirs. The USACE owns and manages two reservoirs in the Roanoke Basin: Philpott Reservoir on the Smith River and John H. Kerr Reservoir on the Roanoke River. Both are multi-purpose reservoirs, with flood risk management and hydropower as primary operational purposes.

The lower Roanoke River flows through a floodplain of national significance, containing “the largest intact and least disturbed bottomland hardwood cypress / tupelo ecosystems on the Atlantic Coast of America”. USFWS and TNC own over 95,000 acres in the lower 134 miles of the Roanoke River. This critical floodplain forest habitat was the impetus to identify a management alternative to restore flows that more closely resemble natural river flows. The alternative chosen is called Quasi-Run-of-River (QRR) that shifts the flood control operations defined in the Water Control Plan to release outflows that more closely mimic inflows. This change provides the flow that benefits the habitat while still supporting flood control and hydropower missions. QRR was officially implemented in June 2016. SRP supports the monitoring of the revised releases to assess if ecological outcomes meet intended results or require adaptive management changes.

The Roanoke River is considered one of the most important riverine systems for diadromous fish reproduction on the Atlantic seaboard. Beginning in 2016, the USACE implemented a more naturally variable flow regime (QRR). Intensive monitoring of diadromous fish recruitment has occurred on the Roanoke both pre and post QRR, yet limited work had been completed for juvenile alosines (blueback herring, alewife, hickory shad) with river flow events.

In FY 2021, an extensive eDNA monitoring effort was initiated on the mainstem and two tributaries spanning adult spawn and juvenile movement season. Blueback herring DNA was found in all five locations sampled.

Status of 2022 work

Duke University researchers completed extensive lab analysis of fish eDNA samples collected in FY 2021 and prepared a report on the study results. The researchers and the SRP team also initiated the FY 2022 ecosystem function model and vegetation studies by collecting tree rings to look at vegetation/water level relationships. The vegetation work started late in the FY due to delays in executing the contract so data collection will continue in FY 2023 in partnership with USFWS biologists.

TNC secured a summer intern to evaluate remote sensing data with flooding and deforestation along the Roanoke and secured permits to conduct electrofishing and netting in 2022.

The HEC-EFM model was initially created in 2022 and will be updated and vegetation relationships are analyzed. The HEC-EFM model will be fully tested in 2023.

Anticipated 2023 work

SRP work that was approved and funded in 2021 was planned to go through 2023 and the team is on track to meet this schedule even with funding delays. Therefore, the team will continue eDNA and vegetation work and development of the ecosystem function model and refine and test the HEC-EFM model.

Future Vision

With the additional information from monitoring, scientists can evaluate the existing QRR impact more fully to the river's geomorphology, floodplain forests and diadromous fish movement. These activities inform decisions about maintaining current operational changes or adapting these changes to better support the ecological outcomes that were defined for ecological health of the Roanoke River. It is anticipated that this information can be regionalized and used by neighboring river basins and beyond.

Salt River, MO – MVS (Gen)

Lake sturgeon were historically common throughout the Mississippi and Missouri River basins. However, by the 1900s they became endemic to the Great Lakes. Multiple states have been involved in lake sturgeon reintroduction programs. Missouri Department of Conservation has been stocking lake sturgeon in the Mississippi and Missouri Rivers since 1984 but only recently has breeding in the wild been observed and documented. Just below the Clarence Cannon hydropower dam on the Salt River, lake sturgeon aggregations and assumed breeding has been documented in 2016-2020.

Status of 2022 work

An on-site meeting with SWPA and MDC was held in spring 2022 to assess water flows under different gate settings and worked with partners on outreach with public. Lake Sturgeon use of the area below the reregulation dam was confirmed during what would be expected spawning season, but water conditions, flows, and timing hampered monitoring, and the ability to detect a spawning event. Given late funding, no pilot project effort was scheduled for FY 2022.

This fall, the CWMS model will be completed along with drafting up of an operational plan in December. The summary report for the project will be completed in December.

Anticipated 2023 work

Building upon the FY 2022 efforts, in FY 2023 the SRP team would plan to 1) host focused meetings with the state and SWPA to discuss the draft operational plan; 2) conduct a pilot project in the spring of 2023 if conditions are suitable; 3) collaboratively monitor lake sturgeon activity/response in the area; 4) continue agency coordination and public outreach, and 5) complete a yearly summary report.

Future Vision

Several years of assessing modifications to flow management coupled with lake sturgeon monitoring is anticipated to refine operations. If the project is successful, lessons learned from the Salt River and the Mel Price L&D Lake Sturgeon project could be used to help other districts implement similar projects in their district for sturgeon or potentially other species with similar requirements.

Trinity River (multiple reservoirs), TX - SWF (Gen)

The Trinity River watershed is entirely in Texas flowing 710 miles south of the high bluffs in north Texas (near Red River) to the Gulf of Mexico near the cities of Houston and Galveston. The Trinity River has four branches in the Dallas/Fort Worth (DFW) Metroplex: Clear Fork, Elm Fork, West Fork, and East Fork. The Trinity River basin covers 15,589 square miles and includes six SWF USACE reservoirs: Benbrook Lake, Joe Pool Lake, Lavon Lake, Lewisville Lake, and Ray Roberts Lake all located in the DFW Metroplex area. These multipurpose reservoirs support flood control, water supply, and recreation use. Each reservoir is guided by project specific WCMs to ensure project compliance with congressionally approved operating purposes. In addition, the SWG Wallisville Lake Project is located along the Trinity River with the following multipurpose uses: navigation, salinity control, water supply, fish and wildlife enhancement, and recreation.

Downstream of the USACE reservoirs, the Texas Parks and Wildlife have designated a section of the Trinity River above Lake Livingstone as an ecologically significant river segment because it supports one of the two largest remaining populations of Texas heelsplitter, an endemic endangered mussel species. The Trinity also supports the endangered Texas fawnsfoot mussel and is an important fishery for freshwater drum, striped bass, white bass, yellow bass, flathead catfish, channel catfish, and numerous sunfish species. Another ecologically significant river segment further downstream supports oxbow lakes and marshes, bottomland hardwood forests, riparian conservation areas (Wallisville Lake Project, the Trinity River National Wildlife Refuge, and Davis Hill State Park), threatened and state listed endangered species (wood stork and alligator snapping turtle) and the estuarine delta.

Status of 2022 work

SRP funding was received in Q4 of FY 2022 and the team began preliminary planning for FY 2023.

Anticipated Work in 2023

Work planned for FY 2023 was funded in FY 2022 and includes formation of a Trinity River Working Group by the SWF and the preparation of a workshop to identify existing data sources and data gaps, and compile data to assess problems and opportunities. The expected outcome would be a summary report including a prioritized list of potential ecosystem projects, research, and/or studies needed within the watershed.

Future Vision

Evaluate the Trinity River for environmental actions that could be implemented by the USACE and their federal and state partners to improve ecological conditions while maintaining authorized purposes of the 6 USACE reservoirs within the basin.

Upper Allegheny River (Navigation System), NY and PA - LRP (LD)

The Allegheny River is over 315 miles long extending from the State of New York to Pittsburgh, PA, where it joins with the Monongahela River to form the Ohio River. Considered one of the most biologically diverse watersheds in Pennsylvania, the Allegheny River provides globally important freshwater mussel habitat. Since the 1900s, habitat in the Allegheny River has been degraded by anthropogenic influences, including the placement of navigation structures, bank stabilization efforts, and pollution from industrial sources. Construction of the contemporary Allegheny River Navigation System was completed in 1938 and consists of eight locks and dams.

