Evaluation of the South Platte Compact Canal and Alternatives

Submitted to:

Nebraska Department of Natural Resources

December 29, 2022

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EXECUTIVE SUMMARY

SOUTH PLATTE COMPACT CANAL

This report assesses the availability of the South Platte River water supplies under the Compact and analyzes the utility of building the Perkins County Canal Project and diverting South Platte River water for Nebraska's current and future needs.

IMPORTANCE OF WATER

Nebraska's water supplies are sacrosanct. These supplies underpin nearly every aspect of Nebraska's vibrant economy. The water derived from Nebraska's river systems enables Nebraska's agriculture to help feed the world, stimulates sophisticated hydropower systems, ethanol production, and municipal growth, and provides sustenance for species and their associated habitats. The water supplies from the South Platte River are integral to Nebraska's economic success.

Nebraska has and will continue to increasingly lose water supplies from the South Platte River. Under the South Platte River Compact (Compact) with the state of Colorado, Nebraska preserves its rights to the South Platte River supplies if it builds the Perkins County Canal Project (also known as the South Divide Canal). Colorado is currently using and plans to accelerate its use of water that has historically entered Nebraska. Nebraska risks losing all of this supply in the future without construction of the Project. In other words, although Nebraska has received benefits from the South Platte River supplies over the last 100 years without the Canal, Colorado's laws, its operational projects in the Lower Section, and publicly stated plans to capture and use the remaining supplies will ensure that all remaining South Platte supplies are used to meet increasing urban growth needs in the Rocky Mountain Front Range.

FUNDAMENTAL CONCLUSIONS

This report has four (4) fundamental conclusions:

1. Colorado signed House Bill 16-1256 declaring Colorado's intent to use Nebraska's South Platte River supply.
2. The South Platte River has significant water supply available for Nebraska's diversions now and in the future.

3. With construction of the Perkins County Canal Project, Nebraska may capture the available water supply for current and future Nebraska water users.
4. The Perkins County Canal Project would provide significant benefits for all Nebraska water users in the Platte River system that exceed Project costs.

FOUR DIRECTIVES FROM LEGISLATIVE BILL 1012

On April 7, 2022, Nebraska adopted Legislative Bill 1012 (LB 1012) into law and created the Perkins County Canal Project Fund to design, engineer, and permit the canal as identified in the South Platte River Compact. LB 1012 specifically directed the Nebraska Department of Natural Resources to commission an independent study (Study) that would address four specific items, described in detail below. These four items required gathering and examining historical information, reviewing the South Platte River Compact, conducting a field site assessment, calculating future water supply availability on the South Platte River system, developing Project alternatives and a timeline to implement the alternatives, and analyzing the Project's costs and benefits. The results of this analysis are summarized below.

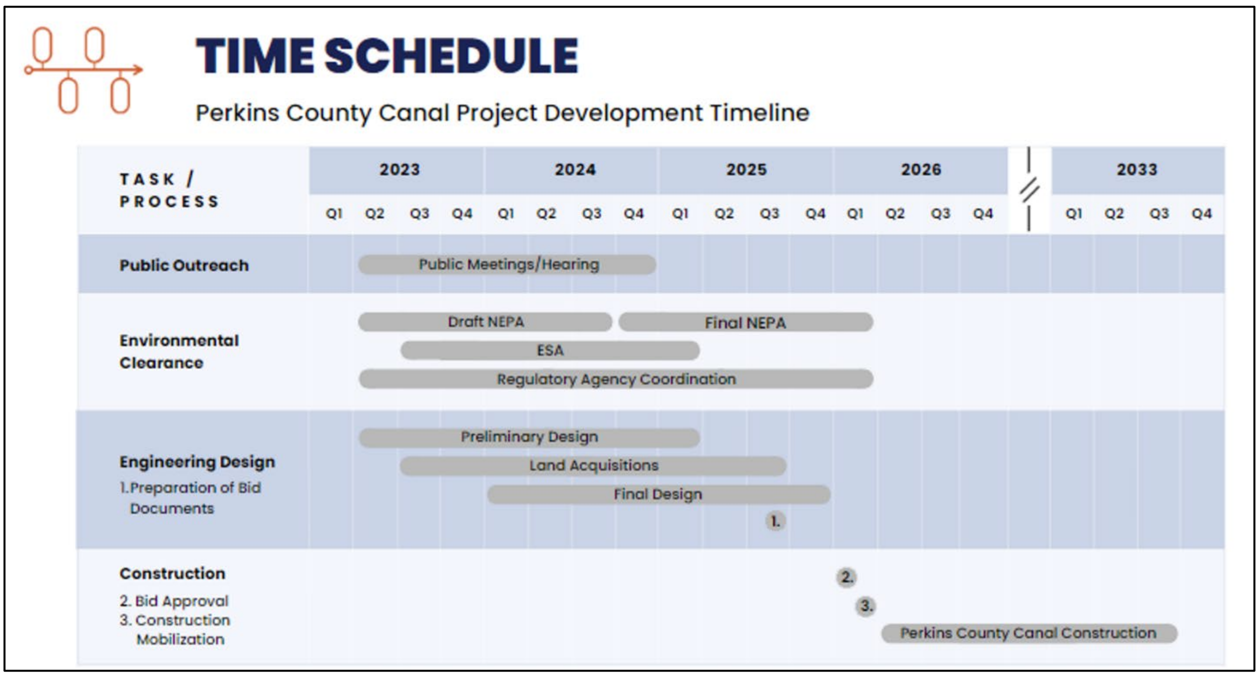
Directive 1: Estimate the costs of completion of a canal and adjoining reservoirs as outlined in the South Platte River Compact.

Nebraska reserved its right to build the Perkins County Canal Project in the South Platte River Compact. In 1982, the United States Bureau of Reclamation released a report for the Perkins County Canal Project that included a diversion structure near the town of Ovid, Colorado, fifty-six miles of conveyance canals, and six storage reservoirs. This report refined that analysis to support a similar diversion location and canal configuration but only two reservoirs based on an updated vision of the Project. The general approach taken for this evaluation was to update previous cost estimates based on review of historical documents, refined canal layout, and increased operational flexibility. The total revised cost to build the Perkins County Canal Project is estimated at $567 million.

Directive 2: Develop a timeline for completion of a canal and adjoining reservoirs as outlined in the South Platte River Compact.

The Perkins County Canal Project would begin in 2023 and has an 11-year planned timeline that should be completed in 2033. The Project timeline includes soliciting public participation, obtaining environmental documentation and clearance, and constructing a final engineered design as well as the associated transactional factors that apply to each Project component. Figure ES-1 shows the proposed Project timeline with the estimated start date in 2023.

Figure ES-1: Perkins County Canal Project Development Timeline



Directive 3: Examine the cost-effectiveness of alternatives, including alternatives that may reduce environmental or financial impacts.

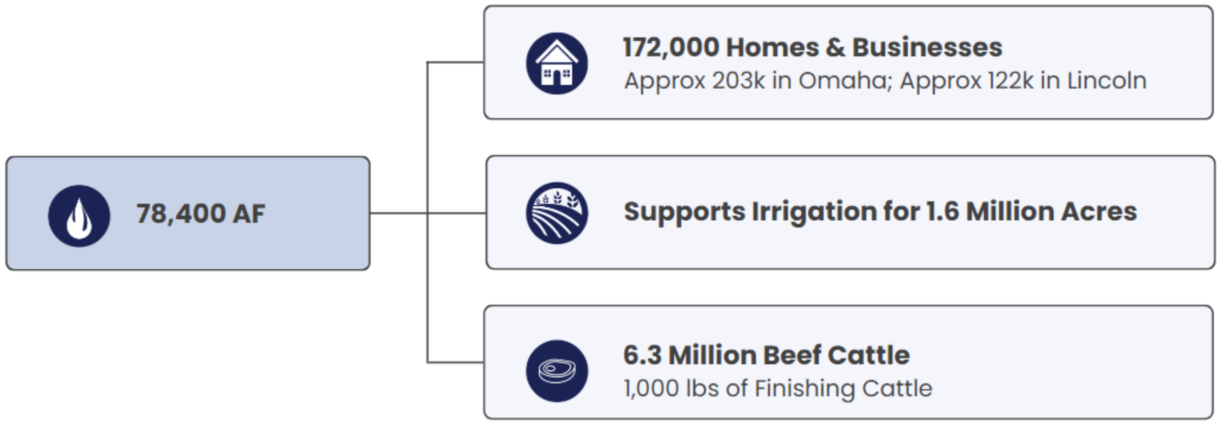
This report examined two alternatives for the Perkins County Canal Project that reduced environmental and financial impacts from previous analyses – one at 500 cubic feet per second (cfs) diversion and conveyance capacity and one at 1,000 cubic feet per second diversion and conveyance capacity. The alternatives were derived from the water supply availability analysis corresponding to the Project's non-irrigation season diversion period identified in the South Platte River Compact. Importantly, the Project could be available for additional diversions in other times of the year when surplus water supplies are available on the South Platte River, although this analysis omitted those opportunities to conservatively estimate the Project's value. Moreover, the design phase may further refine alternatives to reduce costs and improve benefits.

There is variable flow in the South Platte River. A 500 cfs canal makes between 69,900 and 78,400 acre-feet (AF) of volume available in average conditions but greater and lesser amounts may be available depending upon the South Platte River flow in any given year. The water supply availability analysis presented in **Section 2** concluded that on average, based on all water year types – dry through wet – coupled with no increased diversions by Colorado in the Upper Section, approximately 78,400 AF of water would be available between October 15 and April 1 each year and as much as 113,300 AF of water per year would be available on average during that same time period for a 1,000 cfs diversion facility. With a fifty percent (50%) reduction in supply availability based upon increased usage of South Platte River water supplies in Colorado and hydrological variability, 69,900 AF could be available in average years with a 500 cfs diversion facility and 85,600 AF in average years could be available with a 1,000 cfs diversion facility. These water supply figures are the fundamental allowances for deriving Project benefits.

Additional benefits (not quantified in this report) are likely available for this Project, including multiplier effects for:

- ✓ Regional economic benefits
- ✓ Increased wildlife habitat
- ✓ Increased hydropower production

Figure ES-2: Water Supply Availability Scenario for 500 cfs Canal



Benefits from the calculated supply availability were then quantified based on existing information and attributed to agricultural, municipal, industrial, environmental, recreational, hydroelectric, and water quality categories. In total, benefits for the 500 cfs diversion and canal Project ranged from $698 million to $754 million as compared to $567 million in Project costs. Benefits from the 1,000 cfs diversion and canal Project ranged from $719 million to $872 million as compared to $628 million in Project costs. As such, for either alternative, the baseline Project benefits are greater than the costs without incorporating additional benefits that would be likely attributable to the Project. A benefit-cost ratio of greater than 1 shows the Project is cost effective as shown in Table ES-1.

Table ES-1: Cost Effectiveness of Project Options

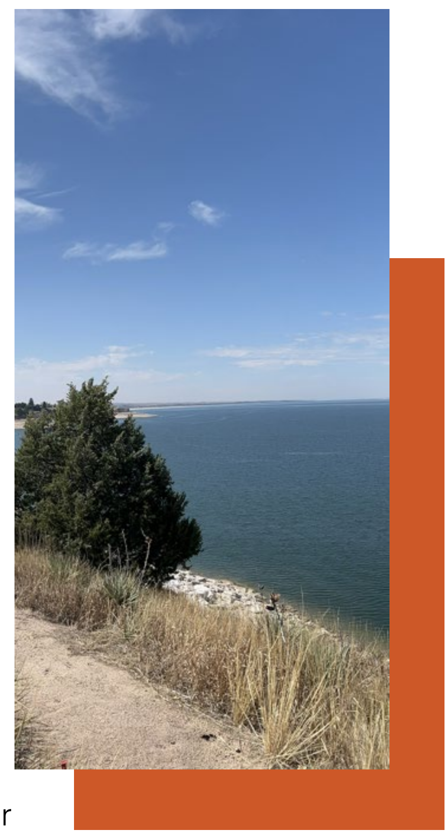
Project	Cost	Benefit	Benefit-Cost Ratio
Alternative 1 (500 cfs Canal)	$567 Million	$698 to $754 Million	1.23 to 1.33
Alternative 2 (1,000 cfs Canal)	$628 Million	$802 to $986 Million	1.28 to 1.57

Directive 4: Evaluate the impacts of the canal on Nebraska water users throughout the Platte River Basin, including the drinking water supplies for the cities of Lincoln and Omaha.

Colorado needs between 600,000 and 1 million AF of water to support growth in the urban centers along the Rocky Mountain Front Range. Colorado's dwindling supplies from the west slope of the Rockies and concerns about climate change compel Colorado to find alternative sources of water supply to satisfy its growth objectives.

As such, Colorado has developed extensive plans to divert, store, and use South Platte River water supplies affecting Nebraska's long-term water supply reliability interests. The Bill Summary for HB16-1256 states "The purpose of the storage study is to determine, for each of the previous 20 years, the amount of water that has been delivered to Nebraska from the river in excess of the amount required under the South Platte river compact. The study must also include a list of locations that have been identified as possible sites for the construction of a reservoir, enlargement of an existing reservoir, or implementation of an alternative storage mechanism along the mainstem and tributaries of the South Platte river between Greeley, Colorado, and Julesburg, Colorado."[1]

Water is the most important natural resource for Nebraska's economy. Any reduction of supply availability would impact the state's economy and productivity. Water used for irrigation from the South Platte River helps support Nebraska's crop and livestock agricultural economy. One in four jobs in Nebraska is related to agriculture and 44.8 million acres (92% of Nebraska's land) is dedicated to farms and ranches. Water also supports Nebraska's ethanol and animal processing industries that are directly tied to Nebraska's agricultural productivity. In some years, the South Platte and Platte River systems supply over 2 million AF of water for irrigation of 1.6 million acres of farmland between the Nebraska state line and the Loup River near Columbus, Nebraska.



Water is also needed to support growth in the municipal centers of Lincoln and Omaha. Douglas, Lancaster, and Sarpy counties, the key urban areas supporting Lincoln and Omaha, are projected to grow by 55.8% to over 1.7 million residents by 2060. This growth requires reliable water supplies that would be derived, in part, from the Platte River system. Reliable water supplies are also required to sustain hydropower production, power-production cooling, and environmental enhancement throughout the Platte River system. Nebraska's power production facilities, both hydropower facilities and water-cooled generators, feed the regional power grid that satisfies statewide electrical power demands and reliable water

[1] HB 16-1256 (Col. 2016). https://leg.colorado.gov/sites/default/files/2016a_1256_signed.pdf

supplies are an integral component for power production longevity. Moreover, Nebraska's commitment to the Platte Recovery Implementation Program (PRRIP) requires reliable supplies to meet endangered species water supply objectives. In short, the Perkins County Canal Project will help maintain water reliability into the future for all agricultural, municipal, industrial, and environmental water users that depend on the Platte River system.

SUMMARY

Colorado has stated its intent to capture and use Nebraska's supplies. Failure to build the Project will forfeit Nebraska's South Platte River water supplies that are used to fuel approximately $700 million in benefits for Nebraska's economy. This analysis demonstrates that building the Project is cost effective.

Section 1

PROJECT BACKGROUND

This report analyzes historical documents, Colorado's South Platte River plans and laws, available engineering assessments, and cost-benefit analyses to determine the utility of building the South Platte River Compact Canal Project.

Protecting water supplies has long been a rallying cry for American states seeking prosperity for their citizens. For Nebraskans, protecting water supplies for beneficial uses on the Missouri River, Republican River, and Platte River systems predates Nebraska's statehood and has continued unabated through Nebraska's progression into the modern era. The waters derived from Nebraska's river systems have enabled Nebraska's agriculture to help feed the world, stimulated sophisticated hydropower production facilities and municipal growth, and provided sustenance for species and their associated habitats. The occurrence, management, and use of water drives Nebraska's economy and its citizens' way of life.

The South Platte River is an integral part of Nebraska's success. Settlors followed the Platte River system from its confluence with the Missouri River up through Nebraska's lowlands to the high plains in North Platte, Nebraska where the North and South Platte Rivers combine on their long journeys from their upstream headwaters. From the major municipal center in Omaha, the settlements up the Platte River system converted large swaths of land into agriculture – for both farming and ranching – and subsequently supported the industrial infrastructure that serves regional electricity needs far beyond Nebraska's borders. Nebraska uses South Platte River supplies and integrates these supplies into a broad management of its statewide water asset portfolio.

The South Platte River system's development, however, spawned discord between Nebraska and Colorado as the water supplies available from the river system were sometimes inadequate to meet each state's residents' needs. To resolve these disputes, Nebraska and Colorado signed the South Platte River Compact (Compact). The Compact was ratified by both states' legislatures and the United States Congress and endures to the present day. The Compact sought to quell all present and future disputes related to the waters of the South Platte River between Colorado and Nebraska and preserved rights and obligations for each state to manage. Today, nearly 100 years after the signing of the Compact, these rights and obligations remain and are juxtaposed with rapid urban and industrial growth in Colorado and changing hydrological conditions.

Nebraska has and will continue to lose South Platte River water supplies unless it builds the Perkins County Canal as described in the Compact. Nebraska is re-examining the Perkins County Canal as Colorado's Front Range urban populations rapidly grow and the South Platte's natural hydrologic systems become more understood. This Study assesses the future availability of South Platte River supplies and analyzes the utility of building the Perkins County Canal. The report also explains the benefits of protecting the South Platte River water supplies for Nebraska's current and future needs based upon Colorado's stated intent to take the South Platte River flows for Colorado's use.

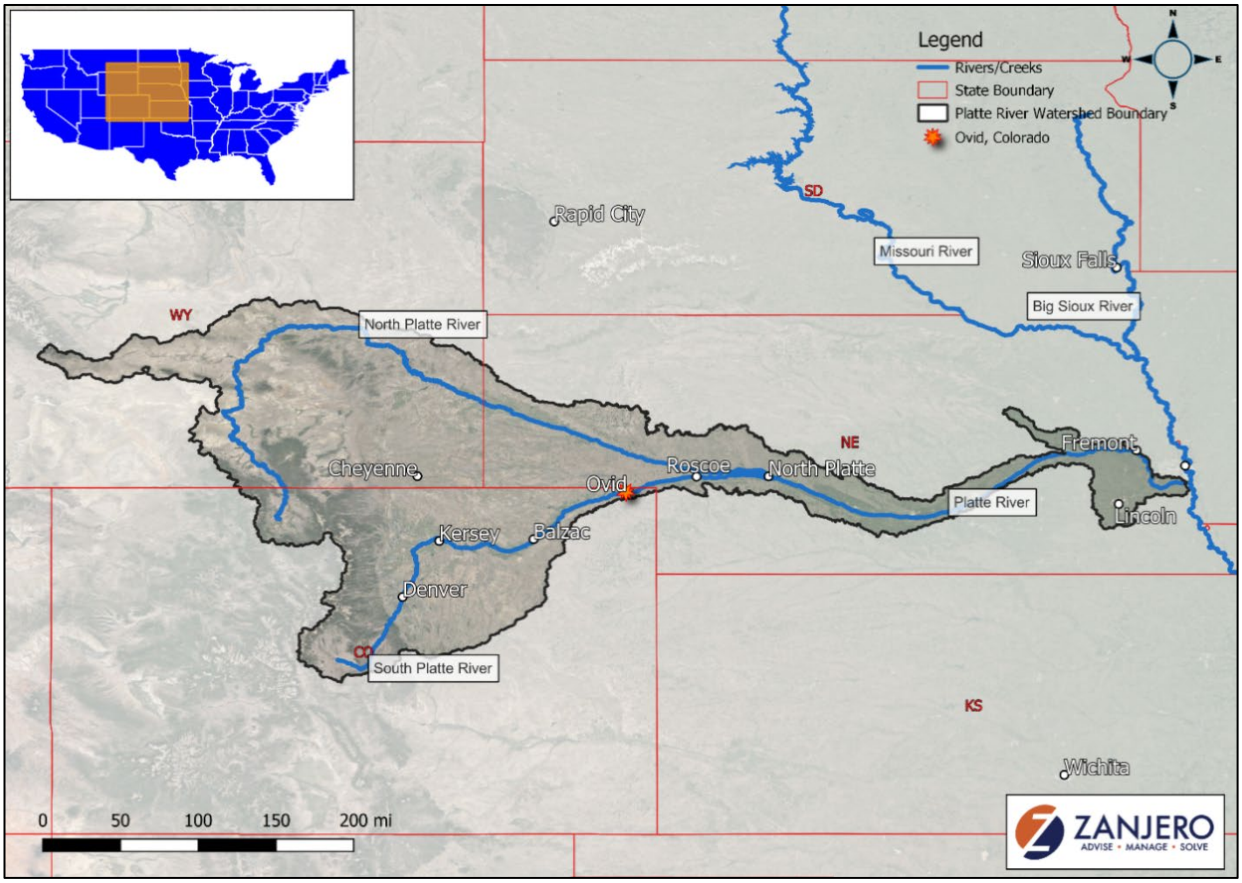
1.1 Background

The South Platte River is an important resource to meet agricultural, urban, and environmental water demands in the State of Nebraska. The South Platte River arises in the mountains of Wyoming and Colorado, weaves through the urban development areas in Colorado's Front Range, and steadily drains to lower elevations in eastern Colorado and western Nebraska until it combines with the North Platte River near the town of North Platte, Nebraska. From North Platte, the waters from the South Platte River constitute a portion of the flows of the combined Platte River that runs from North Platte to the Platte River's confluence with the Missouri River near Omaha, Nebraska.

The South Platte's entire watershed spans approximately 24,300 square miles in three states – Wyoming, Colorado and Nebraska. By the time the South Platte River reaches North Platte, Nebraska its drainage has dropped nearly 12,000 feet of elevation from Colorado's Mt. Lincoln in the west at 14,286 feet to North Platte in the east at 2,802 feet. Colorado contains 79% of the South Platte watershed, Nebraska contains

15%, and Wyoming the remaining 6%. The Platte River loses approximately 1,700 feet in elevation from North Platte, Nebraska to its confluence with the Missouri River in Omaha at 1,089 feet. The entire North and South Platte River watersheds and mainstem Platte River drainage are depicted in the map shown on Figure 1-1.

Figure 1-1: Platte River Watershed and Drainage



The South Platte River water supplies originate primarily from snowfall in the Rocky Mountains and secondarily from rainfall in its lower elevations. Groundwater accretions and depletions to South Platte River flow occur throughout the entire watershed as well. The entire South Platte River watershed supplies fluctuate in any given year, often from drought to flood, due to variable climate conditions. All three states in the South Platte River watershed have developed water projects to expand the utility of the river's water supplies while attempting to moderate supply variability impacts.

The South Platte River water supplies serve irrigation demands, municipal and industrial demands, recreational interests, hydroelectric power generation, and environmental needs throughout the entire reach of the watershed and drainage.

Many of these demands rely upon diversions that are returned to the water system. In fact, Colorado claims that "on average, South Platte River Basin Water is reused at least 7 times."[1] Moreover, return flows are an integral component of supply availability under the Compact.[2] The demands in the watershed continue to expand and the predicted future demands will grow beyond the river's capability to provide the necessary supplies.

The combination of factors that impact water supply availability and water demand in the South Platte River are not new and continue to manifest in different ways. Critical droughts in the 1890's drove Nebraskans to seek connections to the South Platte River to meet their needs. Urban and agricultural demand growth in Colorado caused a rift with downstream Nebraska diverters in the 1910's that led to litigation and eventually the South Platte River Compact. More recently, rapid urban population growth in Colorado's Front Range, dwindling Colorado River supplies on the west slope of the Rocky Mountains, and unforeseen trends in hydrologic variability have refocused attention on the South Platte River's valuable water supplies and how those supplies should be managed between Colorado and Nebraska.

Approximately 90% of Colorado's urban population resides along the Front Range and approximately 70% resides in the South Platte River watershed.[3] Colorado anticipates needing between 600,000 and 1 million acre-feet (AF) annually of additional water supplies to serve its future urban growth[4] and Colorado has enacted legislation that declares Colorado's intent to take additional South Platte River water.[5] The large demand projections include a broad water conservation element where Colorado assumes its per person water use will decrease throughout the state even as its

[1] Department of Water Resources, & United States Geological Survey, (2019). South Platte River Basin Infographic. https://static1.squarespace.com/static/62102d32cbc97713f25c3099/t/62476a063f772c11edd3c371/1648847373470/South-Platte-River-Basin-Infographic-2019-5-print.pdf

[2] South Platte River Compact, Colorado Proceeding 379378 (1925).

[3] Colorado Water Conservation Board, (2022). Colorado Water Plan 2023 (2022 Draft) at 4-47.

[4] South Platte Basin Implementation Plan, Vol. 1, (January 2022) at 42.

[5] HB 16-1256 (Col. 2016). https://leg.colorado.gov/sites/default/files/2016a_1256_signed.pdf

overall demand continues to grow. Nevertheless, the vast majority of Colorado's urban growth will occur in Colorado's Front Range that depends on the South Platte River watershed to provide potable supplies.

In addition to this development, many uses throughout the basin that are junior to the South Platte Canal may rely on augmentation projects. These augmentation projects divert water in the winter to support withdrawals that would be curtailed, based on junior priority, if the canal were in place. Some of these Colorado augmentation projects consume water that would otherwise be arriving at Nebraska's Canal diversion point today.

Colorado has also assessed natural water availability and variability implications in the South Platte watershed caused by climate and hydrologic changes. In Colorado's worst-case scenario, called "Hot Growth," Colorado sees municipal and industrial demands growing even more due to climatic variability. Specifically, Colorado anticipates that its projected demand could increase by over 20% of its "Cooperative Growth" predictions solely because of climate change.[6]

To remedy Colorado's supply deficiency in the South Platte River watershed, Colorado has identified a myriad of projects to capture as much South Platte River supply as it can to meet its growing needs.[7] Colorado contends that the South Platte River Compact allows it to capture and use supplies that currently flow into Nebraska to meet its needs because Nebraska has not built the Perkins County Canal. Specifically, Colorado has identified eight representative storage projects to capture water supplies from the South Platte River watershed to meet its growing demands.[8]

These significant growth and climate projections, coupled with Colorado's plans to use the South Platte River watershed supplies to meet its needs spurred Nebraska to reassess the Compact. Nebraska must build the Perkins County Canal to protect its vested interests in the water supplies derived from South Platte River for its current and future residents. Moreover, Nebraska recognizes that growth in the state and climatic variability necessitate protecting all of its water interests to meet its current and future needs.

[6] South Platte Basin Implementation Plan, Vol. 1, (January 2022) at 42.
[7] Stantec, & Leonard Rice Engineers, (2017). HB16-1256 South Platte Storage Study. Prepared for the Colorado General Assembly.
[8] Id.

1.2 Risk to Nebraska's Water Supply and the Future No Project

Nebraska must build the Perkins County Canal, as identified in the Compact, or risk the continued loss of South Platte water supplies. The plain language of the Compact equates Nebraska's right to divert this water with the construction of the Canal. Colorado currently is using and plans to accelerate its use of this water. Nebraska risks losing all of this supply in the future without construction of the Project. In other words, although Nebraska has received benefits from the South Platte River supplies over the last 100 years, Nebraska cannot call for this water in priority, and therefore cannot ensure its continuation without the Canal. Colorado's laws, its operational projects in the Lower Section, and publicly stated plans to capture and use the remaining supplies will remove these supplies from Nebraska's water supply portfolio unless Nebraska builds the Canal. If Colorado executes its supply plans to support its increased demands and Nebraska does not build the Canal, then the benefits that Nebraska currently receives from the winter supplies will be lost.

1.3 History of the Perkins County Canal

The South Platte River and the Perkins County Canal have a long and storied history. The South Platte River was historically needed for agricultural development in both Colorado and Nebraska and has increasingly transitioned to meet the growing urban development needs in Colorado's Front Range while still meeting the agricultural needs to the east. Prior to the 1890s, Coloradans were perfecting their water rights along the South Platte River to grow crops during the irrigation season while Nebraska was simultaneously irrigating tracks of land along the lower sections of the drainage.[9] These water rights still exist today.

In 1894, the citizens of Perkins County were without adequate water supplies for their sustenance and looked to the South Platte River as the solution. This supply deficit led to the design of a 65-mile irrigation canal near the town of Ovid, Colorado and into Perkins County, Nebraska.[10] The Perkins County commissioners approved $90,000 in bonds and formed the Equitable Irrigation and Water Power Co. to begin the construction of the canal.[11] Mark Burke, a civil engineer, designed the proposed canal path as shown in red in Figure 1-2.

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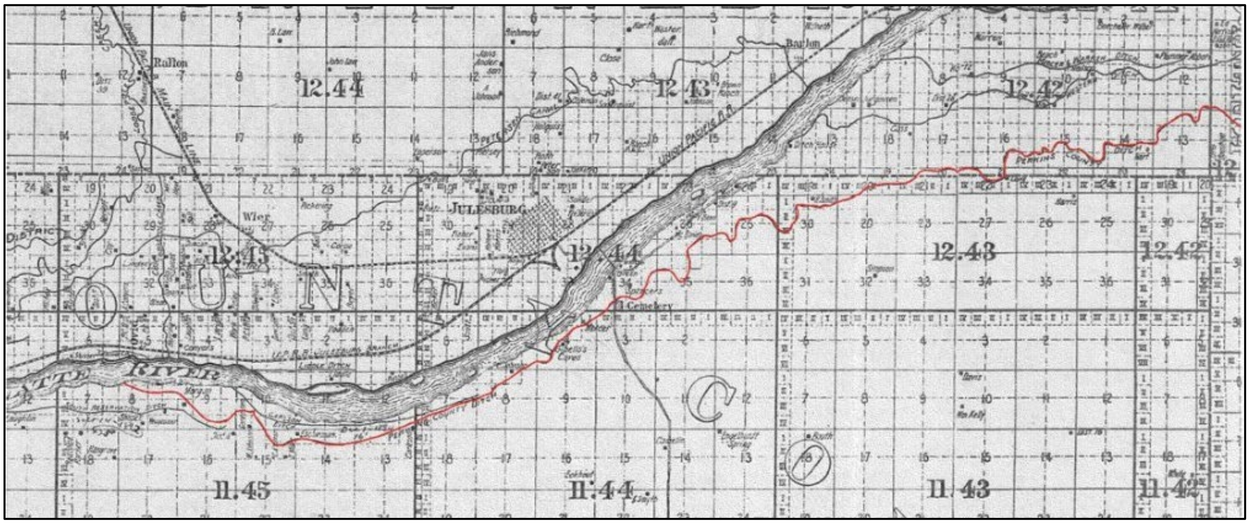
[9] Water Education Colorado (2021). Citizen's Guide to Colorado Interstate Water Compacts, Third Edition. https://issuu.com/cfwe/docs/interstate_compacts_3rded_2021_final

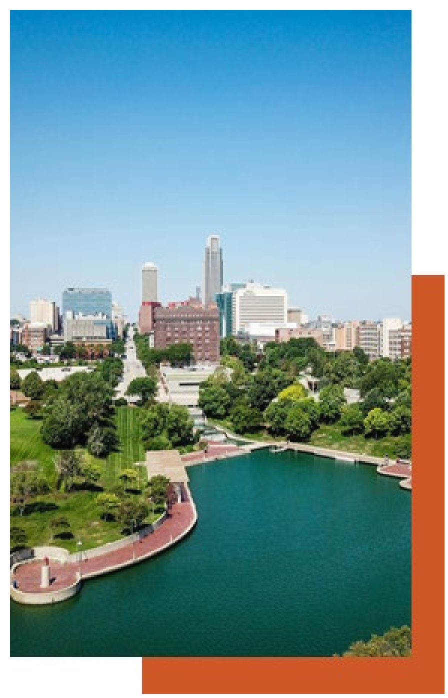
[10] Von Kampen, T., (2022). The Canal Almost Lost to Time. The North Platte Telegraph. https://nptelegraph.com/news/local/the-canal-almost-lost-to-time/article_405e6210-7bd5-11ec-a7f3-abf2a73546a1.html#tncms-source=signup

[11] Id.

Figure 1-2: Original Perkins Canal Route



The residents of Perkins County began the construction of the canal along the South Platte bank near the town of Ovid, Colorado anticipating the financial backing from the County bond funds. The bond sale failed to provide the necessary capital for the project – even after completing about 16 miles of the canal – and development of the Perkins Canal was officially halted on June 24, 1895.[12]



Serious droughts, erratic hydrology, and competition for irrigation supplies from the South Platte River continued to occur and finally culminated in a legal dispute between water users in Nebraska and Colorado. In 1916, the Western Irrigation District in the state of Nebraska sued the state of Colorado and Riverside Irrigation District, contending that Colorado was diverting too much water for irrigation from the South Platte River and depriving Nebraska of flows coming into the state.[13] Western Irrigation District claimed entitlement to 180 cubic feet per second (cfs) for irrigation purposes under the June 14, 1897

[12] Id.

[13] Water Education Colorado (2021). Citizen's Guide to Colorado Interstate Water Compacts, Third Edition. https://issuu.com/cfwe/docs/interstate_compacts_3rded_2021_final

priority date.[14] In response, the Colorado Legislature imposed an export statute in 1917 forbidding Nebraska from diverting water from the South Platte River by construction of the canal.[15] The lawsuit spurred the states of Nebraska and Colorado to begin negotiations to permanently resolve the disputes.

Deliberations between Colorado and Nebraska resulted in one of the first Compacts to settle interstate water conflicts.[16] The South Platte River Compact allocated streamflows from the South Platte River to each state while protecting diverters that relied upon their historical appropriative rights. The Compact identified the Perkins County Canal as an important component of Nebraska's desire to secure its South Platte allocation. The states agreed to the Compact in 1923 and Congress ratified the Compact in 1926.

The design and construction of the Perkins County Canal remained mostly dormant for almost 60 years after the Compact was signed. In 1981, the Nebraska Interagency Water Coordinating Committee requested the United States Bureau of Reclamation (USBR) to conduct an engineering study to evaluate the potential costs associated with construction of the Perkins County Canal Project. USBR developed a multi-part preliminary design project with significant infrastructure. The design included a diversion near the town of Ovid, Colorado, 56 miles of canals, and 6 reservoirs.[17] Although USBR's efforts developed details related to the Perkins County Canal, the effort ultimately was discontinued.

1.4 Recent Activities

From 2019 through 2021, Nebraska's legislature allocated funds to study opportunities to preserve its Compact entitlement and build the Perkins County Canal Project. Nebraska recently expanded its investments in the Project. On January 10, 2022, Governor Ricketts and Attorney General Doug Peterson announced the Governor's proposal to request $500 million in state funding to build the Perkins County Canal. In addition to the funding request, Speaker of the Legislature, Mike Hilgers, introduced LB1015 to authorize the Perkins County Canal Project.

