



## INTRODUCTION

Benton Lake National Wildlife Refuge (NWR), owned and managed by the U.S. Fish and Wildlife Service (USFWS), contains 12,383 acres on the western edge of the Northern Great Plains about 50 miles east of the Rocky Mountains and 12 miles north of Great Falls, Montana in Cascade and Chouteau counties (Fig. 1). Established in 1929 by Executive Order, Benton Lake NWR was created as “a refuge and breeding ground for birds.” The name “Benton Lake” refers to the dominant feature of the NWR, which is a ca. 5,600 acre shallow wetland “lake bed” created during the last Pleistocene glacial period. This large wetland lies within the 146 mile<sup>2</sup> Benton Lake Basin, which is hydrologically “closed”; most natural runoff drains to Benton Lake proper and the basin has no outlet. About 6,800 acres of upland on Benton Lake NWR surround Benton Lake. Benton Lake NWR is recognized as a wetland ecosystem of importance by the North American Waterfowl Management Plan and Western Hemisphere Shorebird Reserve Network. Nineteen bird species of concern, classified by the Montana Natural Heritage Program, currently or historically used habitats and resources on the refuge. Despite alterations to this ecosystem, Benton Lake remains one of the finest examples of a large, closed, wetland basin in the Great Plains of the western United States.

Although Benton Lake NWR was established in 1929, the refuge was not staffed until 1961; until that time the refuge was administered by the National Bison Range located in western

Montana. Water levels in Benton Lake historically fluctuated seasonally and annually depending on annual patterns of precipitation and runoff. During wet years Benton Lake contained more extensive surface water area and supported large numbers of breeding and migrating waterbirds, especially dabbling ducks. The large abundance of waterfowl present on Benton Lake in wet years was a primary factor leading to the recognition of the ecological importance of the area and ultimate motive for establishment of the NWR. During dry years, less water was present in Benton Lake and fewer birds were present. Because of a desire to support more predictable and frequent flooding of the lake bed during summer water for breeding waterbirds, Benton Lake NWR constructed water source, conveyance, and management systems

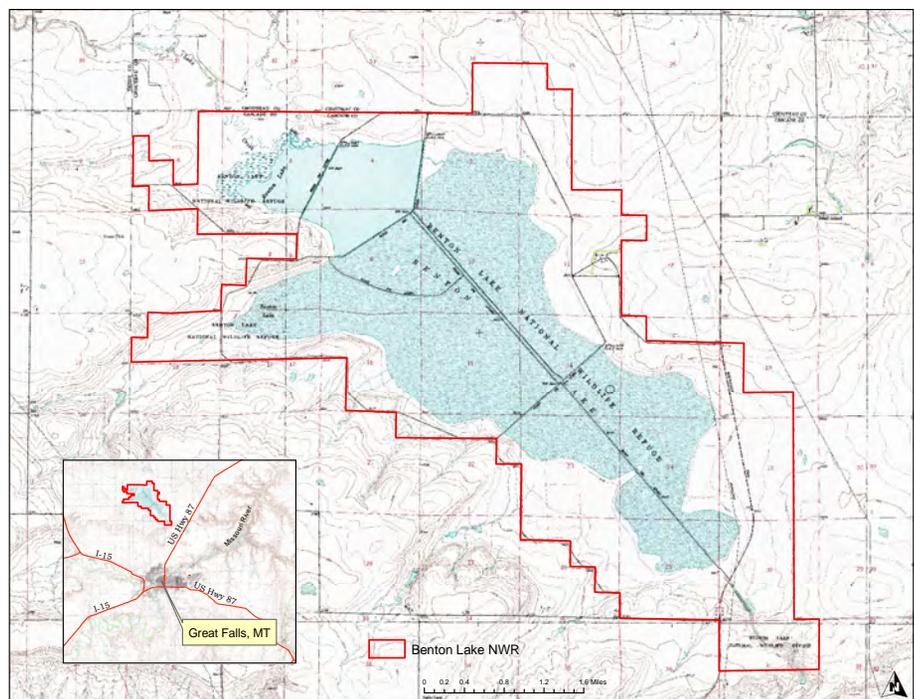


Figure 1. General location map of Benton Lake National Wildlife Refuge.