Between 2003 and 2015, the Upper Allegheny River Navigation System (L&D 5 through L&D 9) has experienced a 94% reduction in commercial traffic. Commercial traffic above L&D 5 is significantly lower than the rest of the navigation system, with zero tons of commodities moved through L&D 9 since 1993 and through L&D 8 since 2012. This decline in commercial traffic provides a unique opportunity to analyze the benefits of the Allegheny River to nearby communities and potential to increase revenue associated with recreational use of the river and increase resiliency of the region's economy. The overall goal of the effort is to inventory existing and historic ecological conditions within the Allegheny River and identify ecosystem improvement and/or enhancement opportunities.

Status of 2022 work

The team was funded by SRP in FY 2022 to complete a summary of environmental characteristics and identify environmental opportunities. Funding arrived late in the FY, but the team was able to compile and document current and historical environmental conditions of the Allegheny River. The team is working to identify species, environmental resources, and ecosystem services that should be targeted for ecosystem enhancement opportunities. The team has also identified a list of stakeholders to include Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Environmental Protection (PADEP), USFWS, U.S. Environmental Protection Agency (USEPA), and other local stakeholders.

Anticipated 2023 work

A continuation of funded FY 2022 work would continue with carry-over funds and includes presenting initial targets from the team's research to environmental stakeholders in early FY 2023. The goal would be to build partnerships and identify locations for implementation of environmental opportunities. The stakeholder input meeting is planned for January 2023 and the final report is planned for to be delivered in February 2023.

Future Vision

Outcomes of the efforts will culminate in a focused list of target species and habitats in the Upper Allegheny Navigation System. This effort is expected to lead to later assessments of the opportunities and development of partnerships for implementation of e-flows throughout the system.

Wabash River, IN – LRC (Gen)

The Wabash River is a 503-mile-long river that drains most of the state of Indiana. It flows from the headwaters in Ohio, near the Indiana border, then southwest across northern Indiana turning south near the Illinois border, where the southern portion forms the Indiana-Illinois border before flowing into the Ohio River. It is the largest northern tributary of the Ohio River. The river's name comes from a Miami word meaning "water over white stones", as its bottom is white limestone, now obscured by mud due to the upper Wabash Flood Control System which includes Mississinewa, J. Edward Roush, and Salamonie Reservoirs. These operate cohesively to reduce flood damages in the upper Wabash River Basin, and secondarily with other facilities downstream to reduce the impact of floods in the lower Wabash and Ohio River. Authorized missions include flood risk management, environmental stewardship, and recreation. Chicago District (LRC) recently completed Master Plan updates for all three facilities and is in the process of updating WCP as well. The upper Wabash River is in its first year (2022) of support by the SRP.

Status of 2022 work

The Upper Wabash SRP Team initiated work in late FY 2022 due to funding delays but had an approved schedule that extended through FY 2023. The team initiated establishing a subject matter working group to support information gathering for riverine and floodplain ecosystem characteristics within the study area and had a kickoff meeting on 01 November 2022. Remaining funds will be carried-in to support the remaining work in FY 2023.

Anticipated 2023 work

The SRP team will develop a Research Report that would conduct a thorough literature review and identify data gaps needed for an e-flows workshop and summary report. In preparation of the workshop, the team would qualitatively describe the existing and needed hydrologic regime to restore and/or sustain riverine and riparian ecosystem health for the upper Wabash River under specific scenarios. If successful, the team would develop an Issue Report documenting primary concerns identified by the USACE, partners, and stakeholders that includes an initial draft of e-flows opportunities.

Future Vision

If fully realized, implementation of changes identified via the SRP process can have positive and lasting impacts on the ecosystem while continuing to provide flood risk management and multi-uses of the reservoir properties. Changes in flows could have positive impacts on threatened and endangered species, riverine obligate fishes, native mussels, lotic macroinvertebrates, riverine mustelids, native pollinators, migratory water birds, and aquatic macrophytes and nutrient processing within the study areas. The outreach to stakeholders and associated issue report, literature review, and workshop would be used to inform future WCP and Master Plan updates, highlighting the authorized purpose of environmental stewardship.

Trinity River (Climate Informed Reservoir Operations, CIRO) - SWF and ERDC (Gen)

Lewisville and Ray Roberts Dams are located on the Elm Fork of the Trinity River in the SWF district. Elm Fork originates in eastern Montague County, Texas just south of the border of Texas and Oklahoma. The river flows in a southeasterly direction for approximately 110 miles. The topography is predominantly gentle slopes and broad floodplains. The overall elevation changes range from 1,210 feet to 435 feet above mean sea level. The climate provides cool, dry winters and hot, humid summers. Tropical maritime air masses from the Gulf of Mexico play a dominant role in the climate from June to November. Thunderstorm activity occurs nearly year-round and can result in highly intense rainfall events. The average annual precipitation is 41 inches and while it can snow in the watershed, snowpack and snowmelt are non-existent.

El Nino and La Nina (and other similar interannual) patterns have a well-established, demonstrably predictable, and quantitatively large impact on flood and drought risk in Texas. It is anticipated that these patterns can be leveraged to improve e-flow reliability without sacrificing flood risk at the Lewisville and Ray Roberts reservoirs. If successful, this approach may have applicability across many more reservoirs in the region.

Status of 2022 work

Funding was received in Q4 of FY22. The team had preliminary coordination meetings with both SWF and the FIRO (Forecast-Informed Reservoir Operations) teams about this work and how it complements the FIRO work starting in SWF. The goal of this effort is to explore the relationship between climatic signals like El Nino/La Nina and water availability with implications for provision of flows for the environment and other purposes. Results have potential to refine reservoir operations, especially regarding pool level targets under different scenarios such as El Nino and La Nina conditions.

In August 2022, the CIRO team began the process to bring on an ORISE fellow to support the data analyses involved in this project. This process carried over into FY 2023 due to delays in moving funds from SRP and HQ to ORISE and CEFMS outages.

Anticipated Work in 2023

In November 2022, the team met with the “Trinity River Environmental Flows Study” team lead by Danny Allen to learn about each other’s projects and to identify any potential cross-pollination. The teams agreed that it would be beneficial to have the CIRO team present at the workshop that Mr. Allen’s team is planning for later in FY 2023. The CIRO team has almost finalized the ORISE process and will begin data analyses when the fellow is fully onboard.

Future Vision

If a statistically significant relationship between inflows to these dams and El Nino/La Nina years can be detected, such a trend could help adjust dam rule curves based on what type of year is projected. Such adjustments could, for example, allow higher flood guide curves in dryer La Nina years, leaving more water for other purposes such as environmental flows.

National Hydropower Program (NHP) – USACE Nationwide Enterprise (Gen)

The USACE Hydropower Program is the largest generator of hydropower in the US, with 75 power-producing dams housing 356 individual generating units. The mission of NHP is to ensure USACE hydropower assets are available to provide reliable renewable energy and flexible capacity to our nations electric grid. USACE hydropower assets generate more than 70 billion kilowatt hours per year of clean renewable energy, the largest producer in the US and the 5th largest electric supplier in the US. This clean energy is enough to power 10 cities the size of Seattle. It is estimated that USACE hydroelectric plants save 50 million metric tons of carbon dioxide-equivalent emissions per year. Additionally, the revenue generated by the hydropower fleet is used to repay the original construction costs of the hydropower projects and to fund operation, maintenance, and modernization investments of the hydropower fleet.

In 2019, NHP prepared a Strategic Plan to guide transforming operations and maintenance of facilities between FY20 and FY24, with implementation of specific actions in 2024. The NHP proposes to work with the SRP to analyze the past, present, and future relationships between hydropower operations and e-flows across USACE multi-purpose projects that could be implemented as part of the transformation.

