

2023 Forecast of Allowable Depletions in the Republican River Basin

*Nebraska Department of Natural Resources
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Background

The State of Nebraska is party to an interstate compact for the management of the Republican River Basin with the states of Colorado and Kansas, administered by the Republican River Compact Administration (RRCA). Pursuant to the current integrated management plans (IMPs) and Neb. Rev. Stat. § 46-715(6), the Nebraska Department of Natural Resources (NeDNR) in consultation with the Lower Republican Natural Resources District, Middle Republican Natural Resources District, and Upper Republican Natural Resources District (Districts) is required to provide an annual short-term and long-term forecast of maximum allowable depletions to streamflow that will ensure compliance with interstate compacts. The NeDNR has determined that the short-term forecast applies to the upcoming year (2023) and that the long-term forecast estimates what conditions may be ten years into the future. Therefore, this document includes the dry-year forecast of allowable depletions to streamflow in 2023 and 2033.

The States of Nebraska, Colorado, and Kansas, acting through the RRCA, adopted a “*Resolution Approving Long-Term Agreements Related to the Operation of Harlan County Lake for Compact Call Years*” (Resolution). The August 24, 2016, Resolution outlines certain actions that Nebraska will take toward Republican River Compact (Compact) compliance during years forecast as Compact Call Years as outlined in the Monitoring and Studies Technical Memorandum sections of the District IMPs. Compliance with the terms of the Resolution constitutes compliance with the Final Settlement Stipulation and Compact.

Short-Term Forecast

The outcome of Nebraska’s short-term forecast is largely dependent on three key elements, much of which are from data secured through the RRCA Compact accounting procedures. These three elements are detailed in the following sections.

1. Applicable compliance tests for 2023

The first key element of the short-term forecast is the identification of the averaging period that will be utilized for assessing compliance for the upcoming year. The compliance tests use five-year averaging upstream of Hardy in every year and may also include an additional test based on two-year averaging upstream of Guide Rock. The averaging period and applicable accounting points are determined based on projections of the total irrigation water supplies available to the Nebraska Bostwick Irrigation District and Kansas Bostwick Irrigation District. The current projection is that 2023 will require the use of five-year averaging to measure Nebraska’s Compact compliance upstream of Hardy and the additional test of two-year averaging upstream of Guide Rock.

2. Previous year balances

The second key element in the short-term forecast is an evaluation of the recent Compact accounting balances for the State of Nebraska as determined using the current RRCA accounting procedures. These procedures allow for the determination of Nebraska’s Compact balance for years through the current year (2022). Nebraska’s Compact balances through 2021 have been approved and finalized by the RRCA. The 2022 balances are provisional. The information used to estimate the 2022 Compact balances are presented in Table 1. Nebraska’s 2018-2021 RRCA-approved balances and 2022 provisional balances upstream of Guide Rock and Hardy are presented in Table 2.

Table 1. Information Used (acre-feet) for 2022 provisional Accounting.

Item	Information Source
Groundwater Use	Prior years’ pumping records
Surface Water Use	Estimated from preliminary data and previous years values
Stream Flow	Provisional records, end-of-year estimated
Evaporation	Prior years’ records, provisional, end-of-year estimated records

Table 2. Nebraska’s 2018- 2021 RRCA-approved balances and 2022 provisional balances upstream of Guide Rock and Hardy.

Year	RRCA Status	Upstream of Guide Rock Balance*	Upstream of Hardy Balance
2018	Approved	-	1,500
2019	Approved	-	153,000
2020	Approved	-	69,700
2021	Approved	25,100	27,000
2022	Nebraska Provisional	-16,100	-11,100
2021-2022 Balance		9,100	-
2018-2022 Balance		-	240,100

* Balances for upstream of Guide Rock are included but not applicable for 2022 compliance.

Note: Values are rounded to the nearest one hundred acre-feet. 2022 values are preliminary and have not been approved by the RRCA.