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[14] Mossman, S. et. al., (2022). Perkins County Canal: A Long Overdue Project With Potentially Long-Term Benefits. The Nebraska Lawyer. www.nebar.com/resource/resmgr/nebraskalawyer_2017plus/2022/mayjune/TNL-0522c.pdf

[15] Id.

[16] Id.

[17] United States Department of the Interior, Bureau of Reclamation. (1982). USBR Project Costs Estimate for the South Divide Canal Project.

LB1015, adopted into law on April 18, 2022, authorized "that a canal and associated storage facilities...shall be developed, constructed, managed, and operated under the authority of the State of Nebraska consistent with the South Platte River Compact and pursuant to the Perkins County Canal Project Act."[18] LB1012, approved by the Governor on April 7, 2022, created the Perkins County Canal Project Fund which designates funds for design, engineering, permitting, and pursuing interests in land purchase related to building the canal outlined in the South Platte River Compact.[19] LB1012 specifically authorized an independent study of the Perkins County Canal that would address the following four items:

1. The costs of completion of a canal and adjoining reservoirs as outlined in the South Platte River Compact.
2. A timeline for completion of a canal and adjoining reservoirs as outlined in the South Platte River Compact.
3. The cost-effectiveness of alternatives, including alternatives that may reduce environmental or financial impacts.
4. The impacts of the canal on Nebraska water users throughout the Platte River Basin, including the drinking water supplies for the cities of Lincoln and Omaha.

Nebraska's Department of Natural Resources issued a request for proposals from qualified firms to answer the legislature's inquiry. This report addresses all four legislative requirements.

1.5 Study Objective and Approach

The objective of this Study is to determine technical feasibility of Perkins County Canal and identify potential alternatives that could optimize or provide for enhanced benefits. The benefits evaluated for this analysis address benefits that will be lost if the Perkins County Canal is not built and supplies currently coming into Nebraska are lost.

The technical feasibility results presented in this report are provided to address those specific directives provided by the Legislature in LB1012. As there are other major non-

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[18] LB1015, 107th Legislature, Second Session. (Neb. 2022). https://nebraskalegislature.gov/FloorDocs/107/PDF/Intro/LB1015.pdf

[19] LB1012, 107th Legislative, Second Session. (Neb. 2022). https://nebraskalegislature.gov/FloorDocs/107/PDF/Slip/LB1012.pdf

technical factors associated with this decision process, this report is not intended to be the final decision, nor is it intended to recommend a specific canal configuration.

The broad approach for the Study is to gather and examine the historical documentation for the Perkins County Canal and prepare new documentation that addresses the water supply availability, canal alternatives, cost-benefit analyses, and reasonable timeline for key activities. This report provides a detailed written assessment that methodically addresses the Legislature's directives and develops fundamental conclusions based upon the Compact, information reviewed, and professional judgment. The fundamental starting point is the repeated declared intent by Colorado that it will capture and use the supplies that are currently relied upon by the state of Nebraska.[20]

This section provides a broad outline of the approach used to develop the findings and a brief description of the approach for each section. The following twelve actions were taken in developing this report:

1. Review existing documentation describing the Perkins County Canal - The Perkins County Canal has not only been evaluated on previous occasions but has remnants of construction that was initiated in the 1890's. The historical investigations and information related to the Perkins County Canal was assembled and reviewed by the Project Team. The Project Team has prepared a reference list related to documents reviewed and cited in **Appendix E**. (Directives 1, 2, 3, and 4)

2. Analyze hydrological and streamflow data relevant to the South Platte River - The Project Team gathered and sorted hydrological and streamflow information that recorded flows in the South Platte River. (Directives 3 and 4)

3. Review the South Platte River Compact - The Project Team reviewed the South Platte River Compact to identify elements that may impact the water

[20] Colorado Water Conservation Board, (2022). Colorado Water Plan 2023 (2022 Draft) at page 3-29.

supply availability analysis and the Project alternatives. The Project Team provided a brief written assessment of the Compact as it relates to this analysis. (Directives 1, 2, 3, and 4)

4. Determine current and future demand on the South Platte River - The Project Team analyzed the current demands that rely on South Platte River water supplies and the supply integration into a larger water management platform in the state of Nebraska. Specifically, the team examined agricultural demand, municipal & industrial demand, hydropower opportunities, and environmental benefits in the South Platte River watershed and the Platte River watershed. (Directives 3 and 4)

5. Investigate hydrologic variability on the South Platte River - The Project Team analyzed the historic and current hydrologic variability on the South Platte River system to ascertain potential future hydrologic trends. The future hydrologic trends may impact the water supply availability analysis and the future Project conditions. The hydrologic variability examined specific factors, like temperature and precipitation trends, that could impact water supply availability. (Directives 3 and 4)

6. Prepare a water availability analysis - The Project Team examined historical water supply and streamflow data and characterized potential future conditions that incorporated potential water utilization under the Compact as well as hydrologic variability to understand water supply availability scenarios. The water supply availability scenarios also addressed hydrologic year types – below average, average, and above average – in order to assess Project utility under changing hydrology and water availability. (Directives 3 and 4)

7. Evaluate conceptual planning-level Perkins County Canal and diversion - The Project Team examined the historical water documentation and conducted an on-site inspection in Colorado and Nebraska to review the Project area. The Project Team used the Project sizing identified in the Compact and assessed options for diversion, canal sizing and location, and storage opportunities. (Directives 1, 3, and 4)

8. Develop and evaluate alternatives of planning-level Perkins County Canal and diversion - The Project Team evaluated alternatives including increased diversion capacity size to potentially capture surplus supplies and increased the canal sizing through the delivery system to reflect the

potential to capture additional water. Further, the alternatives utilize existing infrastructure to reduce costs and environmental impacts, while increasing operational flexibility. (Directives 1, 3, and 4)

9. Identify applicable regulations that impact the Project - The Project Team researched and described the applicable regulatory items that would impact the alternatives. These regulatory items include applicable federal and state laws. Moreover, the Project Team assessed the existing mitigation actions, like Platte River Recovery Implementation Program (PRRIP), that are derived from applicable law and used to address water management functions on the South Platte River system. (Directives 1, 2, 3, and 4)

10. Assess benefits and costs of planning-level Project alternatives – The Project Team aggregated the costs and benefits of the alternatives developed. The costs are derived from development, permitting, and construction of the diversion, canal, and storage system. The benefits are derived from the value of maintaining the water supply, the developed supply's utility in water management throughout the South Platte River and Lower Platte River water system, and the long-term asset value of the water supply in the region. (Directives 1, 3, and 4)

11. Evaluate alternatives based upon all information developed - The Project Team evaluated all aspects of the alternatives to provide a supported conclusion related to each alternative's utility. The evaluation examined the cost-benefits and future considerations related to hydrologic variability in Colorado and Nebraska on the South Platte River system. (Directives 1, 3, and 4)

12. Prepare a timeline showing the relevant activities and dates associated with designing and constructing the Perkins County Canal. (Directive 2)

This report independently assesses the directives posed by LB1012 and provides a summary of the investigation results related to each directive. The information presented in this report consists of an assortment of updated information from past reports, when available and appropriate, and new information developed specifically to meet the needs of this analysis. Information utilized from past studies varies in level of consideration ranging from background and basic factual studies to more robust evaluations, including field investigations.

Section 2

WATER SUPPLY AVAILABILITY

This section addresses the water supply availability for the Perkins County Canal Project. Water availability for the Project is subject to numerous factors with both natural and man-made considerations.

Water availability for the Project must consider current and future natural conditions that generate South Platte River supplies and the criteria in the South Platte River Compact. This section examines the relevant factors that affect water supply availability for the Project in the South Platte River and creates future supply availability scenarios that capture the permutations of the applicable factors to determine future supply availability. The section addresses all four LB1012 directives and concludes that South Platte River water supply is available for the Project under current conditions and all three identified future conditions.

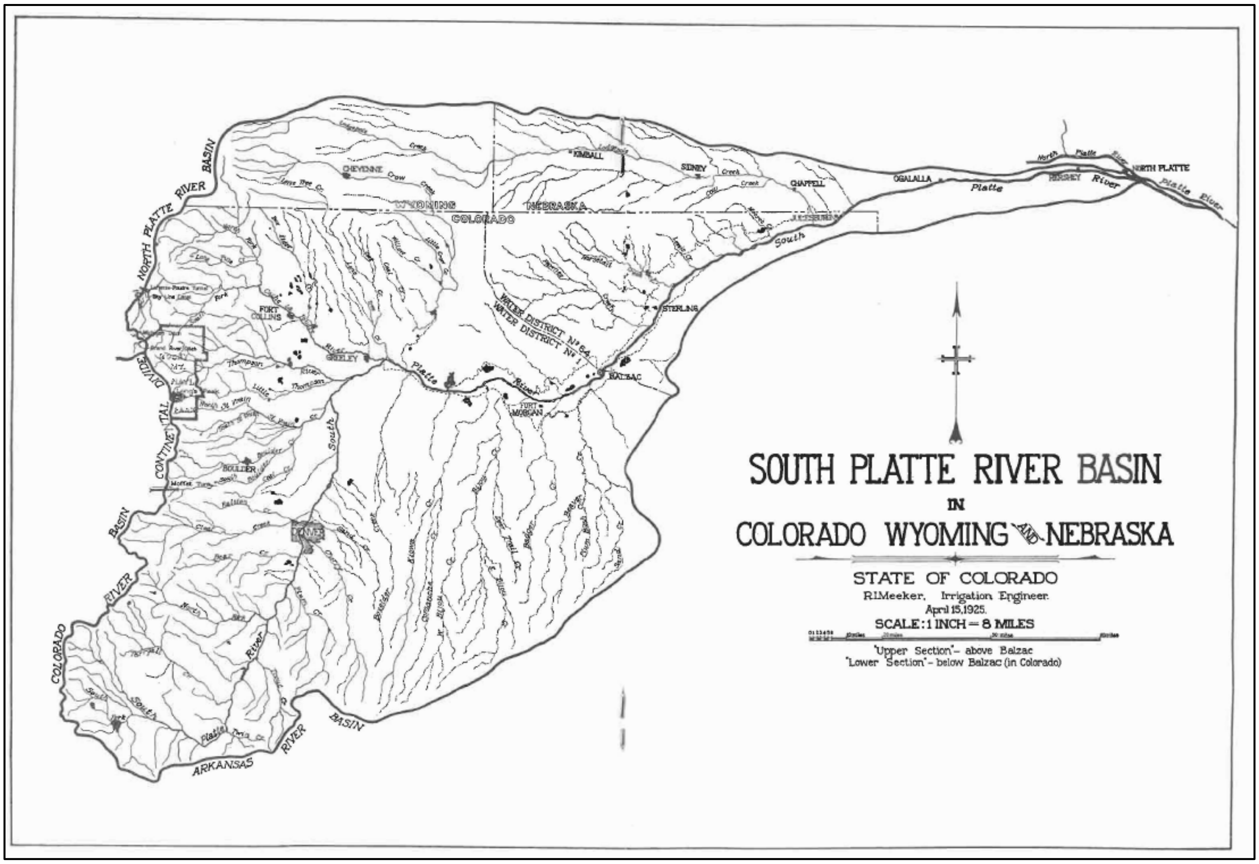
2.1 South Platte River Compact and Water Supply Availability

The states of Nebraska and Colorado adopted the South Platte River Compact (Compact) in 1923 and 1925, respectively. The purpose of the Compact was to *"…remove all causes of present and future controversy between said states… with respect to the waters of the South Platte River…"*. The Compact is divided into eleven Articles that address various issues related to the South Platte River's disposition that arose in the controversy between the two states. The Compact states that Nebraska may build the Perkins County Canal to capture water supply that is available in the South Platte River during the non-irrigation season.

The Compact divides the South Platte River watershed into two sections: the Upper Section and the Lower Section. The Upper Section is defined as "that part of the South Platte River in the State of Colorado above and westerly from the west boundary of Washington County, Colorado." The Lower Section is defined as "that part of the South Platte River in the State of Colorado between the west boundary of Washington County and the intersection of said river with the boundary line common to the signatory states." Colorado developed a map in 1925 that showed the South Platte

River watershed and divided the Upper Section and Lower Section, with the Lower Section corresponding with Water District No. 64[21] (Figure 2-1).

Figure 2-1: Map Depicting South Platte River Basin in Colorado, Wyoming and Nebraska[22]



The mainstem of the South Platte River captures water from a broad watershed in Wyoming, Colorado, and Nebraska. This watershed covers large areas of land and is comprised of many smaller streams that flow into the South Platte River. Article III of the Compact apportions the flows of "Lodgepole Creek," a South Platte River tributary stream, which excludes that stream from this water supply availability analysis.

A revised map depicting the Colorado Proceedings description of the Upper Section and Lower Section, including the boundary line of District 64, is shown below in Figure 2-2. In addition, the map shows the relevant gaging stations that were used to characterize water flows into the Lower Section in this Study. These gaging stations measure all waters, regardless of the legal designation, that pass through the identified gaging stations.

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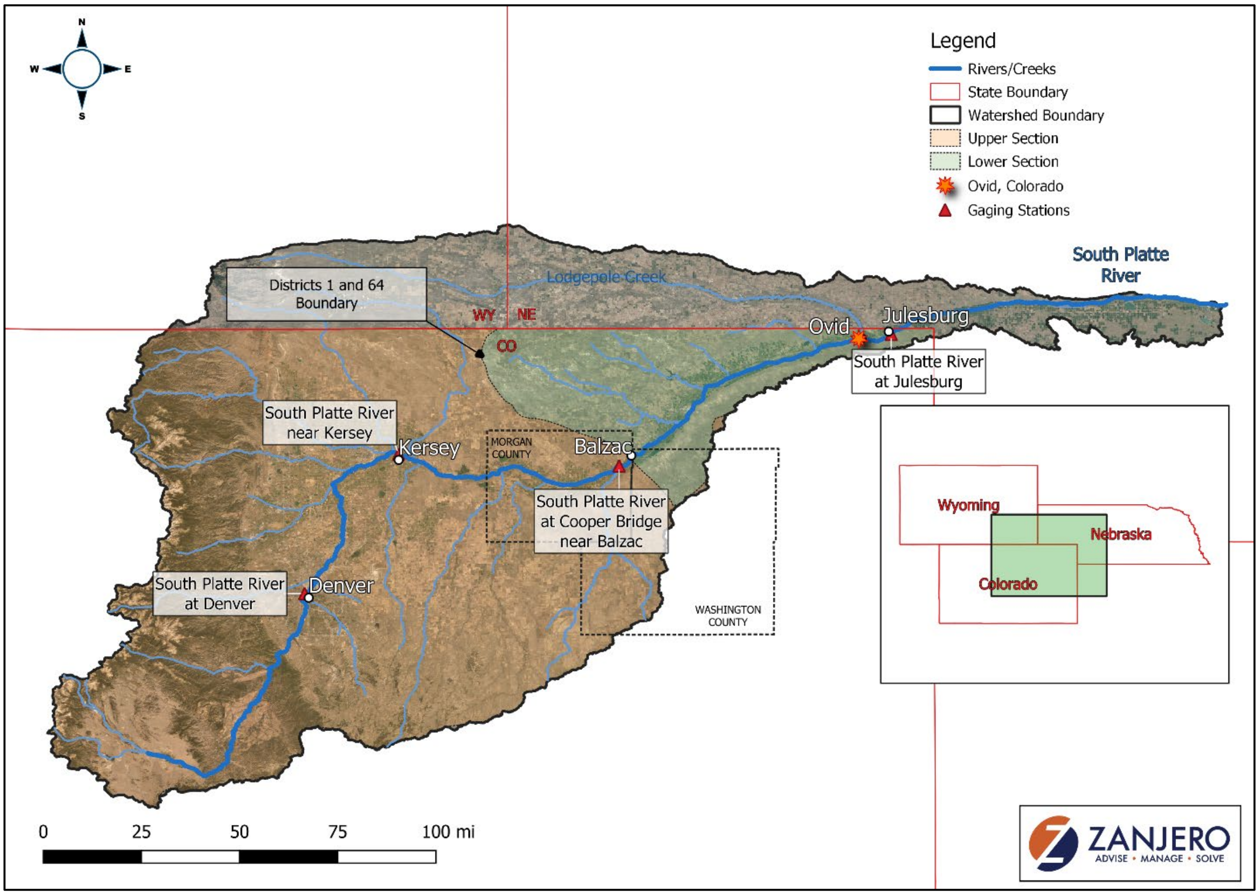
[21] South Platte River Compact, Colorado Proceedings 379378 (1925) at 18.

[22] South Platte River Compact, Colorado Proceedings 379378 (1925) at 16-17.

Figure 2-2: Map Depicting Upper Section and Lower Section of South Platte River



2.1.1 Compact Language for Characterizing Supply Availability

Article VI of the Compact gives Nebraska the right to divert 500 cubic feet per second (cfs) of streamflow from the South Platte River, near the town of Ovid, Colorado, between October 15 and April 1 of each year by building "a canal." Nebraska's 500 cfs diversion right is subject to a 35,000 acre-foot (AF) per year reservation for Colorado in that same period. Nebraska may also divert through the canal "any surplus waters" during any month of the year when those water supplies are available. The water supply availability analysis recognizes that Nebraska may capture supplies outside of Article VI's diversion period that are surplus. The analysis, however, does not attempt to assess how this surplus is determined and whether those supplies will be available for Nebraska's diversion in the future, making this analysis conservative with respect to future water supply availability.

The primary Compact interpretation issues that are relevant to determining water supply availability for the Project are determining (a) how much streamflow may be diverted by the Project between the October 15 and April 1 period; and (b) where the net future streamflow would be measured for diversion by the Project.

2.1.2 Streamflow Available to the Project

This Study considered the available "net future flow" to include flows derived from the entire Upper Section region, including all tributaries of the South Platte River in the South Platte River Basin watershed (excluding Lodgepole Creek) as well as flows derived from return flows from appropriations in the Upper Section and returning to the Lower Section. It is beyond the scope of this analysis to determine the exact nature of Colorado's "future appropriations" in the Upper Section that would occur in light of the historical runoff and return flows. Nevertheless, this examination of the net future flows includes future Colorado diversions and are incorporated into the three broad future supply availability conditions that are characterized in this Study.

Paragraph 2(b) of Article VI states that Nebraska "shall be entitled to divert five hundred cubic feet per second of time from the streamflow of the river in the Lower Section" through the Project. Paragraph 3 in that Article also states, "Any surplus waters of the river… may be diverted by such a canal, subject to other provisions of this Article." The qualification of Paragraph 3 allows for diversions in excess of 500 cfs to be captured by the Project in the period between October 15 and April 1. Moreover, the language in Article IV states that Nebraska may capture "any surplus waters which otherwise would flow past the Interstate Station" during the period between April 1 and October 15 each year. The language of the Compact indicates that Nebraska may capture up to 500 cfs for the Project based on its December 17, 1921 priority date and may capture other surplus flows all year subject to prior appropriations. Accordingly, the Project may be designed to capture flows up to 500 cfs based upon the 1921 priority, flows above 500 cfs from October 15 through April 1, and flows above 120 cfs as measured at Interstate Station from April 1 through October 15 each year.

2.1.3 Measurement of Net Future Streamflow

The Compact does not designate a location to measure available flows coming from the Upper Section to the Lower Section but does identify the precise separation location considered in the Compact. Thus, the availability of water coming from the Upper Section to the Lower Section would ideally be determined at the intersection point between Washington County, Colorado and the South Platte River. There is no stream gage at this location. The nearest stream gage to that location is the gage labeled South Platte River at Cooper Bridge near the town of Balzac, Colorado as shown on the map in Figure 2-2. This gage is located approximately six miles upstream of the section bifurcation point. The current gage was moved to this location in 1987 from its previous location downstream at Balzac. This Cooper Bridge gage provides the best baseline data location for assessing flows on the South Platte River from the Upper Section entering the Lower Section.

2.2 Hydrologic Availability

The Compact provides Nebraska an entitlement of up to 500 cfs from the South Platte River's Lower Section between the period October 15 through April 1 (non-irrigation season). The Compact also provides opportunity for Nebraska to capture surplus water supplies in all months of the year. There are certain criteria in the Compact that were considered in the context of assessing available supplies for the Perkins County Canal (Canal). These considerations include:

1. Priority for Senior Water Rights holders within the Lower Section with priority dates earlier than December 17, 1921 (Article VI);
2. 35,000 AF available for "future" appropriators in the state of Colorado within the Lower Section (Article VI)[23]; and
3. Water supply availability is calculated at the identified point of diversion near Ovid, Colorado (Article VI).
4. Inflows to the Lower Section may be reduced depending on the level of development in the Upper Section (Article VI).

This section includes development of future scenarios that incorporate both existing uncertainties within the Compact and Colorado's Upper Section development as well as climatological and hydrological variability that may impact supply availability for the Project. As noted elsewhere in this section, Colorado is predicting temperature increases that will affect (a) precipitation form and timing, (b) snowpack water equivalent (SWE) and runoff timing, and (c) drought cycles and duration for the South Platte River Basin. Although Nebraska studies find more moderate temperature changes and even stabilized precipitation patterns in the Lower Section, the potential for reductions in natural water supply are possible. As such, water supply availability scenarios developed for this Project encompass a conservative approach in order to

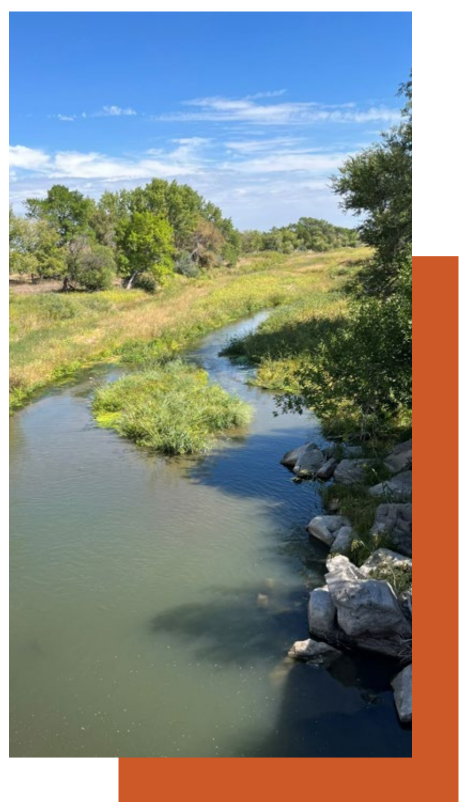
[23] This water may already be developed within Colorado. Further investigation into the status of this water is warranted.

incorporate numerous water availability uncertainties under the Compact and future hydrology.

This section describes the application of these provisions, along with other elements considered, to estimate the water available for Canal diversions during the non-irrigation season. The quantification of water availability, when considered with economic elements associated with the Canal, help determine the feasibility and overall benefits of constructing and operating the Canal. More information on the approach to quantify the water available for Canal diversions during the non-irrigation season is presented in the following subsections. The results of this water availability analysis will be used in conjunction with economic costs and benefits to inform on the overall feasibility of the Project.

2.2.1 Approach

Historic streamflow gage data and water rights records within Colorado were used to develop a baseline estimate of the streamflow available for Canal diversions during the non-irrigation season. The streamflow gage at Balzac was the primary data source with adjustments made to account for the movement of the Balzac gage in 1987 to develop baseline information. Water rights on the system derived from both the Compact and existing senior priorities were also analyzed. Water accretion and depletion information in the Lower Section were calculated based on streamflow information in the Lower Section. For conservative purposes, the historical point of diversion near Ovid, Colorado was used in the accretion and depletion calculation. This point excludes accretions originating from the Lodgepole Creek watershed per Compact Article III, although these accretions could be made available if the point of diversion is located downstream of the Lodgepole Creek and South Platte River confluence. The accretion and depletion information was developed and analyzed for purposes of calculating available water supply for the Project. United States Geological Survey (USGS) and Colorado Decision Support Systems (CDSS) supported by Colorado's Department of Water Resources (CDWR) collected data for relevant streamflow gages. Table 2-1 displays the



quantified metrics, data source, and notes on each element necessary to develop the estimate of water availability.

Table 2-1: Quantified Metrics for Estimate of Available Streamflow

Quantified Metric	Data Source	Notes
Historical Streamflow at Balzac	USGS: Water year 1924 – 1980 CDSS: 1981 - 2019	Gage data from South Platte River at Balzac (USGS) and South Platte River at Cooper Bridge near Balzac (CDSS). Used to develop water availability.
Upper Section "Additional" Demands	CDSS	Water Right entitlements for diversions located downstream of South Platte River at Cooper Bridge near Balzac, and upstream of Section boundary. These data were subtracted from Historical Streamflow at Balzac (applicable period of 1988-2019) to develop water availability.
Senior Appropriators in Lower Section	CDSS	Water Right entitlements with senior priority dates before December 17, 1921 located in the Lower Section. These data were subtracted from Historical Streamflow at Balzac to develop water availability.
35,000 AF Water Stipulation	Calculated	This amount was subtracted from Historical Streamflow at Balzac to develop water availability.
Accretions in Lower Section (upstream of Canal diversion)	Calculated	South Platte River contributions from tributary inflow, return flows of applied water, and aquifer contributions within the Lower Section. This data was added to Historical Streamflow at Balzac to develop water availability.

The elements presented above were used to estimate the streamflow available for Canal diversions using the following formula:

$$Q_{Canal} = Q_{Bal} - WR_{SR} - WR_{35k} - WR_{Add} + ACC$$

The components of the formula are defined as follows:

Q_{Canal} = Available streamflow for canal diversions.

Q_{Bal} = Measured streamflow at Balzac.

WR_{SR} = Quantified Senior Water Rights in Lower Section.

WR_{35K} = 35,000 AF Stipulated in Compact.

WR_{Add} = Additional demands located below Balzac gage and upstream of Lower Section. Only applicable for Water Years after 1987 to account for Balzac gage relocation.

ACC = Accretions occurring in the Lower Section.

Information on the development of each quantified element in **Table 2-1** is presented in the following subsections.

2.2.2 Quantified Metrics

The data used to evaluate the water supply availability for the Project are further described in the subsections below. The data was gathered from existing public sources.

2.2.2.1 Historical Streamflow at Balzac

Historical daily streamflow data recorded along the South Platte River were used as a starting point for representing inflow to the Lower Section. The historical data was obtained from USGS for Water Years 1925 through 1980 and CDSS for Water Years 1981 through 2019. The data reflect a unique issue for Balzac – the gage location was moved upstream approximately 5-miles beginning Water Year 1988. As such, data before 1988 reflects the older gage location and data from 1988 through 2019 reflects the current gage location. An adjustment was made to account for the relocation of the gage and develop a homogeneous dataset. Accordingly, the data is referred to as "Balzac" and the year type designations are determined by using the annual streamflow at Balzac for the 95-year period of record. **Section 2.2.2.2 Upper Section "Additional" Demands**, below, presents more information on the data adjustment.

The dataset was split into three (nearly) equal subsets to develop the "Below Average", "Average", and "Above Average" year types. **Table 2-2** displays the average monthly Historic Streamflow at Balzac during the non-irrigation season for the period of record and year types.

Table 2-2: Historic Streamflow at Balzac (cfs)

Month	All Years	Below Average	Average	Above Average
Oct	223	93	109	462
Nov	167	30	57	408
Dec	272	24	137	645
Jan	405	40	279	883
Feb	377	44	274	802
Mar	344	53	276	693

Average monthly historical streamflow in the South Platte River at Balzac ranged from 167 cfs in November to 405 cfs in January for all months within the period of record. Overall, the monthly average ranged from 24 cfs in December (Below Average) up to 883 cfs in January (Above Average).

2.2.2.2 Upper Section "Additional" Demands

There are approximately six miles between the current Balzac gage and the Upper Section and Lower Section boundary at the intersection of Washington County, Colorado and the South Platte River. As such, water rights upstream of the Upper Section and Lower Section boundary yet downstream of the current Balzac gage (CDWR) were incorporated to develop water available for Project diversions. Prior to Water Year 1988, the USGS gage was located near the Upper Section and Lower Section boundary, and therefore, these additional demands were accounted for in gage data for the period Water Year 1924 through 1987. For Water Years 1988 through 2019, these additional demands were subtracted from the Historical Streamflow at Balzac (CDWR gage) to improve representation of inflow to the Lower Section from the Upper Section. Upper Section diversions occurring between the current and previous Balzac stream gage location were subtracted from the gage streamflow to represent South Platte River water entering the Lower Section. The typical historical annual pattern of diversion was used to determine the amount of water diverted during the non-irrigation season for those diversions occurring between the current and previous Balzac stream gage locations.

The diversion data was obtained from the CDWR and used without adjustments or revisions. This analysis conservatively assumed no return flows associated with this demand. Table 2-3 displays the "Additional" demands incorporated into this analysis beginning in Water Year 1988. This demand is applied during all year types.

Table 2-3: Upper Section Additional Demands (Beginning Water Year 1988, in cfs)

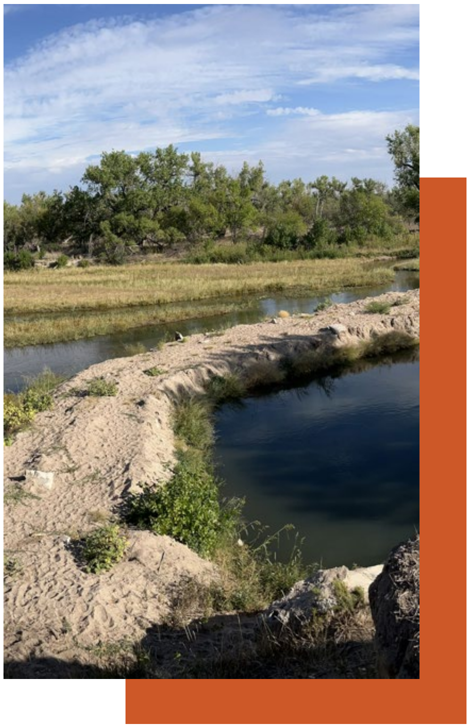
Month	All Years (cfs)
Oct	79
Nov	59
Dec	80
Jan	83
Feb	64
Mar	126

Streamflow diversions from the South Platte River occurring between the current and previous Balzac streamflow gage location did not vary by year type and ranges from 59 cfs in November to 126 cfs in March.

2.2.2.3 Senior Appropriators in Lower Section

Colorado Senior Appropriator Water Rights within the Lower Section were used to develop estimates of remaining water available to the Canal. This demand was subtracted from the Historical Inflow into the Lower Section to reflect South Platte River water supplies available at the Project's point of diversion. Water right locations, appropriation dates, and values were obtained from the Colorado Decision Support System (CDSS). Senior Appropriators are defined as South Platte River appropriators with an appropriation date before December 17, 1921.

Senior Water Rights were adjusted to reflect an expected demand pattern for these water rights during the non-irrigation season. Quantified diversions into Lower Section canals were investigated to determine a reasonable demand pattern for these water rights. The canals used for development of this demand pattern do not include canal diversions to reservoirs, as those diversions may not represent typical irrigation pattern demands. The three (3) canals identified for development of the Senior Water Rights demand pattern are:



1. Pawnee Ditch
2. Petersen Ditch
3. Lowline Ditch

Monthly diversion records were used to approximate the percent of each water right's face value diverted during the non-irrigation season. The face value of a water right is the water right amount identified in the water right rather than the amount actually diverted. Table 2-4 displays the average percentage of the face value diverted. Total face value of Senior Water Rights in the Lower Section equates to 3,809 cfs. The average percent is then applied to the Senior Water Rights within the Lower Section to develop an estimate for the non-irrigation season demand pattern. The Estimated Senior Monthly Demand is subtracted daily from the gage streamflow data to represent South Platte River water available for Canal Diversions.

Table 2-4: Percent of Water Right Face-Value Diverted

Month	Percent of Pawnee Ditch Diverted (%)	Percent of Petersen Ditch Diverted (%)	Percent of Lowline Ditch Diverted (%)	Average Percent (%)
Oct	7.0%	11.0%	6.7%	8.3%
Nov	1.9%	14.6%	7.0%	7.9%
Dec	0.6%	3.6%	0.3%	1.5%
Jan	0.6%	1.9%	0.5%	1.0%
Feb	1.6%	1.8%	0.5%	1.3%
Mar	4.1%	5.4%	2.3%	4.0%

The monthly percent of water right diverted from the South Platte River at the Pawnee, Petersen, and Lowline Ditches ranges from 0.3% (Lowline, December) to 14.6% (Petersen, November). The Average Percent of diversions ranges from 1.0% in January to 8.3% in October.

A return streamflow factor of 20% was applied to Senior Water Right's diversions during the non-irrigation season. The 20% return streamflow factor applied in this analysis is conservative when considering that approximately 60% of water applied for the irrigation of corn may return to the stream.[24] The return streamflow factor represents the amount of water returned to the South Platte River from applied water (primarily irrigation). Table 2-5 displays the estimated Senior Monthly Demand and the effective Senior Monthly Demand (with return streamflow factor of 20% applied). The effective Senior Monthly Demand is applicable for all year types.

Table 2-5: Senior Water Rights Demands (Estimated and Effective)

Month	Estimated Senior Monthly Demand (cfs)	Estimated Effective Senior Monthly Demand (cfs)
Oct	315	252
Nov	299	239
Dec	56	45
Jan	38	30
Feb	50	40
Mar	151	121

The Estimated Effective Senior Monthly Demand from the South Platte River from the Lower Section ranges from 30 cfs in January to 252 cfs in October.

2.2.2.4 35,000 AF Water Stipulation

The Compact stipulates 35,000 AF of water annually is allocated for Colorado's use within the Lower Section (Compact Article VI). This water was represented in the analysis as not being available for Canal diversions and was therefore subtracted from the Historical Inflow to the Lower Section to develop water available for Canal diversions. Table 2-6 displays the monthly distribution, based on the average percentages reported in Table 2-4, of the 35,000 AF converted to cubic feet per second (cfs) (1.0 cfs equals 60.3307 AF per month). This monthly diversion rate was incorporated into this water availability analysis. This water may have already been

[24] State Water Policy: A legislator's Guide to Colorado Water Issues (rev. August 2018).

developed by Colorado in the Lower Section. However, this analysis did not attempt to attribute specific junior water rights holders to the 35,000 AF of water identified in the Compact and assumed it has not yet been developed. In addition, this analysis conservatively assumed no return flows associated with this Lower Section demand and that this demand is applicable during all year types.

