

PROJECT TITLE: Monitoring water quantity and quality from natural and supplemental sources on Benton Lake NWR.

FY Requested Funded
2014 2014

Project Proposal

NWR: BENTON LAKE NATIONAL WILDLIFE REFUGE

RFP ID: 61510-192-2013

Project Type:	Focus:	Scale:
Monitor	Water Resources	Station

☒ Staff Biologist?

☒ This proposal has station support?

☒ FWS protocols were followed regarding data management?

☒ This proposal supports a priority in a CCP/ HMP or other refuge plan

Wetlands and Riparian Areas Objective 1: Over the next 15 years, manage and protect water quality for wetlands and riparian habitats on fee-title lands within the refuge complex such that there is minimal hazard to wildlife from contaminants. Wetlands and Riparian Areas Objective 4: Where it is not currently feasible to restore full hydrologic function within the refuge complex, annually manage wetlands and riparian areas to emulate the natural hydrologic processes—wet-dry cycles—as for the site-specific hydro-geomorphic condition.

☐ This proposal supports a "Top Region 6 Priority"

PROJECT DESCRIPTION

Since 1990, the US Geological Survey (USGS) has measured the daily mean water flows into Benton Lake refuge via Lake Creek, the primary refuge inlet. These data are used by refuge staff to calculate annual flow volume into the refuge from both natural run-off and supplemental pumping from Muddy Creek. This annual record of water inputs is essential to understanding the dynamic hydrology of the wetland basin and planning management strategies. These water data were critical to developing the recent hydro-geomorphic assessment (Heitmeyer et al. 2009) and Comprehensive Conservation Plan for the refuge (USFWS 2012b), as well as the work currently underway to develop a Habitat Management Plan. For example, under the new management direction described in the CCP, the refuge can elect not to pump supplemental water in the fall 4 out of 15 years. Deciding whether or not to turn the pumps on in late August of a given year will depend on accurate natural run-off information, typically occurring from April through June. The USGS gauge collects this information, and provides it nearly "real-time" on a USGS website.

These water quantity data are also important for managing the pump station and monitoring the efficient use of the electric pumps. Efficient and effective management of water flows onto the refuge is especially important given that water management costs can exceed \$115,000 per year in electricity charges and staff time (USFWS 2012a). These data also document water use and protect the refuge water rights on Lake Creek and Muddy Creek. The USGS flow gauge is critical for evaluating water quality. Specifically, these data are used to estimate annual selenium loads onto the refuge since most of the selenium enters the refuge via Lake Creek (Zhang and Moore 1997). Using historic mean concentrations of selenium in natural run-off and pumped water (Nimick et al. 1996), together with total water

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volume from the flow gauge, enables refuge staff to estimate the selenium load entering the refuge via Lake Creek. These calculations have been important for understanding historic selenium inputs and developing effective management strategies to reduce selenium concentrations. The CCP identifies the need to work with partners in the surrounding watershed to reduce Lake Creek selenium inputs. The refuge recently installed a continuous water quality meter in Lake Creek that provides estimated mean daily selenium concentrations. In combination with the daily mean flow data from the USGS gauge, refuge staff will be able to estimate selenium loads more accurately and monitor the effectiveness of any watershed projects implemented to reduce selenium. For many years, the Regional Water Resources Division was able to cover the cost to maintain the gauge. In recent years, however, funding has been cut and the refuge is now paying the full cost of the gauge out of station funds. Refuge staff is working with the Division of Water Resources and USGS to find a cost-effective, long-term solution to refuge water monitoring needs. Possible solutions include a FWS gauge that refuge staff maintains, moving the USGS gauge and/or altering the Lake Creek channel to significantly lower maintenance costs (W. Berkus, USGS, pers. comm). Identifying a long-term solution may take up to a year, therefore, the refuge is requesting regional I&M funding to maintain the gauge for FY2014 while alternate solutions are developed.

OBJECTIVES

To annually measure the quantity of water inputs and the selenium load into Benton Lake refuge via Lake Creek (the primary inlet).

DESIGN AND METHODS

Since 1990, the USGS has maintained a water flow gauge on Lake Creek, just upstream of where the creek enters Benton Lake refuge. Lake Creek is the primary inlet to the refuge wetland basin for natural run-off from the surrounding Lake Creek watershed and the sole conduit for water pumped from the neighboring Muddy Creek watershed. The gauge is typically operational from April – November (the ice-free season). USGS conducts all maintenance, including gauge calibration and quality control/error checking of the data. The gauge continuously measures flow in cubic-feet/second (cfs) across the wide variety of flows that can occur in Lake Creek (historically 0-180cfs). From these data, USGS calculates a mean daily flow that is given to the refuge in an annual data summary. These data are also available on the internet (1 day lag), which facilitates access to the data and analysis by refuge staff (http://waterdata.usgs.gov/mt/nwis/dv/?site_no=06090650&referred_module=sw). Mean daily flows are used to annually calculate the volume of water flowing into the refuge from both natural run-off and pumping from Muddy Creek. In 2007, refuge staff installed a continuous water quality meter near the USGS flow gauge in Lake Creek. The meter measures specific conductance hourly. These data can then be converted to a mean daily selenium concentration based on a linear regression model developed from previous data (Nimick et al. 1996).