Status of 2022 work

This SRP effort was approved and funded in September 2022 and is just getting started with deliverables and milestones scheduled through much of FY 2023.

Anticipated 2023 work

The USACE National Hydropower Program plans to identify candidate topics for development of informational resources that draw connections between hydropower generation and environmental flows. Once identified, the materials will be developed and disseminated. The work will be led by the USACE contractor, Sapere Consulting.

Future Vision

These resources are intended to inform the hydropower and environmental operations of specific projects and to provide a general framework for similar considerations at all 75 USACE projects with hydropower, where appropriate.

TNTCX Rivercane Restoration Alliance (multiple states) – SWD, MVD, LRD, and SAD (Gen)

Rivercane (Arundinaria gigantea) is a cultural keystone species critical to all aspects of life for many Native American communities whose ancestral homelands occurred within the rivercane range (Florida to eastern Texas in the south, parts of the Midwest, and north to New York). Dense stands of cane, known as canebrakes, were once abundant in the southeastern United States. Now canebrakes are a critically endangered ecosystem due to agriculture, grazing, fire suppression, and urbanization throughout their range. This SRP effort began as an investigation of cultural and ecological opportunities related to rivercane restoration in FY 2021. TNTCX formed Rivercane Restoration Alliance to facilitate collaboration between the SRP team, interagency partners, and Tribal partners to integrate Traditional Ecological Knowledge (TEK) and scientific ecological knowledge to recommend approaches to rivercane recovery and planned the Rivercane Restoration Workshop.

Status of 2022 work

FY 2022 work was a continuation of the FY 2021 work, which was initiated late in the FY due to funding delays. The team executed the Indigenous Approaches to Rivercane Restoration Workshop in October 2021 and had 187 participants over the course of the 3 days. Federal agency representatives (n=80) and Tribal Nation representatives (n=50) made up many of the participants. The remaining participants included a mix of state agency, private sector, non-profit, and academia (students and professors). Federal agencies participating in the workshop included USACE, USFWS, USFS, NRCS, Army, USGS, NPS, and BLM. Tribal Nations participating in the workshop included Bayou Lacombe Band of Choctaw Indians, Catawba Indian Nation, Cherokee Nation, Chickahominy Indian Tribe- Eastern Division, Chickasaw Nation, Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Eastern Band of Cherokee Indians, Jena Band of Choctaw Indians, Kiowa Tribe, Miami Tribe of Oklahoma, Mississippi Band of Choctaw Indians, MOWA Band of Choctaw Indians, Poarch Band of Creek Indians, Tunica-Biloxi Tribe of Louisiana, United Keetoowah Band, and the United South and Eastern Tribes / Oneida Nation.

Through the TNTCX social media platforms, webpage, and partner network the Rivercane Restoration Alliance (RRA) was formed and now includes nearly 300 members. As a first step of engagement, a three-day virtual workshop was planned in close collaboration with interagency and Tribal partners. The purpose of the workshop was to provide a forum for the RRA partners to share stories, build relationships, develop conceptual ecological models (CEM), identify existing data and knowledge gaps, and inform recommendations for USACE rivercane restoration studies and projects. The virtual workshop was a huge success and identified three primary areas for continued engagement and development: 1) education about rivercane as a cultural keystone species, the ecological benefits it provides, and management approaches; 2) field studies of rivercane restoration at multiple locations across the range; and 3) access to rivercane stands for Tribal communities. The remaining FY 2021 SRP funds were used to maintain the RRA webpage and list serve, produce monthly newsletters, and completion of the workshop summary report.

Anticipated 2023 work

SRP did not provide additional funding support to Rivercane efforts in FY 2022. The TNTCX team submitted a FY 2023 rivercane restoration proposal that builds off the skills, knowledge, and partnerships fostered by the RRA project. The objective is to identify, refine, and implement environmental strategies at the Robert S. Kerr Lock & Dam in Sallisaw, OK. This site is unique in that it includes the Sequoyah National Wildlife Refuge (NWR), which was established in 1970 as an overlay project of the USACE Robert S. Kerr Reservoir and occurs within the boundaries of the Cherokee and Choctaw Nations of Oklahoma. The goal of this 2-year proposal is to work with the SWT, NWR, and Tribal partners to advance rivercane science and restoration at the project site, test implementation of water management and/or land management practices that promote rivercane restoration, and ultimately incorporate those environmental strategies into a SOP or other appropriate guidance document. Project partners believe this effort will be widely applicable to other USACE project lands that include USFWS, NWR components (Ex: Great Salt Plains Lake and Salt Plains NWR).

The recently released Guidance for Federal Departments and Agencies on Indigenous Knowledge (30 November 2022) acknowledges and promotes use to TEK on federal conservation and restoration projects. The effort will identify site-specific rivercane restoration opportunities and constraints,

develop rivercane restoration alternatives including land/water management recommendations, initiate restoration projects, and develop management recommendations.

Future Vision

The TNTCX SRP team would like to continue strategically building a coalition of scientists, Tribal communities, artists, federal and state agencies, museums, and rivercane enthusiasts in the RRA and use that forum to support rivercane restoration activities throughout its historic range.

TNTCX Tule Restoration Alliance (California) – SPK, SPN (Gen)

Tule (Schoenoplecuts acutus and Schoenoplectus californicus) is a giant sedge in the Cyperacae family, native to freshwater marshes found throughout the U.S. This species provides many benefits to the ecosystem such as fish and wildlife habitat, erosion prevention, flood control, and water quality. Tule is crucial to the culture of many Native American communities, especially those whose ancestral homelands occurred within California's Great Central Valley, and the surrounding foothills. Tule reeds play a vital part in the lives of native people. The harvested material has traditionally been utilized for sacred and cultural practices critical to the continuity of Indigenous lifeways. Tule reeds are collected and used to build boats, houses, sleeping mats, duck decoys, and baskets. The roots and seeds are also edible contributing to a healthy Indigenous traditional diet.

Although, many Tribal communities still harvest and utilize Tule, access to this important species has become severely limited within California. Vast Tule marshlands once covered California’s Great Central Valley, and Tule also grew in broad bands along the lake shores and rivers. However, most of California’s historic range of Tule has now been significantly altered by agriculture, climate change, grazing, water management, and urbanization. FY 2022 was the beginning of SRP’s involvement with the Tule restoration efforts targeted by TNTCX.

Status of 2022 work

In 2022, the TNTCX partnered with Westervelt Ecological Services to form the Tule Restoration Alliance (TRA) is planning to host a tule restoration workshop. Through the TNTCX social media platforms, webpage, and partner network the TRA now includes nearly 70 members with representatives from 14 Tribes, 3 federal agencies, 6 state agencies, and numerous universities. As a first step of engagement, a multi-day workshop is being planned in close collaboration with the interagency and Tribal partners. A steering committee of Tribal, TNTCX, and Westervelt Ecological Services representatives is meeting bi-weekly to develop the workshop agenda and logistics. The workshop is tentatively planned for March 2023 in Sacramento, CA. The purpose of the workshop is to provide a forum for the TRA partners to share stories, build relationships, develop conceptual ecological models (CEM), identify existing data and knowledge gaps, and inform recommendations for USACE tule restoration studies and projects. The tule workshop will generally follow the approach developed for the previous SRP rivercane restoration workshop in 2021 with the added benefit of being held face-to-face. A summary report documenting the participants, discussions, CEMs, and future recommendations will be developed. The report is envisioned to serve as a catalyst for future SRP outreach, science, and implementation projects focused on model development and/or refinement, monitoring plan development, and site specific tule restoration projects.