3. Forecast of available water supplies and consumption for 2023

The third key element is the forecast of available water supplies and consumption within Nebraska for the upcoming year. To carry out this forecast, NeDNR uses a simplified method of estimating the streamflow-related available water supply of the Republican River Basin for Nebraska’s use. The water supply forecast is based on eight key variables:

- Surface water consumptive use in Colorado,
- Surface water consumptive use in Kansas,
- Surface water consumptive use in Nebraska,
- Groundwater consumptive use in Colorado,
- Groundwater consumptive use in Kansas,
- Groundwater consumptive use in Nebraska,
- Nebraska’s Imported Water Supply Credit, and
- Surface water flow at the Kansas – Nebraska state line.

These eight variables may be estimated for the next year:

- Surface water consumption in Colorado is estimated using a two-year average,
- Surface water consumption in Kansas is related to the water available for irrigation in Harlan County Lake at the end of each year,
- Surface water consumption in Nebraska is related to water available for irrigation in the five Bureau of Reclamation project reservoirs in Nebraska at the start of each year,
- Groundwater consumption and the Imported Water Supply Credit are estimated in all three states using a two-year average, and
- Streamflow is estimated assuming that the upcoming year is a dry year and is based on the volume of water in Harlan County Lake and the most recent five years of streamflow.

Historically, Nebraska’s share of the available water supply has been approximately half of the total water supply calculated using these methods. The information used to estimate the forecast of the available water supply and allowable depletions for 2023 are summarized in Table 3.

Table 3. Information Used (acre-feet) for 2023 Forecast of Allowable Depletions.

Year	Item	Information Source
2023 Forecast	Groundwater Consumptive Use and Imported Water Supply Credit	Average of 2020 and 2021
	Surface Water Consumptive Use	Colorado: Previous two-year average of T – 1 and T – 2 SwCBCU _{co}
		Kansas: + (.1858 x HCL content) + 9,575
		Nebraska: - (0.0000004) x (NE lake volume) ² + (0.52) x (NE lake volume) – 42,000
Stream Flow	0.41 + (5-year average of previous years’ Stateline Streamflow) + 0.23 x HCL content - 27,450	

Utilizing the data sources outlined in Table 3, the required components of the forecast can be calculated (Table 4).

Table 4. 2023 Forecast values in acre-feet, where GWCBCU is defined as groundwater computed beneficial consumptive use and SWCBCU is defined as surface water computed beneficial consumptive use.

Forecast Component	Forecast Value Upstream of Guide Rock	Forecast Value Upstream of Hardy
Colorado GWCBCU	27,900	27,900
Kansas GWCBCU	11,600	11,600
Nebraska GWCBCU	174,500	176,900
Nebraska Imported Water Supply Credit	18,900	18,900
Colorado SWCBCU	200	200
Kansas SWCBCU	51,400	51,400
Nebraska SWCBCU	73,400	74,000
Streamflows	102,800	124,100

The 2023 Compact balances – of allocations (available water supply), computed beneficial consumptive use (CBCU, groundwater and surface water consumption), and Imported Water Supply Credit – are calculated from the forecast procedures contained in the Monitoring and Studies Technical Memorandum Section of the IMPs (Table 5).

Table 5. Forecast 2023 Allocations (available water supply), Computed Beneficial Consumptive Use (CBCU, groundwater and surface water consumption), Imported Water Supply Credit, and Compact Balances for Guide Rock and Hardy in acre-feet.

Year	Allocation	Computed Beneficial Consumptive Use	Imported Water Supply Credit	Allocation - CBCU + IWS Credit (Balance)
2023 Forecast upstream of Guide Rock	220,900	247,900	18,900	-8,100
2023 Forecast upstream of Hardy	233,000	250,900	18,900	1,000

Note: Values are rounded to the nearest one hundred acre-feet.

Combining the results from the three key elements (applicable compliance test for 2023, previous years' balances, and forecast of available water supplies and consumption for 2023), Nebraska's 2019-2023 five-year total balance upstream of Hardy is forecast to be 239,500 AF; the additional two-year test upstream of Guide Rock will be applicable and is projected to be a 2022-2023 total balance of -24,200 AF (Table 6).