Table 2-6: Monthly Distribution of 35,000 AF Water Stipulation

Month	Estimated 35,000 AF Monthly Demand (AF)	Estimated 35,000 AF Monthly Demand (cfs)
Oct 16-31	12,123	382
Nov	11,530	194
Dec	2,173	35
Jan	1,461	24
Feb	1,905	34
Mar	5,808	94

The Monthly Distribution of the 35,000 AF Water Stipulation on the South Platte River in the Lower Section ranges from 24 cfs in January to 382 cfs in October (October 16 through October 31).

2.2.2.5 Accretions in Lower Section (upstream of Canal Diversion)

Water originating in the Lower Section (accretions) primarily consist of natural contributions from tributary inflow, groundwater systems, and return flows. These accretions are available for diversions for the Project. A method to quantify the accretions in the Lower Section was developed and included in this water availability analysis. Measured gage data from three gages were used to quantify the accretions for the periods July 1951 through September 1979 and October 2001 through 2019 (common period of record for the gages). Three USGS gages used to estimate the Lower Section accretions include:

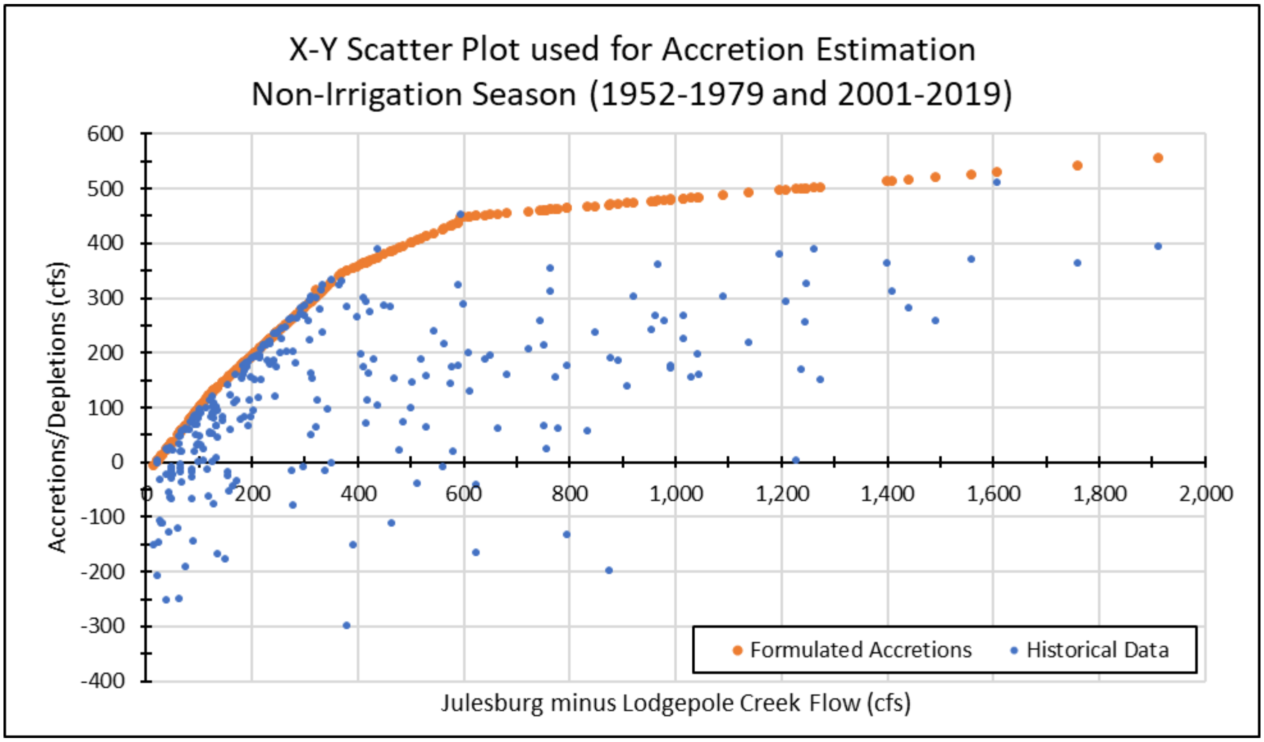
1. South Platte River at Balzac (USGS Gage No. 06760000)
2. South Platte River at Julesburg (USGS Gage No. 06764000)
3. Lodgepole Creek at Ralton, Nebraska (USGS Gage No. 06763500)

Accretions (or depletions) were estimated by taking the downstream streamflow data (South Platte River at Julesburg) and subtracting streamflow data from the upstream gages. When streamflow measured in the downstream gage was greater than the summation of streamflow measured by the upstream gages, accretions to the stream occurred. Conversely, when streamflow as measured in the downstream gage was less than the summation of streamflow measured by the upstream gages, depletions occurred.

Total monthly accretions on the Platte River in the Lower Section were estimated. Daily accretions were computed to provide monthly averages. The monthly averages were then used to create an X-Y Scatter Plot. The Scatter Plot shows two variables for the applicable data set related to the streamflow gages. Monthly accretions and depletions for the non-irrigation season were plotted against the Julesburg minus Lodgepole Creek flow data. Figure 2-3 displays the X-Y Scatter Plot for the non-irrigation season during the common period of record (Lodgepole Creek data was not available for the entire historical period).

The estimated total accretions scatter is caused by the inability to fully characterize all hydrologic parameters. This analysis focused on the non-irrigation season and investigation times when diversions from the Platte River are near zero. If diversion from the Platte River exists during any of the months investigated, the points on Figure 2-3 fall below the orange data shown. Because of this, an estimated total monthly accretion relationship with average monthly streamflow of the South Platte River at Julesburg is expected to encapsulate the scatter shown in Figure 2-3 as shown by the orange data points.

Figure 2-3: Julesburg minus Lodgepole Creek (X-axis) versus Calculated Accretions (Y-Axis)



Accretions for this period were observed using the X-Y Scatter Plot. The 4-equation piece-wise function developed using the X-Y Scatter Plot is determined as:

Eq. 1:	$ACC = (1.27)*Q_{JUL} - 27$	*For periods when,* $Q_{JUL} \leq 119$ *cfs*
Eq. 2:	$ACC = (0.915)*Q_{JUL} + 16$	*For periods when,* $119 \text{ cfs} < Q_{JUL} \leq 369$ *cfs*
Eq. 3:	$ACC = (105/243)*Q_{JUL} + 195$	*For periods when,* $369 < Q_{JUL} \leq 595$ *cfs*
Eq. 4:	$ACC = (32/381)*Q_{JUL} + 410$	*For periods when,* $Q_{JUL} > 595$ *cfs*

Where,

ACC = Accretions (cfs)

Q_{JUL} *= South Platte River at Julesburg Measured Streamflow (cfs)*

The accretion function is dependent on streamflow measured at the South Platte River at Julesburg gage and was used in the computation for water availability for Project diversions. Table 2-7 displays the monthly results of the Accretion estimation by year type.

Table 2-7: Results of Monthly Accretion by Year Types (cfs)

Month	All Years	Below Average	Average	Above Average
Oct	201	99	164	336
Nov	232	145	200	349
Dec	289	193	259	412
Jan	333	220	302	474
Feb	355	257	328	476
Mar	307	210	279	430

Monthly Accretions of the South Platte River in the Lower Section ranges from 99 cfs in October of a Below Average year to 476 cfs in January and February of an Above Average year.

Table 2-8 displays the Accretions to the Lower Section on a per-mile basis between Balzac gage and the proposed Canal diversion location. The results can be compared with previous estimates of accretions which are presented on a cfs per mile basis. For example, a 2013 report to the Colorado Legislature states average stream gains between Balzac and Julesburg during the non-irrigation season is 3.16 cfs/mile. [25]

Table 2-8: Results of Monthly Accretion by Year Types (Balzac to Canal, cfs/mile)

Month	All Years	Below Average	Average	Above Average
Oct	2.4	1.2	1.9	4.0
Nov	2.7	1.7	2.4	4.1
Dec	3.4	2.3	3.1	4.9
Jan	3.9	2.6	3.6	5.6
Feb	4.2	3.0	3.9	5.6
Mar	3.6	2.5	3.3	5.1

[25] Colorado State University, (2013). Report to the Colorado Legislature HB12-1278 Study of the South Platte River Alluvial Aquifer.

Monthly Accretions in cfs per mile of the South Platte River in the Lower Section ranges from 1.2 cfs in October of a Below Average year to 5.6 cfs in January and February of an Above Average year.

2.2.3 Results of Water Availability Analysis

Estimating Canal diversions incorporated the quantified elements presented above. Specifically, the data represents the results from the formula:

$$Q_{Canal} = Q_{Bal} - WR_{SR} - WR_{35k} - WR_{Add} + ACC$$

The results indicate that there is water supply available under historical hydrology conditions with various year types to divert for the Project. These results are identified in Table 2-9 below.

In addition, a sensitivity analysis was conducted to better understand the Project benefits into the future. The sensitivity analysis considered the variables described in other parts of this section that relate to uncertainties in the implementation of the Compact as well as future water supply variability. More specifically, the sensitivity analysis looked to incorporate the compact constraints, regulatory criteria, and natural water supply issues that may impact water supply availability for the Project. As such, the sensitivity analysis included future reduction of South Platte River streamflow entering the Lower Section from the current baseline by 10%, 20%, and 50% to account for these variables. This provides a basic screening platform to consider potential future conditions with respect to water available for Project diversions in the future. These percentage reductions in flow represent future development in the Upper Section and hydrologic variability.

Further, a “Canal Efficiency” factor was introduced to reflect the real-world scenario associated with diversions at, and through, a typical canal. For estimated daily flows exceeding 110% of the Canal Capacity, the Efficiency factor remains at 100% based on the ability to actually divert an amount equivalent to the capacity. For available flows less than 110% of the Canal capacity, an Efficiency factor of 95% was applied to accommodate real-world operations impacting actual diversions. These include passing water, weir seepage, diversion loss, and leakage past the diversion structure. This efficiency-algorithm is included in the results presented in this section.

Table 2-9 displays a summary of the estimated Canal diversions for the period of record and all year types. Monthly amounts for the period of record are presented in Appendix B.

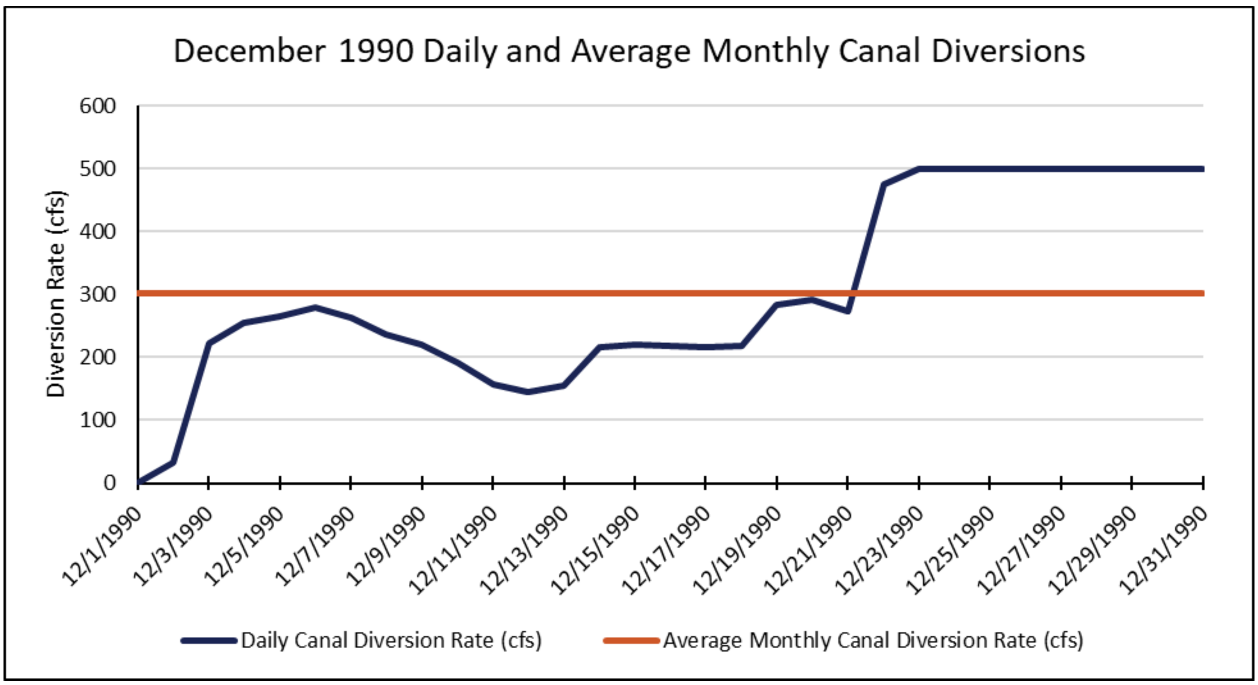
Table 2-9: Estimated 500 cfs Canal Diversions by Year Types (acre-feet and cfs)

Year Type	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
Below Average	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,400 AF (137 cfs)	8,300 AF (135 cfs)	8,200 AF (133 cfs)	7,800 AF (127 cfs)
	Jan	11,900 AF (194 cfs)	11,700 AF (190 cfs)	11,500 AF (187 cfs)	10,800 AF (176 cfs)
	Feb	11,700 AF (211 cfs)	11,600 AF (209 cfs)	11,400 AF (205 cfs)	10,900 AF (196 cfs)
	Mar	4,700 AF (76 cfs)	4,600 AF (75 cfs)	4,400 AF (72 cfs)	3,800 AF (62 cfs)
	Non-Irrigation Season Avg	**36,700 AF (111 cfs)**	**36,200 AF (109 cfs)**	**35,500 AF (107 cfs)**	**33,300 AF (101 cfs)**
Average	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Nov	900 AF (15 cfs)	700 AF (12 cfs)	600 AF (10 cfs)	300 AF (5 cfs)
	Dec	15,200 AF (247 cfs)	14,800 AF (241 cfs)	14,400 AF (234 cfs)	12,900 AF (210 cfs)
	Jan	21,100 AF (343 cfs)	20,700 AF (337 cfs)	20,300 AF (330 cfs)	18,500 AF (301 cfs)
	Feb	19,600 AF (353 cfs)	19,300 AF (348 cfs)	18,900 AF (340 cfs)	17,500 AF (315 cfs)
	Mar	14,000 AF (228 cfs)	13,500 AF (220 cfs)	13,000 AF (211 cfs)	11,200 AF (182 cfs)
	Non-Irrigation Season Avg	**70,800 AF (214 cfs)**	**69,000 AF (208 cfs)**	**67,200 AF (203 cfs)**	**60,400 AF (182 cfs)**
Above Average	Oct	4,000 AF (126 cfs)	3,600 AF (113 cfs)	3,200 AF (101 cfs)	1,900 AF (60 cfs)
	Nov	12,700 AF (213 cfs)	12,200 AF (205 cfs)	11,600 AF (195 cfs)	8,900 AF (150 cfs)
	Dec	27,200 AF (442 cfs)	27,000 AF (439 cfs)	26,700 AF (434 cfs)	25,400 AF (413 cfs)
	Jan	30,600 AF (498 cfs)	30,500 AF (496 cfs)	30,500 AF (496 cfs)	30,200 AF (491 cfs)
	Feb	27,300 AF (492 cfs)	27,300 AF (492 cfs)	27,200 AF (490 cfs)	26,800 AF (483 cfs)
	Mar	24,500 AF (398 cfs)	24,100 AF (392 cfs)	23,700 AF (385 cfs)	21,800 AF (355 cfs)
	Non-Irrigation Season Avg	**126,300 AF (381 cfs)**	**124,700 AF (376 cfs)**	**122,900 AF (371 cfs)**	**115,000 AF (347 cfs)**
All Years	Oct	1,400 AF (44 cfs)	1,200 AF (38 cfs)	1,100 AF (35 cfs)	600 AF (19 cfs)
	Nov	4,600 AF (77 cfs)	4,400 AF (74 cfs)	4,100 AF (69 cfs)	3,100 AF (52 cfs)
	Dec	17,000 AF (276 cfs)	16,800 AF (273 cfs)	16,500 AF (268 cfs)	15,400 AF (250 cfs)
	Jan	21,300 AF (346 cfs)	21,100 AF (343 cfs)	20,800 AF (338 cfs)	19,900 AF (324 cfs)
	Feb	19,600 AF (353 cfs)	19,500 AF (351 cfs)	19,300 AF (348 cfs)	18,500 AF (333 cfs)
	Mar	14,500 AF (236 cfs)	14,200 AF (231 cfs)	13,800 AF (224 cfs)	12,400 AF (202 cfs)
	Non-Irrigation Season Avg	**78,400 AF (237 cfs)**	**77,200 AF (233 cfs)**	**75,600 AF (228 cfs)**	**69,900 AF (211 cfs)**

The estimated average annual Canal diversion is 78,400 AF (237 cfs). Ranges from 1,400 AF (44 cfs) in October to 21,300 AF (346 cfs) in January are observed. Less water is available for Canal diversion in Below Average years (36,700 AF, 111 cfs) and more water is available in Above Average years (126,300 AF, 381 cfs). The sensitivity analysis, at the 50% level, indicates that on average 69,900 AF (211 cfs) is available with a range from Below Average years of 33,300 AF (101 cfs) to Above Average years of 115,000 AF (347 cfs).

It is noted, the values presented in Table 2-9 above are dependent on the diversion and canal capacity of 500 cfs. For example, for December 1990, the average diversion rate over the month is reported as 301 cfs (see Appendix B). However, there are times during this month in which the canal is taking the maximum diversion of 500 cfs. Figure 2-4 displays the daily and average monthly canal diversions showing the monthly diversions that go into the values reported in Table 2-9 and Appendix B are dependent on canal and diversion capacity.

Figure 2-4: Daily and Monthly Average 500 cfs Canal Diversion (cfs)



2.2.4 Non-Irrigation Season Surplus Water

Water in excess of both Nebraska's 500 cfs entitlement and all Lower Section water rights holders junior to the December 17, 1921 priority, is available for diversion (non-irrigation season surplus water). The quantification of non-irrigation season surplus water first builds off the methodology presented above but includes reduction in the computed available flow by these junior water rights holders' demands as well as a diversion and canal capacity of 1,000 cfs. More information on the development of these demands incorporated into the quantification of non-irrigation season surplus water is presented in **Section 4**. **Table 2-10** presents the quantification of non-irrigation season water availability.

Table 2-10: Estimated 1,000 cfs Canal Diversions by Year Types (acre-feet and cfs)

Year Type	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
Below Average	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,900 AF (145 cfs)	8,300 AF (135 cfs)	8,200 AF (133 cfs)	7,800 AF (127 cfs)
	Jan	12,500 AF (203 cfs)	11,700 AF (190 cfs)	11,500 AF (187 cfs)	10,800 AF (176 cfs)
	Feb	12,500 AF (225 cfs)	11,700 AF (211 cfs)	11,500 AF (207 cfs)	10,900 AF (196 cfs)
	Mar	5,000 AF (81 cfs)	4,600 AF (75 cfs)	4,400 AF (72 cfs)	3,800 AF (62 cfs)
	Non-Irrigation Season Avg	**38,900 AF (117 cfs)**	**36,300 AF (110 cfs)**	**35,600 AF (107 cfs)**	**33,300 AF (101 cfs)**
Average	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Nov	900 AF (15 cfs)	700 AF (12 cfs)	600 AF (10 cfs)	300 AF (5 cfs)
	Dec	17,400 AF (283 cfs)	16,100 AF (262 cfs)	15,400 AF (250 cfs)	13,200 AF (215 cfs)
	Jan	28,400 AF (462 cfs)	26,600 AF (433 cfs)	25,200 AF (410 cfs)	20,600 AF (335 cfs)
	Feb	25,600 AF (461 cfs)	24,000 AF (432 cfs)	22,800 AF (411 cfs)	19,100 AF (344 cfs)
	Mar	16,700 AF (272 cfs)	15,400 AF (250 cfs)	14,400 AF (234 cfs)	11,600 AF (189 cfs)
	Non-Irrigation Season Avg	**89,000 AF (269 cfs)**	**82,800 AF (250 cfs)**	**78,400 AF (237 cfs)**	**64,800 AF (196 cfs)**
Above Average	Oct	5,000 AF (158 cfs)	4,300 AF (135 cfs)	3,800 AF (120 cfs)	2,400 AF (76 cfs)
	Nov	16,000 AF (269 cfs)	14,700 AF (247 cfs)	13,400 AF (225 cfs)	9,400 AF (158 cfs)
	Dec	45,300 AF (737 cfs)	43,900 AF (714 cfs)	42,400 AF (690 cfs)	34,700 AF (564 cfs)
	Jan	56,900 AF (925 cfs)	55,800 AF (908 cfs)	54,400 AF (885 cfs)	46,000 AF (748 cfs)
	Feb	49,300 AF (888 cfs)	48,000 AF (864 cfs)	46,400 AF (835 cfs)	38,700 AF (697 cfs)
	Mar	37,100 AF (603 cfs)	34,900 AF (568 cfs)	32,800 AF (533 cfs)	25,600 AF (416 cfs)
	Non-Irrigation Season Avg	**209,600 AF (633 cfs)**	**201,600 AF (609 cfs)**	**193,200 AF (583 cfs)**	**156,800 AF (473 cfs)**
All Years	Oct	1,700 AF (54 cfs)	1,500 AF (47 cfs)	1,300 AF (41 cfs)	800 AF (25 cfs)
	Nov	5,700 AF (96 cfs)	5,200 AF (87 cfs)	4,700 AF (79 cfs)	3,300 AF (55 cfs)
	Dec	24,000 AF (390 cfs)	22,900 AF (372 cfs)	22,100 AF (359 cfs)	18,700 AF (304 cfs)
	Jan	32,800 AF (533 cfs)	31,600 AF (514 cfs)	30,600 AF (498 cfs)	26,000 AF (423 cfs)
	Feb	29,300 AF (528 cfs)	28,100 AF (506 cfs)	27,100 AF (488 cfs)	23,000 AF (414 cfs)
	Mar	19,800 AF (322 cfs)	18,400 AF (299 cfs)	17,300 AF (281 cfs)	13,800 AF (224 cfs)
	Non-Irrigation Season Avg	**113,300 AF (342 cfs)**	**107,700 AF (325 cfs)**	**103,100 AF (311 cfs)**	**85,600 AF (258 cfs)**

The estimated average annual Canal diversion is 113,300 AF (342 cfs). Ranges from 1,700 AF (54 cfs) in October to 32,800 AF (533 cfs) in January are observed. Less water is available for Canal diversion in Below Average years (38,900 AF, 117 cfs) and more water is available in Above Average years (209,600 AF, 633 cfs). The sensitivity analysis, at the 50% level, indicates that on average 85,600 AF (258 cfs) is available. This ranges from Below Average years of 33,300 AF (101 cfs) to Above Average years of 158,800 AF (473 cfs). These values are subject to the same condition depicted in Figure 2-4 above, although with a 1,000 cfs maximum diversion rate.

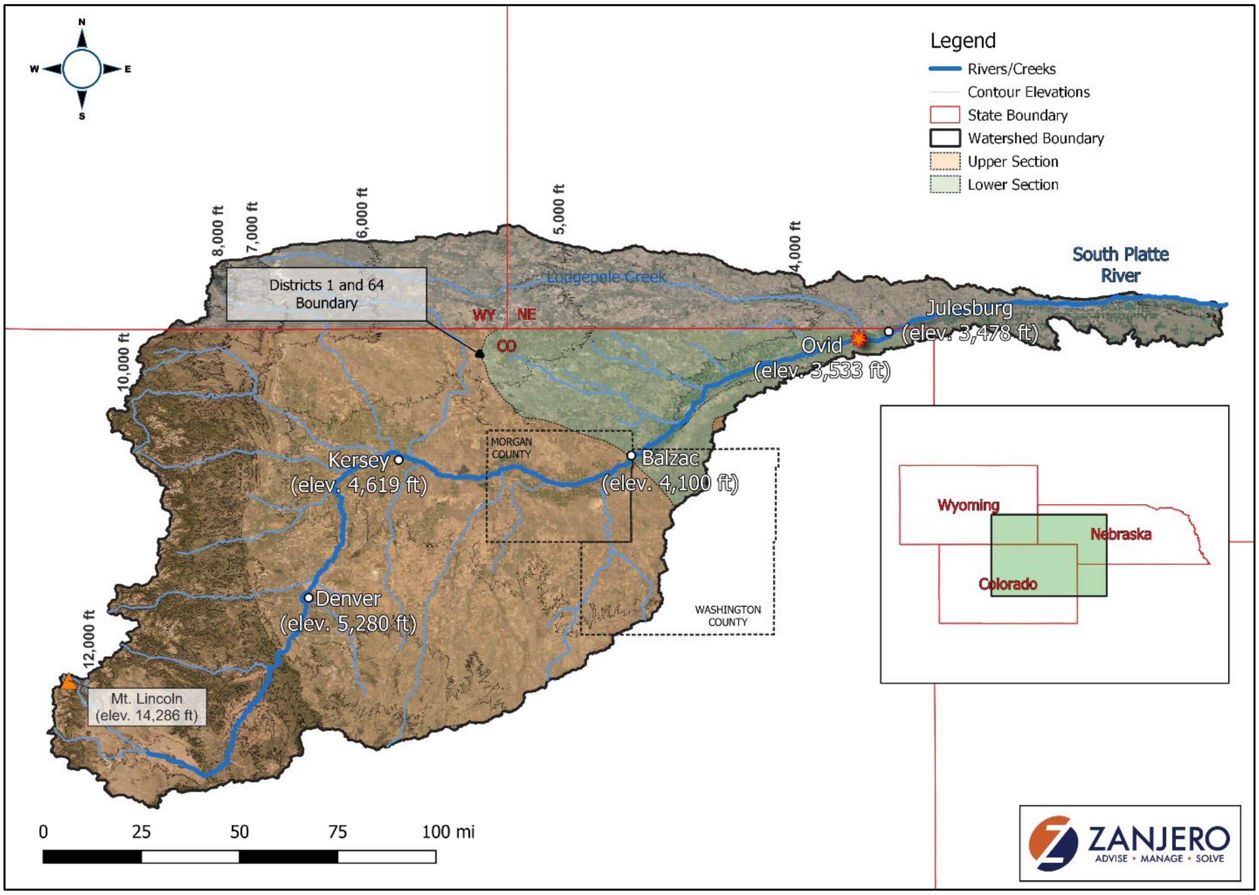
2.3 Hydrologic Variability and Trends

This section describes the South Platte River watershed's geography, climate, and hydrologic variability as well as the hydrologic variability and climate trends as they may apply to water supply availability for the Project. The analysis explains how the watershed's geography impacts the South Platte river's hydrology and assesses climatological factors that impact water supply availability like temperature, precipitation, and snowmelt. These broad factors are further disaggregated in this Section and utilize published information to capture potential impacts to water supply availability to the Project that are captured in the scenarios identified in Section 2.2. The section concludes that hydrological and climatological variability continues to affect the South Platte River watershed water supply, as has occurred throughout the region's history, and that these changes indicate an emerging trend that may impact the South Platte River system's future water supply availability for the Project. There may be less natural occurring water in the future making water storage more valuable. Additional information related to this section may be found in Appendix C.

2.3.1 Geographic Description of Watershed

The South Platte River headwaters are in the mountains of central Colorado at the Continental Divide, with the highest point in the basin at 14,286 feet at Mt. Lincoln. The South Platte River flows generally to the northeast from its headwaters until Kersey, Colorado and then generally easterly across the Great Plains to its confluence with the North Platte River at North Platte, Nebraska at 2,750 feet elevation, about 450 miles. The streamflows that feed the South Platte River and the Basin's relatively shallow unconfined alluvial aquifer along the mainstem and tributaries are highly variable both seasonally and annually. The state of Colorado contains 79% of the South Platte River Basin, Nebraska has 15%, and Wyoming 6%. Figure 2-5 shows a map of the entire South Platte River watershed including its elevation change.

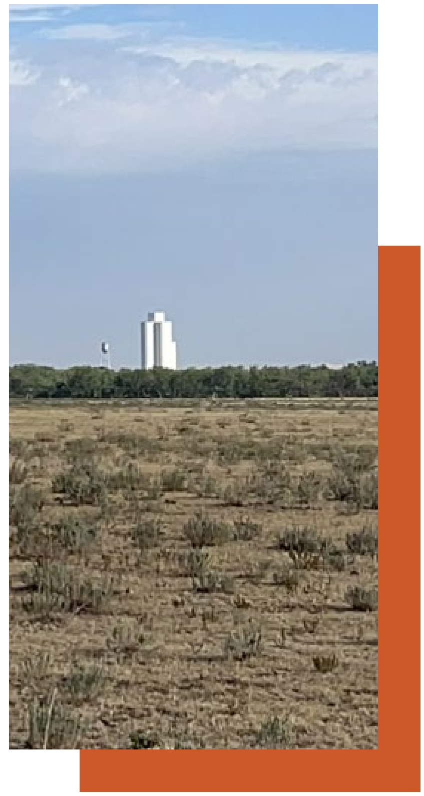
Figure 2-5: South Platte River Watershed with Elevations



The watershed's complex topography – mountains, valleys, plateaus, and rolling plains – influence temperature and precipitation patterns, that dramatically vary both spatially and temporally. Colorado and Nebraska are centrally located in the North American Continent and are far from the coastal states' oceans that moderate temperatures. As such, this continental climate is subject to large swings in temperature across the seasons.[26] These fluctuations are influenced by relatively

[26] Shulski, M.D., Umphlett, N.A., Pathak, T.B., & Hubbard, K.G., (2013). Climate Change: What Does It Mean for Nebraska? School of Natural Resources, Institute of Agriculture and Natural Resources. University of Nebraska–Lincoln. https://extensionpublications.unl.edu/assets/html/g2208/build/g2208.htm; and Lukas, J., Barsugli, J., Doesken, N., Rangwala, I., &Wolter, K., (2014). Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition at p. 17

warmer air and moisture originating in the Pacific Ocean and Gulf of Mexico as well as polar air masses originating in the Arctic and Canada.



Water availability in South Platte River system depends upon the annual hydrological cycle and the precipitation that originates as snowfall in Colorado's Rocky Mountains and rainfall in the lower elevations of the Upper Section and the Lower Section. Streamflows from the mountain headwaters and Lower Section areas have natural variability that dictates natural supply. This natural fluctuation is influenced by geographic location and topography, as well as the regional climate and its prevailing weather conditions. More specifically, the hydrologic fluctuations are influenced by (1) the type, amount, and seasonality of precipitation, (2) the timing, rate, and volume of snowmelt, (3) evaporation and sublimation rates, (4) soil dryness, and (5) the duration and severity of the frost season and heat waves. Nearly all of these factors are linked to temperature and understanding the patterns and trends in this key indicator informs assessment for each specific component that impacts water supply availability in the South Platte River system.

2.3.2 Historical Variability and Impacts on Supply

Climate variability is a recurring theme in the South Platte River basin's history and is traceable through modern measurement techniques and historical records derived from soil profiles and dendrochronology. Climate variability is assessed through temperature change, precipitation amount, precipitation type, and runoff patterns. The climatological variability aligns with the geographic characteristics of the South Platte River watershed. The South Platte River basin and surrounding region has experienced notable climate events over the past century, including the Dust Bowl drought years in the 1930s, a warm period in the 1950s, relatively cool periods in the 1960s and 1970s, intermittent catastrophic floods, and the relatively warm and dry period since 2000.[27] The observed record has had pronounced annual swings, which

[27] Lukas, J., Barsugli, J., Doesken, N., Rangwala, I., &Wolter, K., (2014). Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition at p. 12.

led to tangible impacts on hydrology, but corresponds with larger trends against the 30-year baseline.

Temperature has a direct effect on hydrology. Increased temperature influences water supply availability through greater evapotranspiration, earlier snowmelt and peak runoff, prolonged droughts, and drier soils while cooler temperature trends tend to produce the opposite effects by slowing evapotranspiration, increasing the duration of the snowpack storage, and shifting peak runoff to later in the runoff season. The observed record of Colorado and Nebraska's climate has trended towards higher temperatures, particularly over the last 30 years. Colorado statewide annual average temperatures have increased by 2.0ºF over the past 30 years and 2.5ºF over the past 50 years.[28]

Variance in annual precipitation directly influences annual water supply. Most of the precipitation that contributes to the streamflow of the South Platte River falls as snow throughout the winter in the Rocky Mountains. Areas above 9,000 feet receive the most winter precipitation.[29] Rain, derived from Gulf of Mexico moisture plumes, tends to fall in lower elevations in the late spring and late fall in eastern Colorado and western Nebraska and summer precipitation, often in the form of thunderstorms, is common but the activity varies considerably from year to year. The average October-April precipitation in the Basin varies from 3 inches in the lower plains to 22 inches in the mountains, and 6 and 15 inches, respectively, for the plains and mountains during May-September.[30] Annual precipitation, which has high natural variability, has not seen a statewide trend in Colorado or Nebraska[31] over the period from the 1980s through present.