Other beneficial outcomes include utilizing this stakeholder workshop approach to further develop sustainable federal/Tribal partnerships to promote innovative watershed management and environmental stewardship activities on USACE projects.

Anticipated 2023 work

The TNTCX team would continue work funded late in FY 2022 to include the workshop and summary report. The team plans to continue the TRA and the collaboration with interagency and Tribal partners to complete/maintain the website, design and implement tule restoration at USACE projects, and continue education/outreach by participating in other tule or ecosystem restoration events.

Future Vision

The TNTCX SRP team would like to continue strategically building a coalition of scientists, Tribal communities, artists, federal and state agencies, museums, and tule enthusiasts in the TRA and use that forum to support tule restoration activities throughout its range.

Other SRP Advancements

The location-based sections above detail work that was funded in FY 2022. SRP also accomplished other work, including tasks funded in FY 2021 and described in last year's IPR found at https://www.hec.usace.army.mil/sustainablerivers/publications/. The following are other SRP advancements occurring in FY 2022:

- Alabama River: The SAM team worked with the SRP management team to prepare a work plan to gather and assess baseline fisheries data in FY2023 that will help understand the system and species interactions with the physical environment extending from the freshwater system to the Gulf of Mexico.
- Big Cypress Bayou – Caddo Lake (Lake O' the Pines): Advanced the hydrology analysis and terrain data for completing e-flow alternatives using Riverware and HEC-EFM.
- Cossatot River (Gillham Lake): Advanced scoping for spring and early summer drawdowns, minimum releases, and fall flooding at Mud Lake; evaluated hydrology, preliminary operating rules, and began environmental assessment (EA) of potential shorebird, waterfowl, and native vegetation habitat restoration benefits to the alligator gar, Harperella, and trees; and initiated State of the Science report to support e-flows workshop.
- Galisteo Creek: Calibrated hydraulic modeling and completed baseline wildlife surveys for possible seasonal wetland creation.
- Kanawha River (London Lock and Dam): Completed assessment of three acres of river bottom that would be exposed with a one-foot drop of pool elevation, eight acres exposed at a two-foot drop, and fringe habitat that would be exposed along the banks of the pool. Determined USACE is not authorized to operate London Locks and Dam for the proposed drop in pool elevation and changes would require a re-authorization from Congress for a minimal return of ecological benefits.
- Kansas River (multiple reservoirs): Finalized peer reviewed Kansas River SRP E-Flows Recommendations Workshop Summary Report and initiated planning 2nd e-flows workshop to evaluate potential changes to existing e-flows for the geographic extension areas, oxbow restoration, in-lake restoration, and related Water Injection Dredging Demonstration at Tuttle Creek Lake.
- Kiamichi River (Sardis Lake): Completed hydrology and hydraulics duration analysis and hydrographs needed to test e-flow prescriptions. Hosted technical e-flows workshop attended by 25 stakeholders from USACE, USFWS, USGS, USFS, Oklahoma Water Resources Board, Oklahoma Department of Wildlife Conservation, Oklahoma Conservation Commission, Choctaw Nation, Chickasaw Nation, local universities, and non-profits. Initiated work on draft State of the Science Report.
- Lake Washington Ship Canal (Ballard Locks): Completed update to the CE-QUAL-W2 model by incorporating new salinity and temperature data for years 2016-2020, calibrated to < $\pm$1^{o}C at depth, and completed sensitivity analyses while increasing flow through the locks or introducing discrete cold-water outlets at various points in the ship canal. Created new post-processing techniques to visualize model results and build capacity by training staff in CE-QUAL-W2.
- Mill Creek (Mill Creek Flood Control Project): Finalized the Mill Creek Forebay SRP report including 4 recommendations: 1. collaborate with Walla Walla Conservation District stream restoration project upstream of the USACE property boundary between the years of 2023 and 2027; 2. optimize floodplain and side-channel design to ensure side-channels remain flowing

and functional during the spring steelhead outmigration to avoid fish stranding and ensure proper sediment capture; 3. further investigate the planned wetland for possible maintenance issues at the toe drain; and 4. ensure proper creek channel alignment of the new fishway and low-flow outlet at the Diversion Dam as it is critical to maintain fishway exit and flood gate function.

- Pecos River: Refined the State of the Science report, prepared the model (HEC-RAS, HEC-EFM, HEC-RPT), and held a virtual e-flows workshop attended by 31 participants including staff from USACE, Bureau of Reclamation, New Mexico Interstate Stream Commission (NMISC), TNC, several universities, Pecos Valley Artesian Conservancy District (PVACD), Fort Sumner Irrigation District (FSID), and the Carlsbad Irrigation District (CID).
- Rogue River (Lost Creek and Applegate): Completed literature review and internal collaboration with Operations Division and the District's fish biologist and externally with Oregon Department of Fish and Wildlife (ODFW) and determined that existing operations were optimal for environmental responses considering existing constraints.
- Sugar Creek (Beach City): Collected necessary field data and prepared baseline condition report, collaborated with Muskingum Watershed Conservancy District (MWCD); completed Reservoir Simulation (ResSim) modeling, frequency of fill curves for conservation pool and no-conservation pool alternatives using hourly lake elevations; completed duration analysis within ResSim to determine percent exceedance of varying pool elevations; collaborated with Ohio Office of TNC, MWCD, Ohio Department of Natural Resources (ODNR), and USFWS to agree that the current "lake" conditions did not provide any beneficial natural habitat during the warm summer months to the local wildlife population due to warm temperatures; resulting consensus around restoring the "lake" area into wetland habitat that could support migratory birds and passive recreation.
- Yakima River Delta (McNary Lock and Dam): Updated and finalized the Yakima River SRP 2021 Data Summary Report which documents temperature monitoring, bi-monthly water quality survey results, and Thermal Mapping via a fixed-wing unmanned aircraft system and identified relationships between system drivers and temperature response.

APPENDIX A: Deliverables and Milestones - Status and Schedule - 2022

Project: Sustainable Rivers Program (2022)
Baselining Date: 02/04/2022

Note Numbering below refers to SRP tasks and 1-7 are program- level tasks including preparation of RFPs, website development, assistance to location-based efforts, leading SRP meetings, etc. and 8 is location-based work utilizing FY 2021 carryover and are not included in this table. Location-based efforts funded in FY 2022 begin with task 9 MVR – Iowa River and continue through 34. SAW – Roanoke and Cape Fear Rivers and are provided here. "Team" dates reflect schedule at time of the FY 2022 IPR.*

Effort Started: 10/01/2021 *(actual)*
Effort Finished: 09/30/2023 *(planned)*

9. MVR - Iowa River - FY22					
1.4 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/4/2022	2/16/2022	2/16/2022	PWS advanced for review 2/4. Funded 2/16 (12 days, 6 review, 6 funding).
Milestone 2:	Draft flow prescription routed to stakeholders for comment	4/7/2022	4/7/2022	4/7/2022	
Milestone 3:	Draft AMMP routed to stakeholders for comment	6/10/2022	6/10/2022	6/10/2022	
Milestone 4:	One-day AMMP workshop with stakeholders	8/31/2022	8/31/2022	11/14/2022	Team will provide a formal presentation for stakeholders
Milestone 5:	Final AMMP with workshop input incorporated and noted	11/30/2022		3/31/2023	
Milestone 6:	Effort Finished	11/30/2022		3/31/2023	