Table 6. 2019-2021 approved Compact balance total upstream of Hardy, 2022 provisional balances upstream of Guide Rock and Hardy, and 2023 forecast balances upstream of Guide Rock and Hardy in acre-feet.

Year	Upstream of Guide Rock Balance*	Upstream of Hardy Balance
2019-2021 total, approved	-	249,600
2022, provisional	-16,100	-11,100
2023, forecast	-8,100	1,000
Two-year (2022-2023) Total	-24,200	-
Five-year (2019-2023) Total	-	239,500

* Balances for upstream of Guide Rock are included but not applicable for 2022 compliance.

Note: Values are rounded to the nearest one hundred acre-feet. 2022 values are preliminary and have not been approved by the RRCA.

Compact Call Year Evaluation

The Monitoring and Studies Technical Memorandum of the District IMPs specifies the process that will be completed by NeDNR to determine a Compact Call Year. The process of determining if the following year will be a Compact Call Year is completed in two evaluations: one evaluation for the 5-year Hardy balances and one for the 2-year Guide Rock balances. Both evaluations must be completed each year, as shown in Figure 1.

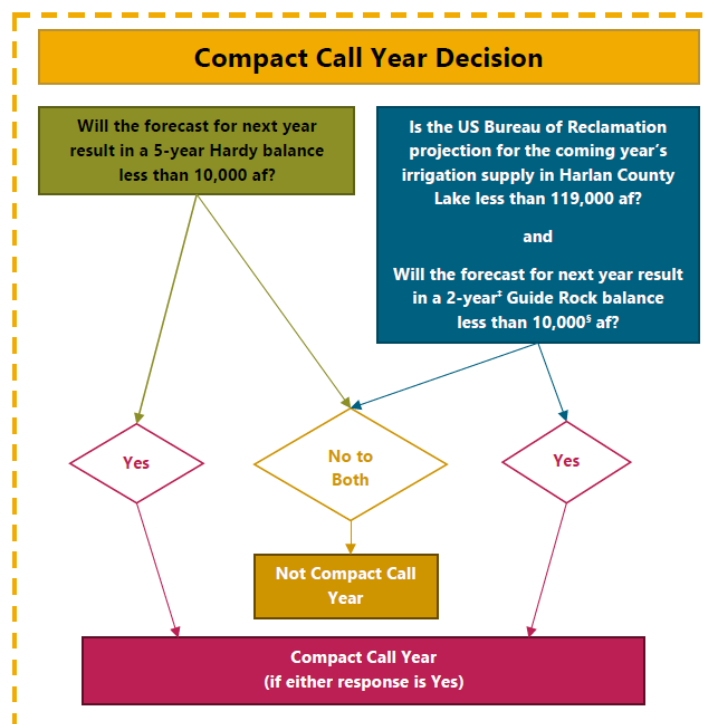


Figure 1. The Compact Call Year decision framework for the Republican River Basin consists of two evaluations: one evaluation for the 5-year Hardy balances and one for the 2-year Guide Rock balances, as illustrated in this figure.

The forecast for 2023 resulted in a 5-year Hardy balance of in excess of 10,000 acre-feet. The US Bureau of Reclamation projection, dated 11/17/2022, for 2023 irrigation supply in Harlan County Lake is 112,900 AF and the 2-year Guide Rock balance is -24,200 AF. Based on review of the IMP evaluations with the information presented in this document, a Compact Call Year designation is required for 2023.

Review of Resolution Provisions

The balance of Remaining Compact Compliance Volume (RCCV) was equal to 9,300 acre-feet on January 1, 2020. A Compact Call Year was not designated for 2020, therefore RCCV was immediately reduced by 20%. An equal volumetric reduction (1,860 acre-feet) is applied to the balance of RCCV for four subsequent years. On January 1, 2021, RCCV was reduced to 5,580 acre-feet; on January 1, 2022, RCCV was reduced to 3,720 acre-feet; on January 1, 2023, RCCV will be reduced to 1,860 acre-feet.

Nebraska will evaluate the actual hydrologic conditions on a regular basis to estimate the Compact Compliance Volume (CCV) for 2023. The first update to this estimate will be provided no later than May 10th and will be updated each month thereafter. Nebraska will finalize the CCV no later than December 31, 2023.

