



Republican River Accounting: How It's Done

Nebraska's forecast of available water supplies in the Republican Basin

This is the final installment of a four-part series exploring how Nebraska, Kansas, and Colorado work together to administer the Republican River Compact (Compact) and how Nebraska uses Compact accounting data to help manage water and forecast future water availability in the Republican River Basin.

By Kari Burgert

As much as we would like to be able to “go with the flow,” so to speak, of surface water supply availability in the Republican River Basin, it is imperative that NeDNR, the natural resources districts, and water users in the basin have a sense of certainty in the maximum amount of surface water that may be available for use in the coming year. Since the Republican River Compact (Compact) data exchange and accounting calculations for assessing compliance with the Compact are not finalized by the Republican River Compact Administration (RRCA) until after the end of the year, Nebraska needs to have a prediction of the coming year's allocation and use to begin assessing what management actions might be needed for compliance in the coming year. NeDNR is required to consult with the three NRDs in the fully appropriated portion of the Republican River Basin (i.e., Upper Republican, Middle Republican, and Lower Republican NRDs) to provide an annual forecast of the maximum amount of water that may be available from streamflow for beneficial use in the short term and long term to ensure Nebraska's compliance with the Compact (*Neb. Rev. Stat. § 46-715 (6)*). The forecasted values must also comply with the requirements of the groundwater and surface water



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controls within the integrated management plans (IMPs) jointly developed by NeDNR and the three NRDs.

NeDNR estimates how much water use can occur for the coming year by assuming conditions will be dry. In December 2017, NeDNR issued a short-term forecast of dry-year, or maximum, allowable depletions to streamflow in the Republican River Basin of Nebraska for 2018 and a long-term forecast for a decade later – 2028. NeDNR's *Forecast of Allowable Depletions in the Republican Basin during 2018 and 2028* and previous year's forecasts are available online at <https://dnr.nebraska.gov/water-planning/republican/publications>. Detailed in the IMPs, NeDNR's short-term forecast is largely dependent on the two- and five-year averaging periods used by the RRCA to assess Nebraska's compliance, the previous years' balances, and the projection of the available water supplies and water consumption within the basin in Nebraska for the coming year.

The period used by the RRCA to assess Nebraska's Compact compliance is determined based on projections of the total irrigation water supplies available to the Nebraska Bostwick Irrigation District and Kansas Bostwick Irrigation District (KBID). The forecast projection is that 2018 will require use of the more restrictive two-year averaging (2017-2018) upstream of Guide Rock, in addition to five-year averaging (2014-2018) upstream of Hardy to measure Nebraska's Compact compliance. Nebraska's Compact balances upstream of Guide Rock and Hardy have been approved and finalized by the RRCA through 2016. The 2017 balance used in the

forecast was estimated by NeDNR using the current RRCA accounting procedures.

NeDNR has developed a method of forecasting the streamflow-related available water supply of the Republican River Basin for Nebraska's use, which is detailed in the IMPs. Estimation of supplies and consumption is based on previous years' averages, water available for irrigation in the five Bureau of Reclamation project reservoirs in the Basin in Nebraska at the start of each year,



and recent stateline streamflow.

The 2017-2018 Compact balance above Guide Rock is forecast to be -11,100 acre-feet. Since the two-year balance above Guide Rock is projected to be required and is negative, 2018 is a Compact Call Year. Since 2018 is a Compact Call Year, an additional 9,300 acre-feet of water that Kansas did not request to be made available in Harlan County Lake in the most recent Compact Call Years, referred to as Remaining Compact Compliance Volume, is available for Kansas to

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request in addition to the potential that Nebraska may need to address the projected 11,100 acre-foot shortfall. The five-year (2014-2018) Compact balance above Hardy is forecast to be positive and is not expected to require additional actions by Nebraska.