10. SAW - Cape Fear River - FY22					
4.7 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/4/2022	5/10/2022	5/10/2022	PWS advanced for review 2/4. Funded 5/10 (95 days, 8 review, 87 funding).
Milestone 2:	Fish Passage - Get contracts in place with Clemson and NC WRC. Prepare equipment	2/15/2022	2/15/2022	2/15/2022	Funds for this milestone provided in February after scope approval and from CR PBud funding.
Milestone 3:	Fish Passage - Re-deploy equipment and start fish tagging effort; Water Quality - Update contracts with UNC Researchers and decide additional sampling locations; Stakeholders - Engage broader SAW staff on pulse research and	2/28/2022	9/30/2022	9/30/2022	Fish (Clemson) - 3/1/2022 WQ (UNC contract) - 7/28/2022 SAW staff engagement - 3/1/2022

	findings; Locks and Dams - Cond				
Milestone 4:	Fish Passage - Monitor diadromous fish over the locks and dams via telemetry, eDNA, and traditional sampling; Locks and Dams - SAW begins RAS modeling of LD2 and LD3	3/15/2022	9/30/2022	9/30/2022	Fish sampling - 3/1/2022 LD modeling begins - 8/1/2022
Milestone 5:	Stakeholders - Engage stakeholders to review pulse results, identify ongoing needs, and brainstorm ways to move from implement to incorporate; Locks and Dams - SAW and partners use RAS to analyze alternatives and flows	4/30/2022	11/30/2022	2/28/2023	larger district meeting - 1/15/2023 SRP event/larger stakeholder group - 2/15/2023 alt analysis - 1/15/2023
Milestone 6:	Fish Passage - eDNA samples analyzed. UNC-W continues to study the sturgeon young of year and watch for a fall sturgeon spawn; Water Quality - Equipment deployed to monitor temperature and mixing. Grab sampling to document chlorophyll-a and algal concentration	6/30/2022	12/31/2022	11/22/2022	eDNA analysis - 10/15/2022 samples near complete UNCW sturgeon - 9/22 thru 11/22 field work done UNC CH - 6/15/2022 to Oct 2022
Milestone 7:	Stakeholders - Finalize report of meeting summaries and steps identified to progress to incorporate; Locks and Dams - Finalize report documenting RAS results and identifying opportunities and concerns with fish passage alternatives	10/31/2022	1/31/2023	3/31/2023	stakeholder report - 5/31/2023 RAS model report - 2/15/2023

Milestone 8:	Fish Passage - Summary report of findings and sharing of results; Water Quality - Complete lab work and share results; summary document prepared	12/31/2022	2/28/2023	9/30/2023	9/30/2023
Milestone 9:	Effort Finished	12/31/2022	2/28/2023	9/30/2023	9/30/2023

11. SAW - Roanoke River - FY22					
2.9 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/4/2022	5/10/2022	5/10/2022	PWS advanced for review 2/4. Funded 5/10 (95 days, 8 review, 87 funding).
Milestone 2:	eDNA - Blank sampling for eDNA. Vegetation - Establish CESU contract extension	2/28/2022		4/15/2022	did not receive funds until April, but bank sampling occurred based on funds from FY21.
Milestone 3:	eDNA - Initiate eDNA sampling of adult diadromous fish	3/31/2022		2/28/2022	Researchers at ECU were fully prepped and ready. Added traditional fish sampling with the eDNA to attempt to get quantity estimates of fish with eDNA results. Weekly sampling occurred from Feb and is still going (ends in Nov). Contracts are secured to replicate the work in 2023, per SRP's FY22 funds (which were set up in August of this year). The researchers send quarterly updates and are making their way through the lab analysis that accompanies the field work. The eDNA work will be featured in North Carolina TNC's Winter Newsletter that reaches 25,000+ people.
Milestone 4:	eDNA - Initiate traditional and eDNA sampling of juvenile alosines	4/30/2022		4/30/2022	Done
Milestone 5:	Vegetation - Begin field sampling of floodplain vegetation	5/31/2022	6/30/2023	10/31/2022	Based on the timing of funding and contracts, Duke received their contract in Sept 2022. The researchers finished the field sampling with USFWS in late October 2022.
Milestone 6:	Vegetation - Begin analysis: Previous vegetation analysis updated, new statistics run, updates to vegetation relationships with hydrology	8/31/2022	8/31/2023	9/30/2023	draft report provided from previous work submitted (first contract had until Sept 2022). Current analysis of the vegetation results is just starting.

Milestone 7:	eDNA - Prepare analysis and summary of work	10/31/2022	10/31/2023	10/31/2023	ECU sends quarterly reports.
Milestone 8:	eDNA - Prepare/conduct symposium/webinar for the Corps	12/31/2022	12/31/2023	12/31/2023	TNC has proposed that ECU present at a SRP Science or the SRP National Meeting.
Milestone 9:	Vegetation - Update EFM and finalize summary report	2/20/2023	12/31/2023	12/31/2023	To do. Due Sept 2023.
Milestone 10:	Effort Finished	2/20/2023	12/31/2023	12/31/2023	The researchers have until Sept 2023 based on the CESU contract.

12. TNTCX - Tule restoration - FY22

2 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/4/2022	5/10/2022	5/10/2022	PWS advanced for review 2/4. Funded 5/10 (95 days, 5 review, 90 funding).
Milestone 2:	Receive funds and initiate partner discussions	3/31/2022	5/31/2022	5/31/2022	
Milestone 3:	Establish Tule Restoration Alliance webpage with email sign-up prompt	5/1/2022	12/31/2022	12/31/2022	
Milestone 4:	Hold restoration workshop	10/15/2022	4/30/2023	4/30/2023	
Milestone 5:	Prepare workshop reports	1/31/2023		5/31/2023	
Milestone 6:	Submit final deliverables	3/31/2023		6/30/2023	
Milestone 7:	Effort Finished	3/31/2023		6/30/2023	

13. NWK - Osage River - FY22

1.1 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/7/2022	6/4/2022	6/4/2022	PWS advanced for review 2/7. Funded 6/4 (117 days, 98 review, 19 funding).
Milestone 2:	Complete series of science meetings	7/31/2022	10/31/2022	3/31/2023	
Milestone 3:	Complete science report and e-flows workshop	8/31/2022	10/31/2022	4/30/2023	
Milestone 4:	Complete e-flows workshop summary report	10/31/2022		6/30/2023	
Milestone 5:	Effort Finished	10/31/2022		6/30/2023	

14. LRP - Ohio River - LD - FY22

3.3 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/8/2022	5/10/2022	5/10/2022	PWS advanced for review 2/8. Funded 5/10 (91 days, 2 review, 89 funding).
Milestone 2:	Complete stakeholder meeting and meeting summary	7/31/2022	10/4/2022	10/20/2022	Meeting held 10/4, meeting minutes developed and shared externally 10/20

Milestone 3:	Complete workgroup meetings and meetings summary	11/30/2022	12/31/2022	2/28/2023	Workgroups under development, to begin meeting Nov 2022 through Feb 2023
Milestone 4:	Complete and share implementation plan	3/31/2023		5/31/2023	Timing adjusted due to delay in receipt of funds
Milestone 5:	Complete final report and transfer deliverables	3/31/2023		5/31/2023	Timing adjusted due to delay in receipt of funds
Milestone 6:	Effort Finished	3/31/2023		5/31/2023	Timing adjusted due to delay in receipt of funds, no increase in overall study duration

15. LRP - Allegheny River - LD - FY22

0.8 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/8/2022	6/28/2022	6/28/2022	PWS advanced for review 2/8. Funds provided 6/28 (140 days, 1 review, 139 funding).
Milestone 2:	Complete summary of environmental characteristics	7/31/2022	11/30/2022	11/30/2022	
Milestone 3:	Complete final report and transfer deliverables	12/31/2022	2/10/2023	5/15/2023	
Milestone 4:	Complete identification of environmental opportunities	12/31/2022	2/10/2023	5/15/2023	
Milestone 5:	Effort Finished	12/31/2022		5/15/2023	