Subject to the Compact Call Year designation and the terms of the Resolution, Kansas may request that any Remaining Compact Compliance Volume, including CCV for 2023, be made available in the Kansas Account prior to June 1, 2024. Kansas must finalize their request prior to October 1, 2023.

Review of Integrated Management Plan Provisions

Due to the Compact Call Year designation for 2023, NeDNR will provide the Districts with an estimate of how much yield from potential management actions may be needed within the year. A summary of the Districts' provisional 2022 Guide Rock balances, forecast 2023 Guide Rock balances, RCCV, and summed balances for the compliance period are provided in Table 7.

In Compact Call Years, NeDNR will implement additional surface water controls. NeDNR will issue an order designating 2023 as a Compact Call Year and carry out the necessary administration of natural flow and storage surface water appropriations within the basin. The Department will coordinate with the Districts to provide updated water supply projections throughout 2023 and inform the Districts if Kansas requests Remaining Compact Compliance Volume in the fall of 2023.

The Compact Call Year determination for the first Compact Call Year after non-Compact Call Years includes a provision that the balance must exceed 10,000 acre-feet to account for potential outliers from the forecast empirical formulas which use recent years values. Since the forecast balances are intended to be representative of dry-year allowable depletions, the potential remains for an additional forecast balance decrease of 10,000 acre-feet to be realized in 2023. The extent to which it will affect each NRDs is not part of the forecast.

Table 7. Summary of Guide Rock Balances and total projected Compact Obligation for each District within the Basin in acre-feet.

Year	LRNRD	MRNRD	URNRD
2022 Provisional	-6,500	100	-9,700
2023 Forecast	-5,000	800	-4,000
Two-Year Total	-11,500	900	-13,700
Remaining Compact Compliance Volume	-820	-920	-120
Total Potential Management Actions required for IMP compliance	12,320	20	13,820

Note: Values are rounded to the nearest one hundred. The 2022 values are based on current RRCA accounting procedures at the Guide Rock location. 2022 values are not finalized by the RRCA. 2023 Forecast values are computed at the Guide Rock location. The provisional 2022 balances for each District reflect the management actions taken in 2022.

Summary of the Short-Term Forecast for 2023

Nebraska’s 2023 compliance will be measured by the five-year average upstream of Hardy which is projected to be in excess of 10,000 acre-feet positive, and the additional two-year test upstream of Guide Rock will be applicable and is projected to be less than 10,000 acre-feet. Therefore, the Districts are expected to have Compact Call Year obligations for 2023 up to the volumes outlined in Table 8. By January 31, 2023, each District will inform NeDNR of the management actions they intend to take to ensure compliance, and then NeDNR will evaluate whether the planned management actions are sufficient to ensure compliance, as described in the IMPs.

Table 8. Forecast of potential management actions for each District to comply with IMP requirements.

Year	LRNRD	MRNRD	URNRD
Total Potential Management Actions required for IMP compliance	12,320	20	13,820
Total Potential Management Actions required for IMP compliance with additional 10,000 acre-feet *	22,320	10,020	23,820

* Includes an additional 10,000 acre-feet for each District to account for the dry-year forecast outliers for the first Compact Call Year after non-Compact Call Years.

Long-Term Forecast

Due to the absence of a long-term trend in water supply, the periods of low water supplies in the future are likely to be similar to periods of low water supplies from the past. Historically, the minimum water supplies that have been available to Nebraska were approximately 200,000 acre-feet. Therefore, the amount of water that may be available from streamflow for beneficial use ten years in the future (2033), assuming several consecutive dry years, is estimated to be approximately 200,000 acre-feet. In an effort to continue to ensure long-term Compact compliance through future dry years, the Compliance Standards in the IMPs outline objectives to maintain groundwater depletions at a relatively constant level over the long-term. The NeDNR and Districts will continue to evaluate the trends in long-term groundwater depletions over typical wet and dry cycles and jointly assess whether additional management actions are necessary to accomplish this objective.