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A guide to integrated water management in Nebraska

Integrated Water Management in Nebraska: Current Projects

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Nebraska's water supplies vary greatly across the state and over time. Just consider the flooding of 2011 compared to the drought in 2012 or the typical amount of precipitation in the eastern part of the state compared to the Panhandle. With this variability, it is important to understand how water moves through the hydrologic cycle to properly manage supplies for various uses. Integrated Water Management (IWM) is Nebraska's management process aimed at understanding and maintaining a balance between water supplies and uses while protecting existing uses.

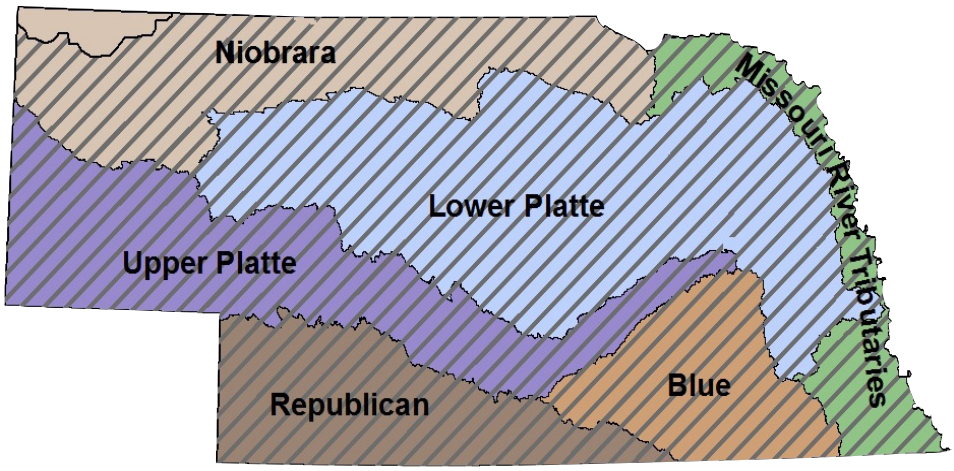


Figure 1. Major River Basins in Nebraska. Cross-hatching indicates areas of the state with current local projects.

IWM is accomplished through integrated management plans (IMPs). In an IMP, the local natural resources district (NRD) and the Nebraska Department of Natural Resources (Department) develop management goals, objectives, and actions with input from stakeholders. Once implemented, the effects of the IMP are monitored and adjustments are made if needed to meet the goals and objectives. The process is adaptable to accommodate variation in water supplies and demands over time (see *Water Matters, No. 1* for more on IMPs).

The IWM Division of the Department specializes in the IWM process and provides technical expertise, planning, and coordination to aid with the development and implementation of IMPs. This issue of *Water Matters* describes statewide projects and the multiple local projects being developed through collaborative efforts with local NRDs and stakeholders to better understand regional hydrogeology and water availability to assist with water management across Nebraska (figure 1).

There are two statewide projects occurring in IWM right now, CROPSIM and INSIGHT. The statewide **CROPSIM Model** will provide data and information for use in determining water supplies and demands for all regions of Nebraska. It may also be used in the Department's annual evaluation of hydrologically connected water supplies and to assist in IMP projects and other water planning efforts.

CROPSIM utilizes a soil-water balance model developed at the University of Nebraska-Lincoln that will provide data and information to use in the development of other modeling tools and analyses discussed in this publication.

CROPSIM calculates estimates for three components of the soil-water balance at a number of quality-controlled climate station locations across the state: 1) deep percolation (groundwater recharge); 2) irrigation requirements (groundwater pumping);

and 3) watershed runoff. These datasets are key inputs integrated into other modeling projects.