16. MVR - Farm Creek - DD - FY22

0.5 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/10/2022	6/4/2022	6/4/2022	PWS advanced for review 2/10. Funded 6/4 (114 days, 7 review, 107 funding).
Milestone 2:	Report of activities, results, and future actions	2/13/2022	9/30/2022	9/30/2022	
Milestone 3:	Locate two local teachers willing to partner on this effort	5/31/2022	9/30/2022	9/30/2022	
Milestone 4:	Train school classes on observation methods, documentation, and identification of targeted species	5/31/2022	9/30/2022	9/30/2022	
Milestone 5:	Students visit Farmdale when possible, identify and document species	9/30/2022		6/30/2023	
Milestone 6:	USACE compiles field findings, prepares draft document of species found	9/30/2022		7/31/2023	
Milestone 7:	Implement small scale restoration activities	12/31/2022		10/31/2023	
Milestone 8:	Effort Finished	12/31/2022		10/31/2023	

18. LRC - Wabash River - FY22

2.5 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/16/2022	5/10/2022	5/10/2022	PWS advanced for review 2/16. Funded 5/10 (83 days, 1 review, 82 funding).
Milestone 2:	Complete summary of decisions report	11/30/2022		3/31/2023	
Milestone 3:	Complete science research report	3/15/2023		3/15/2023	
Milestone 4:	E-flows workshop	5/31/2023		5/31/2023	
Milestone 5:	Final report of e-flows recommendations	9/30/2023		9/30/2023	
Milestone 6:	Effort Finished	9/30/2023		9/30/2023	

19. MVP - Bois de Sioux River - FY22

1.9 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/16/2022	6/4/2022	6/4/2022	PWS advanced for review 2/17. Funded 6/4 (107 days, 95 review, 12 funding).
Milestone 2:	Funding of FY22 work and kickoff	3/1/2022	6/4/2022	6/4/2022	complete
Milestone 3:	Final EA and memo document completed	6/1/2022	6/1/2023	6/1/2023	Drafted, not complete due to data collection needs
Milestone 4:	Anticipated start of drawdown	6/15/2022	6/15/2023	6/15/2023	June/July 2024 due to funding delay
Milestone 5:	Summary report	11/30/2022	11/30/2023	11/30/2023	
Milestone 6:	Effort Finished	11/30/2022	11/30/2023	11/30/2023	

20. SPL - Gila River - DD - FY22

2.0 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/22/2022	5/10/2022	5/10/2022	PWS advanced for review 2/22. Funded 5/10 (77 days, 10 review, 67 funding).
Milestone 2:	Site selection complete	5/31/2022	9/30/2022	6/15/2022	6-7 wells (testing soon), owned by Corps, proposing a perennial wetland feature for wildlife in the region, 1/4 acre feature, depressional feature, lined, solar pump, construction in-house
Milestone 3:	Stakeholder register complete (outreach)	6/30/2022	9/30/2022	9/30/2022	Delayed due to PDT shifting focus to other projects at end of FY, made contacts in AZ re: recreation, wildlife, hunting, possible volunteers.
Milestone 4:	NEPA compliance complete	10/31/2022		3/31/2023	EA - No Cat Ex
Milestone 5:	Project plan complete	11/30/2022		3/15/2023	
Milestone 6:	Contract package complete (SOW, cost estimate)	1/31/2023		4/28/2023	
Milestone 7:	Outreach site visit complete	4/30/2023		4/30/2023	
Milestone 8:	Contract award	5/31/2023		7/31/2023	

Milestone 9:	Construction begins	9/30/2023		10/30/2023
Milestone 10:	Outreach event	9/30/2023		10/30/2023
Milestone 11:	Construction complete	4/30/2024		4/30/2024
Milestone 12:	Outreach event	5/31/2024		5/31/2024
Milestone 13:	Year 1 monitoring	4/30/2025		4/30/2025
Milestone 14:	Year 1 monitoring report submitted	8/31/2025		8/31/2025
Milestone 15:	Effort Finished	8/31/2025		8/31/2025

21. MVS - Kaskaskia River - FY22

2.2 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/23/2022	6/4/2022	6/4/2022	PWS advanced for review 2/23. Funded 6/4 (101 days, 91 review, 10 funding).
Milestone 2:	Implementation of environmental levels, public meeting, and compilation of comments received	9/30/2022	9/30/2022	9/30/2022	
Milestone 3:	Complete vegetation surveys and report briefing materials	10/31/2022		10/31/2022	
Milestone 4:	Complete imagery analysis and report briefing materials	11/30/2022		3/31/2022	
Milestone 5:	Complete drone imagery collection and report briefing materials	12/31/2022		3/31/2022	
Milestone 6:	Effort Finished	12/31/2022		3/31/2022	Anticipate that the remaining deadlines can be met.

22. MVS - Mississippi River - LD - FY22

2.1 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	2/23/2022	6/4/2022	6/4/2022	PWS advanced for review 2/23. Funded 6/4 (101 days, 82 review, 19 funding).
Milestone 2:	Sturgeon - Fish tagging	4/1/2022	5/31/2023	5/31/2022	
Milestone 3:	Sturgeon - Spawn monitoring and fish tracking	5/31/2022	5/31/2023	9/30/2022	
Milestone 4:	Veg - Refine ecological information for modeling	7/15/2022	9/30/2022	9/30/2022	
Milestone 5:	Habitat - Analysis of H&H and dredge data	8/1/2022	10/31/2022	3/31/2023	
Milestone 6:	Sturgeon - Model enhancement and historical conditions analysis	8/31/2022	10/31/2022	10/31/2022	
Milestone 7:	Habitat - Habitat assessment	9/1/2022	10/31/2022	4/30/2023	
Milestone 8:	Shorebirds - Analysis of daily release and water surface elevation	9/30/2022		9/30/2022	

Milestone 9:	Shorebirds - Perform shorebird use surveys	9/30/2022		10/31/2022
Milestone 10:	Shorebirds - Video/photo station	9/30/2022		9/30/2022
Milestone 11:	Sturgeon - Operationalize e-flows	9/30/2022	5/15/2023	5/31/2023
Milestone 12:	Shorebirds - Summary report	9/30/2022		2/28/2023
Milestone 13:	Shorebirds - Sediment moisture and invertebrate sampling	9/30/2022		9/30/2022
Milestone 14:	Habitat - Drawdown summary report	9/30/2022		5/31/2023
Milestone 15:	Veg - Vegetation resilience surveys	10/31/2022		10/26/2022
Milestone 16:	Veg - Modeling	10/31/2022		11/30/2022
Milestone 17:	Veg - Model verification	11/30/2022		11/30/2022
Milestone 18:	Sturgeon - Season-end findings summary report	11/30/2022	11/30/2023	3/31/2022
Milestone 19:	Veg - Vegetation and modeling summary report	12/31/2022		4/30/2022
Milestone 20:	Effort Finished	12/31/2022	11/30/2023	5/31/2023

23. MVR - Des Moines River - FY22

1.8 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	3/3/2022	6/4/2022	6/4/2022	PWS advanced for review 3/2. Funded 6/4 (94 days, 2 review, 92 funding).
Milestone 2:	Waterbirds: Complete photo processing and time-lapse video. Nutrients: Characterize delta geomorphology and analyze sediments. Photography: Capture drone footage, video interviews of key researchers, develop and distribute educational materials	3/30/2022	9/30/2022	3/31/2023	This effort has 3 efforts combined in one Row; will report status of each on a Word document.
Milestone 3:	Waterbirds: Distribute time-lapse video of delta and initiate planning for 2022 delta/waterbird research. Nutrients: Complete field work and biochemistry analysis	6/30/2022	9/30/2022	3/31/2023	This effort has 3 efforts combined in one Row; will report status of each on a Word document.