The RRCA was able to take advantage of this forecast of Nebraska's available streamflow in the Republican River basin to fine-tune Nebraska's potential management actions for compliance to what Kansas' irrigation water requirements are for the coming year. As described in Part 3 of this newsletter series in the Autumn 2017 NeDNR newsletter, Kansas did not

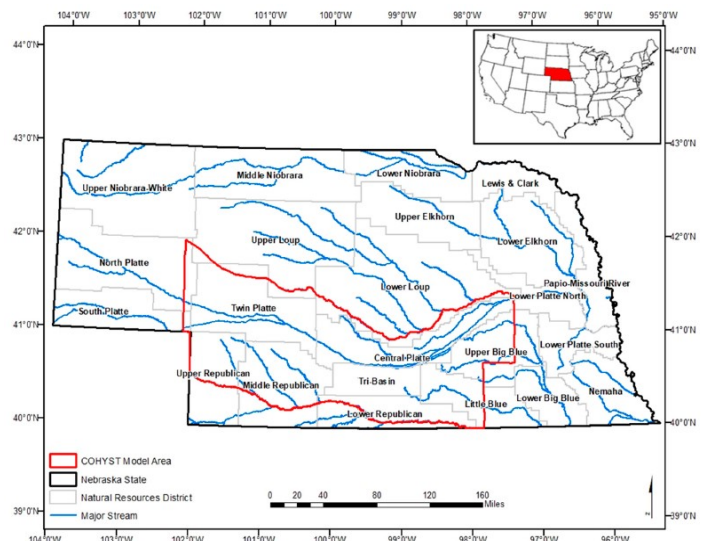
request any water from the Remaining Compact Compliance Volume to be made available to KBID in Harlan County Lake by June 1 of this year. This means that management actions that in the past would have been required can now be deferred until at least Fall 2018, at a time when Nebraska can more accurately determine what, if any, shortfall may exist. The 2018 forecast volumes will be updated with actual values as 2018 progresses, and a forecast for 2019 will be discussed with the RRCA to determine if any management actions will be necessary in the fall of this year.

Tracking Irrigated Crop Acres Across the State with Remote Sensing Technology in a Cost-Effective Manner

By Mahesh Pun

Introduction

The management of water resources is critical to a sustainable and viable agricultural sector, economic growth, and social welfare of Nebraska. The Nebraska Department of Natural Resources (NeDNR) aspires to sustainably manage the state water resources through conjunctive planning of groundwater and surface water use, also known as Integrated Water Management (IWM). Beneath IWM are hydrological models that water resource managers at the state and local agencies use to better water balance accounting. The precursor to a successful IWM is good quantitative data on water inflows, outflows, storage, diversions, and consumers in a system. In Nebraska, irrigated



Remote Sensing Continued from Page 3

agriculture is the largest consumer of available water resources, and unfortunately, also the most complex to appraise and monitor. The mapping of irrigated fields and tallying of water application rates across the state empowers water resources management departments and agencies to derive informed decisions and enforce water rights and allocation statutes. In an effort to acquire complete understanding of irrigation water consumption, NeDNR resolved to develop a method to sustainably identify, map, and quantify irrigated croplands across the state.

Identifying Irrigated Croplands

With oversight and funding from NeDNR, an irrigation mapping scheme (NDVI-Evaporation Fraction-Greenness Index (NEG) classification scheme) was recently developed and published (Pun et al., 2017), to identify and map irrigated croplands. The scheme leverages remote sensing, a widely regarded technique for resolving land use and land cover patterns over expansive areas. The scheme synergies two indices (NGI and EGI) formulated to highly contrast irrigated and non-irrigated cropland signatures. The two indices are functionally different because one is a phenological index and the other is a scaled soil water stress index. The ability to contrast irrigation-status based soil water stress enhances the scheme applicability in humid climate and/or wet growing seasons. The thresholds of the indices were calibrated on the