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DATA ANALYSIS/MODELS

The mean daily flows are used to calculate the volume (acre-feet) of water flowing into the refuge each year. To calculate the total volume of natural run-off entering the refuge basin each year, staff use a combination of the flow data from the USGS gauge (Lake Creek inputs) and readings from staff gauges in the wetland units (to estimate other ancillary inputs). Since all pumped water enters the refuge via Lake Creek, the USGS gauge is used to measure flow volume and is compared to pumping effort (pump capacity, electrical charges, etc.) to estimate quantity delivered. The volume of water entering the refuge is reported each year to the Regional Water Resources Division. These reports and water data are used to document and protect the Service water rights in both the Lake Creek and Muddy Creek watersheds. Additionally, the volume of water entering the refuge is used to estimate annual selenium loading. Based on pumphouse records, it is possible to partition the flow data into natural run-off and pumped water. The USGS measured selenium concentrations in natural run-off and pumped water from 1990-1992 and calculated mean selenium concentration for natural run-off and pumped water during this period (Nimick et al. 1996). An estimate of the annual selenium load entering the refuge from pumping and natural run-off is then calculated by multiplying the appropriate volume of water measured at the Lake Creek gauge and the mean selenium concentrations by a units-conversion factor. It will be possible to improve these selenium loading estimates using the continuous water quality meter installed by the refuge in Lake Creek. The meter measures hourly specific conductance. These data can then be used to update and improve the reliability of mean selenium concentration estimates for natural-runoff and pumped water (Nimick et al. 1996).

REVIEWERS:

PARTNERS

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SOURCES OF SUPPORT:

Years Funding Requested:

1

Request From I&M Program:	\$10,000.00
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Contributed By Station:	\$1,216.00
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Contributed By Partners:	\$0.00
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Allocation Grand Total:	\$11,216.00
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Salary & Benefits:	\$0.00
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Equipment:	\$0.00
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Contracts:	\$10,000.00
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Travel:	\$0.00
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Other:	\$0.00
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	Year 1	Year 2	Year 3
Personnel 1:			
Personnel2:			
Personnel3:			
Salary and Benefits Sum:	\$0.00		
Equipment:			
Contracts:	\$10,000.00		
Travel:			
Other:			
Project Cost IM:	\$10,000.00	\$0.00	\$0.00
Station Contribution:	\$1,216.00		
Partner Contribution:			
Project Cost Totals:	\$10,000.00	\$0.00	\$0.00
Allocation Totals	\$11,216.00		\$0.00

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	Year 4	Year 5
Personnel 1:		
Personnel2:		
Personnel3:		
Salary and Benefits Sum:		
Equipment:		
Contracts:		
Travel:		
Other:		
Project Cost IM:	\$0.00	\$0.00
Station Contribution:		
Partner Contribution:		
Project Cost Totals:	\$0.00	\$0.00
Allocation Totals	\$0.00	\$0.00

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DATA MANAGEMENT:

Description of data entry, verification, editing and software.

Data are available nearly in real time (1 day lag) on the internet, which facilitates access to the data and analysis by refuge staff. USGS provides the refuge with an annual data summary once per year. USGS also conducts quality assurance/quality control protocols to verify the data. The refuge currently has Excel spreadsheets that summarize total water inputs and annual selenium loads. The water quantity data is summarized in an annual water use report. A copy of the water use report is submitted to the Regional Office and stored in refuge files. Jo Ann Dullum, Region 6 I&M program, has developed a preliminary Access database to store the flow and specific conductance data. The database will provide rapid calculations of total flow volume and selenium loads as well as annual summary reports. Some additional assistance from Jo Ann will be needed to finalize this database.

Please describe metadata including the who, what, where, and when of the data.

Please describe data security and archiving. Provide the schedule and location for regularly backing up files.

STATUS AND RESULTS

ADDITIONAL INFORMATION:

LITERATURE CITED:

Heitmeyer, M.E., V.L. Fields, M. Artmann and L.H. Frederickson. 2009. An evaluation of ecosystem restoration and management options for Benton Lake National Wildlife Refuge. Greenbrier Wetland Services. Advance, MO. 59pp. Nimick, D.A., J.H. Lambing, D.U. Palawski and J.C. Malloy. 1996. Detailed study of selenium in soil, water, bottom sediment, and biota in the Sun River Irrigation Project, Freezeout Lake Wildlife Management Area and Benton Lake National Wildlife Refuge, west-central Montana, 1990-92. US Geological Survey Water-Resources Investigation Report 95-4170. Helena, MT. 120pp. U.S. Fish and Wildlife Service. 2012a. Draft Comprehensive Conservation Plan and Environmental Assessment, Benton Lake National Wildlife Refuge Complex. Lakewood, CO: U.S. Department of the Interior, U.S. Fish and Wildlife Service, Mountain-Prairie Region. 366p. U.S. Fish and Wildlife Service. 2012b. Comprehensive Conservation Plan, Benton Lake National Wildlife Refuge Complex, Montana. Lakewood, CO: U.S. Department of the Interior, U.S. Fish and Wildlife Service, 305p. Zhang, Y. and J. Moore. 1997. Final report on biogeochemical cycling of selenium in Benton Lake, Montana. University of Montana, Missoula, MT, 228pp.