February 2014 No. 9

Water Matters

Published by the Nebraska Department of Natural Resources

A guide to integrated water management in Nebraska

Balancing Water Supplies Through Groundwater Recharge

Part Two: A Conjunctive Management Demonstration Project

Key concept

A conjunctive management demonstration project was conducted in 2011 on the Upper Platte River in order to more accurately quantify and manage the complex relationships between hydrologically connected surface water and groundwater resources. Throughout the project's planning, coordination, and implementation phases, project sponsors demonstrated the ability to divert and store excess flows in order to increase the availability and reliability of water supplies in the future, while also mitigating the negative impacts of flooding events.

Introduction

Water resources in Nebraska are managed in order to best serve the interest of the state's citizens. The storage of water in the state's aquifers has been determined to be a beneficial use of water resources. Properly managing hydrologically connected water resources is essential not only to maintain the economic and physical well-being of the Nebraska's citizens, but also to ensure that these vital resources are available for use at the most opportune time and location. Given that water resources and those who depend on them are vulnerable to extremes in regard to quantity, an adept and comprehensive method of managing these resources is required.

Water Matters, No. 8 described the hydrologic basis and authority under which conjunctive management projects can be implemented. Techniques for conjunctively managing hydrologically connected surface and groundwater resources provide managers with a broad set of options through which the use of these resources can be optimized, while minimizing inefficiencies and other negative impacts on users and the environment. At times, the availability of water resources is frequently out of balance with user demand and the occasions at which these inconsistencies might arise can be highly variable.

Image 1: Photograph of a canal used during the 2011 groundwater recharge demonstration project.

While the information presented in this article is technical in nature, it has been generalized to appeal to a broader audience. This article provides an overview of a very complex topic.

This edition of *Water Matters* describes a cooperatively undertaken conjunctive management demonstration project that was initiated in order to determine the potential ability of the aquifer adjacent to the Upper Platte River to store excess surface water flows for later use. Numerous benefits were realized through the implementation of this project, including a quantification of the timing and rates of groundwater recharge and accretion along the Upper Platte River, as well as a demonstration of the ability of managers to use the existing hydrology and infrastructure of the region to mitigate negative impacts of flooding events. Additionally, the project provided an opportunity for the project sponsors to demonstrate their capability for coordination and implementation of timely conjunctive management action when an opportunity presents itself.

Demonstration of the Process

In the late winter and early spring of 2011, the Bureau of Reclamation projected potential flood flows on the North Platte River. These flood flows were expected to be in excess of all demands. With this understanding, the Department of Natural Resources (Department), several natural resources districts (NRDs), and multiple irrigation districts began a demonstration project to evaluate the effects of diverting excess streamflow into existing canals. In addition to recharging groundwater and adding accretions to streamflow, another expected benefit of the project was the mitigation of the flooding predicted by the Bureau of Reclamation.

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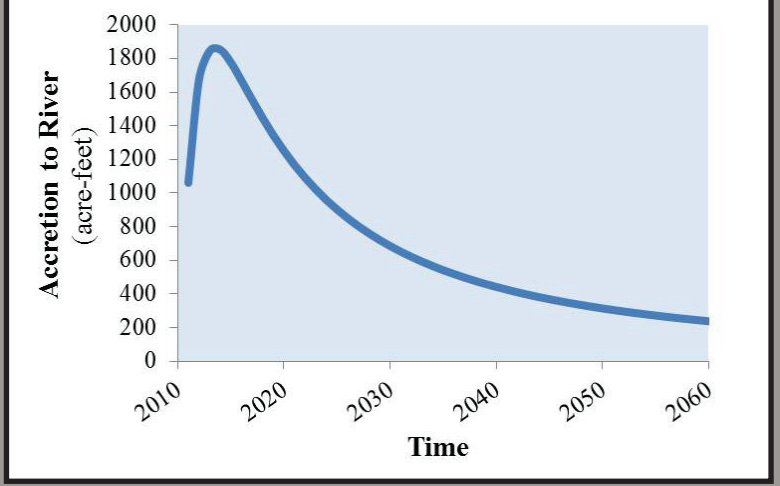
In order to carry out the project, applicable surface water appropriation permits were applied for by the irrigation districts and subsequently approved by the Department. Part of the permit application process included demonstrating that excess flows were available in the Platte River system. In 2010, a report on the availability of excess flows in the Platte River was compiled and published by the Department. The purpose of the report was not only to evaluate the historic quantity of excess flows in the Platte River, but also to assist managers in the development of a planning tool that could be used to estimate the approximate duration and frequency of those flows.

Ultimately, the results of the streamflow study showed that excess flows are available on a periodic basis and can be utilized for recharging groundwater storage. Combined with the data gathered from the groundwater recharge project and other pertinent investigations, the excess streamflow study provided valuable information to Nebraska's water managers. More details about the excess streamflow study and the full report can be found on the Department's website at: http://dnr.nebraska.gov/iwm/historic-platte-river-streamflow-excess-protected-target-flows.



Year	Estimated Annual Accretion to River (acre-feet)
2011	1,062
2020	1,251
2030	685
2040	442
2050	315
2060	238
10-year Cumulative Benefit	**15,474**
50-year Cumulative Benefit	**36,168**

Figure 1, Table 1: Estimated accretions to the river resulting from the 2011 recharge demonstration project.