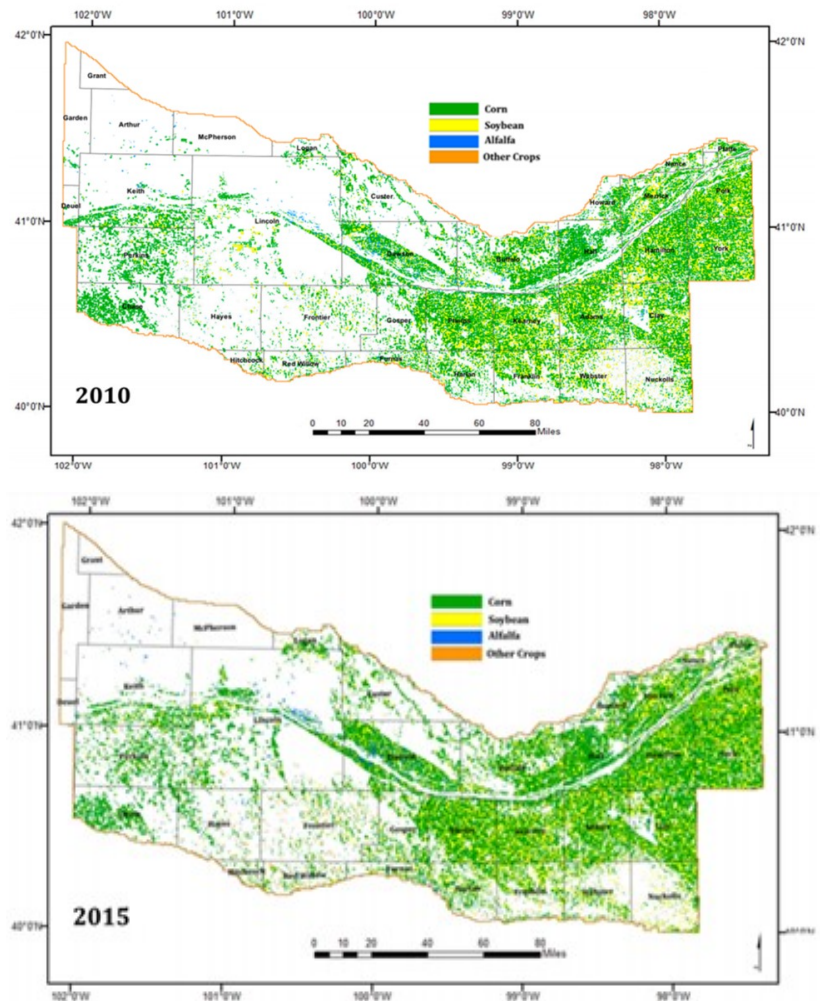


Figure 1. Irrigated fields in the COHYST model region during the growing season of 2010 and 2015, derived by NEG classification scheme.

wettest recent growing season, so that they became better classifiers during normal and dry growing seasons

Irrigated Croplands of COHYST

The scheme was applied to COHSYT, a region with wide climate variation, and to multiple

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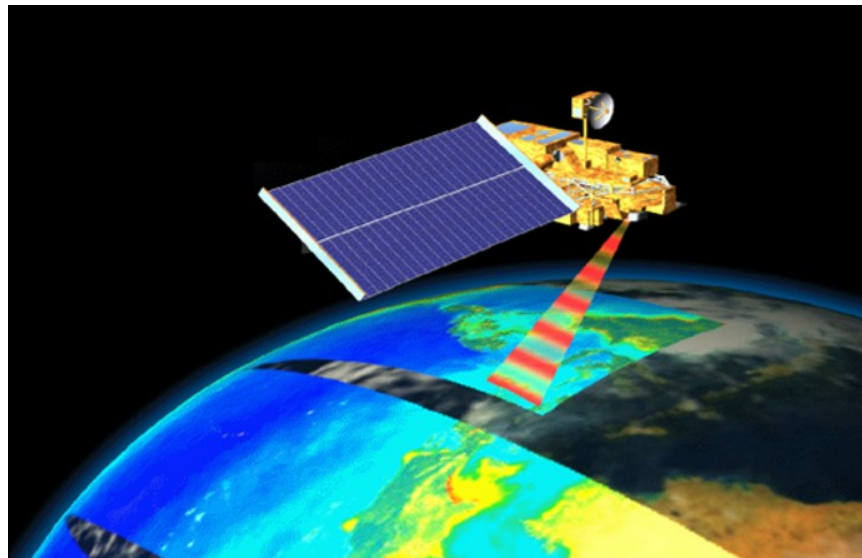
growing seasons – wet, normal, and dry. The results revealed that across multiple growing seasons, the scheme was 92.1% accurate. There is a characteristic distribution of extensive irrigation in the east of cohyst that disperses westward (Figure 1). York and Hamilton counties, both in the east, were the most irrigated counties with more than 70% of county area classified as irrigated cropland. Across the region, a total of 1,606,008 ha in 2015 and 1,462,004 ha in 2010 were classified as irrigated, many of which were corn