beginning in the late 1950s and early 1960s. This water “system” included a pump station and pipeline that moved irrigation return flow from Muddy Creek, about 15 miles to the west, to Benton Lake. Water from Muddy Creek was moved about 5 miles through an underground pipeline over a low drainage divide and then discharged into the Lake Creek natural drainage channel where it flowed about 12 miles to its mouth in Benton Lake.

The historic Benton Lake bed was divided into 6 “pools” or water management “units” by dikes/levees, ditches, and water-control structures from 1960 to 1962. Since the early 1960s, management of Benton Lake NWR has focused on managing water and wetland vegetation within Benton Lake, mostly to enhance waterfowl production and migration habitat. Management of uplands also has occurred to sustain native grassland communities, provide nesting cover for waterfowl, and provide forage/cover for native birds and mammals. Over time the refuge developed a series of roads that provide access to refuge lands and also constructed numerous parking lots, building complexes, walk-ways into wetlands, and excavations in wetland pools to create nesting islands, drainage ditches, and deeper open water areas.

The combination of hydrological and topographic alterations on Benton Lake NWR and land use changes in the watershed areas surrounding the refuge have gradually altered this ecosystem and created many management challenges to sustaining historic Benton Lake plant and animal communities. Ecological issues that have developed over time at Benton Lake NWR include increased concentrations of contaminants, especially selenium; siltation and altered topography of the historic lake bed; altered vegetation communities; increased distribution and abundance of invasive species; periodic botulism outbreaks that cause high mortality of waterbirds in some years; and decreased presence and productivity of waterbirds (e.g., Hultman 1991, Nimick 1997, Thompson and Hansen 2002).

In 2009, the USFWS began efforts to prepare a Comprehensive Conservation Plan (CCP) for Benton Lake NWR. The CCP process seeks to articulate the management direction for the refuge for the next 15 years and it develops goals, objectives, and strategies to define the role of the refuge and its contribution to the overall mission of the National Wildlife Refuge system. At Benton Lake NWR, the CCP process is being facilitated by a contemporary evaluation of ecosystem restoration and management options using Hydrogeomorphological Methodology (HGM). HGM

now is commonly used to evaluate ecosystems on National Wildlife Refuges (e.g., Heitmeyer and Fredrickson 2005, Heitmeyer et al. 2006, Heitmeyer and Westphall 2007) by obtaining and analyzing historic and current information about: 1) geology and geomorphology, 2) soils, 3) topography and elevation, 4) hydrology, 5) plant and animal communities, and 6) physical anthropogenic features of refuges and surrounding landscapes. Specifically, HGM analyses for Benton Lake NWR: 1) uses the above information to develop appropriate, realistic, and sustainable “habitat-based” objectives for the refuge; 2) seeks to emulate natural hydrological and vegetation/animal community patterns and dynamics within the Benton Lake Basin ecosystem; 3) understands, complements, and at least partly mitigates negative impacts and alterations to Benton Lake and surrounding lands; 4) incorporates “state-of-the-art” scientific knowledge of ecological processes and requirements of key fish and wildlife species in the region; and 5) identifies important monitoring needs of abiotic and biotic features.

This report provides HGM analyses for Benton Lake NWR with the following objectives:

1. Identify the pre-European settlement ecosystem condition and ecological processes in the Benton Lake region.
2. Evaluate changes in the Benton Lake ecosystem from the pre-settlement period with specific reference to alterations in hydrology, vegetation community structure and distribution, and resource availability to key fish and wildlife species.
3. Identify restoration and management options and ecological attributes needed to successfully restore specific habitats and conditions within the area.