The South Platte River Basin depends on snowpack and spring runoff to replenish and sustain its streamflow. Winter snowpack is a critical source of water for the Basin as it acts as its largest storage component for the South Platte River water supply. Historical snowpack totals for the South Platte River Basin are highly variable from year to year across the observed record. Figure 2-6 uses the Snow Water Equivalent (SWE) metric which is a common snowpack measurement to gage amount of liquid

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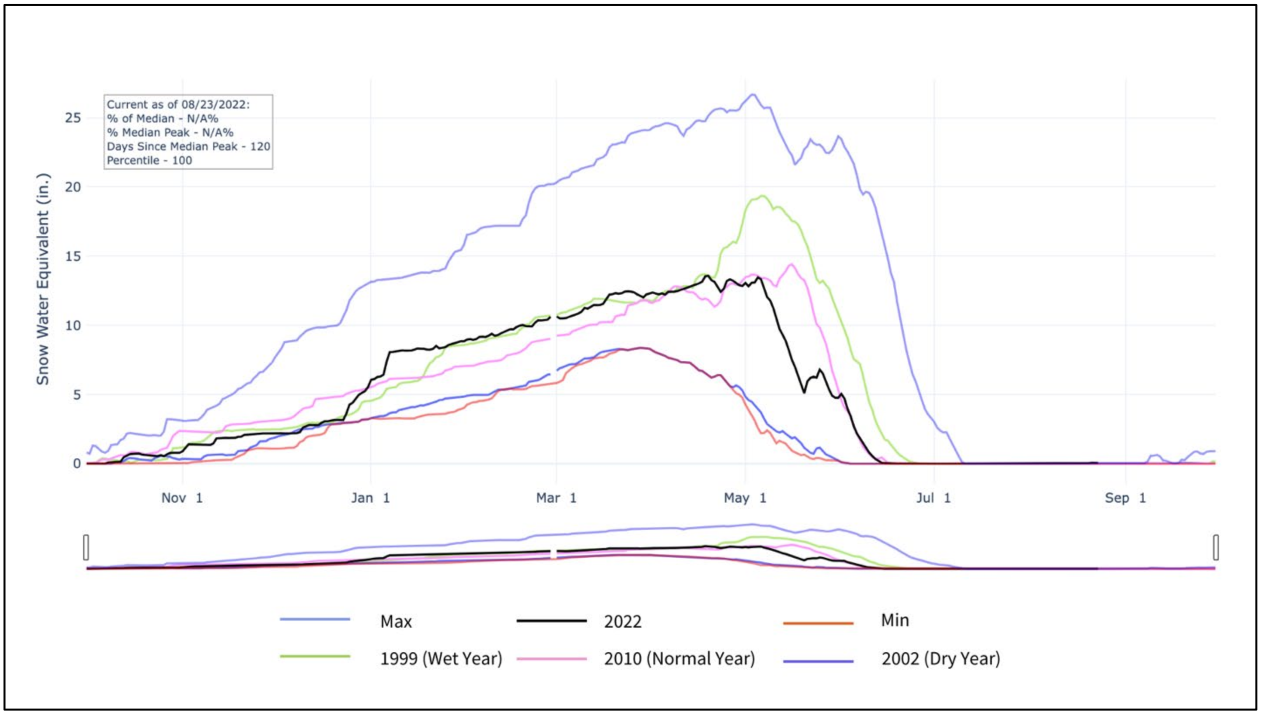
[28] Lukas, J., Barsugli, J., Doesken, N., Rangwala, I., &Wolter, K., (2014). Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition at p. 11.
[29] Lukas, J., Barsugli, J., Doesken, N., Rangwala, I., &Wolter, K., (2014). Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition at p. 13.
[30] Colorado Water Conservation Board, (2022). Colorado Water Plan 2023 (2022 Draft) as Section 4, page 47.
[31] Bathke, D.J., Oglesby, R.J., Rowe, C., & Wilhite, D.A., (2014). Understanding and Assessing Climate Change: Implications for Nebraska. School of Natural Resources, Institute of Agriculture and Natural Resources. University of Nebraska–Lincoln at p. XI.

water contained within snowpack and shows a long-term 70-year SWE decreasing trend for the South Platte Basin.[32]

Figure 2-6: Variability of South Platte Basin Snow Water Equivalent (inches) – Oct 1981 – Sept 2021



The South Platte River Basin depends on winter snowpack and subsequent runoff for water supply. Runoff timing has important implications for water supply availability as approximately 70% of the annual streamflow in the basin occurs during spring runoff.[33] Runoff timing generally correlates with peak SWE. The median SWE snowpack peak between 1991-2020 is calculated as April 26. Figure 2-7 shows the SWE Peaks and earlier runoff timing.[34] A 2010 study found shifts to earlier snowmelt and runoff timing in Colorado from 1978-2007 of roughly 1-4 weeks.[35]

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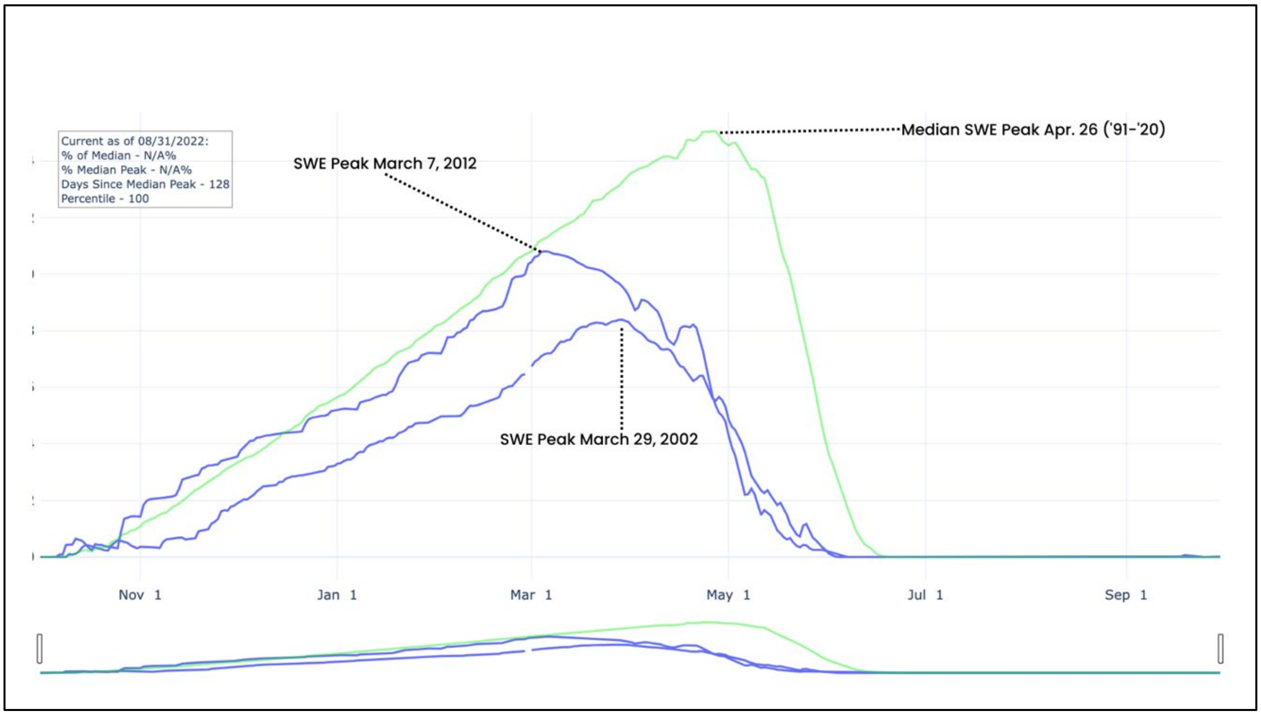
[32] Lukas, J., Barsugli, J., Doesken, N., Rangwala, I., &Wolter, K., (2014). Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition at p. 26.

[33] Colorado Water Conservation Board, (2022). Colorado Water Plan 2023 (2022 Draft) as Section 4, page 47.

[34] Lukas, J., Barsugli, J., Doesken, N., Rangwala, I., &Wolter, K., (2014). Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition at p. 29.

[35] Clow, D.W., (2010). Changes in the timing of snowmelt and streamflow in Colorado: A response to recent warming. Journal of Climate, 23(9), 2293–2306.

Figure 2-7: Peak SWE Dates – 2002, 2012, Median (1991-2020)



Extreme variability in temperature and precipitation can result in droughts and floods. The South Platte River Basin is prone to these events, and over the last two decades the region has experienced both. Drought – especially prolonged drought – can have significant and lasting effects on water supplies and availability. Wet years offer some relief and opportunities to store water and recharge aquifers. For example, three of Colorado's worst annual droughts have occurred in the last 20 years – 2002, 2012 and 2018 – as a part of a longer two-decade dry period. Yet, during the same 20-year period the state saw extreme precipitation at some locations.[36] During the 2002 drought the Denver Basin Aquifer in the Upper Section, which has provided plentiful supply to urban and rural areas along the Front Range, saw declines in the Arapahoe formation and drying-up of wells along the western edge.[37] Annual streamflow averages for the period 2000-2012 at the Julesburg gage in the Lower Section were observed at 213,446 AF mainly due to drier conditions. This is compared with the long-term annual streamflow averages for the period 1969-2012 of 478,261 AF at the Julesburg gage.[38]

[36] Section 3, p. 8 - 2023 Colorado Water Plan, 2022 Draft, Colorado DNR
[37] Section 3, p. 6 - 2023 Colorado Water Plan, 2022 Draft, Colorado DNR
[38] p. 10 - Report to the Colorado Legislature - HB12-1278 Study of the South Platte River Alluvial Aquifer December 31, 2013

Like most significant watersheds, the South Platte River Basin has a history of flood events. The September 2013 floods were caused by heavy rainfall over a large area of the Front Range and adjacent plains between September 9-16. The rainfall was equivalent to nearly a full year of precipitation for these areas. As many as 88 weather stations exceeded 24-hour precipitation records, and the hardest hit areas received more than 600 percent of average precipitation for the month.[39] Severe flooding occurred in across the Front Range and extended across the South Platte River Basin plains and into Nebraska. The South Platte River Basin historical record has documented many smaller floods and most have been associated with large summertime thunderstorm events or protracted springtime rains on top of snowmelt swelling streams.

The historical record of the South Platte Basin, particularly the last 30 years, has shown a temperature warming trend. Historical data have been used to create widely used models to project future trends and variability in climate. These regional climate models are essential tools for projecting the impacts of temperature change on hydrologic variability.[40] Colorado and Nebraska water resource and climate studies use the IPCC Representative Concentration Pathway (RCP) climate models in documents referenced in this section. The climate models project warming across the United States, including the Front Range and South Platte Basin.[41]

The models are less conclusive about increases or decreases in precipitation for North America and even regionally. Precipitation variability trends remain relatively stable in the South Platte River watershed and are incorporated into the water supply availability analysis described in this section. Although total precipitation may remain stable, there has been a decline in snowpack in the South Platte River Basin since 1955[42]. The decline in snowpack may impact the timing and amount of streamflow in the South Platte River watershed. In addition to changes in snowpack, a shift in peak runoff from the South Platte River Basin's runoff may occur with earlier snowmelt derived from increased temperatures. Snowpack runoff may shift 1-3 weeks earlier in the season.[43] This shift in runoff timing may provide more water earlier in the runoff season that could be available for the Project. Nevertheless, in order to provide a

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[39] Colorado Water Conservation Board, (2022). Colorado Water Plan 2023 (2022 Draft) at Section 3, p. 8.
[40] Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections. https://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html
[41] Bathke, D.J., Oglesby, R.J., Rowe, C., & Wilhite, D.A., (2014). Understanding and Assessing Climate Change: Implications for Nebraska. School of Natural Resources, Institute of Agriculture and Natural Resources. University of Nebraska–Lincoln at p. 30.
[42] United States Department of Agriculture, Natural Resources Conservation Service (2022). Snow telemetry (SNOTEL) and snow course data and products.
[43] Colorado Water Conservation Board, (2022). Colorado Water Plan 2023 (2022 Draft) at Section 3, p. 25.

conservative water supply availability prediction, this analysis has not incorporated the earlier runoff potential into the water supply availability scenarios in this section.

NEBRASKA WATER USE

Section 3

This section addresses the state of Nebraska's water use related to the South Platte River. The Perkins County Canal Project will preserve the state's water use for irrigation, municipal, industrial, environmental, recreational, and hydroelectric purposes.

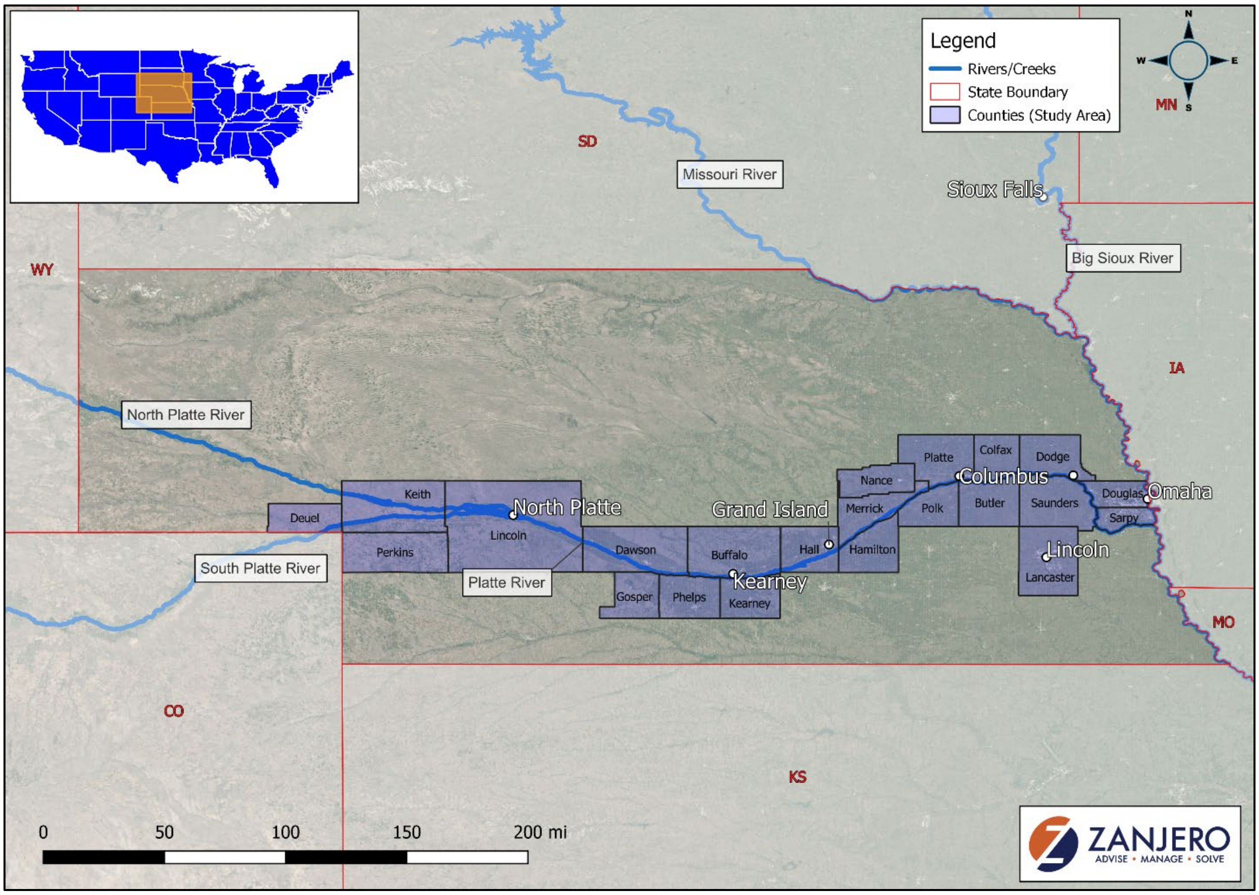
The Perkins County Canal Project (Project) is the only means for Nebraska to ensure that South Platte supplies during the non-irrigation season are required to remain available for Nebraska's use. Nebraska diverts and distributes South Platte River water to meet existing demands and manages South Platte River supplies with other regional supplies to provide benefits throughout the state. Water management in the North Platte River combined with water management in the South Platte River impact agricultural, environmental, municipal, industrial, and hydropower needs throughout Nebraska's portion of the Platte River Basin (Basin). Accordingly, this section addresses LB1012's directive 4, the demands in the Basin that are potentially impacted without the Project, and how the South Platte River supplies conveyed by the Project may aid Basin-wide water management to continue to meet Nebraska's demands.

This analysis assumes that operational priority will be given to irrigation, either directly or indirectly through recharge, as the first use of the water. The remaining benefits discussed here are considered to be ancillary uses to irrigation.

3.1 Nebraska Water Use

Nebraska's demand for South Platte River water begins at the Colorado and Nebraska border and spreads easterly along the lower Platte River drainage to its confluence with the Missouri River. Joint management of captured South Platte River water supplies with North Platte River supplies generally arise in operations at Lake McConaughy on the North Platte River. A few smaller reservoirs, including Sutherland Reservoir and Lake Maloney, on the South Platte River are also managed in connection with these supplies. Water management and operations in this system first and foremost impact existing agricultural production by meeting irrigation demands for both farming and ranching operations. Irrigation water is conjunctively managed with water for hydropower generation, cooling of Gerald Gentlemen Station, and environmental flows. Industrial production (for ethanol, manufacturing, and animal processing) and municipal demands are also met through groundwater recharge and surface water return flows throughout the Basin and eastward across the state to Nebraska's population centers in Lincoln and Omaha. Collectively, this broad area constitutes the "Study Area" for this assessment (Figure 3-1).

Figure 3-1: Nebraska "Study Area" and Overlying Counties



This section concludes that Nebraska needs the Perkins County Canal Project to avoid losing the water that meets these current demands. In other words, Nebraska stands to lose the water supply that provides benefits to its residents if it does not build the Project. Nebraska needs to secure the water supply under the Compact to maintain beneficial use of these supplies that help support the state's economy.

3.1.1 Agriculture Water Use

Agriculture is the backbone of Nebraska's economy. In 2020, for example, Nebraska exported $7.1 billion in agricultural items that provided an additional $7.4 billion in agriculture-related economic activity.[44] One in four jobs in Nebraska is related to agriculture and 44.8 million acres (approximately 92% of Nebraska's land) is dedicated to farms and ranches.[45] On these lands, Nebraskans produce a number of crops including corn, hay, soybeans, sorghum, sugar beets, wheat, pinto beans, and sunflowers as well as significant cattle, chicken, turkey, bison, and pig ranching for commercial meat production. Farming and ranching products enable industrial activities like ethanol production and animal processing along with services related to the farms, ranches, and agriculture-related industrial activities.

Agricultural irrigation accounts for the majority of water use in Nebraska. Agriculture uses water from the South Platte whether through surface water diversions or groundwater augmentation derived from flows coming into the state. Failure to build the Project could eliminate agriculture that depends upon South Platte supplies.

Diversion works and canals supply water from surface water bodies to arable lands, and groundwater wells are the largest source for irrigation water in the state.[46] Today, over 100,000 high-capacity irrigation wells are registered and operating in the state and thousands of miles of ditches, canals, and reservoirs capture and deliver surface water supplies for the agriculture industry.[47] The irrigated acreage in the Study Area currently covers about 1.64 million acres of land[48] and covers a designated Subarea within the Study Area

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[44] Nebraska Department of Agriculture, (2022). Nebraska Agriculture Fact Card. https://nda.nebraska.gov/facts.pdf

[45] Ibid.

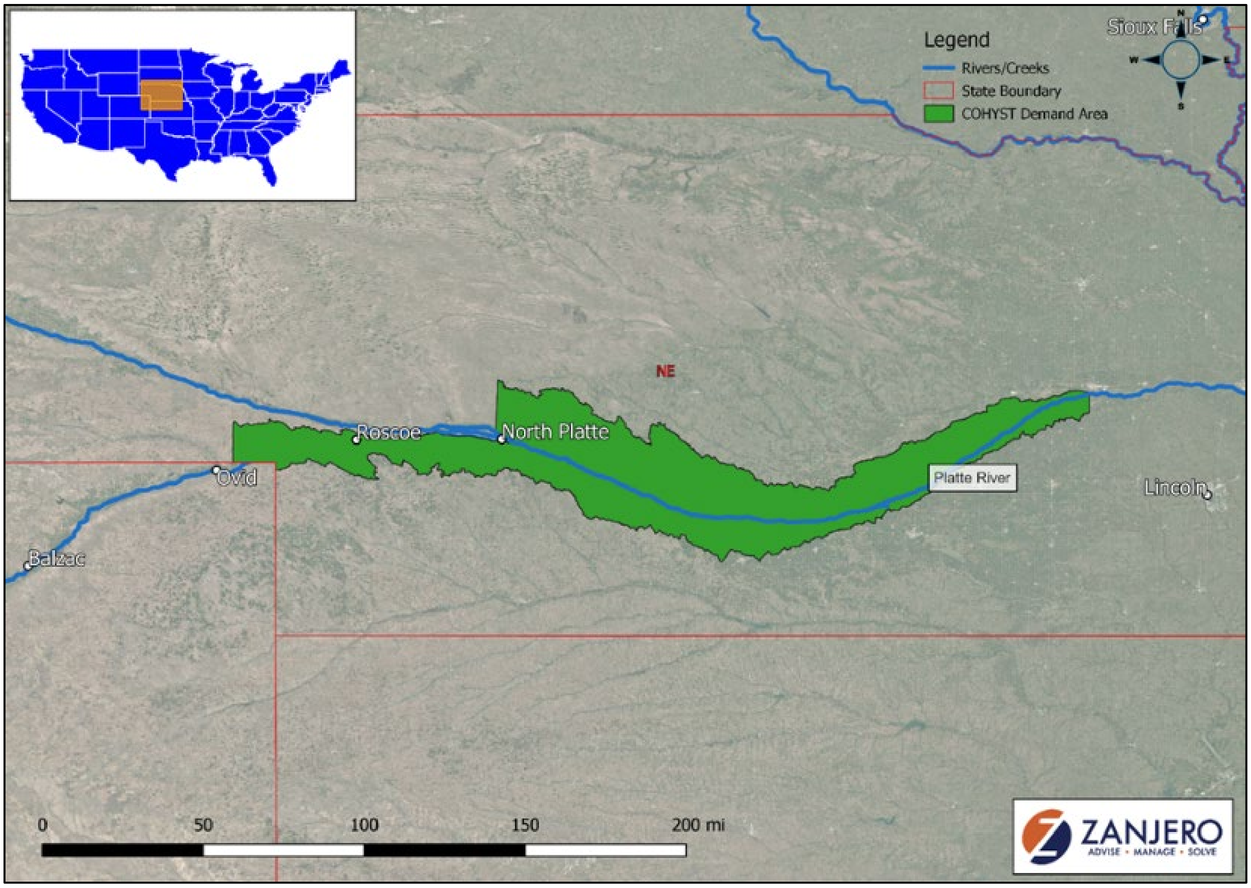
[46] Simons & Associates Inc., August 2000 https://platteriverprogram.org/sites/default/files/PubsAndData/ProgramLibrary/Simons%20and%20Associates%202000_Physical%20History%20of%20the%20Platte%20in%20NE.pdf

[47] Nebraska Irrigation Facts Sheet, UNL, Dept of Ag Economics, September 2011, https://agecon.unl.edu/a9fcd902-4da9-4c3f-9e04-c8b56a9b22c7.pdf

[48] https://cohyst.nebraska.gov/

upstream of the Platte River confluence with the Loup River near Columbus, Nebraska (Figure 3-2).

Figure 3-2: Platte River System in Nebraska to Loup River Confluence ("Subarea")



The irrigation demand area was chosen because in the more arid western part of Nebraska irrigation is a necessary component of total water demand, while in the typically wetter eastern part of the state irrigation functions only as a hedge against dry conditions that may occur during a crop's fundamental development period.

Irrigation demand in the Subarea was determined by quantifying the total number of irrigated acres and identifying how much water is provided through surface water diversions and groundwater pumping. South Platte River supplies are an important component of supplying this acreage. The information is derived from data, concepts, processes, and values developed by the Cooperative Hydrology Study (COHYST).[49]

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[49] https://cohyst.nebraska.gov/

Table 3-1 shows the Irrigated acres associated with the South Platte and Platte River irrigation demand.

Table 3-1: Irrigated Acres in Study Area

Period of Record	Year	Irrigated Acres			
		Groundwater	Surface Water	Comingled	Total
	2007	1,222,912	46,867	388,662	1,658,441
	2008	1,180,555	38,218	373,996	1,592,770
	2009	1,215,493	44,451	394,289	1,654,234
	2010	1,203,246	41,272	389,360	1,633,878
	2011	1,203,381	41,256	389,376	1,634,013
	2012	1,206,640	41,256	389,376	1,637,272
	2013	1,210,144	41,256	389,376	1,640,776
1950-2013	Min	136,390	38,218	68,782	433,729
1950-2013	Max	1,222,912	229,270	394,289	1,658,441
1950-2013	Avg	382,227	505,121	216,364	757,681
2007-2013	Avg	1,205,371	42,220	387,510	1,635,101

Agricultural irrigated acreage and irrigation demands (**Tables 3-1** and **3-2**) are derived from COHYST data which allows for accurate spatial representation of this report's specific Study Area from 1950 through 2013.[50] The total irrigated acres ranged between 1.65 million and 433,729 since 1950. From 2007 through 2013, the average irrigated acreage exceeded 1.63 million. Consistent with statewide data, most land in the Study Area is irrigated with groundwater, or groundwater is a comingled component of the irrigation system. **Table 3-2** shows the Min/Max/Avg over the period or record since 1950. As shown in the table, there is wide variance in annual figures due to many factors including hydrologic variability and the amount and type of irrigation practiced. While the data available and presented in **Table 3-1** only goes

[50] COHYST Model data is currently only available through 2013.

through 2013, total irrigated acreage in the Study Area since the early 2000s has stayed relatively constant, and likely plateaued, representing current conditions. In fact, prior to that time frame, much of the acreage in the Study Area became designated as fully or over appropriated[51]. The earliest period of the 2000s data was not included because of how the intense and extensive drought, and the lack of available surface water to irrigate, would have potentially skewed the data.

Drought is a part of Nebraska's water cycle and protecting against drought with storage protects Nebraska's agricultural interests. Figure 3-3 shows the Western Canal Company diversion structure and the drought-stricken crops in the Western Canal Company service area in 2022.

Figure 3-3: Western Canal and Drought Stricken Crops

Table 3-2 shows the water amounts associated with South Platte and Platte River irrigation uses throughout the Study Area.

[51] The Basin-Wide Plan for Joint Integrated Water Resources Management of Overappropriated Portions of the Platte River Basin, Nebraska, Second Increment (2019-2029) has comprehensive goals to move from an overappropriated condition to fully appropriated (Appendix C)

Table 3-2: South Platte and Platte River Irrigation Demand[52](values in acre-feet)

Year	Groundwater	Surface Water Delivery	Surface Water Seepage	Comingled Delivery	Comingled Seepage	Total Irrigation	Precipitation	Total Water
2007	717,767	32,665	2,221	127,188	10,447	890,288	4,632,187	5,522,474
2008	886,213	28,282	1,871	134,462	10,948	1,061,776	4,551,688	5,613,464
2009	906,536	35,996	2,041	145,142	11,156	1,100,872	3,669,725	4,770,597
2010	583,721	20,017	821	62,358	4,220	671,138	4,050,424	4,721,561
2011	710,645	33,727	2,351	158,697	13,676	919,096	3,773,075	4,692,171
2012	1,799,423	71,270	5,011	336,710	28,045	2,240,459	1,822,271	4,062,730
2013	1,235,758	47,653	3,273	248,578	20,517	1,555,780	3,196,629	4,752,409
Period of Record (1950-2013)								
Min	120,730	14,544	821	11,854	1,017	329,783	601,493	1,271,408
Max	1,799,423	374,400	36,802	336,710	28,045	2,240,459	4,632,187	5,613,464
Average	757,831	163,854	15,753	161,111	14,975	1,113,524	2,330,859	3,444,383
Current (2007-2013)								
Min	583,721	20,017	821	62,358	4,220	671,138	1,822,271	4,062,730
Max	1,799,423	71,270	5,011	336,710	28,045	2,240,459	4,632,187	5,613,464
Average	977,152	38,516	2,513	173,305	14,144	1,205,630	3,670,857	4,876,487

[52] https://cohyst.nebraska.gov/

As shown in **Table 3-2**, total recent agriculture demand on the irrigated acres ranges between 4 million and 5.6 million acre-feet (AF). Total recent applied irrigation demand ranges between 2.2 million AF in dry years to 671,138 AF in a wet year. The correlation between increased irrigation needs when precipitation declines is also shown in **Table 3-2**, highlighted by the drought year of 2012. This correlation persists even with improved efficiency in irrigation practices over time. As such, the sliding demand scale between a normal year and an extremely dry year indicates a continuous need for additional irrigation supply in conditions that are drier than normal years.

An additional agricultural water use is related to the raising of various livestock and poultry, including milk and egg production, beef cattle, pigs, chickens and turkeys in pastures and confinements. Although this demand is small in comparison to the irrigation demand it is still an important component of, and contributes significant value to, the agricultural economy in the State of Nebraska.

In the United States, Nebraska is first among the fifty states in commercial red meat production and second in total cattle inventory (USDA, 2017). In 2016, the total value of the livestock sector (including poultry) in Nebraska was $12.2 billion, which was equivalent to 54% of the total economic value of the state's agricultural sector (USDA-ERS, 2017). Given its importance to the state's economy and its impacts on the water resources, there are only a few studies on the water productivity of the different livestock products.[53]

The future condition for agriculture demand is assumed to remain relatively constant with similar irrigated water demands occurring to maintain agricultural productivity. The moratorium on various aspects of developing irrigated lands in Nebraska –

[53] 2019 Nebraska Water Productivity Report, Daugherty Water for Food Global Institute, https://waterforfood.nebraska.edu/-/media/projects/dwfi/resource-documents/reports-and-working-papers/nebraska-water-productivity-report.pdf

whether through surface water or groundwater irrigation – likely means that the irrigated acreage will remain stable. Accordingly, the future agriculture demand condition is not anticipated to change from existing conditions. Therefore, this Study assumed that this water will be applied, either directly or indirectly, to satisfy these needs.

3.1.2 Environmental Water Use

The Platte River Recovery Implementation Program (PRRIP) also uses water supplies from the South Platte River. The PRRIP was developed by Wyoming, Colorado, and Nebraska in 2006 with the goal of the program to provide sufficient water to and through the Platte River habitat area through flow re-timing to meet the environmental restoration objectives. "The Program proposes to reduce shortages to U.S. Fish and Wildlife Service target flows and provide additional land habitat for endangered species in the Lexington to Chapman reach of the river."[54] The PRRIP agreement also addresses Endangered Species Act (ESA) compliance for water users in the Platte River basin, upstream of the Loup River confluence, for any potential effects to the target species.[55]

The overall water objectives for the First Increment (2007-2019) were to improve flows by an average of 130,000 to 150,000 AF per year.[56] Currently, three initial projects: Tamarack I groundwater recharge project in Colorado, the Pathfinder Modification Reservoir Environmental Account (EA) in Wyoming, and the Lake McConaughy EA in Nebraska contribute to meeting the water objectives.[57] The three projects within the First Increment totaled an average of 80,000 AF per year.[58] Objectives are achieved by storage releases, revising operations of other water systems, and general re-timing of Platte River system water projects, as well as implementing new water projects.[59]

As of July 2018, two of the ten PRRIP Program Milestones had not been achieved, including water supply target flows. Compliance with the objectives is measured through the progress of achieving all ten milestones. On December 30, 2019, a 13-year

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[54] Nebraska Department of Natural Resources. (2010).
[55] Platte River Program. (n.d.). *Water Plan*. Platte River Recovery Implementation Program. https://platteriverprogram.org/about/water-plan
[56] Id.
[57] Id.
[58] Id.
[59] Platte River Program. (n.d.). *Target Flows*. Platte River Recovery Implementation Program. https://platteriverprogram.org/target-flows

First Increment Extension (2020-2032) was implemented to provide additional time.[60] Managed South Platte River flows could help meet the water supply target flows and water conveyance needs of PRRIP.

3.1.3 Municipal and Industrial Water Use

This section characterizes Municipal and Industrial (M&I) demand by focusing on three primary components. First, the analysis assesses population trends in the Study Area and assesses demands on a gallons per capita per day (gpcd) usage attributed to that population. This approach characterizes use in households throughout the Study Area in a generalized manner in order to predict future water usage trends in the same area. Second, industrial consumptive uses (not hydropower) are examined in various industries that rely on water supplies. Some of these industries are located in the population centers while others, like ethanol production, are spread throughout the Study Area. Last, the Study assesses non-consumptive industrial use, primarily hydropower generation, that could be developed and re-managed in the Platte River system with increased supply availability from the Project.

Municipal and Industrial water use for the Study Area is concentrated in the eastern part of Nebraska at the far reach of the Platte River. The most populous counties – Douglas, Sarpy and Lancaster – encompass the Omaha and Lincoln metro areas and comprise the most M&I demand in the state. M&I use in the rest of the Basin is concentrated along the Platte River. Additionally, there are several hydropower and fuel-powered generation facilities along the Platte River that depend on flows for electricity generation and cooling.

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[60] Nebraska Department of Natural Resources. (2005). *Attachment 2 Milestones Document*. Platte River Recovery Implementation Program. https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/PRRIP_Milestones.pdf

The Omaha metro area partially relies on the Platte Basin's water, combined with conjunctive use of Missouri River surface water and groundwater from the Missouri Tributaries Basin. Omaha's Municipal Utilities District (MUD) produces raw water from the Platte South Water Treatment and Platte West Water Treatment facilities, both of which draw from the Platte River aquifer. Lancaster County and the Lincoln metro area depend almost entirely on the Basin supply. The South Platte River provides seven percent of Lincoln's water supply during droughts.[61] Moreover, the long-term yield of the City of Lincoln's raw water supply is correlated to the streamflow in the Platte River[62]. Future demand in the state will be driven by growth in these areas.

3.1.3.1 Population Trends

Over the past twenty years, growth in the state has been concentrated in the "big three" counties surrounding Lincoln and Omaha. Douglas, Lancaster—and particularly Sarpy—counties have sustained Nebraska's population growth with double digit figures from 2000-2020 (Figure 3-4). These regions account for an estimated 56% of the state's total population (Table 3-3). Growth in these counties will be the main factor for increasing demand for municipal water supplies.