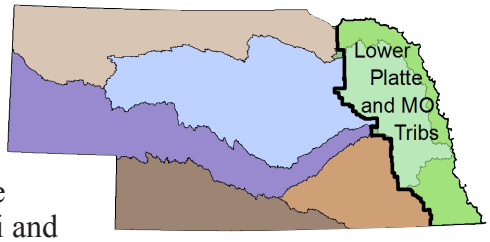
INSIGHT, an Integrated Network of Scientific Information and GeoHydrologic Tools, is an online portal to Nebraska water use and supply information currently in development. INSIGHT will assist scientists, managers, and the public in acquiring information related to water supplies and uses across the state. The information will be supported by many of the projects discussed in this publication and will provide easy access to the data, tools, and information that support the Department's annual evaluation of hydrologically connected basin water supplies and other integrated management planning activities.

Data available in INSIGHT will include streamflow measurements, consumptive surface water and groundwater use estimates, canal diversion records, and distribution of irrigated lands. Interactive maps and other tools will help users understand how groundwater and surface water interact and the water budgets that exist across the state.

INSIGHT will also include the results of groundwater modeling and the hydrologic assessments of many of the state's major river basins.

Lower Platte and Missouri River Tributaries Assessment

The Lower Platte and Missouri River Tributary Basins include the surface area of the Nebraska tributaries that drain into the Missouri and Lower Platte Rivers downstream of the Niobrara/Missouri and Loup/Platte River confluences (but not the surface area associated with the Upper Elkhorn River) as well as the groundwater areas that impact surface water.



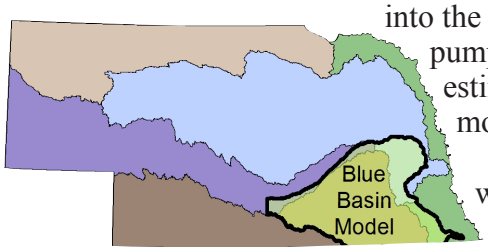
The **Lower Platte and Missouri River Tributaries Assessment** will develop a conceptual flow model of the area and associated datasets, which will be available through INSIGHT. From this, recommendations will be made about developing a potential groundwater modeling tool.

The Department is working with a contractor on three phases of the project. Phase I, completed in June 2012, assessed available data and tools. Phase II, competed in fall 2012, developed a detailed conceptual model. Phase III will make a recommendation about the feasibility of developing a groundwater model.

Blue Basin Groundwater Model Project

The **Blue Basin Groundwater Model Project** will evaluate datasets and develop a regional groundwater flow modeling tool, both of which will be available through INSIGHT. The Department is working with a contractor on three phases of the project. Phase I, now complete, assessed available datasets and models to determine their suitability and whether they could be used to adapt or redevelop existing tools.

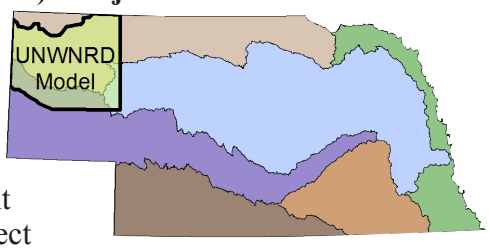
Phase II, completed in late summer 2012, built on Phase I results and provided recommendations for the conceptualization, construction, and calibration of a groundwater flow model. The Basin NRDs (Upper Big Blue, Little Blue, Lower Big Blue, and Tri-Basin) have provided data, model files, and other information for Phases I and II. The NRDs have also provided land use and irrigation data for the soil-water balance model (CROPSIM), which will be incorporated into the groundwater pumping and recharge estimates in the model.



Phase III will produce a documented model that simulates the interaction of surface water and groundwater over time in the Big Blue and Little Blue River Basins.

Upper Niobrara-White NRD Conjunctive Water Use Model

The **Upper Niobrara-White Natural Resources District (UNWNRD) Conjunctive Water Use Model** is part of the larger Niobrara River Basin Study to evaluate and implement water management options. This project will assist in meeting the goals and objectives of the UNWNRD IMP, which include the short-term goal of minimizing groundwater depletions and a long-term goal of sustaining the water in the aquifer.