and soybean. It is evident that the extent and intensity of irrigation in a region depends on four key factors: rainfall, water accessibility, topography, and soil type. During the months of intensive irrigation, rainfall distribution across the region can decrease from east to west by as much as 89 mm. The variation is significant given that the average crop water consumptive use for irrigated corn is about 548 mm and 452 mm for soybeans. Precipitation may be a constraining factor; however, the main limiting factor of intensive irrigation expansion in the western part of Cohyst is the nutrient-deficient and low water holding capacity sandy soils that dominate the

region. Consequentially, the region is dominated by grass and pasture for ranching, winter wheat, and alfalfa.

Conclusion

Irrigated agriculture consumes the largest share of available water, and awareness of the *where, when, and how much* water is applied by the practice is paramount to a sustainable conjunctive water management. To improve our understanding of irrigation practices, NEG



classification scheme derived from land-atmospheric interaction and crop development indicators was developed to identify and map irrigated and non-irrigated croplands. The results from applying the scheme across COHYST showed an accurate and consistent scheme to identifying irrigation status with 92.1% accuracy, and a scheme applicable in a wide range of climate, and from dry to normal and wet growing seasons. The scheme resolves the *where* piece of the irrigation practice puzzle, moving NeDNR a step closer to a completely informed IWM implementation across the state.

Nebraska Platte-Republican Conservation Reserve Enhancement Program (CREP)

By Susan France

The Nebraska Platte-Republican Conservation Reserve Enhancement Program (CREP) is a cooperative effort between the USDA Farm Services Agency (FSA), the Natural Resources Conservation Service (NRCS), and the State of Nebraska. The CREP is part of the Conservation Reserve Program (CRP), operated by FSA for the Commodity Credit Corporation (CCC). This is a voluntary program where producers can enter into coordinating contracts with the FSA and the Department of Natural Resources agreeing not to irrigate their land for ten to 15 years and to return the land to a vegetative cover that will enhance associated wildlife habitat. The FSA pays the farmer irrigated rental rates, and the Department and the FSA split the cost of establishment of the vegetative cover. This program began in 2005 and was the first in the nation with a purpose to reduce consumptive use.

During the 2017 federal reporting year (October 1, 2016, to September 30, 2017) the Department received 22 new applications for CREP contracts. Seven contracts were scheduled to expire on September 30, 2017. Six of the seven contracts

were renewed for an additional ten to 15 years. Below are several summaries showing the distribution of existing contracts as of September 30, 2017.

The Department of Natural Resources initiated the CREP program with the federal government in an effort to reduce consumptive use in the overappropriated area of the Platte River Basin, and the fully appropriated area of the Republican River Basin. Below is a table showing the estimated amount of consumptive use water savings by year. Acres irrigated by both groundwater and surface water are described as commingled acres.