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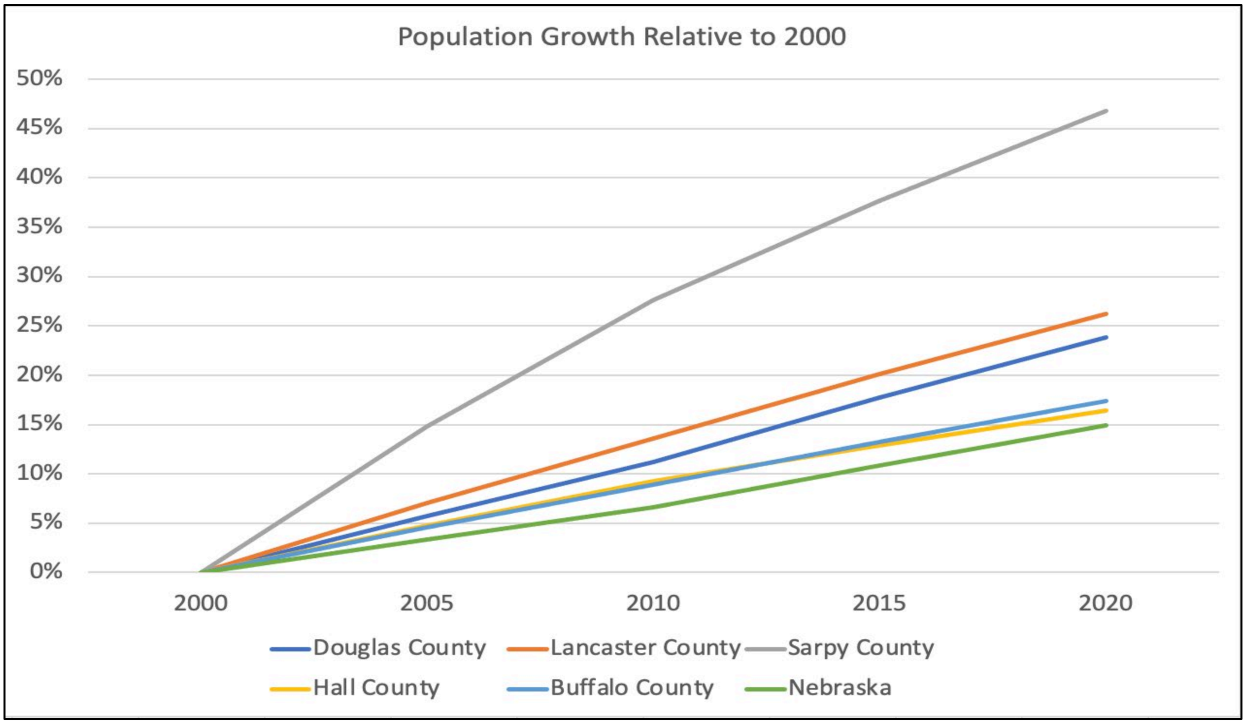
[61] Testimony of Elizabeth Elliot to Natural Resources Committee, February 9, 2022.
[62] p. 3-1, City of Lincoln Water System Facilities Master Plan, 2014.

Figure 3-4: Population Growth in 5 Largest Nebraska Counties, 2000-2020



Basin water users equate to about 73% of the state's total as of 2020 (**Table 3-3**). "Overlying Counties" include counties in the Basin that benefit from South Platte River and Platte River water that are in addition to the "big three" counties. In other words, Overlying Counties in the tables below do not include the "big three" counties but are counties that overlie the Study Area as shown in **Figure 3-1**. The cities of Fremont, North Platte, Columbus, Kearney, and Grand Island are notable population centers in the Overlying Counties that are beneficiaries of Platte River supplies.

Table 3-3: Distribution of Water Users in Nebraska (2020)[63]

Area	Population	Percent of Total
Douglas, Lancaster, Sarpy	1,111,418	56%
Overlying Counties	342,509	17%
Perkins County Canal Study Area County Total	1,453,927	73%
Nebraska	1,980,221	100%

The population in many communities outside of Nebraska's two major urban centers have remained relatively stable or even declined in recent years, with a few exceptions. Buffalo County, Hall County and Platte County saw a population increases from 2000-2020 and are expected to grow modestly over the 2060 planning horizon. Much of the Study Area in Nebraska is home to rural communities. Rural communities in particular rely on groundwater supplies that are linked to basin surface water sources.

Over the planning horizon through 2060, the "big three" counties cumulative growth averaged together is expected to be about 56% of total growth, with the remaining Overlying Counties in the Study Area having cumulative growth at a combined 16% (Table 3-4). The state of Nebraska is projected to grow a total of 33% from 2020 to 2060.

[63] Hauer, M. (2021, August 10). Population projections for all U.S. counties by age, sex, and race controlled to the Shared Socioeconomic Pathways. https://doi.org/10.17605/OSF.IO/9YNFC, Courtesy of the Nebraska Department of Economic Development

Table 3-4: Population Growth Trends and Projections in Nebraska Counties, 2020 - 2060

Region	2020	2030	% Growth 2020 - 2030	2040	2050	2060	Total % Growth 2020 - 2060
Douglas County	588,511	658,989	12.0%	728,070	796,259	865,650	47.1%
Lancaster County	328,725	376,523	14.5%	425,801	478,768	536,082	63.1%
Sarpy County	194,181	228,569	17.7%	262,861	296,564	329,989	69.9%
Total "Big 3"	1,111,418	1,264,081	13.7%	1,416,731	1,571,591	1,731,720	55.8%
Overlying Counties	342,509	353,382	3.2%	365,108	379,050	398,682	16.4%
Total Study Area	1,453,927	1,617,464	11.2%	1,781,840	1,950,641	2,130,403	46.5%
Total Nebraska	1,980,221	2,135,745	7.9%	2,290,439	2,451,656	2,634,613	33.0%

Projected population growth over the planning horizon from 2020 to 2060 in the Study Area is highly concentrated in these metro areas, ultimately accounting for 81% of the Study Area's population through 2060 (Table 3-5).

Table 3-5: Study Area Population Distribution by County, 2060

Study Area Estimated Population Distribution, 2060	
Big 3 Counties % of Study Area Whole	81%
Overlying Counties % of Study Area Whole	19%

The City of Lincoln's 2020 Water System Facilities Master Plan Update (LWS Plan) provides detailed analysis of water demand in the Lincoln Water System (LWS) and has a basis for calculating municipal water demands for the Study Area. Per-capita water usage in Lincoln has been on a downward trend since 2000 with the lowest total water use in the City reported in 2015 of 116 gallons per capita per day (gpcd). This trend is flattening and the City anticipates a low limit will be reached over the coming decade.[64] Average Lincoln Usage, which includes volumes of metered usage and non-revenue water, was reported as 141 gpcd during the period between 2000-2018. This total Lincoln water usage is expected to trend down to 125 gpcd by 2032[65] and maintain through the planning horizon.

The LWS Plan developed water demand projections for the planning horizon through 2060 based on population forecasts, residential per-capita usage, percentage residential usage, non-revenue water, and peaking factors. The 2020 LWS Plan Update included two additional demand factors: potential large use customers north of I-80, and the adjustment of seasonal peak well field pumpage based on climatic variability. The potential addition of large use customers increased potential demand conditions, and climatic variability was factored in to demand analysis by incorporating the likelihood of increased frequency of hotter and drier years.

The City of Lincoln updated its projected water demands in the 2020 LWS Plan Update, incorporating potential future large use and climatic variability. These demands are shown in Table 3-6.

[64] p. 3-11 - City of Lincoln Water System Facilities Master Plan Update, 2020
[65] p. 3-18 - City of Lincoln Water System Facilities Master Plan Update, 2020

Table 3-6: City of Lincoln Future Demand Projections[66]

Year	Estimated Population	Average Day Well Field Pumpage (mgd)	Average Day Lincoln Useage (mgd)	Maximum Day Well Field Pumpage (mgd)	Maximum Day Lincoln Usage (mgd)	Maximum Hour Lincoln Usage (mgd)	Seasonal Peak 90-Day Demand (mgd)
2020 (Base Year)	291,677	45.9	41.0	102.0	95.0	179.2	71.7
2025	309,902	47.1	40.1	108.3	101.0	183.1	79.7
2030	329,266	48.3	41.3	111.4	103.8	188.6	83.4
2032 (12-Year CIP)	337,496	49.3	42.3	113.6	105.9	192.5	85.7
2040	371,700	53.4	46.4	123.5	115.1	210.1	95.7
2050	418,281	59.2	52.2	137.5	128.2	235.1	107.7
2060	470,700	65.7	58.7	153.5	142.9	263.2	121.5

The comprehensive nature of the LWS Master Plan Update serves as a good basis for M&I demand projection for the rest of the state. Average Day gpcd numbers that incorporate historical and future water use trends were applied to the estimated population of the Study Area to form Average Annual Demand projections. These demand factors include the increases due to potential large use industrial customers and climatic variability factors noted above, which provide a conservative cushion when applied to the more rural areas overlying the Study Area in the rest of the state. Average Annual Demand is projected to increase by about 30% from 2020 to 2060, even with gpcd figures dropping by 11% from 141 gpcd to 125 gpcd. This information is presented in **Table 3-7**.

[66] City of Lincoln Water System Facilities Master Plan Update, 2020

Table 3-7: Projected Municipal Demand - Platte River Basin Study Area, 2020 – 2060

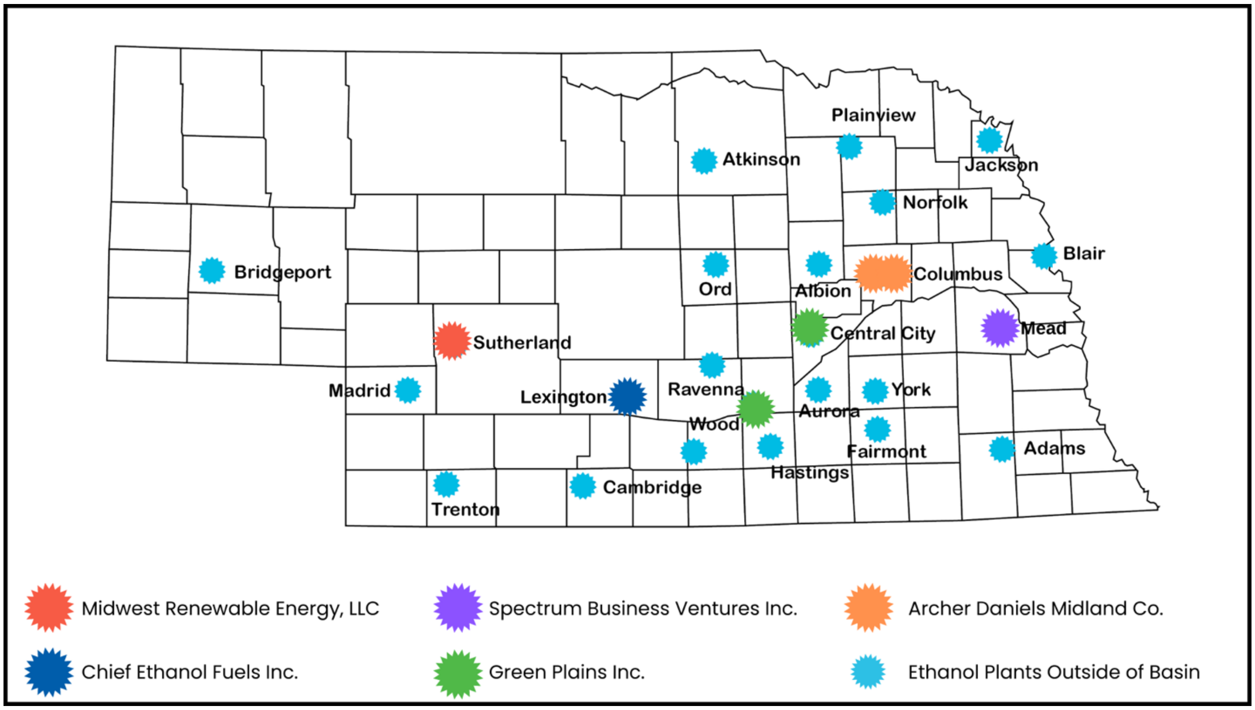
Year	Estimated Population	Average Day GPCD	Average Annual Demand (AF)
2020 (Base Year)	1,453,927	141	228,928
2025	1,535,271	129	222,525
2030	1,617,464	125	227,254
2035	1,698,874	125	238,510
2040	1,781,840	125	249,154
2045	1,865,529	125	260,782
2050	1,950,641	125	272,680
2055	2,039,567	125	284,909
2060	2,130,403	125	297,598
Study Area Increase 2020 - 2060	47%		30%
Nebraska Population 2020 - 2060			
2020	1,980,221		
2060	2,634,613		
Population Increase	33%		

3.1.3.2 Industrial Water Use

The M&I demands shown in Table 3-7 in the previous section incorporate reasonable use and provide projections for industrial demand that is tied into city water systems. There are other significant industrial users in the Study Area, some of which fall into a self-suppled designation by way of pumping their own groundwater. These include industries such as ethanol, animal processing, and sand and gravel mines.

Ethanol plants are some of the most significant industrial operations along the Platte River. The state of Nebraska is a leading producer of ethanol in the United States, housing 24 ethanol plants with a capacity of more than 2.5 billion gallons. The plants together process over 700 million bushels of corn[67] (directly linking existing agriculture water demand). Seven of these ethanol plants are located in the Platte River Basin (Figure 3-5). Corn ethanol production requires water for grinding, liquefaction, fermentation, separation, drying, and cooling. The majority of consumptive use comes from evaporation during cooling and wastewater discharge. Modern plants are designed to recycle water and employ water treatment processes and average consumptive water use in ethanol plants declined from 5.8 gal/gal ethanol to about 3.0 gal/gal ethanol from 2007-2017[68].

Figure 3-5: Locations of Ethanol Plants in Nebraska



The state of Nebraska Department of Environment and Energy published ethanol facilities capacity reports by plant through 2018, at which point the plants along the Platte River had a total capacity of 747 million gallons per year (mgy) which also matched the operating production that year. Average capacity of the plants was 107 mgy (Table 3-8). In 2018 the state anticipated 30 mgy of production capacity in

[67] https://ethanol.nebraska.gov/about/nebraska-ethanol-plants/

[68] p. 37 - Consumptive Water Use in the Production of Ethanol and Petroleum Gasoline — 2018 Update, Energy Systems Division, Argonne National Laboratory - Wu, Xu et all

construction or expansion, and recent approval for continued research of E30 fuel has bolstered the outlook for market expansion in the state.[69]

Table 3-8: Capacity of Selected Ethanol Plants Along Platte River Basin (2018)[70]

Company	Location	Nameplate Capacity (million gallons per year)
Chief Ethanol Fuels Inc.	Lexington	50
Green Plains Inc.	Central City	110
Green Plains Inc.	Wood River	121
Midwest Renewable Energy, LLC	Sutherland	28
Archer Daniels Midland Co. Plant 1	Columbus	100
Spectrum Business Ventures Inc.	Mead	25
Archer Daniels Midland CO. Plant 2	Columbus	313
	Total Capacity	747
	Average Capacity	107

Publicly available water consumption data for individual plants is unavailable, but using 2018 numbers for ethanol plant capacity[71]—and applying the production conversion of 3 gallons water used for 1 gallon ethanol—can provide a reasonable consumption estimate for the plants in the Basin. Total ethanol production capacity of 747 mgy would roughly equate to 6,877 AFY of water use, or approximately 3% of the estimated 2020 demand shown in **Table 3-8**. This water demand would increase as new plants come online in the Basin. Since Nebraska produces enough corn for its

[69] https://governor.nebraska.gov/press/gov-ricketts-announces-epa-approval-state%E2%80%99s-expanded-e30-demonstration-project
[70] Fuel Ethanol Facilities, Capacity by State and by Plant, (Million Gallons Per Year as of September 2018) - Source: https://neo.ne.gov/programs/stats/inf/122.htm
[71] https://neo.ne.gov/programs/stats/inf/122.htm

ethanol plants (approximately 40% of the state's corn production[72]) ethanol producers are likely to produce to plant capacity.

Additional industrial demands in the basin include animal processing plants, of which there are about a dozen located in the counties in the Study Area. Primary water demand for these facilities is for chilling, scalding, can retorting, washing, cleaning, and waste conveying. Appendix C shows animal processing plants in the Study Area along with estimated amount of per head water used for processing activities.

Sand and gravel mines also exist in the Basin, including three Western Sand and Gravel locations along the Platte River in Ashland, Louisville and Fremont. Typically, sand and gravel mines increase the surface water area of diversions and have an evaporative consumptive use rate of about 3 AF/acre annually. Future demands for these mines could be calculated on a per acre basis of existing and planned mines.

Most water use figures for industrial operations are not publicly available. However, the USGS publishes water use data by state and county. USGS reported no self-supplied surface-water withdrawals in the Overlying Counties, and a total of 24,262 AFY of self-supplied groundwater withdrawals. Specific demand by industry, and consumptive versus non-consumptive use was not part of the data set. This data is available in Appendix C.

Future industrial water demand can be expected to increase in step with additional capacity in industries such as ethanol, animal processing, and mining operations. Water reliability is a factor in these industries and is one of the additional benefits presented in Section 5.3.4.

3.1.3.3 Hydroelectric Power Generation – Non-Consumptive Use

Power generation, a major industrial water use, along the Platte Basin is dependent on river flows to generate hydropower and for cooling fossil fuel power plants. Nebraska Public Power District (NPPD) and Central Nebraska Public Power and Irrigation District (CNPPID) operate these plants and the various dams and canals that divert and return Platte River flow.

NPPD owns and operates two hydropower facilities; the North Platte Hydro in North Platte that can divert water from the South Platte River, and Kearney Hydro in Kearney further east along the Platte River. The two fossil plants, that can also receive water

[72] https://agecon.unl.edu/cornhusker-economics/2018/evolution-nebraska-corn-basis#:~:text=Nebraska%20currently%20has%2025%20ethanol

supply from the South Platte River, are both owned and operated by NPPD: Gerald Gentleman Station (GGS) in Sutherland (coal), and Canaday Station (Canaday) in Lexington (natural gas). Gerald Gentleman Station has two units in operation which have a combined capacity of 1,365 MW. The main demand for water in thermoelectric power plants is for condensing steam. After the steam is exhausted from the turbine it is condensed and discharged from cooling. GGS employs this once-through cooling system at a rate of 1,150 cfs, after which it returns the condensed water to a cooling pond and then back to the Sutherland Reservoir. The Canaday Station has a 100 MW capacity and also uses a once-through cooling system which discharges cooling water to the Tri-County Supply Canal.

In addition to the Kingsley hydro at Lake McConaughy on the North Platte River, CNPPID operates three facilities that use diversions from the Platte River just below the confluence of the North and South Platte Rivers. They are the Jefferey, Johnson 1 (J1), and Johnson 2 (J2) power plants which are located along a 75-mile Supply Canal that receives its water from the Central District Diversion Dam at North Platte.

These facilities are all in western Nebraska (with the exception of Kearney Hydro in the central part of the state), which allow them to provide significant flexibility to water users along the Platte. The reservoirs and canals help keep flows above minimum thresholds during times of shortage. NPPD diverts South Platte River water into the Korty canal which flows to Sutherland Reservoir (the location of Gerald Gentleman Station). Water then flows from Sutherland Reservoir to Lake Maloney before its use at the North Platte Hydro facility and eventually returns to the South Platte River just above the confluence of the North Platte and South Platte rivers. The CNPPID Supply Canal diverts water released from Lake McConaughy (North Platte River) and the South Platte River and directs it through several regulating reservoirs. These reservoirs provide irrigation deliveries (during the irrigation season) or water back to the Platte River during non-irrigation season. There are two returns to the Platte River, one after the Jeffery Power Plant, and the other at the end of the canal past the J1, J2 hydropower facilities.

The five hydropower plants that are connected to the Study Area have a combined power generation capacity of about 88 megawatts (MW): Jeffery (20 MW); J1 (20 MW); J2 (23 MW); North Platte Hydro (24 MW); Kearney Hydro (1 MW)[73]. Hydroelectric generation is used to meet demands as part of a complex and comprehensive

[73] https://www.nppd.com/powering-nebraska/energy-resources/hydropower?locale=en; https://www.cnppid.com/operations/hydropower/

power generation and distribution strategy throughout the state, which includes some out-of-state power exports and imports through potential supply, exchange, and demand contracts. Water availability, pricing, and generation system mix considerations factor into the opportunity to use hydroelectric plants. When it is dry the water supply may be less reliable; storage may become a higher priority, or there may be lack of water availability. In average water supply periods, generation mix, spinning reserve and pricing may be more important than generation as a demand. When it is wet and there is an abundance of available water, generator installed capacity is generally the demand limiting factor. Hydropower plants have water appropriation rights, but being non-consumptive, they are tied to other non-consumptive use in the basin.

To summarize, hydropower demand can be considered as an opportunity related to the Project that would improve managed water availability that could be used for power production in the state of Nebraska.

3.2 Summary

Nebraska currently uses water from the South Platte River for water uses and flow management throughout the Platte River Basin. Any decline in the availability of these supplies will result in changed water management actions and economic losses to the state. The Perkins County Canal Project will enable Nebraska to continue to provide South Platte River supplies to meet its irrigation needs, while providing secondary benefits to municipal and industrial, environmental, and hydroelectric uses in the Basin. These benefits are quantified in Section 5.

Section 4

PERKINS COUNTY CANAL PROJECT AND ALTERNATIVES

This section describes the Perkins County Canal Project and Alternatives developed to reduce environmental and financial impacts.

This section presents the alternatives developed for the Perkins County Canal Project in response to LB1012's directive 3. Information presented in this section includes Project elements for each alternative identified. In addition, the methodology for determining water availability for an increased canal capacity is also presented.

4.1 Perkins County Canal Project

On December 28, 1981, the Nebraska Interagency Water Coordinating Committee requested the United States Bureau of Reclamation (USBR) to conduct an engineering study to evaluate the potential costs associated with construction of the Perkins County Canal Project (1982 Report).[74] The 1982 Report's proposed project divided the Perkins Canal into three (3) sections: the 1st Section, 2nd Section, and the Roscoe Canal section. The 1st Section consisted of 24 miles of concrete-lined canal from the South Platte River at a location one (1) mile west of Ovid, Colorado that carried the diverted water east to the Keith County line into Nebraska.[75] From that point, the water would discharge into the 2nd Section, consisting of 32 miles of earth canal followed the high ridge along the southern border of Keith County until its terminus at the proposed Roscoe Draw Reservoir.[76] From here, the Roscoe Canal would convey water discharged from Roscoe Reservoir approximately 51 miles to the existing Lake Maloney. Figures 4-1 and 4-2 below depict Perkins County Canal Project as envisioned in the 1982 Report, including the three canal sections and six (6) proposed reservoirs.

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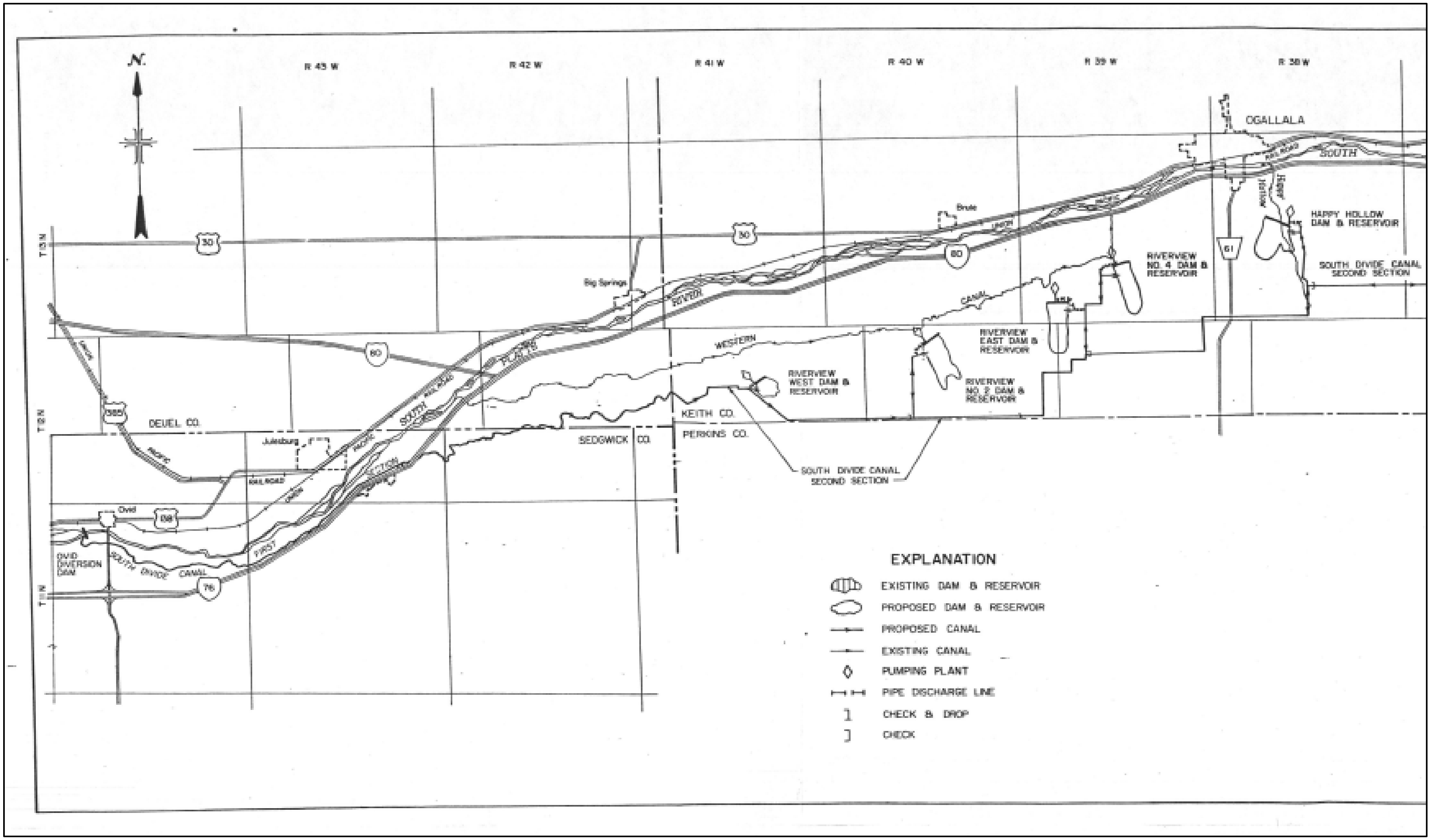
[74] United States Department of the Interior, Bureau of Reclamation. (1982). USBR Project Costs Estimate for the South Divide Canal Project.

[75] Id.

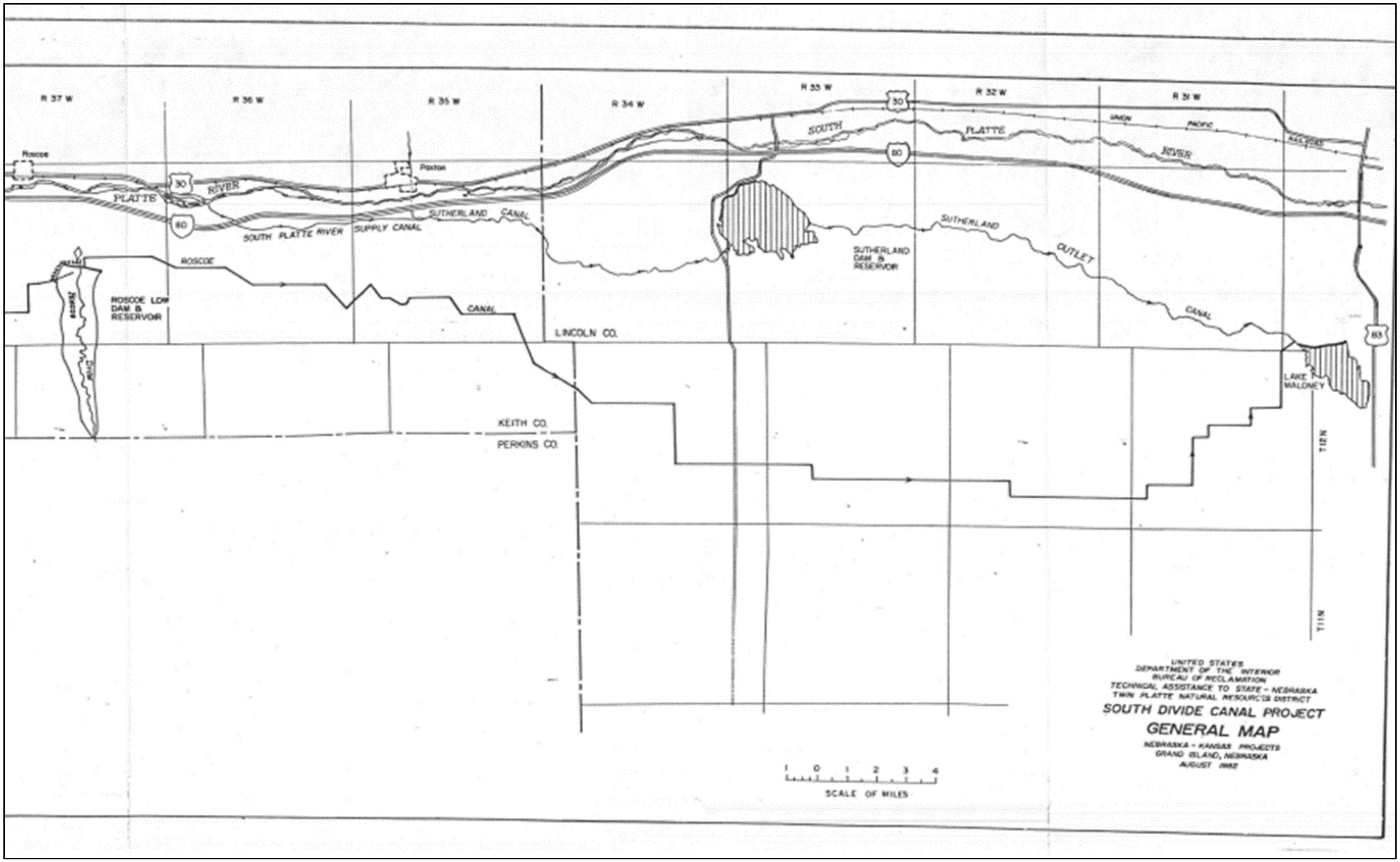
[76] Id.

Figure 4-1: General Map Part I[77]



[77] Id.

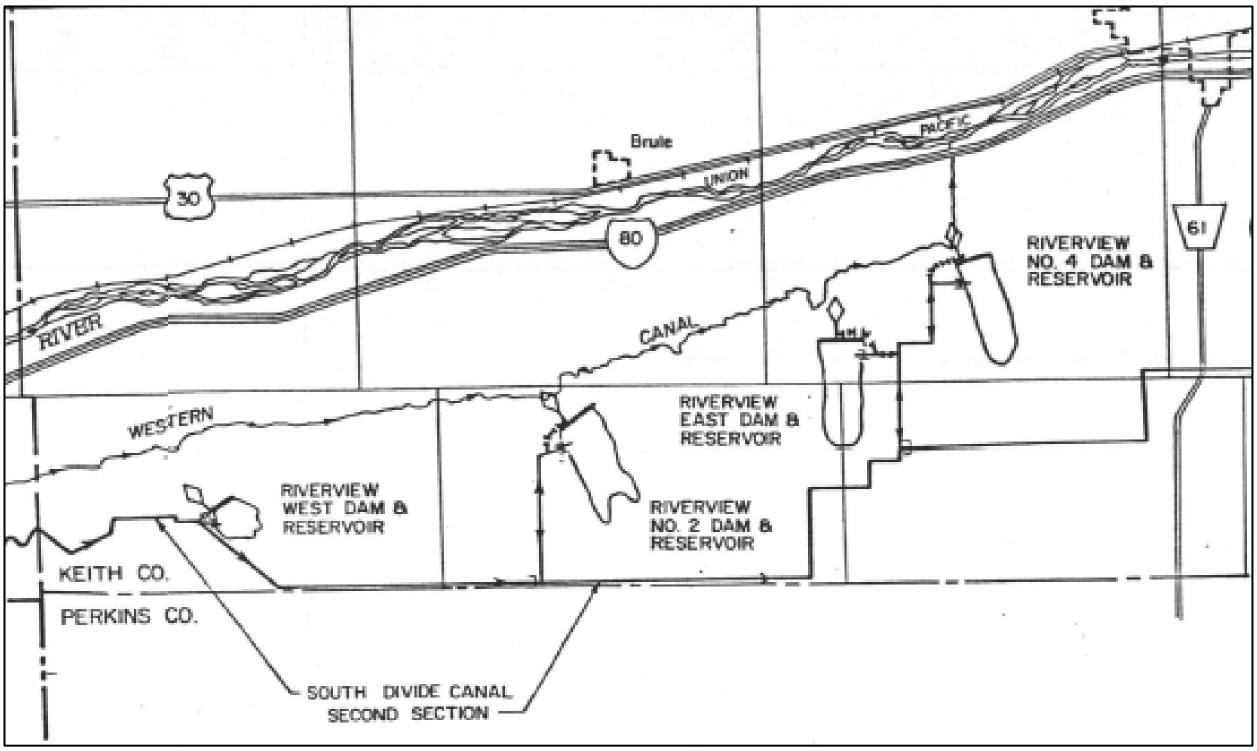
Figure 4-2: General Map Part II[78]



[78] Id.