Milestone 4:	Waterbirds: Complete 2022 research season. Nutrients: Complete field work and biochemistry analysis. Photography: Develop and distribute educational materials	9/30/2022		3/31/2023	This effort has 3 efforts combined in one Row; will report status of each on a Word document.
Milestone 5:	Effort Finished	9/30/2022		3/31/2023	technical note from Chuck Thieling in the next week.

24. LRP - Upper Ohio River - FY22					
1.1 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	3/3/2022	5/10/2022	5/10/2022	PWS advanced for review 3/3. Funded 5/10 (68 days, 1 review, 67 funding).
Milestone 2:	Complete survey of scour sites	6/30/2022	10/15/2022	11/15/2022	
Milestone 3:	Complete resource agency engagement for the AMMP	7/31/2022	12/30/2022	12/30/2022	followup with Su and team
Milestone 4:	Provide cross section habitat data collected by the USGS	7/31/2022	10/31/2022	11/30/2022	
Milestone 5:	Complete appendix to the AMMP	12/30/2022		3/31/2023	
Milestone 6:	Complete HEC-RAS update and deliverables	12/30/2022		5/31/2023	followup with John
Milestone 8:	Transfer all deliverables	12/30/2022		6/30/2023	
Milestone 9:	Effort Finished	12/30/2022		6/30/2023	

25. NAB - Potomac River North Branch - FY22					
1.7 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	3/4/2022	5/10/2022	5/10/2022	PWS advanced for review 3/4. Funded 5/10 (67 days, 17 review, 50 funding).
Milestone 2:	Complete initial coordination to identify resources for input to State of Science Report and develop initial issues report	5/31/2022	7/31/2022	7/31/2022	Some coordination still occuring as additional sources are identified
Milestone 3:	Develop initial draft State of Science Report for review	9/30/2022	12/31/2022	12/31/2022	Report is in progress at 75% completion
Milestone 4:	Complete draft State of Science Report as read ahead for e-flows workshop and incorporate initial review comments	11/30/2022	2/28/2023	2/28/2023	
Milestone 5:	Complete e-flows workshop	1/31/2023		5/31/2023	If this date slips it will likely slip into September 2023 in order to maximize participation due to field seasons beginning

Milestone 6:	Finalize State of Science Report and workshop summary report detailing e-flow recommendations	5/1/2023		8/31/2023	
Milestone 7:	Effort Finished	5/31/2023		9/29/2023	

26. MVS - Salt River - FY22

1.8 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	3/4/2022	6/4/2022	6/4/2022	PWS advanced for review 3/4. Funded 6/4 (92 days, 67 review, 25 funding).
Milestone 2:	Onsite meeting and workshop	4/10/2022	9/30/2022	9/30/2022	
Milestone 3:	Onsite fish monitoring and existing conditions assessment	5/31/2022	9/30/2022	9/30/2022	
Milestone 4:	Deployment of velocity meter below the re-reg dam	7/31/2022	11/30/2022	11/30/2022	
Milestone 5:	Development and completion of CWMS model	9/30/2022	12/31/2022	12/31/2022	
Milestone 6:	Agency coordination and public outreach activities (ongoing through the end FY22)	9/30/2022	12/31/2022	12/31/2022	
Milestone 7:	Draft operational e-flows recommendation for FY23	10/31/2022		4/30/2023	Need follow up work with SWPA, MDC, lake and plant staff to determine if CWMS model results are achievable.
Milestone 8:	Season-end findings summary report	12/31/2022		3/31/2023	
Milestone 9:	Effort Finished	12/31/2022		4/30/2023	

27. MVN - Atchafalaya River - FY22

1.0 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	3/16/2022	5/12/2022	5/12/2022	PWS advanced for review 3/16. Funded 5/12 (57 days, 57 review, 0 funding).
Milestone 2:	Complete initial scientific review, stakeholder engagement, and scoping	9/30/2022	9/30/2022	9/30/2022	
Milestone 3:	Complete experimental design and e-flow management and monitoring plan	9/30/2023		9/30/2023	
Milestone 4:	Complete e-flow implementation, monitoring and associated results report	9/30/2024		9/30/2024	
Milestone 5:	Effort Finished	9/30/2024		9/30/2024	

28. SAM - Chattahoochee River - FY22					
1.6 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	3/23/2022	5/10/2022	5/10/2022	PWS advanced for review 3/23. Funded 5/10 (48 days, 2 review, 46 funding).
Milestone 2:	Pre-workshop webinar: Discuss water quality trends and potential impacts on aquatic species, identify and review existing data, identify data gaps, develop plan for monitoring activities, data gathering to fill data gaps	6/30/2022	6/29/2022	6/29/2022	
Milestone 3:	Complete monitoring activities and data gathering and distribute information	12/1/2022		12/1/2023	
Milestone 4:	Conduct water quality workshop (2-3 days)	1/30/2023		1/26/2023	
Milestone 5:	Complete workshop report	3/15/2023		3/15/2023	
Milestone 6:	Effort Finished	3/15/2023		3/15/2023	

29. ERDC - Trinity River - FY22					
1.8 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	7/18/2022	7/27/2022	7/27/2022	PWS advanced for review 7/18. Funded 7/27 (9 days, 6 review, 3 funding).
Milestone 2:	Quantify interannual patterns at the Lewisville and Ray Roberts reservoirs	12/31/2022		4/30/2023	Still establishing ORISE agreement
Milestone 3:	Evaluate shifts in flood risk and e-flow reliability under operations	6/30/2023		6/30/2023	
Milestone 4:	Summary report and operational recommendations	6/30/2023		6/30/2023	
Milestone 5:	Effort Finished	6/30/2023		6/30/2023	

30. SWF - Trinity River - FY22					
1.0 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	7/18/2022	7/27/2022	7/27/2022	PWS advanced for review 7/18. Funded 7/27 (9 days, 6 review, 3 funding).
Milestone 2:	Trinity River workshop	4/15/2023		4/15/2023	planning in process - was on-hold in FY22 due to staffing - goal is for March 23
Milestone 3:	Draft and final ecosystem priorities â€“ Trinity River workshop summary report	4/30/2023		5/31/2023	

Milestone 4:	Effort Finished	4/30/2023		5/31/2023	

31. SWF - Brazos River - FY22					
2.0 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	7/18/2022	9/9/2022	9/9/2022	PWS advanced for review 7/18. Funded 9/9 (53 days, 36 review, 17 funding).
Milestone 2:	SRP e-flow evaluation workshop	8/31/2022	12/31/2022	2/15/2023	planning in process - was on-hold in FY22 due to staffing (Jan goal)
Milestone 3:	Identify e-flow opportunities within the flood pool	12/31/2022		3/15/2023	
Milestone 4:	Conceptual operational model for the Brazos basin	3/31/2023		3/31/2023	
Milestone 5:	Complete assessment of the operational flexibility across Brazos system	7/31/2023		7/31/2023	
Milestone 6:	Finalize development of Brazos watershed level e-flow opportunities	9/30/2023		9/30/2023	
Milestone 7:	Effort Finished	9/30/2023		9/30/2023	