For the purpose of the estimates of consumptive use savings of irrigation water, it is assumed that for those acres irrigated from groundwater (which includes acres identified as commingled) the full irrigation requirement would be met. For those acres irrigated only by surface water, further analysis is required. Surface water appropriations may be closed during times of low flow, based upon the priority of the appropriation, thus one cannot assume that a full irrigation

SUMMARY OF ACRES APPROVED BY BASIN AS OF SEPTEMBER 30, 2017

THE BASIN NAME	APPROVED APPLICATIONS	GW ONLY ACRES	SW ONLY ACRES	COM-MINGLED ACRES	TOTAL IRR. ACRES	NON IRR. ACRES	TOTAL ACRES
<i>Platte Basin Below Lake McConaughy</i>	38	1,180.36	318.44	461.07	1,959.87	0.70	1,960.57
<i>Platte Basin Above Lake McConaughy</i>	92	2,088.13	3,230.29	274.9	5,593.32	19.10	5,612.42
<i>Republican</i>	337	26,095.43	3,830.81	4,138.02	34,064.26	1,355.08	35,419.34
TOTALS	467	29,363.92	7,379.54	4,873.99	41,617.45	1,374.88	42,992.33

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requirement is met for surface water. In addition, water saved by not releasing storage water for irrigation is calculated based upon several factors, including storage in reservoirs during the year. Because the federal reporting period ends September 30, surface water savings are calculated and reported one year later. Therefore, the full amount of estimated water savings for 2017 will be reported in 2018.

CREP annual reports to the federal government can be found at <https://dnr.nebraska.gov/surface-water/crep>. Further explanation of the calculation of water savings is in the report. Water quality improvement and wildlife preservation are also goals of the CREP program, and the estimated effects on these goals are included within the report.

SUMMARY OF ACRES APPROVED BY COUNTY AS OF SEPTEMBER 30, 2017

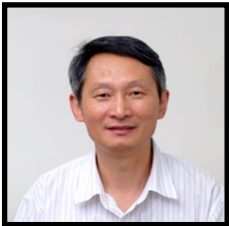
County	Count of Contracts	GW Only Acres	SW Only Acres	Comingled Acres	Total IR Acres	Total Non IR Acres	Total Acres
Banner	2	258.6			258.6	9.2	267.8
Chase	39	5,077.43		108.6	5,186.03	270.4	5,456.43
Dawson	22	879.62	73.81	134.5	1,087.93		1,087.93
Deuel	1	15.8			15.8		15.8
Dundy	28	4,820.5		41.2	4,861.7	248.3	5,110
Franklin	28	1,11.59	257.55	447.7	2,216.84	65.1	2,281.94
Frontier	28	2,989.6	31.5	112.7	3,133.8	125.5	3,259.3
Furnas	37	2,789.68	251.5	47.0	3,088.18	224.68	3,312.86
Garden	15	469.2	205.8	27	702.01		702.01
Gosper	16	1,377.62			1,37.62	49.7	1,427.32
Harlan	17	1,304.27		136.36	1,440.63	60.85	1,501.48
Hayes	18	1,482.13	18.4	180.3	1,680.83	37.52	1,718.35
Hitchcock	51	2,108.5	1,073.9	1,364.11	4,546.51	53.48	4,599.99
Keith	3	241.54			241.54		241.54
Lincoln	18	1,434.9	244.63	326.57	2,006.1	40.6	2,046.7
Morrill	37	1,098.33	770.46	108.7	1,977.49	9.9	1,987.39
Nuckolls	1		11		11		11
Red Willow	56	982.81	1,832.46	1,565.65	4,380.92	157.65	4,538.57
Scotts Bluff	33	262	2,030.92	139.2	2,432.12		2,432.12
Sioux	5		223.1		223.1		223.1
Webster	12	259.8	354.5	134.4	748.7	22	770.7
Grand Total	467	29,363.92	7,379.54	4,873.99	41,617.45	1,374.88	42,992.33

A Look Ahead and Behind

As we began a new year, our division heads were asked to reflect on the accomplishments of 2017 and put forth some goals for 2018. What follows is just a glimpse of all of the good work of 2017 and what to look forward to in 2018.