The 2nd Section would have discharged water directly into Riverview West and Roscoe Draw Reservoirs and three sub-canals would have directed water from the Second Section into three other proposed reservoirs. The Riverview No. 2 Subcanal is an earth canal that is 2.3 miles long, connecting the 2nd Section to the proposed Riverview No. 2 Reservoir. The Riverview No. 4 Subcanal is 3.3 miles long connecting the 2nd Section to the Riverview No. 4 Reservoir as well as the Riverview East Reservoir. These reservoirs are connected by the Riverview East Subcanal, a 0.9-mile-long earth canal.[79]

Figure 4-3: 2nd Section Riverview Subcanals and Reservoirs[80]

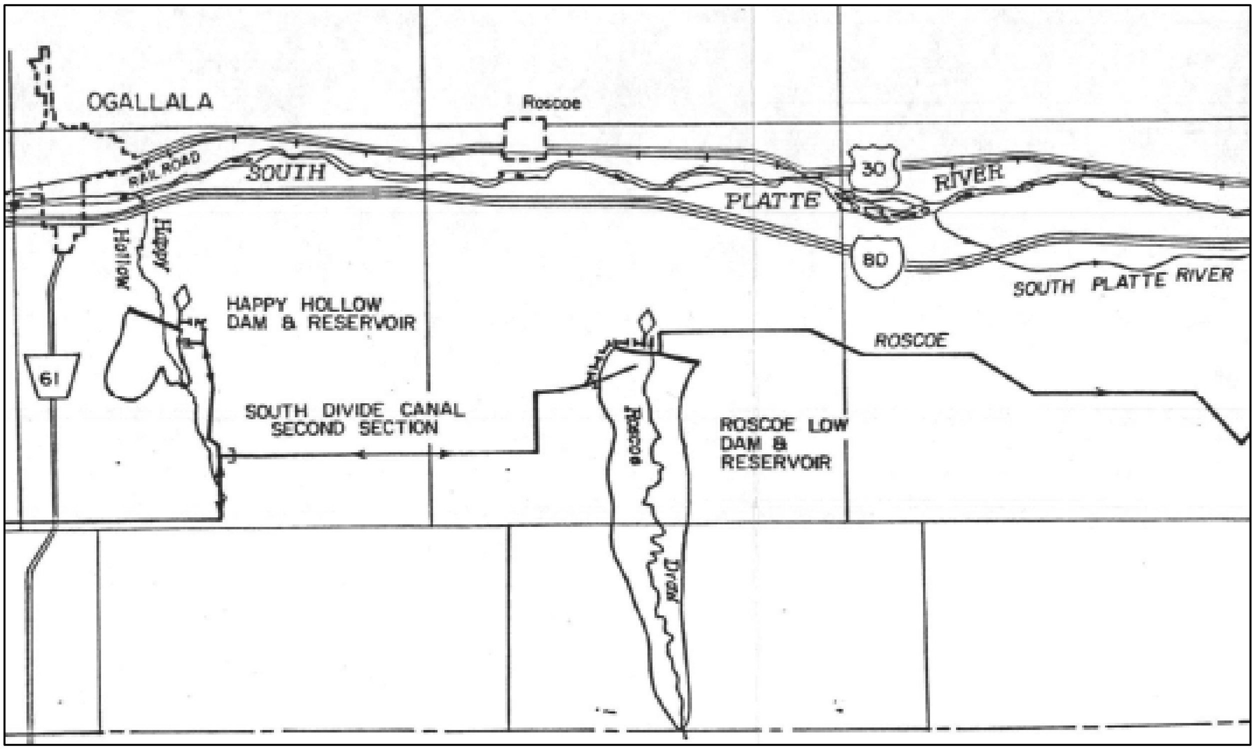


These subcanals, shown in Figure 4-3 above, were designed to carry water in both directions, from the 2nd Section and into the reservoirs for storage and carried back into the 2nd Section for further delivery down the system.[81] Further east, the Happy Hollow Subcanal, identified in Figure 4-4 below, consisted of 2 miles of earth canal that carries water into the Happy Hollow Reservoir from the 2nd Section. The proposed reservoirs were to be filled by gravity flow. However, the Riverview West Reservoir and

[79] Id.
[80] Id.
[81] Id.

damsite (*see* Figure 4-3 above) requires pumping plants to send water back to the canal from the reservoir.[82]

Figure 4-4: 2nd Section Subcanals and Reservoirs[83]



The South Platte River Compact states that the proposed Perkins County Canal alignment may run "easterly through Colorado along or near the line of survey of the formerly proposed Perkins County Canal."[84] This description was used as the basis of the USBR engineering study, however, roughly two (2) miles of the canal were relocated due to Colorado Interstate 76 and additional locations were selected to allow the canal to be the main distribution system and supply water to the proposed reservoir sites.[85] It was noted that the 1982 engineering study likely represents a high-end cost estimate and the evaluation likely exceeds the necessary components of the final system design.[86]

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[82] Id.
[83] Id.
[84] Article VI, The South Platte River Compact, April 27, 1923.
[85] United States Department of the Interior, Bureau of Reclamation. (1982). USBR Project Costs Estimate for the South Divide Canal Project.
[86] Nebraska Department of Natural Resources. (2022). RE: United States Department of the Interior, Bureau of Reclamation. (1982). USBR Project Costs Estimate for the South Divide Canal Project.

This Study used the canal alignment and project elements presented in the 1982 Report as the starting point for development of two (2) alternatives, assessing initial costs, and estimating a timeline for completion aimed at addressing LB1012's Legislative directives. Standard engineering practices and principles were utilized in the development of the conceptual-level designs. More information on the physical description of the two (2) Project alternatives developed for this Study is presented in the following sections.

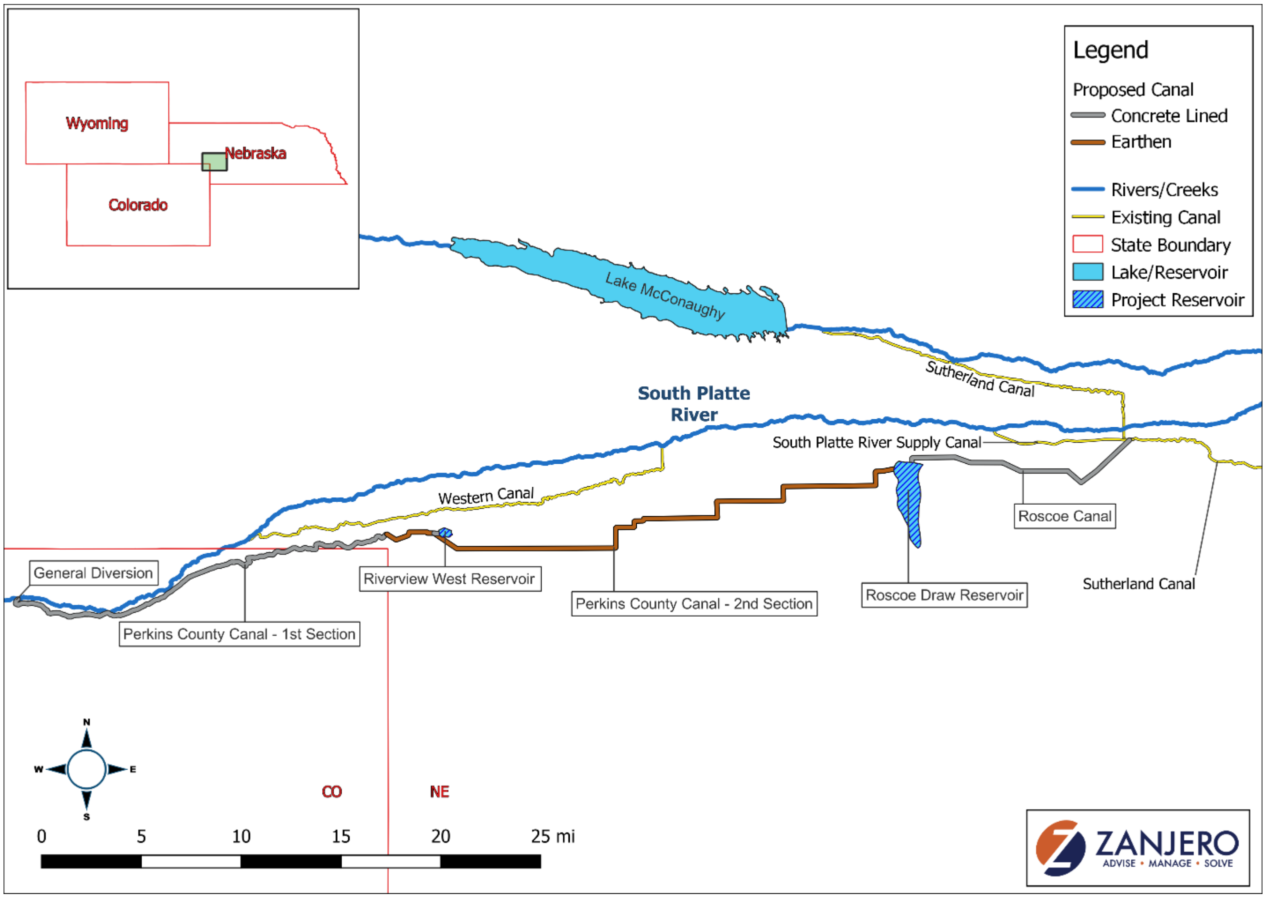
4.2 Perkins County Canal – Alternative 1

As stated earlier, the 1982 Report was used as the basis for developing alternatives to address LB1012 directives. The BOR's 1982 Report canal overall length was shortened with its terminus location modified based on water supply availability, utilizing existing infrastructure, environmental impacts and benefits, and anticipated costs. This alternative (Alternative 1) includes the following elements:

- Diversion Facility (specific layout to be determined, capacity = 500)
- South Divide Canal – 1st Section (capacity = 500 cfs, concrete lined, 24.0 miles)
- South Divide Canal – 2nd Section (capacity = 500 cfs, earthen, 32.0 miles)
- Riverview West Reservoir (including drop structure, dam, and reservoir)
- Roscoe Draw Reservoir (including drop structure, dam, and reservoir)
- Roscoe Canal and Drop Structure (capacity = 500 cfs concrete lined, 13.0 miles)

Figure 4-5 displays the elements presented in this evaluation. More information on each of Alternative 1's components is presented in the following subsections.

Figure 4-5: Alternative 1 Overview



4.2.1 Alternative 1: Diversion Facility

A diversion facility to take water from the South Platte River would be constructed to allow water diversion into the Perkins County Canal. One possible diversion facility (typical to the Platte River system) would include a concrete diversion dam located across the South Platte River that would raise the water level to allow the water to be redirected to the Perkins County Canal. Another possible diversion could occur with the use of Ranney Wells. Ranney Wells are a set of large-diameter wells that would draw water from the sands and gravel of the aquifer under the South Platte River and redirect it to the Perkins County Canal. The most cost-effective and efficient diversion facility will be determined to deliver water in the necessary quantity and quality of water.

In the original design, the diversion facility from the South Platte River was to be located near the town of Ovid, Colorado.

Ovid, Colorado, near the potential location of Canal Diversion Facility. (Photo by Michael Preszler, Zanjero)

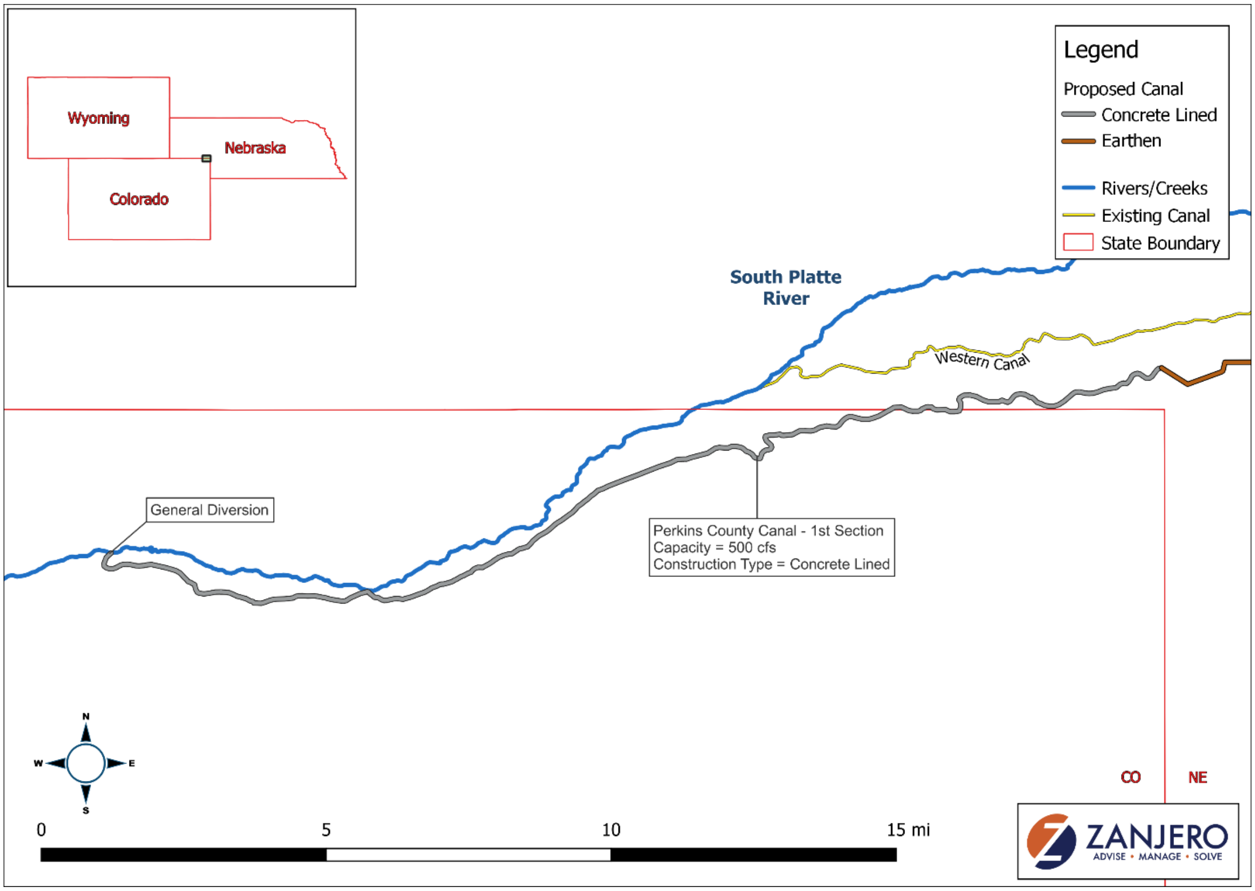
4.2.2 Alternative 1: Perkins County Canal – 1st Section

The Perkins County Canal – 1st Section is a 24-mile concrete lined canal, with a design capacity of 500 cfs. The canal begins at the South Platte River diversion, with an approximate elevation of 3,525-feet above mean sea-level (msl) and proceeds through Sedwick County (Colorado) until it intersects at the north side of Interstate 76. Here, an inverted siphon is required to convey water under Interstate 76. The canal then continues and crosses the state line at approximately Township 12 North, Range 42 West, Section 21 (12N-42W-21). The terminus of this canal section is located near the Deuel County and Keith County boundary line, within 12N-42W-13.

There are a total of 19 bridges (farm access, Highway and County Road crossings) identified and a total of 4 road relocations (farm access, Highway and County Road) required in this section of the Project. This canal is proposed to include fencing on both sides, totaling 48-miles. It is anticipated that cattle guards are required at various locations along this canal section.

It is assumed this canal section requires a 175-foot right of way width for the entire 24-mile length, totaling approximately 510 acres. The canal is designed to have a depth of 7-feet, bottom width of 10-feet, side slope of 3:2, and a grade slope of 0.000166 ft/ft. Figure 4-6 displays an overview map of Alternative 1's Perkins County Canal – 1st Section.

Figure 4-6: Alternative 1 – Perkins County Canal – 1st Section Overview



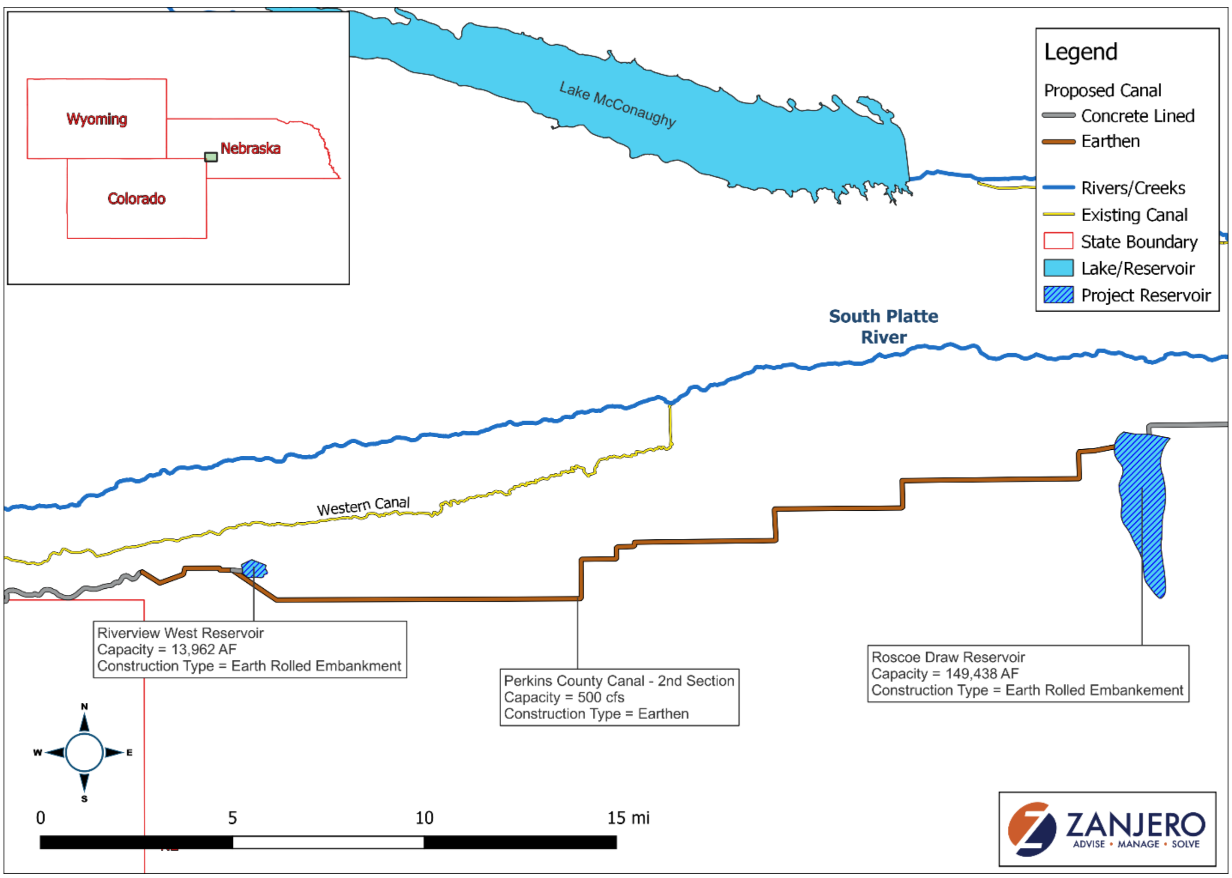
4.2.3 Alternative 1: Perkins County Canal – 2nd Section

Alternative 1's Perkins County Canal – 2nd Section is a 32-mile long earthen canal, with a design capacity of 500 cfs. This section of the canal begins where the 1st Section terminates. The canal runs approximately 3-miles to the Riverview West Reservoir, to an elevation of approximately 3,502-feet msl where a drop structure allows the delivery of water from this canal to the off-canal Riverview West Reservoir (see below for details) along the border of 12N-41W-09 and 12N-41W-16. The canal continues for approximately 29-miles through Keith County until it reaches Roscoe Draw Reservoir within 13N-37W-21. A drop structure would be used to deliver water from this canal to the Roscoe Draw Reservoir (see below for details). There is approximately 200-feet of required canal drops along the 29-mile portion of this canal section bringing the elevation of the terminus of this portion of the canal to approximately 3,300-feet msl. It is noted, seepage associated with this earthen canal will contribute to the local groundwater aquifer, generally increasing groundwater levels and supply availability.

There are a total of 30 bridges (farm access, highway and county road) identified and no road relocations. This canal is proposed to include fencing on both sides, totaling 64-miles. It is anticipated that cattle guards are required at various locations along this canal section.

It is assumed this canal section requires a 200-foot right of way width for the entire 32-mile length, totaling approximately 780 acres. This section of the canal is designed to have a depth of 6.1-feet, bottom width of 28-feet, side slope of 2:1, and a grade slope of 0.000131 ft/ft. Figure 4-7 displays an overview map of Alternative 1's Perkins County Canal – 2nd Section.

Figure 4-7: Alternative 1 – Perkins County Canal –2nd Section Overview



4.2.4 Alternative 1: Riverview West (Drop Structure, Dam, and Reservoir)

The Riverview West Drop Structure is used to convey water from the canal to the reservoir. This drop structure has an approximate drop of 40-feet, running approximately 1,300-feet long, 9.47-feet wide, with walls 9.5-feet tall. In addition, this drop structure incudes a total of 455 3x2 foot baffles along the 1,300-foot length used for energy dissipation.

The Riverview West Dam is proposed to be an earth rolled embankment dam, with a crest elevation of 3,504-feet msl and a drainage outlet elevation of 3,460-feet msl. The crest length is proposed to be approximately 6,100-feet, with a maximum structural height of 64-feet (top of crest to bottom of dam), and a crest top width of 30-feet. The Riverview West Reservoir is proposed to have a surface area of approximately 646-acres, 13.3-square miles of watershed drainage area, a maximum water surface elevation of 3,497-feet msl, and a total estimated useable capacity of 13,962 acre-feet (AF) (dead storage approximately 1,292 AF). In total, the Riverview West Dam and Reservoir would require approximately 1,920 acres of Rights-of-Way acquisition, approximately 8-miles of security fencing, and relocation of approximately 1-mile of county roads.

4.2.5 Alternative 1: Roscoe Draw (Drop Structure, Dam, and Reservoir)

The Roscoe Draw Drop Structure is used to deliver water from the canal to the Roscoe Draw Reservoir. This drop structure has an approximate drop of 145-feet, running approximately 2,200-feet long, 9.47-feet wide, with walls 9.5-feet tall. In addition, this drop structure incudes a total of 770 3x2 foot baffles along the 2,200-foot length used for energy dissipation. The Roscoe Draw Dam is proposed to be an earth rolled embankment dam, with a crest elevation of 3,300-feet msl and a drainage outlet elevation of 3,205-feet msl. The crest length is proposed to be approximately 6,800-feet, with a maximum structural height of 105-feet (top of crest to bottom of dam), and a crest top width of 30-feet.

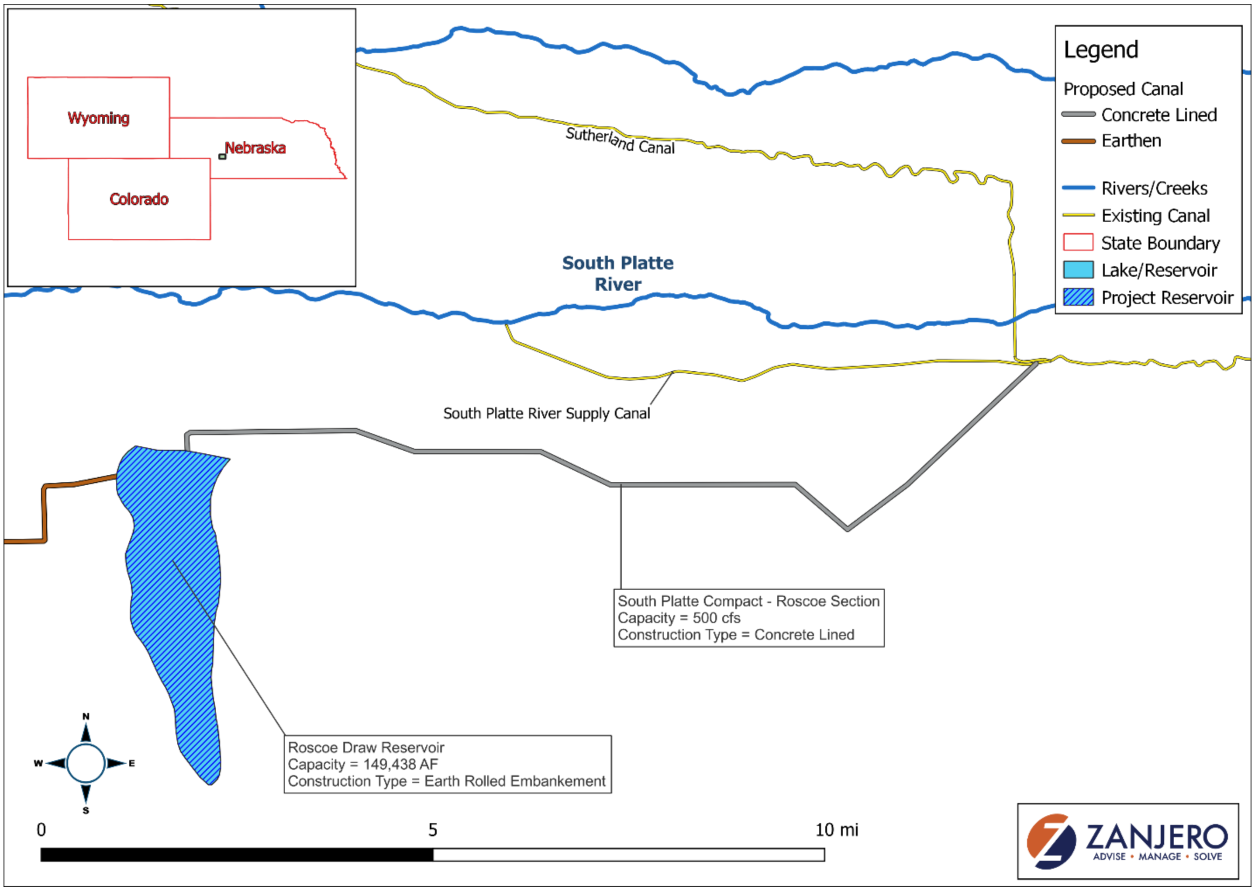
The Roscoe Draw Reservoir is proposed to have a surface area of approximately 4,844-acres, 63.0-square miles of watershed drainage area, a maximum water surface elevation of 3,287-feet msl, and a total estimated useable capacity of 149,438 AF (dead storage approximately 1,688 AF).

In total, the Roscoe Draw Dam and Reservoir would require approximately 10,160 acres of Rights-of-Way acquisition, and approximately 24.5-miles of security fencing. In addition, the Roscoe Draw Dam and Reservoir would require relocation of approximately 2.0-miles of existing transmission lines, and the addition of approximately 7.0-miles of new transmission lines.

4.2.6 Alternative 1: Roscoe Canal and Drop Structure (to South Platte River Supply/Sutherland Canal)

The Roscoe Canal is an approximately 13-mile concrete lined canal, with a design capacity of 500 cfs. This canal originates at the Roscoe Draw Reservoir outlet, with an approximate starting elevation of 3,205-feet msl. This canal requires approximately 45-feet of required canal drops along the 13 miles. The terminus of this canal is approximately located at the confluence of the existing Supply Canal and North Platte Canal, at an elevation of roughly 3,100-feet msl within 13N-35W-09. There are a total of 9 bridges (highway and county road) identified in this preliminary feasibility study and no road relocations. This canal is proposed to include fencing on both sides, totaling 26 miles. It is anticipated that cattle guards are required at various locations along this canal. It is also assumed this canal requires an 175-foot right of way width for the entire 13-mile length, totaling approximately 280 acres. The canal is designed to have a depth of 7.0-feet, bottom width of 10.0-feet, side slope of 3:2, and a grade slope of 0.000166 ft/ft (approximately 0.9 ft/mile). Figure 4-8 displays an overview map of Alternative 1's Roscoe Canal.

Figure 4-8: Alternative 1 – Roscoe Canal Overview



4.2.7 Alternative 1: Supply Availability

Results from water supply availability (developed in Section 2) are again shown in Table 4-1 below. Recall, these results used the capacity of diversion facility and canal for Alternative 1 (500 cfs) as an upper limit. That is, there were times when more than 500 cfs was available, but due to Alternative 1's diversion and canal capacity of 500 cfs, the maximum diversion was limited to this capacity.

Table 4-1: Estimated Alternative 1 Supply Availability by Year Types (acre-feet and cfs)

Year Type	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
Below Average	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,400 AF (137 cfs)	8,300 AF (135 cfs)	8,200 AF (133 cfs)	7,800 AF (127 cfs)
	Jan	11,900 AF (194 cfs)	11,700 AF (190 cfs)	11,500 AF (187 cfs)	10,800 AF (176 cfs)
	Feb	11,700 AF (211 cfs)	11,600 AF (209 cfs)	11,400 AF (205 cfs)	10,900 AF (196 cfs)
	Mar	4,700 AF (76 cfs)	4,600 AF (75 cfs)	4,400 AF (72 cfs)	3,800 AF (62 cfs)
	Non-Irrigation Season Avg	**36,700 AF (111 cfs)**	**36,200 AF (109 cfs)**	**35,500 AF (107 cfs)**	**33,300 AF (101 cfs)**
Average	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Nov	900 AF (15 cfs)	700 AF (12 cfs)	600 AF (10 cfs)	300 AF (5 cfs)
	Dec	15,200 AF (247 cfs)	14,800 AF (241 cfs)	14,400 AF (234 cfs)	12,900 AF (210 cfs)
	Jan	21,100 AF (343 cfs)	20,700 AF (337 cfs)	20,300 AF (330 cfs)	18,500 AF (301 cfs)
	Feb	19,600 AF (353 cfs)	19,300 AF (348 cfs)	18,900 AF (340 cfs)	17,500 AF (315 cfs)
	Mar	14,000 AF (228 cfs)	13,500 AF (220 cfs)	13,000 AF (211 cfs)	11,200 AF (182 cfs)
	Non-Irrigation Season Avg	**70,800 AF (214 cfs)**	**69,000 AF (208 cfs)**	**67,200 AF (203 cfs)**	**60,400 AF (182 cfs)**
Above Average	Oct	4,000 AF (126 cfs)	3,600 AF (113 cfs)	3,200 AF (101 cfs)	1,900 AF (60 cfs)
	Nov	12,700 AF (213 cfs)	12,200 AF (205 cfs)	11,600 AF (195 cfs)	8,900 AF (150 cfs)
	Dec	27,200 AF (442 cfs)	27,000 AF (439 cfs)	26,700 AF (434 cfs)	25,400 AF (413 cfs)
	Jan	30,600 AF (498 cfs)	30,500 AF (496 cfs)	30,500 AF (496 cfs)	30,200 AF (491 cfs)
	Feb	27,300 AF (492 cfs)	27,300 AF (492 cfs)	27,200 AF (490 cfs)	26,800 AF (483 cfs)
	Mar	24,500 AF (398 cfs)	24,100 AF (392 cfs)	23,700 AF (385 cfs)	21,800 AF (355 cfs)
	Non-Irrigation Season Avg	**126,300 AF (381 cfs)**	**124,700 AF (376 cfs)**	**122,900 AF (371 cfs)**	**115,000 AF (347 cfs)**
All Years	Oct	1,400 AF (44 cfs)	1,200 AF (38 cfs)	1,100 AF (35 cfs)	600 AF (19 cfs)
	Nov	4,600 AF (77 cfs)	4,400 AF (74 cfs)	4,100 AF (69 cfs)	3,100 AF (52 cfs)
	Dec	17,000 AF (276 cfs)	16,800 AF (273 cfs)	16,500 AF (268 cfs)	15,400 AF (250 cfs)
	Jan	21,300 AF (346 cfs)	21,100 AF (343 cfs)	20,800 AF (338 cfs)	19,900 AF (324 cfs)
	Feb	19,600 AF (353 cfs)	19,500 AF (351 cfs)	19,300 AF (348 cfs)	18,500 AF (333 cfs)
	Mar	14,500 AF (236 cfs)	14,200 AF (231 cfs)	13,800 AF (224 cfs)	12,400 AF (202 cfs)
	Non-Irrigation Season Avg	**78,400 AF (237 cfs)**	**77,200 AF (233 cfs)**	**75,600 AF (228 cfs)**	**69,900 AF (211 cfs)**

4.3 Perkins County Canal – Alternative 2

This section describes Alternative 2 as variances, or changes from the Alternative 1 presented in the previous section. Further, this section includes information on the hydrology and water rights associated with Alternative 2.

Development of Alternative 2 originates from the acknowledgment of Nebraska's ability to access surplus flows that exceed the 500 cfs entitlement stipulated in the Compact. Based on water availability, there are times during the non-irrigation period when available water exceeds Nebraska's 500 cfs entitlement. During these periods, the additional water can be diverted for subsequent beneficial use within Nebraska.

An alternative was described and included in the USBR's 1982 Report. Specifically, the 1982 Report identified an alternative that increased the Perkins County Canal (1st and 2nd Sections) from 500 cfs to 1,000 cfs capacity. This Study uses the BOR's 1982 1,000 cfs alternative as the starting point for developing an alternative to address LB1012's directive.

Alternative 2 uses many of the same elements identified for Alternative 1 (see Section 4.2 and subsections). This includes the diversion facility type, canal alignment, and reservoir locations and capacities. Modifications to Alternative 2 primarily include increasing diversion capacity and capacity of the Perkins County Canal from 500 cfs to 1,000 cfs. The increased capacity requires a larger canal "footprint". That is, the proposed increase in canal capacity requires increases in Rights-of-Way acreage and larger bridges associated with road crossings (farm access, highway and county road).

The following subsections describe Alternative 2 project elements. For completeness purposes, all elements associated with Alternative 2 are included and may be a duplicate of the description presented in prior sections. Specific elements differing from Alternative 1 presented in the previous sections are highlighted with bold text.

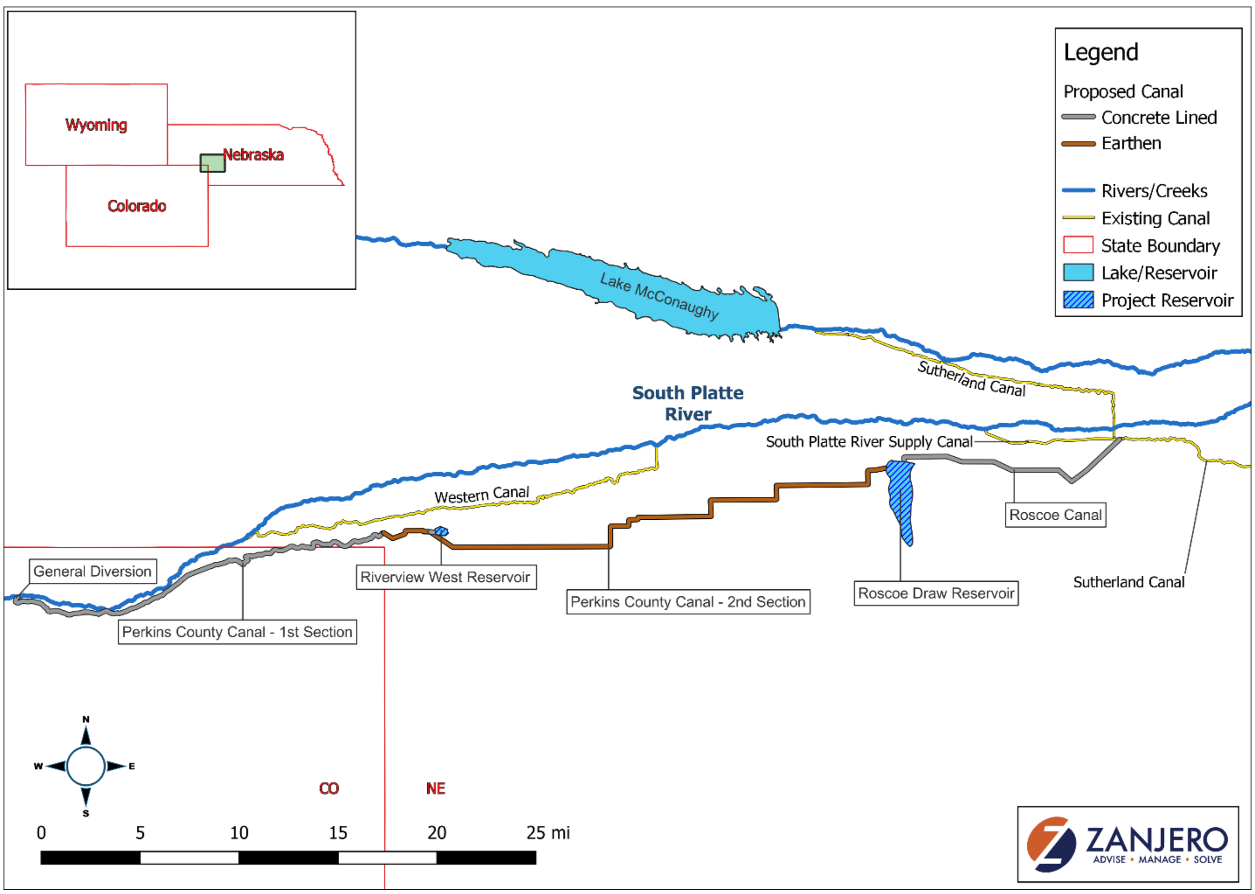
Alternative 2 includes the following elements:

- Diversion Facility (specific layout to be determined, **capacity = 1,000 cfs**)
- South Divide Canal – 1st Section (**capacity = 1,000 cfs**, concrete lined, 24.0 miles)

- South Divide Canal – 2nd Section (**capacity = 1,000 cfs**, earthen, 32.0 miles)
- Riverview West (including drop structure, dam, and reservoir)
- Roscoe Draw (including drop structure, dam, and reservoir)
- Roscoe Canal and Drop Structure (capacity = **1,000** cfs concrete lined, 13.0 miles)

Figure 4-9 displays the Alternative 2 elements presented in this evaluation. More information on each of the identified Alternative 2 elements is presented in the following subsections.