32. SWF - Neches River - FY22					
2.0 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	7/18/2022	9/9/2022	9/9/2022	PWS advanced for review 7/18. Funded 9/9 (53 days, 36 review, 17 funding).
Milestone 2:	Finalize Neches River workshop report	8/31/2022	12/31/2022	3/15/2022	in process
Milestone 3:	SRP e-flow evaluation workshop	8/31/2022	12/31/2022	4/30/2023	planning in process - was on-hold in FY22 due to staffing (Jan goal)
Milestone 4:	Identify e-flow opportunities within the flood pool	12/30/2022		3/31/2023	
Milestone 5:	Finalize development of e-flow opportunities	4/30/2023		5/31/2023	
Milestone 6:	Effort Finished	4/30/2023		5/31/2023	

33. NHP - Hydropower and Enviro - FY22					
2.4 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	9/6/2022	9/18/2022	9/18/2022	PWS advanced for review 9/6. Funded 9/18 (12 days, 4 review, 8 funding).
Milestone 2:	Identify candidate topics for development of informational resources	11/30/2022		3/15/2023	
Milestone 3:	Complete and disseminate informational resources for select topics	6/30/2023		6/30/2023	

Milestone 4:	Effort Finished	6/30/2023		6/30/2023	

34. SAW - Roanoke and Cape Fear Rivers - FY22					
1.4 % of budget		**Planned**	**Team (Nov 22)**	**Team (Nov 22)**	**Comments (Nov 22)**
Milestone 1:	Effort Started	9/27/2022	10/4/2022	10/4/2022	PWS advanced for review 9/27. Funded 10/4 (7 days, 1 review, 6 funding).
Milestone 2:	Share data between climate team and Corps	10/31/2022		10/31/2022	
Milestone 3:	Provide HEC-ResSim and HEC-RAS models to climate team; identify alternatives of interest; gather necessary data to support simulation of alternatives (climate, flows, etc.)	1/31/2023		1/31/2023	
Milestone 4:	Run ResSim for alternatives identified; document methods and share results with partners	2/28/2023		2/28/2023	
Milestone 5:	Review research team findings on future climate and hydrologic projections in terms of inflows to involved reservoirs	3/31/2023		3/31/2023	
Milestone 6:	Summarize tradeoffs and risks associated with environmental operations and lessons learned working with climate and hydrologic projections	9/30/2023		9/30/2023	
Milestone 7:	Effort Finished	9/30/2023		9/30/2023	

APPENDIX B: Funding and Execution - Fiscal Year 2022 (as of 10/1/22)

In FY 2022, SRP was in the President's Budget $500k and received $5M through appropriations. Funds above the President's Budget became available to SRP on 05 May 2022, which means the Program received 90% of its budget with 40% of the fiscal year remaining. Dates of location-based teams first receiving FY 2020 funds to support their efforts are listed as the "Estimated" dates in Appendix A. Some location-based carryover was planned as execution schedules for that work had tails in FY 2023.

Table B1. Allocations and carryover per major program components, FY 2022 ($, millions).

Component FY 2022:	Budgeted	Carryover to FY 2023
Programmatic	2.6	0.8
- Program support	*1.1*	*0.6*
- Technologies	*0.8*	*0.1*
- Validation	*0.5*	*0.0*
- Program balance	*0.2*	*0.2*
Location-based	2.4	1.7
- Labor (generated by HEC)	*1.9*	*1.4*
- Repositions, MIPRs, etc.	*0.5*	*0.3*
Total	5.0	2.5

Table B2. Allocations and carryover per major program components, FY 2021 ($, millions).

Component FY 2021:	Budgeted	Carryover to FY 2022	Carryover to FY 2023
Programmatic	1.9	0.3	0.0
- Program support	*0.8*	*0.3*	*0.0*
- Technologies	*0.6*	*0.0*	*0.0*
- Validation	*0.5*	*0.0*	*0.0*
Location-based	3.1	1.8	0.8
- Labor (generated by HEC)	*1.9*	*1.1*	*0.5*
- Repositions, MIPRs, etc.	*1.1*	*0.8*	*0.3*
Total	5.0	2.1	0.8

Table B3. Allocations and carryover per major program components, FY 2020 ($, millions).

Component FY20:	Budgeted	Carryover to FY21	Carryover to FY22	Carryover to FY23
Programmatic	2.9	0.6	0.0	0.0
- Program support	*0.8*	*0.1*	*0.0*	*0.0*
- Technologies	*1.3*	*0.5*	*0.0*	*0.0*
- Validation	*0.7*	*0.0*	*0.0*	*0.0*
Location-based	2.1	0.5	0.2	0.0
- Labor	*1.4*	*0.5*	*0.2*	*0.0*
- Repositions, etc.	*0.7*	*0.0*	*0.0*	*0.0*
Total	5.0	1.1	0.2	0.0

Table B4. Allocations and carryover per detailed program components, FY 2022 ($, thousands).

	Budgeted	Obligated	Carryover (labor)	Carryover (reposition)
Programmatic	2,576	1,754	610	211
- Program support	1060	483	366	211
- HEC	195	144	50	0
- IWR	201	139	62	0
- MVP	93	19	73	1
- IPA	149	149	0	0
- Detail	77	28	49	0
- Web support	20	3	17	0
- National meeting	200	0	40	160
- Regional meeting	125	0	75	50
- Tech	826	740	86	0
- Java tools for ecosystems	497	497	0	0
- Habitat mapping	224	224	0	0
- NWW support for technologies	104	18	86	0
- Validation (SRP-Science)	532	532	0	0
- Des Moines River	200	200	0	0
- North Carolina Rivers	100	100	0	0
- Upper Ohio River	108	108	0	0
- Willamette River	124	124	0	0
- Program balance	158	---	158	---
Location-based	2,374	678	1,396	300
- LRC - Wabash River	125	11	114	0
- LRD - Ohio River	164	22	142	0
- LRP - Allegheny River locks and dams	38	9	28	0
- LRP - Upper Ohio River	55	3	52	0
- MVN - Atchafalaya River	50	16	34	0
- MVP - Bois de Sioux River	95	9	81	6
- MVR - Des Moines River	90	64	26	0
- MVR - Farm Creek	23	1	22	0
- MVR - Iowa River	70	36	34	0
- MVS - Kaskaskia River	110	34	76	0
- MVS - Mississippi River	104	56	48	0
- MVS - Salt River	90	26	54	10
- NAB - North Branch Potomac River	83	52	31	0
- NHP - Hydropower and e-flows	120	0	0	120
- NWK - Osage River	55	0	40	15
- SAM - Chattahoochee River	80	14	57	9
- SAW - Cape Fear River	261	122	44	96
- SAW - Climate concerns for e-flows	70	0	70	0
- SAW - Roanoke River	151	131	20	0
- SWF - Brazos River	100	0	100	0
- SWF - Lower Neches River	100	0	100	0
- SWF - Trinity River	50	0	50	0
- SWF/ERDC - Trinity River	90	0	45	45
- SPL - Gila River	100	39	61	0
- TNTCX - Tule restoration	100	34	66	0
Total	4,950	2,433	2,006	511

Table B5. Program administrative costs, FY 2022 ($, thousands). All SRP components with administrative costs are included in this table. Associated budgeted totals are from Table B3.

	Budgeted	Administrative	Notes (assumptions)
Program support			
- HEC	195	97	50% of budgeted
- IWR	201	101	50% of budgeted
- MVP	93	46	50% of budgeted
Location-based			
- SAW - Cape Fear River	261	16	CESU fees
- SAW - Roanoke River (veg)	151	23	CESU fees
Totals (program budget, admin, %)	4,950	283	5.7%