Engineering Division—Shuhai Zheng

Accomplishments:



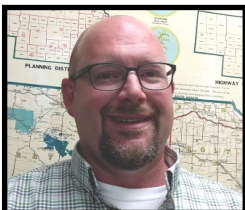
- The Dam Safety Program with the assistance of the NeDNR Field Offices completed 703 dam inspections across Nebraska.
- Twenty-five significant problems found at dams across Nebraska were fixed in 2017. Working with dam owners, some of the problems that were addressed included the clearing of plugged spillways, repairing leaky spillway conduits, expanding undersized auxiliary spillways, and updating obsolete emergency action plans.
- The Dam Safety Program issued a new 20-page booklet for dam owners entitled, *Inspection and Maintenance of Your Earthen Dam*.
- Won Tom Lee State Award for Excellence for our Floodplain Management Program.

Goals:

- Continue to work with dam owners to correct problems that could lead to dam failure.
- Work with dam owners whose emergency actions plans are outdated.
- Complete visits to the over 550 dams across Nebraska that are due for inspection.
- Provide best available information and technical assistance to local entities in compliance with floodplain management regulations.
- Our division's overarching goal is to prevent Nebraskan's life and property losses from flooding and dam failure by leveraging federal funding resources and improving our programs' effectiveness and efficiencies.

Water Administration—Jeremy Gehle

Accomplishments:



- In 2017 the Water Administration Division made its voluntary water use reporting application available to all surface water users across the state. Responses to the survey poured in over the last three weeks of December. The information gathered will be valuable to assess current surface water usage and make future water management decisions.
- The NeRAIN program completed its website update. The original website, dating back to 2004, was replaced with an all-new website during May 2017. With the most recent update during late 2017, NeRAIN has almost all of the reports and functionality of the original website, as well as several new features. Reporting rain gauges are now connected to a nearby

A Look Ahead and Behind Continued from Page 8

National Weather Service station so that precipitation can be compared with normal (defined as the 30-year average, from 1981-2010).

- In 2017 the Department's Streamgaging website upgraded its functionality to display instantaneous and daily quality control flags. Instantaneous graphs now show if the data is being influenced by four different criteria; ice effect, equipment malfunctions, rating curve in development, and if the gage is only operated seasonally. The daily quality control flags display whether the data is either provisional or approved. These upgrades provide greater transparency to the public to know and assess the quality of the streamflow data that is presented on our site.

Goals:

- Implement a continuous streamflow record working process where daily discharge is reviewed and approved on a quarterly basis. Implementing this process will give the customers of our surface water data better information on more frequent intervals.
- Move our GIS based field inspection form to mobile platform utilizing ESRI Survey 123 and Collector. This enhancement would allow the data collection to analysis process be further streamlined making it more effective and efficient.
- Finalize and deploy the updated Platte Water Accounting Program (PWAP). The PWAP program was last updated in 1999 and needs to be moved to a new coding language to ensure its continued operation.

Information Technology—Kim Menke

Accomplishments:



- Created Dam Inspection off-line data collection system utilizing ESRI's Survey123 and integrated data with Dam Safety's enterprise system.
- Updated open and closing notice tracking system to incorporate Bridgeport office functions. Bridgeport used the website application this summer to send out notices. All field offices are using the same notice tracking system.
- Launched new website for NeRAIN, which included easier reporting, updated graphs and charts, and new logo. Current system was outdated and could no longer be maintained.

- IT utilized Smartsheets to track project progress and priorities across sections and divisions.

Goals:

- Continue to create off-line applications for collecting data via mobile devices using ESRI products Survey123 and Collector.
- Migrate to a paperless environment through OnBase. First project is migrating groundwater section to an OnBase workflow.
- Migrate PWAP (Platte Water Accounting Program) to a web application. Current system is outdated and can no longer be maintained.
- Migrate NeDNR to the States domain.