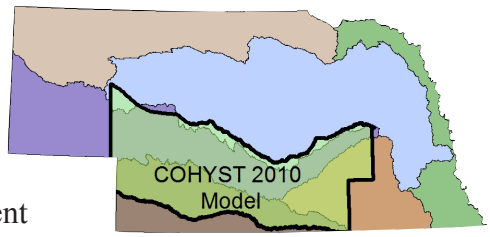


In 2011, the Department received a U.S. Bureau of Reclamation WaterSMART Program Grant to provide water supply and demand information for the Niobrara River Basin Study and to develop the UNWNRD model. These efforts will assist in developing a better understanding of the connections between surface water and groundwater in the basin.

The UNWNRD model will explore how surface water and groundwater irrigation development has impacted the Niobrara River and will investigate opportunities to conjunctively manage surface water and groundwater. The model will integrate a surface water operations model, a groundwater flow model, and a soil-water balance model (CROPSIM) to develop operational scenarios, evaluate conjunctive management alternatives, and maximize water use efficiency.

COHYST 2010 and WWUM

Both the Platte River **Cooperative Hydrology Study (COHYST 2010)** and **Western Water Use Model (WWUM)** will develop analysis tools to effectively manage water resources and meet the goals and objectives of the Upper Platte Basin NRDs' IMPs and the Platte Basin-Wide Plan. The Plans' goals and objectives focus on the management of hydrologically connected surface water and groundwater in the Upper Platte Basin to achieve a balance between water uses and water supply so that economic viability, social and environmental health, safety, and welfare are maintained and to ensure compliance with applicable interstate laws, compacts, decrees, or other formal state agreements. Other goals include continuing to support and develop data, models, and tools to gain a better understanding of Platte River Basin hydrogeology.



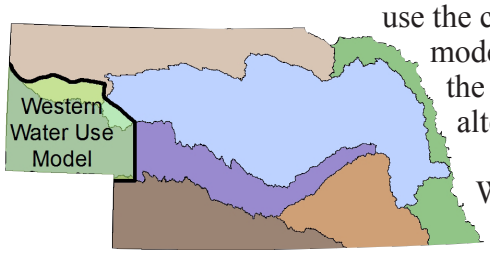
COHYST first began in 1998 to model the entire Upper Platte Basin upstream of Chapman, Nebraska, to the Wyoming and Colorado borders. COHYST 2010 and WWUM build upon the results of COHYST 1998, but divide the area of analysis into eastern and western regions. These two regions differ in their hydrogeology as well as the NRDs' management approaches, so developing separate models for eastern and western portions of the Upper Platte Basin is a more effective way to model the water budget for each region and to evaluate water management alternatives.

COHYST 2010 is a collaboration between the Department; the Central Platte, Twin Platte, and Tri-Basin NRDs; public power and irrigation districts; and the Nebraska Game and Parks Commission. COHYST 2010 will model the eastern portion of the Upper Platte Basin upstream of Chapman, Nebraska, to the upstream end of Lake McConaughy.

WWUM is a coordinated effort between the Department and the North and South Platte NRDs. It will model the western portion of the Upper Platte Basin upstream of Lake McConaughy to the Wyoming state line and Lodgepole Creek in the South Platte Basin.

The primary analysis tools being developed for both regions are comprehensive water budget models that integrate a surface water operations model, a groundwater flow model, and a soil-water balance model (CROPSIM). The integrated models will be used to evaluate various management alternatives.

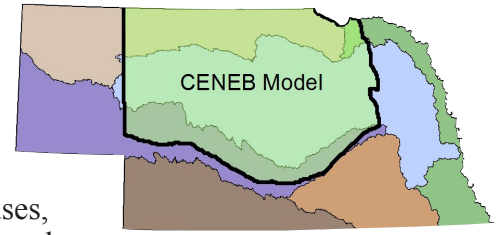
Phase I of COHYST 2010 developed the groundwater budget. Phase II will develop the three separate models and then develop, review, and calibrate a model integrating all three. Phase III will use the calibrated model to evaluate the management alternatives.