Once the necessary permits were approved, excess flows were diverted throughout the early spring until irrigation season began, and again in the fall once irrigation season was over. The Department's Bridgeport Field Office, in conjunction with the NRDs and irrigation districts, monitored the diversions of the stream to each canal as well as many of the diversions' canal returns back to the river. Image 2 shows a dry canal before the project began and image 3 shows a canal filled with diverted water during the project. A significant accomplishment of the demonstration project was the cooperative manner in which the project sponsors worked through the required administrative procedures to obtain permits and coordinated monitoring responsibilities. Demonstrating the capability to effectively collaborate on a complex project such as this ensures that a timely response can be made in the event of a flood flow prediction.

The demonstration project diverted 141,911 acre-feet of water. The estimated amount of water purposefully recharged into the aquifer was 64,699 acre-feet, with 36,168 acre-feet of the recharge expected to reach the river as accretions within 50 years.

The demonstration project diverted 141,911 acre-feet of water. The estimated amount of water purposefully recharged into the aquifer was 64,699 acre-feet, with 36,168 acre-feet of the recharge expected to reach the river as accretions within 50 years. The accretions to the river through time are shown in figure 1 and table 1. The general method used to estimate the recharge amount presupposed that: (1) a simple water balance equation would be used to estimate recharge as the difference between the amount of water diverted and the amount of water returned to the stream; (2) rainfall and evaporation were not considered to significantly impact the amount of water recharged; and (3) in the canals where the field office staff were not able to measure the return, a conservative estimate would be made.

In many ways, the groundwater recharge and flood mitigation demonstration project was a success. The project sponsors were able to work through the administrative requirements, implement the project in a timeframe that allowed for taking advantage of flood flows present at the time, and recharge a significant amount of water to the aquifer. A technical memo documenting the demonstration project in more detail is available on the Department's website at: http://dnr.nebraska.gov/iwm/conjunctive-management-toolbox.

Diversion Canals	
▪ Belmont Canal	▪ Minatare Canal
▪ Castle Rock Canal	▪ Nine Mile Canal
▪ Central Canal	▪ North Platte Canal
▪ Chimney Rock Canal	▪ Orchard-Alfalfa Canal
▪ Cozad Canal	▪ Pathfinder Canal
▪ Dawson Co. Canal	▪ Paxton-Hershey Canal
▪ Enterprise Canal	▪ Phelps County Canal
▪ Farmers Canal	▪ Suburban Canal
▪ Gothenburg Canal	▪ Thirty-Mile Canal
▪ Kearney Canal	▪ Western Canal
▪ Keith-Lincoln Canal	▪ Winters Creek Canal
▪ Lisco Canal	

Table 2: Canals used to divert flows during the 2011 recharge demonstration project.

Image 2: Photograph of a dry canal before the groundwater recharge demonstration project began.

Image 3: Photograph of a filled canal during the groundwater recharge demonstration project.

Conclusions

Conjunctive management projects, such as the one described above, are designed to provide managers with information necessary to determine how hydrologically connected surface and groundwater resources can be most efficiently and effectively put to use. As was outlined in *Water Matters,* No. 8, the recharge rate of aquifers, and the response time and accretion rates between hydrologically connected aquifers and streams, vary depending on local hydrological conditions. This project provided resource managers with the opportunity to more accurately quantify the hydrologic relationship between surface water flows, groundwater recharge, storage capacity, and accretion rates along the Upper Platte River.

Given the unpredictable nature of water availability, obtaining data such as that provided by the 2011 recharge demonstration project will remain a vital component of sound conjunctive management decision-making. While this *Water Matters* focused on the groundwater recharge of excess flows, the same principles apply to other sources of recharge water as well, such as water in surface water reservoirs and existing water rights that could be transferred for groundwater recharge use. Through water management planning, conjunctive management strategies help to ensure the availability and reliability of water supplies for future use.

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Image 4: Photograph of a canal used during the groundwater recharge demonstration project.

Project Partners
NRDs
▪ Central Platte NRD
▪ North Platte NRD
▪ South Platte NRD
▪ Tri-Basin NRD
▪ Twin Platte NRD
Irrigation Districts
▪ Bridgeport Irrigation District
▪ Castle Rock Irrigation District
▪ Central Irrigation District
▪ Central Nebraska Public Power and Irrigation District
▪ Chimney Rock Irrigation District
▪ Cozad Canal Company
▪ Enterprise Irrigation District
▪ Farmers Irrigation District
▪ Keith-Lincoln County Irrigation District
▪ Lisco Irrigation District
▪ Minatare Canal Company
▪ Nebraska Public Power District
▪ Nine Mile Irrigation District
▪ Pathfinder Irrigation District
▪ Paxton-Hershey Water Company
▪ Platte Valley Irrigation District
▪ South Side Irrigation Company
▪ Suburban Irrigation District
▪ Thirty-Mile Canal Company
▪ Western Irrigation District
▪ Winters Creek Canal Company

Table 3: NRDs and irrigation districts that participated with the Department in the 2011 recharge demonstration project.

The theoretical concepts on which this project is based are described in more detail in *Water Matters*, No. 8.

Nebraska Department of Natural Resources

Please contact the Nebraska Department of Natural Resources with questions or concerns about this publication at (402) 471-2363.

Visit the Integrated Water Management Division's website at http://www.dnr.nebraska.gov/IWM for up-to-date information. *Water Matters* is available at this website.