A Look Ahead and Behind Continued from Page 9

Permits and Registrations—Mike Thompson

Accomplishments:



- Approved the first instream flow application in almost 20 years, which provides for stream flow protection for fisheries in the lower reach of the Niobrara River in Nebraska.
- Enhanced both groundwater and surface water interactive maps on our website, providing popular self-service options for our customers as the Division continued to dominate the charts with web page hits.
- Groundwater well registration section moved further “green” by significantly reducing the amount of paper utilized in processing forms. Around 85% were processed online.

Goals:

- Groundwater Registrations will make improvements to the interactive web map resource in order to better distinguish categories of wells. They will also work with software programmers to make improvements to the formatting of water well information displayed on the public website. Both these online resources are heavily used by Nebraskans.
- Surface Water Permitting will continue to implement incremental process improvements to reduce application processing time. In addition, new policies and procedures will be developed to assist appropriators in perfecting their water rights once they have been approved.

Special Projects—Susan France

Accomplishments:



- The Special Projects Division spearheaded the review of all Department rules for the Director. Governor Ricketts asked each code agency to review their rules to determine what rules might be repealed and what rules might be modified to be more public friendly. Special Projects Division met with all divisions of the Department regarding rules relevant to that division and came up with a recommended list of rules that could be modified or repealed. Department staff also reviewed Natural Resources Commission rules with the Commission. After review by Director Fassett, information on each rule was provided to the Governor’s Policy Research Office (PRO) for their review. The Department is currently reviewing comments from PRO and will be working on appropriately modifying rules in the coming year.
- The Special Projects Division completed review of the data entry of all stream and canal gage information. Water Administration staff and Special Projects staff are placing all the gage location information into GIS. The historical gage data will be added to the gage data on the internet in the next few months. Work is continuing on getting the historical miscellaneous measurements data completed so that it can also be added to the public internet site.
- As part of reorganization of the Department’s layout, Division staff purged old records, downsized the library, and created a new section of the library that memorializes documents produced by the Department and its predecessors. Additionally, staff indexed many records and sent them to storage to allow more room within the office. The Department will scan and code permanent records of the Department based on priorities and staff time availability.

A Look Ahead and Behind Continued from Page 10

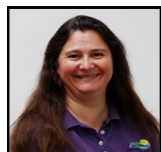
- Staff wrote detailed procedures concerning several areas such as contracts and Natural Resources Commission records that have proved helpful when staff turnover occurs or when staff are absent because of illnesses, or there are changes in job duties.

Goals:

- Revising rules as needed.
- Finalizing the library update project.
- Finalizing a new database for CREP.
- Finalizing a new database for Contracts – getting the statewide upload computerized.
- Completing scanning and coding of instream flow hearing files.
- Uploading the historical gage data to the internet.
- Completing the input of all miscellaneous measurement data into the computer.

Water Planning—Jennifer Schellpeper

Accomplishments:



- Lower Platte Basin-wide Plan written and approved by all NRD boards.
- Published paper on remote sensing for determining irrigated lands.
- New interactive education page on streamflow: <https://nednr.nebraska.gov/dynamic/WaterScenario/Game1.aspx>.

Goals:

- Finalize Republican River basin-wide plan.
- Finalize Upper Platte basin-wide plan.
- Finalize Lower Platte North / Lower Elkhorn / Little Blue Integrated Management Plans.

John Miller Graduates from Nebraska Water Leaders Academy



John Miller recently graduated from the seventh class of the Nebraska Water Leaders Academy, a one-year program that provides leadership training and educates participants about the vital role rivers, streams, and aquifers play in the economic sustainability of the state.

John, Natural Resources Program Specialist with the NeDNR, received a bachelor's degree in Environmental Studies from the University of Nebraska-Lincoln.

A project of the Water Futures Partnership-Nebraska, Academy sessions feature classroom as well as field trip experiences presented by acknowledged experts in leadership and natural resource topics held at locations across the state.

The Water Leaders Academy is partially funded through a grant from the Nebraska Environmental Trust and more than 25 other organizations and individuals.