Figure 4-9: Alternative 2 Overview



4.3.1 Alternative 2: Diversion Facility

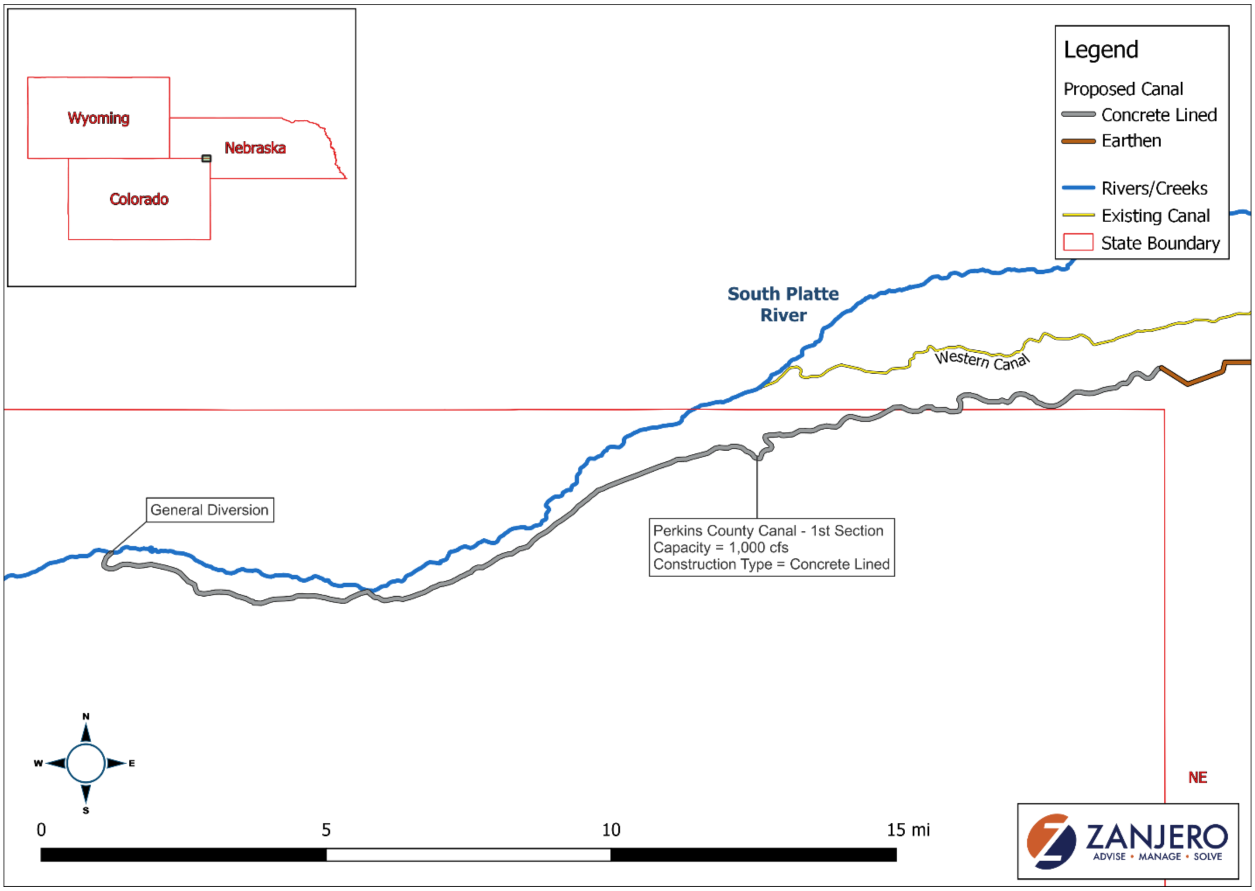
Like Alternative 1, a diversion facility to take water from the South Platte River would be constructed to allow water diversion into the Perkins County Canal, although constructed to allow a 1,000 cfs diversion instead of 500 cfs. Also like Alternative 1, the diversion facility could include a concrete diversion dam located across the South Platte River or the potential use of Ranney Wells.

4.3.2 Alternative 2: Perkins County Canal – 1st Section

Like Alternative 1, Alternative 2's Canal – 1st Section is a 24-mile concrete lined canal, although with an increased design capacity of 1,000 cfs. The Canal begins at the South Platte River diversion, like Alternative 1, with an approximate elevation of 3,525-feet above mean sea-level (msl) and proceeds through Sedwick County (Colorado) until it intersects at the north side of Interstate 76. Here, an inverted siphon is required to convey water under Interstate 76. The canal then continues and crosses the state line at approximately 12N-42W-21. The terminus of this canal is located near the Deuel County and Keith County boundary line, within 12N-42W-13.

Like Alternative 1, there are a total of 19 bridges (farm access, highway and county road) identified and a total of 4 road relocations (farm access, highway and county road). This canal is proposed to include fencing on both sides, totaling 48-miles. It is anticipated that cattle guards are required at various locations along this canal section. It is assumed this canal requires a 200-foot right of way width for the entire 24-mile length, totaling approximately 582 acres. The canal is designed to have a depth of 9.0-feet, bottom width of 12.0-feet, side slope of 3:2, and a grade slope of 0.000189 ft/ft (approximately 1 ft/mile). Figure 4-10 displays an overview map of Alternative 2's Perkins County Canal – 1st Section.

Figure 4-10: Alternative 2 – Perkins County Canal – 1st Section Overview



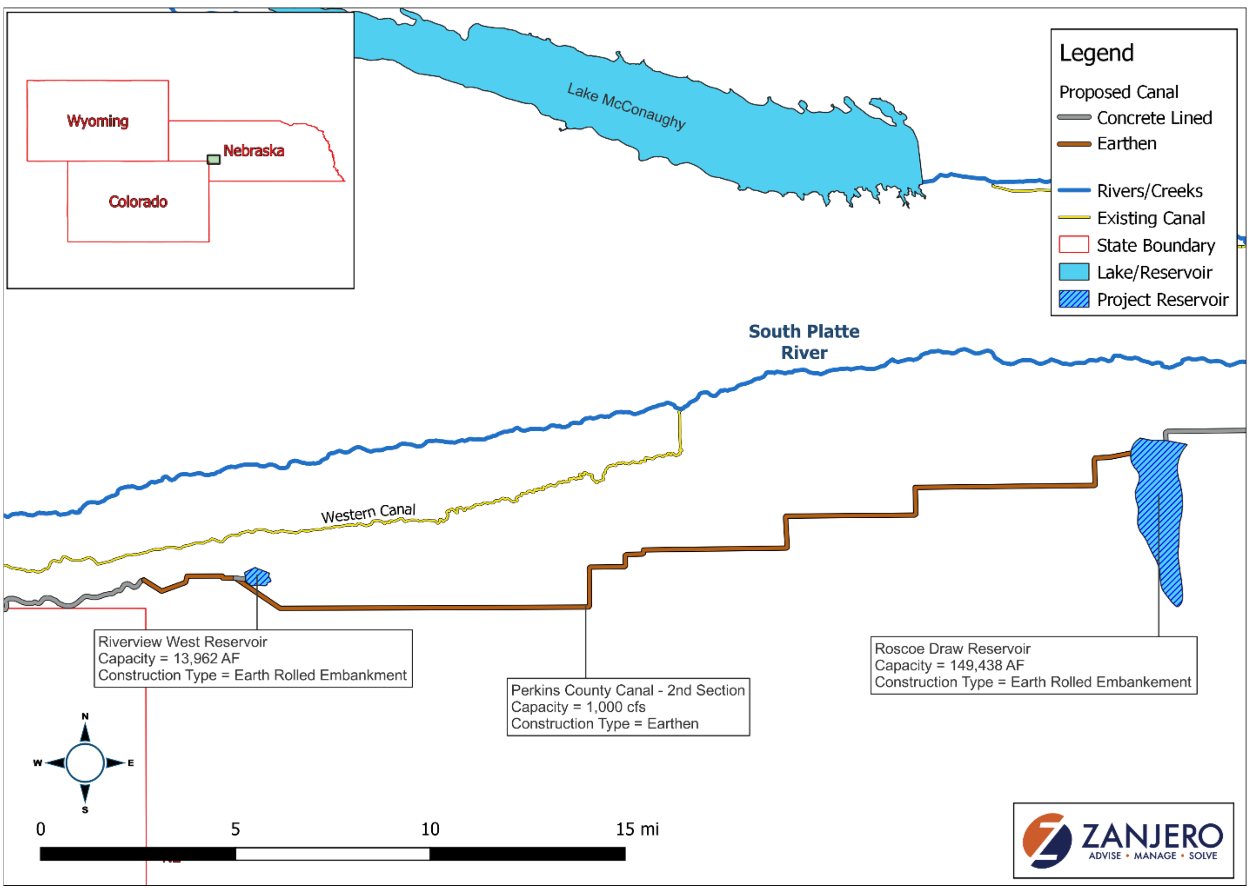
4.3.3 Alternative 2: Perkins County Canal – 2nd Section

Like Alternative 1, Alternative 2's Perkins County Canal – 2nd Section is a 32-mile earth canal, although with an increased design capacity of 1,000 cfs. This section of the canal begins where the 1st Section terminates. The canal runs approximately 3-miles to the Riverview West Reservoir, to an elevation of approximately 3,502-feet msl where a drop structure allows the delivery of water from this canal to the off-canal Riverview West Reservoir (see below for details) along the border of 12N-41W-09 and 12N-41W-16. Like Alternative 1, this canal section continues for another 29-miles through Keith County until it reaches Roscoe Draw Reservoir within 13N-37W-21. A drop structure would be used to deliver water from this canal to the Roscoe Draw Reservoir (see below for details). There is approximately 205-feet of required drops along the 29-mile portion of this canal bringing the elevation of the terminus of this portion of the canal to approximately 3,300-feet msl.

Like Alternative 1, there are a total of 30 bridges (farm access, and highway and county road) identified and no road relocations with Alternative 2's Perkins County

Canal – 2nd Section. This canal is proposed to include fencing on both sides, totaling 64-miles. It is anticipated that cattle guards are required at various locations along this canal, as with other sections in both alternatives. It is assumed this canal requires a 220-foot right of way width for the entire 32-mile length, totaling approximately 853 acres. The canal is designed to have a depth of 9.1-feet, bottom width of 36-feet, side slope of 2:1, and a grade slope of 0.000087 ft/ft (approximately 0.45 ft/mile). Figure 4-11 displays an overview map of Alternative 2's Perkins County Canal – 2nd Section.

Figure 4-11: Alternative 2 – Perkins County Canal – 2nd Section Overview



4.3.4 Alternative 2: Riverview West (Drop Structure, Dam, and Reservoir)

The Riverview West Drop Structure is used to convey water from the canal to the reservoir. This drop structure has an approximate drop of 40-feet, running approximately 1,300-feet long, 9.47-feet wide, with walls 9.5-feet tall. In addition, this drop structure incudes a total of 455 3x2 foot baffles along the 1,300-foot length used for energy dissipation.

The Riverview West Dam is proposed to be an earth rolled embankment dam, with a crest elevation of 3,504-feet msl and a drainage outlet elevation of 3,460-feet msl. The crest length is proposed to be approximately 6,100-feet, with a maximum structural height of 64-feet (top of crest to bottom of dam), and a crest top width of 30-feet. The Riverview West Reservoir is proposed to have a surface area of approximately 646-acres, 13.3-square miles of watershed drainage area, a maximum water surface elevation of 3,497-feet msl, and a total estimated useable capacity of 13,962 AF (dead storage approximately 1,292 AF). In total, the Riverview West Dam and Reservoir would require approximately 1,920 acres of Rights-of-Way acquisition, approximately 8-miles of security fencing, relocation of approximately 1-mile of county roads.

4.3.5 Alternative 2: Roscoe Draw (Drop Structure, Dam, and Reservoir)

The Roscoe Draw Drop Structure is used to deliver water from the canal to the Roscoe Draw Reservoir. This drop structure has an approximate drop of 145-feet, running approximately 2,200-feet long, 9.47-feet wide, with walls 9.5-feet tall. In addition, this drop structure incudes a total of 770 3x2 foot baffles along the 2,200-foot length used for energy dissipation.

The Roscoe Draw Dam is proposed to be an earth rolled embankment dam, with a crest elevation of 3,300-feet msl and a drainage outlet elevation of 3,205-feet msl. The crest length is proposed to be approximately 6,800-feet, with a maximum structural height of 105-feet (top of crest to bottom of dam), and a crest top width of 30-feet.

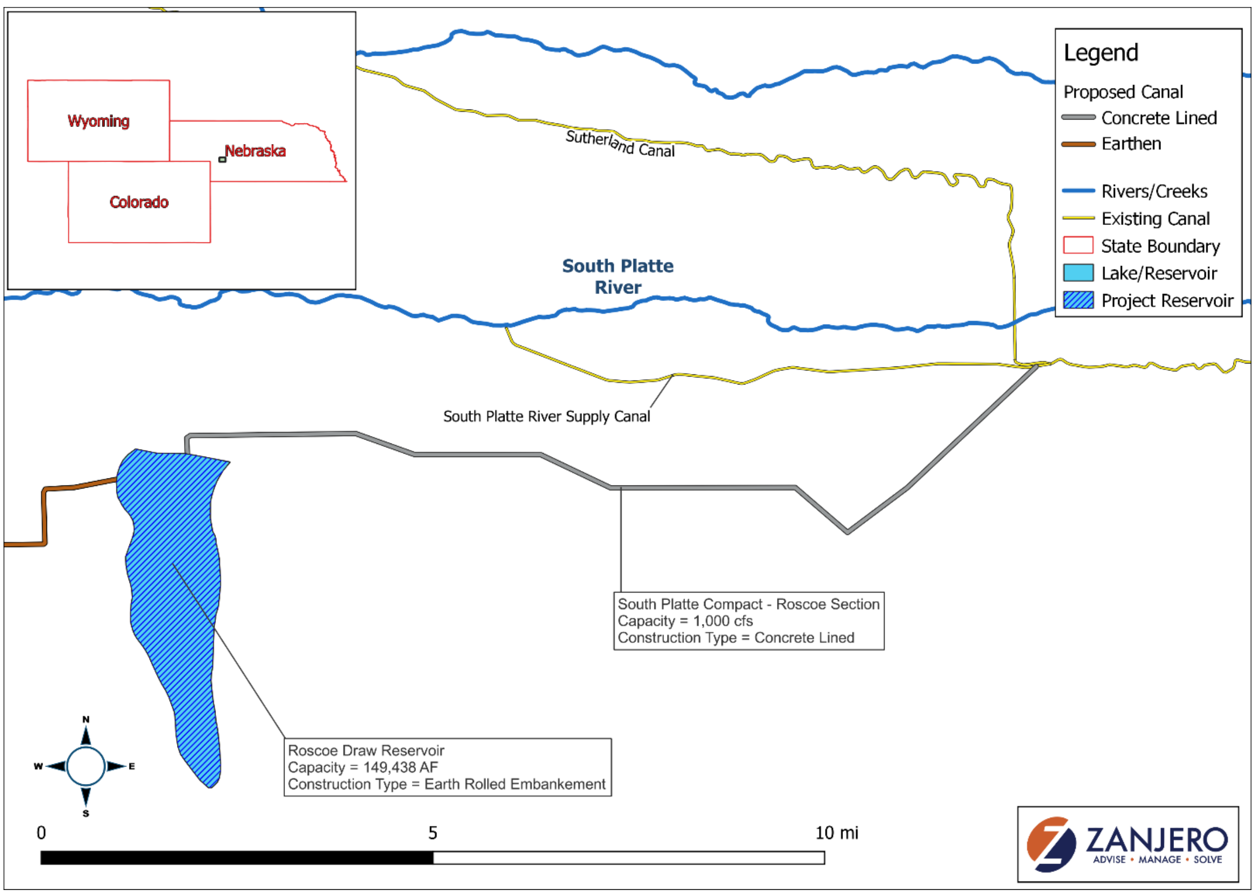
The Roscoe Draw Reservoir is proposed to have a surface area of approximately 4,844-acres, 63.0-square miles of watershed drainage area, a maximum water surface elevation of 3,287-feet msl, and a total estimated useable capacity of 149,438 AF (dead storage approximately 1,688 AF). In total, the Roscoe Draw Dam and Reservoir would require approximately 10,160 acres of Rights-of-Way acquisition, and approximately 24.5-miles of security fencing. In addition, the Roscoe Draw Dam and Reservoir would require relocation of approximately 2.0-miles of existing transmission lines, and the addition of approximately 7.0-miles of new transmission lines.

4.3.6 Alternative 2: Roscoe Canal and Drop Structure (to South Platte River Supply/Sutherland Canal)

Like Alternative 1, Alternative 2's Roscoe Canal is an approximately 13-mile concrete lined canal, although with an increased design capacity of 1,000 cfs. This canal originates at the Roscoe Draw Reservoir outlet, with an approximate starting elevation of 3,205-feet msl, like Alternative 1. This canal requires approximately 145-feet of required drops along the 13 miles. The terminus of this canal is approximately located at the confluence of the existing Supply Canal and North Platte Canal, at an elevation of roughly 3,100-feet msl within 13N-35W-09.

As the case with Alternative 1, there are a total of 9 bridges (Highway and County Road) identified in this preliminary feasibility study and no road relocations. This canal is proposed to include fencing on both sides, totaling 26 miles. Like Alternative 1, it is anticipated that cattle guards are required at various locations along this section. It is assumed this canal requires a 200-foot right of way width for the entire 13-mile length, totaling approximately 320 acres. The canal is designed to have a depth of 9.0-feet, bottom width of 12.0-feet, side slope of 3:2, and a grade slope of 0.000189 ft/ft (approximately 1 ft/mile). Figure 4-12 displays an overview map of Alternative 2's Roscoe Canal.

Figure 4-12: Alternative 2 – Roscoe Canal Section Overview



4.3.7 Alternative 2: Water Availability

Alternative 2 includes facilities to divert up to 1,000 cfs from the South Platte River during the non-irrigation season based on investigations into water supply availability. Accordingly, the hydrology presented in Section 2 is incorporated into the analysis to determine the water supply availability associated with Alternative 2. This section describes the approach used and the quantification of annual diversions from the South Platte River associated with Alternative 2.

The primary difference in determining the water supply availability for Alternative 2 incorporates the Lower Section Junior Water Rights holders' demands. The Compact provides Nebraska an Appropriation Date of December 17, 1921 for up to 500 cfs, and diversion above 500 cfs may be subject to prior appropriation limitations. As such, this analysis to quantify water supply availability associated with the Alternative 2 incorporates Junior Water Right entitlements prior to making diversions above 500 cfs.

This water supply availability analysis for Alternative 2 uses the defined year types (Below Average, Average, and Above Average), the various scenarios (reduction in Balzac flow of 10%, 20% and 50%), and the "Canal Efficiency" factor presented in Section 2 of this Report.

4.3.7.1 Alternative 2: Water Availability Approach

The approach for quantifying water supply available for diversion associated with Alternative 2 includes acknowledgement of the lack of priority associated with canal diversions above 500 cfs. It is assumed that diversions above 500 cfs are subject to Lower Section Water Rights entitlements. The approach for quantifying the water supply available for diversions above 500 cfs builds off the formula presented in Section 2, which aimed to only quantify Nebraska's 500 cfs entitlement. The following formula is used to quantify the diversions after Nebraska's 500 cfs entitlement (up to 1,000 cfs) associated with the Alternative 2 during the non-irrigation period:

$$Q_{Canal\ (1{,}000\ cfs)} = Q_{SPR} - WR_{JR}$$

The components of the formula are defined as follows:

$Q_{Canal\ (1{,}000\ cfs)}$	=	Available flow for canal diversions above 500 cfs entitlement.
Q_{SPR}	=	South Platte River flow after Nebraska's 500 cfs diversion.
WRJ_R	=	Quantified Junior Water Rights in Lower Section.

This analysis incorporates Lower Section Junior Water Rights entitlements when computed flow in the South Platte River allow for these diversions. That is, only during periods that the Lower Section Junior Water Rights demands are fully diverted is water available for canal diversions under Alternative 2 (above the 500 cfs Compact entitlement). Lower Section Junior Water Rights face value total 5,243 cfs. This analysis assumes the same demand pattern developed for incorporation of Lower Section Senior Water Rights presented in **Section 2** (see **Table 2-4**). **Table 4-2** presents the Lower Section Junior Water Rights demands used in this analysis under all year types.

Table 4-2: Distribution of Junior Water Rights Demands during Diversion Period

Month	Average Percent (%)	Estimated Junior Monthly Demand (cfs, all year types)
Oct	8.3%	346
Nov	7.9%	329
Dec	1.5%	62
Jan	1.0%	42
Feb	1.3%	55
Mar	4.0%	166

The estimated junior monthly demand on the South Platte River in the Lower Section ranges from 42 cfs in January to 346 cfs in October.

4.3.7.2 Alternative 2: Water Availability Results

Table 4-3 displays a summary of the estimated Alternative 2 diversions for the period of record and all year types, under the scenarios originally presented in **Section 2**

(reduced inflow by 10%, 20% and 50% from Upper Section). Monthly amounts for all years in the period of record for both alternatives are presented in Appendix C.

Table 4-3: Estimated Alternative 2 Supply Availability by Year Types (acre-feet and cfs)

Year Type	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
Below Average	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,900 AF (145 cfs)	8,300 AF (135 cfs)	8,200 AF (133 cfs)	7,800 AF (127 cfs)
	Jan	12,500 AF (203 cfs)	11,700 AF (190 cfs)	11,500 AF (187 cfs)	10,800 AF (176 cfs)
	Feb	12,500 AF (225 cfs)	11,700 AF (211 cfs)	11,500 AF (207 cfs)	10,900 AF (196 cfs)
	Mar	5,000 AF (81 cfs)	4,600 AF (75 cfs)	4,400 AF (72 cfs)	3,800 AF (62 cfs)
	Non-Irrigation Season Avg	**38,900 AF (117 cfs)**	**36,300 AF (110 cfs)**	**35,600 AF (107 cfs)**	**33,300 AF (101 cfs)**
Average	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Nov	900 AF (15 cfs)	700 AF (12 cfs)	600 AF (10 cfs)	300 AF (5 cfs)
	Dec	17,400 AF (283 cfs)	16,100 AF (262 cfs)	15,400 AF (250 cfs)	13,200 AF (215 cfs)
	Jan	28,400 AF (462 cfs)	26,600 AF (433 cfs)	25,200 AF (410 cfs)	20,600 AF (335 cfs)
	Feb	25,600 AF (461 cfs)	24,000 AF (432 cfs)	22,800 AF (411 cfs)	19,100 AF (344 cfs)
	Mar	16,700 AF (272 cfs)	15,400 AF (250 cfs)	14,400 AF (234 cfs)	11,600 AF (189 cfs)
	Non-Irrigation Season Avg	**89,000 AF (269 cfs)**	**82,800 AF (250 cfs)**	**78,400 AF (237 cfs)**	**64,800 AF (196 cfs)**
Above Average	Oct	5,000 AF (158 cfs)	4,300 AF (135 cfs)	3,800 AF (120 cfs)	2,400 AF (76 cfs)
	Nov	16,000 AF (269 cfs)	14,700 AF (247 cfs)	13,400 AF (225 cfs)	9,400 AF (158 cfs)
	Dec	45,300 AF (737 cfs)	43,900 AF (714 cfs)	42,400 AF (690 cfs)	34,700 AF (564 cfs)
	Jan	56,900 AF (925 cfs)	55,800 AF (908 cfs)	54,400 AF (885 cfs)	46,000 AF (748 cfs)
	Feb	49,300 AF (888 cfs)	48,000 AF (864 cfs)	46,400 AF (835 cfs)	38,700 AF (697 cfs)
	Mar	37,100 AF (603 cfs)	34,900 AF (568 cfs)	32,800 AF (533 cfs)	25,600 AF (416 cfs)
	Non-Irrigation Season Avg	**209,600 AF (633 cfs)**	**201,600 AF (609 cfs)**	**193,200 AF (583 cfs)**	**156,800 AF (473 cfs)**
All Years	Oct	1,700 AF (54 cfs)	1,500 AF (47 cfs)	1,300 AF (41 cfs)	800 AF (25 cfs)
	Nov	5,700 AF (96 cfs)	5,200 AF (87 cfs)	4,700 AF (79 cfs)	3,300 AF (55 cfs)
	Dec	24,000 AF (390 cfs)	22,900 AF (372 cfs)	22,100 AF (359 cfs)	18,700 AF (304 cfs)
	Jan	32,800 AF (533 cfs)	31,600 AF (514 cfs)	30,600 AF (498 cfs)	26,000 AF (423 cfs)
	Feb	29,300 AF (528 cfs)	28,100 AF (506 cfs)	27,100 AF (488 cfs)	23,000 AF (414 cfs)
	Mar	19,800 AF (322 cfs)	18,400 AF (299 cfs)	17,300 AF (281 cfs)	13,800 AF (224 cfs)
	Non-Irrigation Season Avg	**113,300 AF (342 cfs)**	**107,700 AF (325 cfs)**	**103,100 AF (311 cfs)**	**85,600 AF (258 cfs)**

The estimated annual diversion under Alternative 2 is 113,300 AF (342 cfs). Ranges from 1,700 AF (54 cfs) in October to 32,800 AF (528 cfs) in January. Less water is available for Canal diversion in Below Average years (38,900 AF, 117 cfs) and more water is available in Above Average years (209,600 AF, 633 cfs). The sensitivity analysis, at the 50% level (assuming 50% less water available at Balzac), indicates that on average 85,600 AF (258 cfs) is available with a range from Below Average years of 33,300 AF (101 cfs) to Above Average years of 156,800 AF (473 cfs).

Tables 4-4 through **4-7** present a comparison of the quantified canal diversions for Alternative 1 and Alternative 2 under the various scenarios (taken from **Tables 4-1** and **4-3**).

Table 4-4: No Change Scenario - Supply Availability Results for Alternatives (acre-feet and cfs)

Year Type	Alternative 1	Alternative 2	Percent Change (%)
Below Average	36,700 AF (111 cfs)	38,900 AF (117 cfs)	6.0%
Average	70,800 AF (214 cfs)	89,000 AF (269 cfs)	25.7%
Above Average	126,300 AF (381 cfs)	209,600 AF (633 cfs)	66.0%
All Years	78,400 AF (237 cfs)	113,300 AF (342 cfs)	44.5%

Table 4-5: 10% Reduced Scenario - Supply Availability Results for Alternatives (acre-feet and cfs)

Year Type	Alternative 1	Alternative 2	Percent Change (%)
Below Average	36,200 AF (109 cfs)	36,300 AF (110 cfs)	0.3%
Average	69,000 AF (208 cfs)	82,800 AF (250 cfs)	20.0%
Above Average	124,700 AF (376 cfs)	201,600 AF (609 cfs)	61.7%
All Years	77,200 AF (233 cfs)	107,700 AF (325 cfs)	39.5%

Table 4-6: 20% Reduced Scenario - Supply Availability Results for Alternatives (acre-feet and cfs)

Year Type	Alternative 1	Alternative 2	Percent Change (%)
Below Average	35,500 AF (107 cfs)	35,600 AF (107 cfs)	0.3%
Average	67,200 AF (203 cfs)	78,400 AF (237 cfs)	16.7%
Above Average	122,900 AF (371 cfs)	193,200 AF (583 cfs)	57.2%
All Years	75,600 AF (228 cfs)	103,100 AF (311 cfs)	36.4%

Table 4-7: 50% Reduced Scenario - Supply Availability Results for Alternatives (acre-feet and cfs)

Year Type	Alternative 1	Alternative 2	Percent Change (%)
Below Average	33,300 AF (101 cfs)	33,300 AF (101 cfs)	0.0%
Average	60,400 AF (182 cfs)	64,800 AF (196 cfs)	7.3%
Above Average	115,000 AF (347 cfs)	156,800 AF (473 cfs)	36.3%
All Years	69,900 AF (211 cfs)	85,600 AF (258 cfs)	22.5%

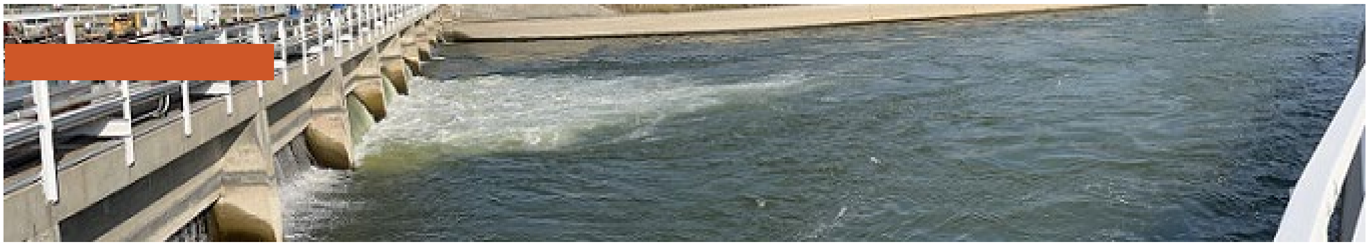
4.4 Project Operation

The operation of both Alternative 1 and Alternative 2 would begin at the South Platte River diversion facility where water would be diverted from the South Platte River into the Perkins County Canal. From there, water would be conveyed through the canal (1st and 2nd Sections) to the Riverview West Reservoir. Along this conveyance, irrigation deliveries would occur. At the Riverview West Reservoir location, water would be delivered to fill the reservoir and continue in the 2nd Section for subsequent irrigation deliveries and to the Roscoe Draw Reservoir. Water stored in both the Riverview West and Roscoe Draw reservoirs would be used to make irrigation deliveries. Water would be released from the Roscoe Draw reservoir into the canal where it could meet irrigation demands prior to excess water flowing into Sutherland Canal. A coordinated operation of the Perkins County Canal and the Sutherland Canal will be required to properly manage these supplies within the current system that integrates North Platte River and South Platte River supplies. For example, when there are adequate flows from the Perkins County Canal Project (released from Roscoe Draw), flows in the Sutherland Supply Canal can be reduced to preserve water in Lake McConaughy. Conversely, if there are adequate supplies in Lake McConaughy, releases originating from the Perkins County Canal Project could be instead remain in storage for subsequent delivery.

In addition to irrigation deliveries, water originating from this Project may be exchanged with other water sources in Lake McConaughy and used to meet flow targets associated with the Platte River Recovery Implementation Program (PRRIP). The PRRIP objective "is to use incentive-based water projects to provide sufficient water to and through the central Platte River habitat area to assist in improving and maintaining habitat for target species."[87] The PRRIP associated habitat area is located along the Platte River, between Lexington and Chapman within Nebraska.

The interconnected configuration of the existing water systems and the elements of the Perkins County Canal Project would dictate the final operation plan of the Perkins County Canal Project. Coordinated operations would promote the optimal use of water. Lake levels, groundwater elevations, and water quality measurements may be used as triggers and thresholds in determining the final operations plan with respect to the integrated systems. Operation and maintenance costs of the Project would be determined upon development of this plan and assigned based on beneficiaries of the Project. Ultimately, regional hydrology and a stakeholder process should be used to establish the operations plan.

[87] Water Plan, (n.d.). Platte River Recovery Implementation Program. https://platteriverprogram.org/about/water-plan



Section 5

ECONOMIC EVALUATION

This section quantifies the economic impact (which is referred to as Project benefit) at stake should Nebraska experience a reduced available water supply from the South Platte River.

This evaluation serves to address the Legislator's LB1012 to provide an "[e]xamination of the cost-effectiveness of alternatives, including alternatives that may reduce environmental or financial impacts" and a "timeline for completion of a canal and adjoining reservoirs as outlined in the South Platte River Compact". This economic evaluation compares conceptual-level construction costs with quantified benefits. Benefits equate to the loss in economic productivity that would occur without this project. In other words, Colorado's actions to take water from the South Platte River will eliminate Nebraska's benefits currently enjoyed from this water supply.

The conceptual-level construction costs are associated with development of each alternative (500 cfs and 1,000 cfs). Canal costs are used to evaluate overall cost-effectiveness, per the Legislative directive. The general approach taken for this evaluation was to update previous cost estimates based on review of historical documents, refined canal layout, and increased operational flexibility.

The benefit calculation is based on the December 2021 Draft and the February 2022 Final ERA Report *"Economic Benefits Analysis of the South Platte River Water Supply Protection"* (ERA Report). The Draft ERA Report lays out methods to calculate benefits for different categories stemming from water made available by the Perkins County Canal. Based on a conservative approach, established through the water availability analysis described in Section 2, as well as current projects and stated goals in Colorado's Water Plan, it is anticipated that economic activity in Nebraska will be greatly reduced without the Project.

While benefit figures are not intended to precisely quantify potential economic losses, they provide a general indication of the magnitude of the potential impact of water shortages on economic activity in Nebraska.

More information on the costs and benefits are presented in the following subsections.

5.1 Construction Costs

Conceptual-level construction cost estimates are based on the Project as described in Section 4 of this report. Construction costs are intended to include estimates associated for agency approvals (permitting, licensing, environmental mitigation, and water rights), land acquisition or easement requirements, cost of construction, design engineering, and construction engineering. A set of contingency factors considered appropriate for this conceptual-level analysis has been included in each of the construction cost estimates. No design engineering was performed to complete the cost estimates. Cost estimates are computed for the year 2022. A detailed cost evaluation for the 500 and 1,000 cfs capacity diversion scenarios of the Perkins County Canal is presented in Appendix D. Summary results of the evaluations are presented in Tables 5-1 and 5-2 on the following pages.