For the WWUM, the groundwater budget has been developed. Phase II will involve the completion of calibrated groundwater and surface water models. The fully integrated model will be developed to include the results of CROPSIM soil-water balance analysis and will be used to evaluate management alternatives.

CENEB: CEntral NEBraska Modeling Study

The **CENEB Modeling Study** will identify management opportunities to meet water needs in the region by characterizing water supplies, uses, and demands through development of evaluation tools, models, and datasets.



The project covers portions of the Niobrara, Loup, and Elkhorn Basins, is part of the Department's Niobrara River Basin Study, and is partially funded under a Bureau of Reclamation WaterSMART Program Grant. This project will provide an accounting structure to aid in the annual assessment of hydrologically connected water supplies and demands.

The CENEB study will develop hydrologic evaluation tools that integrate a groundwater flow model, a soil-water balance model (CROPSIM),

and a surface water operations model for portions of the region. The tools will enable water managers to understand the effects of various management decisions.

The Department is working with a contractor on the construction of the groundwater flow model. The basin NRDs (Middle Niobrara, Lower Niobrara, Upper Elkhorn, Lower Elkhorn, Upper Loup, and Lower Loup) and the Bureau of Reclamation have provided input and datasets to assist in development of the soil-water balance and surface water operations models.

Development of the CENEB modeling tools is currently underway. The tools will be used in evaluation of management scenarios and in the annual assessment of hydrologically connected water supplies.

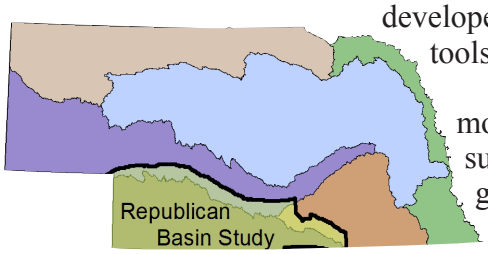
Republican Basin Conjunctive Management Study

The Department and the Republican River Management Districts Association are conducting the **Republican Basin Conjunctive Management Study** to evaluate current conditions, to provide tools to better manage Nebraska's water allocation under the Republican River Compact, and to meet the goals and objectives of the basin's IMPs.

The study results will be used to optimize the use of Nebraska's allocation, minimize the need to implement compact call-year controls, and maximize economic development. The study will estimate current and future water supplies and demands under existing infrastructure and operations.

In 2012, Nebraska, Colorado, and Kansas received a U.S. Bureau of Reclamation WaterSMART Program Grant to conduct additional analyses of current and potential future water supplies and demands and will evaluate water management alternatives in the entire Republican River Basin.

Phase I, now completed, worked with stakeholders to identify management scenarios for Nebraska and developed hydrologic tools.



Phase II will model and evaluate surface water/groundwater conjunctive management scenarios for Nebraska's portion of the Republican Basin to assess the hydrologic and economic implications and will also evaluate additional management alternatives within the entire Republican Basin. Based on the results of these analyses, Phase II will also develop plans to implement management strategies and infrastructure changes.

Definitions

Calibration: changing model input parameters to more closely match field conditions observed in the modeled area.

Conceptual model: a schematic or diagram of the currently understood relationship between components contained in a model.

Conjunctive management: the adaptive process of using the connection between surface water and groundwater to maximize use while minimizing impacts to streamflow and groundwater levels.

Groundwater flow model: a model which computes the flows of water into and out of the groundwater system.

Hydrologically connected: the condition when surface water and groundwater occur as a single resource.

Soil-water balance model: a model of water flows into and out of the soil. This includes precipitation, evaporation, transpiration, runoff, and groundwater recharge.

Surface water operations model: a model of water flows into and out of the surface water system, including the operations of man-made systems such as hydroelectric plants, reservoirs, and irrigation canals.

Water budget: the amount of water entering, leaving, and stored within a specific basin or area. Much like a financial budget, the inflows, outflows, and changes in storage must balance.

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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.ne.gov/IWM for up-to-date information. *Water Matters* is available at this website.