More information can be found at www.waterleadersacademy.org.

Employee News



Assistant Director Rex Gittins retired at the end of 2017 after 14 years with NeDNR. Director Jeff Fassett presented Rex with a glass water drop to commemorate his time with NeDNR.

Rex said he has enjoyed working with everyone at NeDNR and will miss them.

We sure miss him, too!



Rick Vollertsen, Water Planning Division, passed away suddenly on February .10.

Rick worked at NeDNR for 28 years. He is deeply missed.



Madeline Hoffer, Process Improvement Coordinator, was awarded the Lean Six Sigma Green Belt by Governor Ricketts at a luncheon held at the Governor's Residence.

Director Jeff Fassett was there to congratulate Madeline.

As the Process Improvement Coordinator, Madeline works hard to help NeDNR streamline processes saving time and money.

Congratulations, Madeline!



Tom Mitchell from the Crawford office out of Bridgeport field office retired in January. Tom started with NeDNR in 1971.

Jeremy Gehle, Water Administration head, presented Tom with a glass water drop to commemorate his service.

We wish Tom all the best in his retirement.

Colorado/Nebraska Republican River Settlement

Below is an abridged version of a media release produced by the Governors and Attorneys General of Nebraska and Colorado concerning a \$4 million settlement agreement between the two states regarding the Republican River Compact.

On February 22, the Governors and Attorneys General of Nebraska and Colorado announced their settlement of claims regarding Colorado's past use of water under the Republican River Compact. A new agreement between the states was signed by Governor John Hickenlooper of Colorado and Governor Pete Ricketts of Nebraska in recent weeks. The agreement builds upon the states' recent collaborative water management efforts and approval of detailed interstate Compact accounting procedures of water in the Republican River basin. While the States are currently in compliance with the terms of the Compact, this settlement resolves potential claims related to alleged past violations. The two-page settlement:

- Avoids any future litigation on these matters, by forever barring Nebraska from bringing claims against Colorado for violation of the Compact and the prior 2002 Final Settlement Stipulation for the accounting period ending on or prior to December 31, 2013; and,
- Subject to appropriation, provides a negotiated level of payment to the State of Nebraska; and,
- Establishes no precedent for water valuation in any of the States, including this river basin; and
- Requires payment by December 31, 2018.

Governor Hickenlooper commented that "the settlement provides funds that could be used in the Republican River Basin within Nebraska and creates additional opportunities for cooperative water management between the states."

Governor Ricketts agreed that "Nebraska and Colorado can now continue to focus on providing their water users with greater certainty and to pursue other collaborative opportunities to benefit their shared economies."

Attorney General Doug Peterson of Nebraska also expressed his approval, stating that "this settlement is in the best interest of the State, and builds on our previous collaborative efforts."

Governor Ricketts underscored the importance of these State-to-State collaborative efforts and the ongoing dialogue and water planning efforts between the State of Nebraska and the water users in this particular river basin. Through cooperation and targeted water resources investment, greater certainty, predictability, and stability for the overall economy has been brought to the over 1.1 million acres of irrigated land, just in Nebraska. The agricultural economies of the three states' surface and groundwater users in this interstate river basin are tied together and can mutually benefit from the ongoing collaboration.

After signing the agreement, Governor Ricketts recommended that the Legislature invest the funds provided through this settlement in surface water resource conservation projects in the Republican River basin. Nebraska water users were affected by the reduced water supply allocated to the State, as a result of Colorado's past years of use. These water users should benefit from further investments. Since establishing their streamflow augmentation project and other measures, Colorado has been in full compliance with the Compact since 2015.

Governor Ricketts praised the efforts of his Department of Natural Resources and the Office of the Attorney General to open and establish a long-term commitment to dialogue among water users, regulators and States, and support the movement away from the era of litigation and controversy that began over 20 years ago. Dialogue and recent court decisions supporting the State's views have created an environment for advancing solid strategies for future water planning and investment in water management, efficiencies, and conservation.