Information presented in this report consists of an assortment of updated information from past reports, when available and appropriate, and new information developed specifically to meet the needs of this analysis. Cost estimates are based on acceptable engineering principles for a pre-engineering design planning effort. The planning level information presented in this report should be adequate to meet the needs of this Study.

5.1.1 Perkins County Canal

The conceptual-level costs to construct the Perkins County Canal at both 500 and 1,000 cfs diversion capacities are based on a review of existing documents and updating the project by re-envisioning the canal conveyance capacity, number of reservoirs, and terminus of the canal. Compared to the 1982 USBR Study, the canal length is shortened by moving its terminus from Lake Maloney, as originally envisioned, to the existing Sutherland Canal. This allows the advantage of utilizing existing facilities to optimize operation of the Perkins County Canal. By utilizing the Sutherland Canal, the overall length of the Perkins County Canal is reduced by about 38 miles, translating to a reduction in associated cost and environmental effects. The project was limited to two reservoirs (Riverview West and Roscoe Draw) instead of six reservoirs as envisioned in the 1982 USBR Study. This makes for an optimized project as the value of the eliminated reservoirs are limited. Previous incarnations of the Perkins County Canal envisioned a 250 cfs canal capacity below Roscoe Draw Reservoir. Maintaining the full 500 cfs capacity (or 1,000 cfs capacity with respect to that scenario) downstream of Roscoe Draw reservoir provides for additional operational flexibility.

The Perkins County Canal major elements are separated into 3 main categories that include dams and reservoirs, canals and agency approvals. Each of these major elements are discussed below.

5.1.2 Dams and Reservoirs

As detailed in Section 4 of this report, the Project includes a diversion structure located near Ovid, Colorado. The exact location of the diversion is to be determined. When considering costs, it is assumed that a concrete dam located across the South Platte River will be constructed to allow diversion of water. It is possible that another diversion structure is more cost effective, such as Raney Wells. The Project also includes two reservoirs, Riverview West (regulating reservoir) and Roscoe Draw (storage reservoir). The detailed construction cost estimates are shown in Appendix D and a summary is shown in Table 5-1 for the 500 cfs canal and Table 5-2 for the 1,000 cfs canal.

5.1.3 Canals

The Project includes a canal separated into three sections: 1st Section , 2nd Section, and Roscoe Canal. As detailed in Section 4 of this report, the 1st Section and Roscoe Canal section are concrete lined and the 2nd Section is earthen. Construction cost estimates for the canal sections include land and rights-of-way, relocation of property of others, structures and improvements, waterways, waterway structures, and waterway protective works. The detailed construction cost estimates are shown in Appendix D and a summary is shown in Table 5-1 for the 500 cfs canal and Table 5-2 for the 1,000 cfs canal.

5.1.4 Agency Approvals

The Project construction cost include an estimate for agency approvals. This includes the activities of project permitting, licensing, environmental mitigation, and water rights. Cost estimates for agency approval is shown in Appendix D and Table 5-1 for the 500 cfs canal and Table 5-2 for the 1,000 cfs canal.

The Perkins County Canal construction costs are summarized in Table 5-1.

Table 5-1: Construction Cost, Perkins County Canal, 500 cfs

Description	Total Field Costs	Other Costs	Total Costs
Dams and Reservoirs			
Ovid Diversion Dam (500 cfs capacity)	$22,400,000	$5,600,000	$28,000,000
Riverview West (Gravity)	$53,600,000	$13,400,000	$67,000,000
Roscoe Draw (High)	$153,000,000	$38,000,000	$191,000,000
Canals			
South Divide Canal, 1st Section, Concrete Lined, 24 mi.	$76,600,000	$30,600,000	$107,200,000
South Divide Canal, 2nd Section, Earth, 32 mi.	$71,100,000	$28,400,000	$99,500,000
Roscoe, Concrete Lined, 13.0 mi.	$45,900,000	$18,400,000	$64,300,000
Agency Approvals			
Permitting, licensing, environmental mitigation, and water rights.			$10,000,000
	Total Estimated Costs, 500 cfs Canal =		$567,000,000

Table 5-2: Construction Cost, Perkins County Canal, 1,000 cfs

Description	Total Field Costs	Other Costs	Total Costs
Dams and Reservoirs			
Ovid Diversion Dam (1,000 cfs capacity)	$23,900,000	$6,000,000	$29,900,000
Riverview West (Gravity)	$53,600,000	$13,400,000	$67,000,000
Roscoe Draw (High)	$153,000,000	$38,000,000	$191,000,000
Canals			
South Divide Canal, 1st Section, Concrete Lined, 24 mi.	$95,500,000	$38,200,000	$133,700,000
South Divide Canal, 2nd Section, Earth, 32 mi.	$83,400,000	$33,400,000	$116,800,000
Roscoe, Concrete Lined, 13.0 mi.	$57,000,000	$22,800,000	$79,800,000
Agency Approvals			
Permitting, licensing, environmental mitigation, and water rights.			$10,000,000
	Total Estimated Costs 1,000 cfs Canal =		$628,200,000

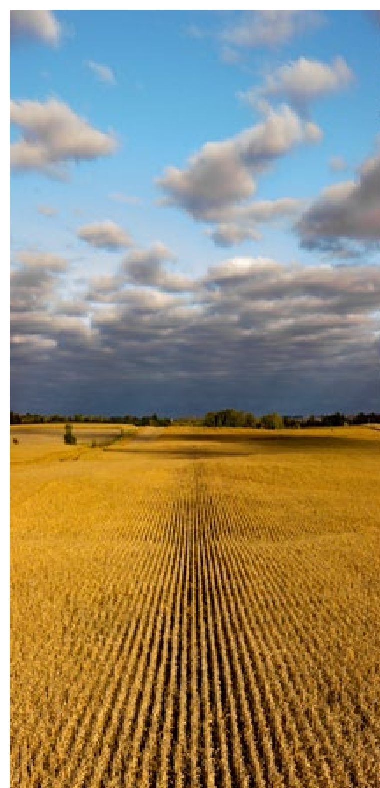
Results indicate the construction cost ranges from $567 million for the 500 cfs diversion capacity to $628 million for the 1,000 cfs diversion capacity scenario.

5.2 Estimated Economic Impacts

Conceptual-level economic benefits of the construction of the Perkins County Canal are based on the Project as described in Section 4 of this report. Economic benefits were developed for the following major categories.

- Agricultural
- Municipal & Industrial
- Environmental
- Recreation
- Hydropower
- Water Quality

As discussed in Chapter 2, *Water Supply Availability*, a sensitivity analysis was conducted to better understand the range of water available to the Project into the future. The sensitivity analysis considered reduction of South Platte River flow entering the Lower Section in Colorado from the current baseline by 10%, 20%, and 50%. When considering Project benefits, both the baseline (0%) and the 50% reduction are considered to illustrate the potential effect of Colorado consuming additional water from the South Platte River in the Upper Section.



Project benefits are realized annually for the duration of the Project. This evaluation conservatively assumed a Project life-span of 50 years, although benefits beyond 50 years will likely occur.

This evaluation uses a Discount Rate of 3% for analyzing the annual benefits. As stated in the ERA report[88], "The University of Nebraska system issued $400 million in bonds at an effective interest rate of 2.99 percent in 2021", and "In light of these uncertainties, a real (inflation-adjusted) discount rate of 3 percent is applied for this initial analysis."

The total estimated economic benefits realized by construction of the Perkins County Canal are compared to the overall cost estimate in Section 5.1 (and subsections) of this chapter.

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[88] ERA Economic LLC. Economic Analysis of South Platte River Water Supply Development Draft, Prepared for Nebraska Department of Natural Resources, (December 2021).

5.2.1 Agricultural

It is estimated that construction of the 500 cfs Perkins County Canal will allow, at least, 78,400 AF annually of water to be maintained in the South Platte River and available to Nebraska – not counting for any surplus flow availability. This value assumes baseline conditions in the Upper Section of Colorado. A reduction of 50% in the Upper Section, making 69,900 AF of South Platte River available to Nebraska, was also evaluated to understand potential variability of the benefits made possible with construction of the Perkins County Canal. For this evaluation, it is assumed that all the water made available by the Perkins County Canal will be used for agricultural purposes.

This evaluation uses a value of Project agricultural water supply of $176 per AF. This represents the value of irrigated land compared to the value of non-irrigated land. As shown in the ERA Report for a 10-year period of 2009 – 2018, the average difference land value equates to $176 per AF.

At a rate of $176 per AF and an availability of water ranging from 78,400 to 69,900 AF[89], the benefit to agriculture of the construction of the Perkins County Canal is estimated at $12.7 and $11.3 million per year, respectively. This equates to a net present value (NPV) of $337 to $301 million as shown below for a 500 cfs diversion canal and $487 to $368 million for a 1,000 cfs diversion canal.

Table 5-3: Agriculture Project Benefit, Perkins County Canal, 500 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Agriculture	$12.7	$11.3	$337	$301

Table 5-4: Agriculture Project Benefit, Perkins County Canal, 1,000 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Agriculture	$18.4	$13.9	$487	$368

5.2.2 Municipal & Industrial

It is assumed that a 20% return flow will be made available from applied agricultural water. The 20% return streamflow factor applied in this analysis is conservative when considering that approximately 60% of water applied for the irrigation of corn may return to the stream.[90] The ERA report estimates the value of water for municipal use

[89] Actual volume analyzed is 95% of volume presented to account for Project losses and maintain conservative approach.

[90] State Water Policy: A Legislator's Guide to Colorado Water Issues (rev. August 2018).

at $250 per AF. This value represents the capital cost to develop projects to meet water demands of users in Lincoln and Omaha. At a value of $250 per AF and an availability of water ranging from about 15,000 to 13,000 AF (20% of applied agricultural water), the benefit to municipal & industrial of the construction of the Perkins County Canal is $3.6 and $3.2 million per year, respectively. This equates to an NPV of $95.8 to $85.4 million as shown below for a 500 cfs diversion canal and $139 to $105 million for a 1,000 cfs diversion canal.

Table 5-5: Municipal & Industrial Project Benefit, Perkins County Canal, 500 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Municipal & Industrial	$3.6	$3.2	$95.8	$85.4

Table 5-6: Municipal & Industrial Project Benefit, Perkins County Canal, 1,000 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Municipal & Industrial	$5.2	$3.9	$139	$105

5.2.3 Environmental

To determine potential environmental benefits, it is assumed that a portion of water made available by the Project will be used to meet identified environmental flow targets through agricultural use and exchange. For this evaluation, it is assumed that the pulse flows identified in the PRIPP can be met from water made available from the Project. These flows are quantified as 5,000 to 8,000 cfs for three consecutive days two out of three years. Because releases from Lake McConaughy are generally limited to 3,000 cfs, the Project can be used to help provide the additional flow to help meet this flow target. This equates to 7,932 AF per year on average. The ERA report states "the least cost alternative to generate these high flow events, the alternative cost of providing pulse flows would be $571 per AF". For this Study, we likewise used a benefit unit value of $571 per AF when considering pulse flows. At a rate of $571 per AF and a water use of 7,932 AF, the benefit to helping provide environmental pulse flows in the Platte River is $3.6 and $3.2 million per year for the 0% and 50% scenarios, respectively.

Additionally, this evaluation assumes that 25% of the agricultural flow made available by the project also benefits the environment by flowing this water in the Platte River prior to making available for agriculture use. The ERA report concludes a benefit unit value is $176 per AF (same as agriculture) when considering these environmental flows. At a rate of $176 per AF and a water use of 16,637 AF (25% of water available for agricultural is assumed to benefit the environment other than pulse flows), the benefit to the Platte River equates is $2.9 and $2.6 million per year, for the 0% and 50% scenarios, respectively.

The total environmental benefit provided by the Perkins County Canal project is $7.2 and $6.9 million per year. This equates to an NPV of $192 to $183 million as shown below for a 500 cfs diversion canal and $229 to $200 million for a 1,000 cfs diversion canal. Importantly, the Project would also help ensure the continuation of the Platte River Recovery Implementation Program (PRRIP), as discussed earlier – without the project, the environmental benefits for PRRIP could be jeopardized. The financial impact of the loss of PRRIP has not been included in this analysis.

Table 5-7: Environmental Project Benefit, Perkins County Canal, 500 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Environmental	$7.2	$6.9	$192	$183

Table 5-8: Environmental Project Benefit, Perkins County Canal, 1,000 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Environmental	$8.7	$7.5	$229	$200

5.2.4 Recreation

Recreation benefit of the Perkins County Canal is based on the flat-water recreation opportunities that will be made available at Riverview West and Roscoe Draw reservoirs. The ERA report concludes an annual benefit of $7.1 million for flat water recreation. This equates to a unit benefit value of $882.17 per reservoir surface area acre. At a value of $882.17 per acre and a surface area total for Riverview West and Roscoe reservoirs of 5,529 acres, the benefit to recreation of the construction of the Perkins County Canal is $4.7 million per year. This equates to an NPV of $125 million as shown below.

Table 5-9: Recreation Project Benefit, Perkins County Canal, 500 and 1,000 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Recreation	$4.7	$4.7	$125	$125

5.2.5 Hydropower

Hydropower benefit is based on additional efficiency that is made available by construction and operation of the Perkins County Canal. The ERA report concludes a unit benefit to hydropower of $1.76 per acre-foot (AF) based on the additional efficiency of existing hydroelectric facilities at Lake McConaughy. This efficiency increase is realized by the additional water made available by the Project allowing Lake McConaughy to operate at a higher head thus generating additional energy. For this evaluation, it is assumed that 75% of the water made available by the Project will provide hydropower benefits. At a value of $1.76 per AF and an availability of water ranging from about 56,000 to 50,000 AF (75% of available Project water), the benefit to hydropower of the construction and operation of the Perkins County Canal is $0.10 and $0.90 million per year, respectively. This equates to a net present value of $2.5 to $2.3 million as shown below for a 500 cfs diversion canal and $3.7 to $2.8 million for a 1,000 cfs diversion canal.

Table 5-10: Hydropower Project Benefit, Perkins County Canal, 500 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Hydropower	$0.10	$0.09	$2.5	$2.3

Table 5-11: Hydropower Project Benefit, Perkins County Canal, 1,000 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Hydropower	$0.14	$0.10	$3.7	$2.8

5.2.6 Water Quality

Water quality will benefit from the operation of the Perkins County Canal by helping manage sediments and degraded water from the South Platte River as well as providing clean surface water for irrigation. The benefit of this is unknown at this time and considered to be relatively small. For this evaluation, the benefit to water quality of the construction of Project is assumed at $0.03 and $0.02 million per year, respectively. This equates to a net present value of $1.0 to $0.9 as shown below for a 500 cfs diversion canal and $1.1 to $1.0 million for a 1,000 cfs diversion canal.

Table 5-12: Water Quality Project Benefit, Perkins County Canal, 500 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Water Quality	$0.03	$0.02	$1.0	$0.9

Table 5-13: Water Quality Project Benefit, Perkins County Canal, 1,000 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Water Quality	$0.04	$0.03	$1.1	$1.0

5.3 Summary Impact of Future Water Shortage on Economic Development

Based on conservatively low water availability projections and a 500 cfs diversion canal, the impact of future water shortage on economic development in Nebraska (benefits) range from $678 million assuming Upper Section flows are consist with historical patterns, to $631 million if Colorado increases its consumption and reduces the water leaving the Upper Section by 50%. If the diversion canal has a 1,000 cfs capacity those benefits range from 986 to $802 million. Table 5-14 and Table 5-15 summarize benefits of the Project.

Table 5-14: Project Benefit, Perkins County Canal, 500 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Agriculture	$12.7	$11.3	$337	$301
Municipal & Industrial	$3.6	$3.2	$95.8	$85.4
Environmental	$7.2	$6.9	$192	$183
Recreation	$4.7	$4.7	$125	$125
Hydropower	$0.10	$0.09	$2.5	$2.3
Water Quality	$0.03	$0.02	$1.0	$0.9
		Total Benefit	$754	$698

Table 5-15: Project Benefit, Perkins County Canal, 1,000 cfs ($millions)

Category	Annual Benefit, 0%	Annual Benefit, 50%	50 Year NPV, 0%	50 Year NPV, 50%
Agriculture	$18.4	$13.9	$487	$368
Municipal & Industrial	$5.2	$3.9	$139	$105
Environmental	$8.7	$7.5	$229	$200
Recreation	$4.7	$4.7	$125	$125
Hydropower	$0.14	$0.10	$3.7	$2.8
Water Quality	$0.04	$0.03	$1.1	$1.0
		Total Benefit	$986	$802

5.3.1 Economic Evaluation Results

Summary results of Project NPVs are presented in Table 5-16. Construction costs estimates range from $567 million for a 500 cfs diversion capacity canal to $628 million for a 1,000 cfs diversion capacity canal. The total estimated economic benefit realized by construction of the Perkins County Canal are compared to the overall cost estimate in Section 5.3.3.

Table 5-16: Summary of Project Cost and Benefit, Perkins County Canal, ($millions)

Category	Total NPV, 0%	Total NPV, 50%
Project Cost, 500 CFS diversion	$754	$698
Project Cost, 1,000 CFS diversion	$986	$802

5.3.2 Payback Period and Net Benefit

The Project's payback period, defined as the time required to recover the original investment, provides useful information regarding the cost-effectiveness of Nebraska's investment in the Project. Using annual discounted benefits for Agriculture, Municipal and Industrial, Environmental, Recreation, Hydroelectric, and Water Quality, the payback period was computed for the 500 cfs and 1,000 cfs alternatives under the baseline and 50% reduction scenarios. The economic evaluation conservatively incorporated a Project life-span of 50 years. A payback period of 30 years, results in 20 years of realized benefits above the initial investment. Table 5-17 presents the 50-year value of the Project's net benefits and corresponding payback period.

Table 5-17: 50-Year Net Benefit and Payback Period for Alternatives

Category	Water Supply Scenario	Net Benefit ($millions)	Payback Period (Years)
500 cfs Canal	0%	$187	30
	50%	$131	34
1,000 cfs Canal	0%	$357	23
	50%	$174	32

The 50-year net benefit ranges from $131 to $187 million dollars for the 500 cfs Canal between the baseline and 50% water supply scenarios. The resulting payback period for the 500 cfs Canal is reported to range from 30 years up to 34 years depending on the water supply scenario. As seen in Table 5-17, the additional four years of investment recovery (payback period) results in a decrease of approximately $56 million of net benefit for the 500 cfs Canal.

For the 1,000 cfs diversion Canal, the 50-year net benefit ranges from $174 to $357 million between the baseline and 50% water supply scenarios. The resulting payback period is reported to range from 23 years to 32 years depending on the water supply scenario. The additional nine years of investment recovery in Table 5-17 results in a decrease of approximately $184 million of net benefit for the 1,000 cfs Canal.

5.3.3 Benefit-Cost Comparison

An economic evaluation of the Project was carried out by comparing the Project cost to the Project benefits. Table 5-18 presents the comparison of Project Costs and NPVs for the baseline and 50% scenarios over the Project's assumed 50-year lifespan. In addition, the resulting Benefit-Cost (B/C) Ratio is presented for the range of water supply scenarios used in this evaluation.

Table 5-18: Summary Comparison of Project Benefits and Costs

Category	Cost ($millions)	50-Year NPV, 0% ($millions)	50-Year NPV, 50% ($millions)	B/C Ratio
500 cfs Canal	$567	$754	$698	1.33 – 1.23
1,000 cfs Canal	$628	$986	$802	1.57 – 1.28

A benefit-cost ratio is a way to consider the cost effectiveness of the Project. This ratio is the Benefits, in dollars, divided by the costs, in dollars. The higher the value, the more cost effective the project. The benefits-cost ratios ranging from 1.33 - 1.23 for the 500 cfs canal and 1.57-1.28 for the 1,000 cfs canal. A project is considered cost-effective when the benefit-cost ratio is 1.0 or greater.[91]

5.3.4 Conservative Nature of Estimating Economic Impacts

In considering the economic impact (referred to as Project benefit) that is at stake if Nebraska experiences a reduced available water supply from the South Platte River, a conservative approach is used as the benefits are based on the amount of water available to the canal under Nebraska's entitlements in the Compact in the Lower Section and not the total water that is shown to be available. In reality, Surplus Water is likely to remain available with the Project for many years. The benefits provided by Surplus Water, if included, would significantly increase stated benefit values.

Although the Project has an estimated life-span of up to 100 years, a conservative approach assuming a project life of 50-years for this economic evaluation was utilized. Benefits continue to accrue long after 50 years. The benefits provided by evaluating a longer period would significantly increase benefits.

Additionally, there are other economic benefits that will occur with the construction and operation of the Perkins County Canal Project that were not quantified in this evaluation to provide a conservative characterization of Project benefits. The benefit of each of these would add to the benefit quantified in this evaluation. A listing of economic benefits not quantified in this evaluation is presented below.

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[91] https://www.fema.gov/grants/tools/benefit-cost-analysis#toolkit

- Regional Economic Effects
- 100-year planning horizon
- Reliability (managed supplies)
- Drought resiliency
- Capturing surplus supplies
- Potential for small hydroelectric
- Increased wildlife habitat
- Increased hydroelectric on current system
- Value of water

With exception to the potential for a small hydroelectric, these benefits occur from the operation of the Project without additional direct costs. As noted in Section 2 of this report, there may be a shift in the natural timing of runoff that would provide additional water available to the Project.

The value of water could be used to help understand the economic benefit of the Perkins County Canal Project, including the items listed above. The value of water is discussed in the following section.

5.4 Value of Water

The value of water is important to consider when determining the value of the Perkins County Canal Project. Water has an intrinsic monetary value as a commodity. Markets do not treat water as a commodity in the same way other commodities, like corn and copper, because of its disposition in the hydrologic cycle, the rules and regulations that govern its use, and the outright necessity of its use. Nevertheless, even with these identified constraints on water and the assortment of legal rules that attach to water to protect its various uses, markets for water have developed and matured.

The essential component of a functioning water market is establishing water price. The price for water may greatly vary because of the water right disposition and the available uses attached to the right. In other words, not all water has the same value – even for supplies derived from the same source and located on neighboring lands. Water valuation may be derived from four primary methodologies – (1) market value; (2) least cost alternative; (3) land value with and without water supplies; and (4) auction value. All four of these methods have important details and uncertainties impacting how water pricing may occur. For example, the geographic boundary for a water market affects value. Some water markets are highly localized – where the available supplies are sold among neighbors that share a single and confined water source. Other markets, however, may have regional, interstate, and even international boundaries that seek to synthesize competing water management rules with market mechanisms. As such, stating that water values can be precisely determined for Nebraska as part of this Project ignores many variables that affect pricing. Nevertheless, there are market indicators that provide a range of value for water derived from the Project. Water for the Perkins Canal Project originates in Colorado on the South Platte River. Colorado has an active water market and has representative transactions on the South Platte that may show the value of the Project's water supply. One study examining transactions between 2008 and 2018 found that there were 523 water right transactions on the South Platte River in Colorado with unit price values between $198 per AF per year to $67,015 per AF per year.[92] The median sale price in this study was $8,470 AF per year.[93] In addition, water value can be established using the land price differential method. A 140-acre farm in Weld County with water rights near Kersey is listed at $2.25 million while 148-acre parcel in Weld County without water rights is listed at $340,000.[94] The price of land on a per acre basis is $16,072 per acre on land with water versus $2,298 per acre on lands without water. As such, the value of water per acre could be estimated at $13,774 for water in Weld County.[95] None of these prices are directly applicable to the Project water supply but can inform a range of values for the supply. In summary, there are significant variations in market value for water supplies in the South Platte River watershed in Colorado that may be relevant to an assessment of canal viability.

As an example, the Perkins Canal Project could divert 500 cfs for a continuous period between October 15 and April 1 of each year. Continuous diversion of 500 cfs during this period equates to approximately 165,620 AF of water. Using the median price derived from the 2008-2018 study of $8,470, the value of the Project supply is $1.4 billion per year. This price is not determinative of the actual price that could be

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[92] Womble, P., & Hanemann, W. M. (2020). Water markets, water courts, and transaction costs in Colorado. *Water Resources Research, 56*, e2019WR025507. https://doi.org/10.1029/2019WR025507

[93] Id.

[94] Land.com. (2022). *148 acres CR 25*. https://www.land.com/property/148-acres-in-Weld-County-Colorado/14962266/ and Land.com. (2022). *140 acres in Weld County, Colorado*.

[95] Id.

obtained for the water available to the Perkins Canal Project. Nevertheless, these values do indicate that the water alone, divorced from its application to any use, has significant intrinsic value.

5.5 Institutional Feasibility

The purpose of this section is to identify the major federal, state, and local administrative, regulatory and legal factors within Nebraska that may impact the planning and permitting process within the South Platte basin for the construction of the Perkins County Canal Project.

5.5.1 Federal

The Perkins County Canal Project may require obtaining federal permits, licenses, and approvals. Although currently unclear if one exists, existence of a federal nexus would trigger review under the National Environmental Policy Act (NEPA). The regulatory certainty created by the PRRIP is aimed at streamlining new water projects on the river to avoid the lengthy environmental impact assessment otherwise required by NEPA.[96]

Federal agencies are required under Endangered Species Act of 1973 (ESA) to conserve endangered and threatened species. The PRRIP agreement addresses ESA compliance for existing and certain water-related activities for water users in the Platte River basin, upstream of the Loup River confluence, for any potential effects to the target species.[97] As such, portions of the Project's environmental review may be streamlined.

5.5.2 State

Under Title 117 of the Nebraska Administrative Code, the Nebraska Department of Environment and Energy (NDEE) is responsible for all surface waters within the state.[98] The NDEE, in accordance with Section 401 of the Clean Water Act and Title 120 of the

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[96] Jenkins, A., (1991). The Platte River Cooperative Agreement: A Basinwide Approach to Endangered Species Issue. *Great Plains Research: A Journal of Natural and Social Sciences*. *9*(1), 13.
[97] Water Plan, (n.d.). Platte River Recovery Implementation Program.
[98] Nebraska Department of Environment and Energy. (2022). Section 401 Water Quality Certification. http://dee.ne.gov/NDEQProg.nsf/OnWeb/S401

Nebraska Administrative Code, administers the Section 401 Water Quality Certification Program.[99] The NDEE must approve construction activities through a site-specific National Pollutant Discharge Elimination System (NPDES) permit application. Submitted to the NDEE "at least 180 days prior to the date of first discharge."[100]

5.5.3 Local

The quantification and mitigation of water depletions for any new and expanded uses of water after July 1, 1997, is required by the PRRIP implementation responsibilities, Nebraska New Depletions Plan (NNDP), and Nebraska state law.[101] The state has provided annual updates detailed in the Upper Platte Basin Robust Review.[102] The results of the Robust Review and the initiation of the second increment planning activities indicated that Nebraska is in full compliance with the NNDP as of January 1, 2020.[103] However, continued compliance must be achieved through the NNDP.

5.5.4 Summary

Legal, administrative and regulatory issues will need to be addressed for the proposed Perkins County Canal Project and compatibility with the PRRIP offers a streamlined approach toward achieving a portion of this compliance. In addition, partnerships and collaborations with key water use stakeholder in the Platte Basin such as Western Irrigation District, Twin Platte Natural Resources District, South Platte Natural Resources District, Central Platte Natural Resources District, Nebraska Public Power District, and the Central Nebraska Public Power and Irrigation District allows for efficiency in moving through these legal, administrative, and regulatory issues.

5.6 Project Timeline

The construction timeline of the Perkins County Canal was evaluated to identify potential timelines for major phases. This draft timeline is based on experience with major civil water projects and an understanding of the Project's order of operations and a determination of how long each phase will take. It is important to understand

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[99] Nebraska Department of Environment and Energy. (2022). Section 401 Water Quality Certification. http://dee.ne.gov/NDEQProg.nsf/OnWeb/S401

[100] Nebraska Department of Environment and Energy. (2022). NPDES Program. http://dee.ne.gov/NDEQProg.nsf/OnWeb/NPDES

[101] Fassett, J. (2019). Nebraska's Update on Robust Review Results and Second Increment Planning. *Platte River Recovery Implementation Program Nebraska New Depletion Plan.* https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/upper-platte/platte-river-recovery-implementation-program/20191230_GCUpdateonNNDP_2019_Final.pdf

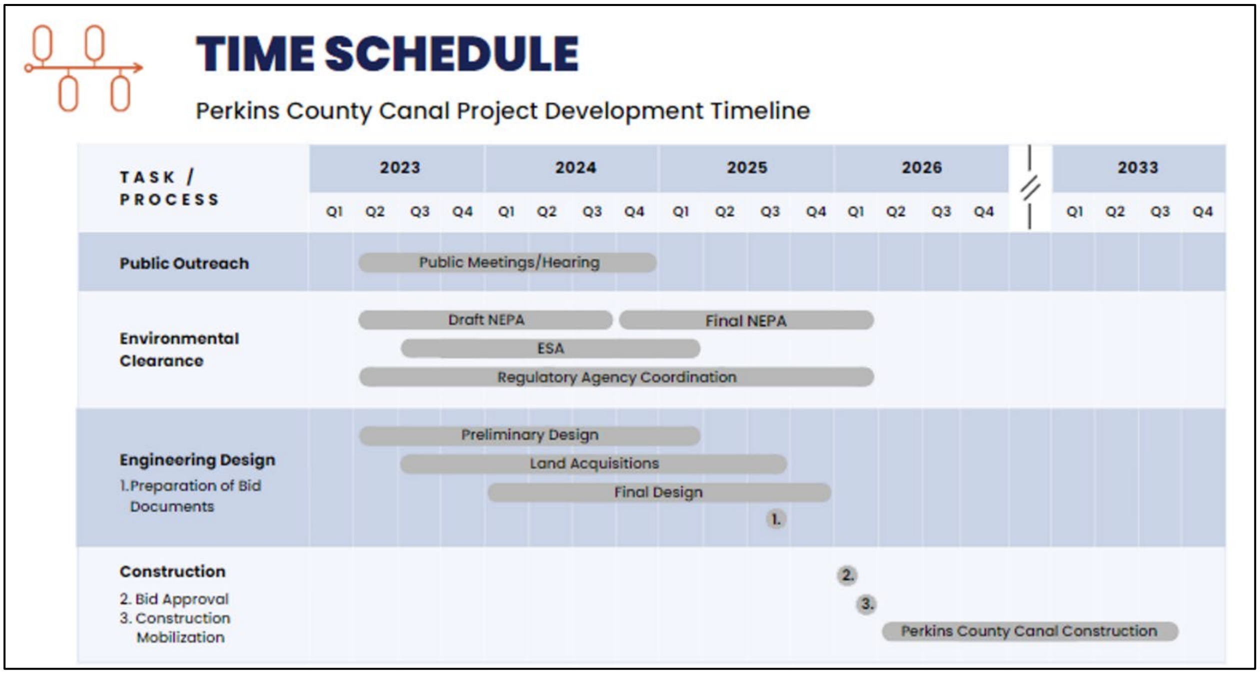
[102] Id.

[103] *Id.* see Summary.

the Perkins County Canal construction timeline to set reasonable expectations and avoid costly delays. Additionally, this initial timeline sets stakeholder expectations.

The construction timeline below is presented to illustrate the potential development schedule of the Perkins County Canal Project.

Figure 5-1: Perkins County Canal Project Development Timeline



Appendix A

South Platte River Compact Language

1-105. SOUTH PLATTE RIVER COMPACT

(1) Ratification by Nebraska Legislature

COMPACT WITH COLORADO, SOUTH PLATTE RIVER

AN ACT to ratify and approve the Compact between the States of Colorado and Nebraska, respecting the South Platte River, and to declare an emergency.

Be it enacted by the people of the State of Nebraska:

Section 1. **Compact Betweeen States of Colorado and Nebraska.** The compact concluded and signed on the 27th day of April A. D. 1923, by Commissioners for the States of Colorado and Nebraska, acting under appointment by the Governors of said States respectively, providing for the use and disposition of the waters of the South Platte River, is hereby ratified and approved by the Legislature of the State of Nebraska, which said Compact is in words and figures as follows:

SOUTH PLATTE RIVER COMPACT BETWEEN THE STATES OF

COLORADO AND NEBRASKA

The State of Colorado and the State of Nebraska, desiring to remove all causes of present and future controversy between said States, and between citizens of one against citizens of the other, with respect to waters of the South Platte River, and being moved by considerations of interstate comity, have resolved to conclude a compact for these purposes, and, through their respective Governors, have named as their Commissioners:

Delph E. Carpenter, for the State of Colorado; and Robert H. Willis, for the State of Nebraska; who have agreed upon the following articles:

ARTICLE I

In this compact: (1) The State of Colorado and the State of Nebraska are designated, respectively, as "Colorado" and "Nebraska." (2) The provisions hereof respecting each signatory State, shall include and bind its citizens and corporations and all others engaged or interested in the diversion and use of the waters of the South Platte River in that State. (3) The term "Upper Section" means that part of the South Platte River in the State of Colorado above and westerly from the west boundary of Washington County, Colorado. (4) The term "Lower Section" means that part of the South Platte River in the State of Colorado between the west boundary of Washington County and the intersection of said river with the boundary line common to the signatory States. (5) The term "Interstate Station" means that stream gaging station described in Article II. (6) The term "flow of the river" at the Interstate Station means the measured flow of the river at said station plus all increment of said flow entering the river between the Interstate Station and the diversion works of the Western Irrigation District in Nebraska.

ARTICLE II

(1) Colorado and Nebraska, at their joint expense, shall maintain a stream gaging station upon the South Platte River at the river bridge near the town of Julesburg, Colorado, or at a convenient point between said bridge and the diversion works of the canal of The Western Irrigation District in Nebraska, for the purpose of ascertaining and recording the amount of water flowing in said river from Colorado into Nebraska and to said diversion works at all times between the first day of April and the fifteenth day of October of each year. The location of said station may be changed from year to year as the river channels and water flow conditions of the river may require. (2) The State Engineer of Colorado and the Secretary of the Department of Public Works of Nebraska shall make provisions for the cooperative gaging at and the details of operation of said station and for the exchange and publication of records and data. Said state officials shall ascertain the rate of flow of the South Platte River through the Lower Section in Colorado and the time required for increases or decreases of flow, at points within said Lower Section, to reach the Interstate Station. In carrying out the provisions of Article IV of this compact, Colorado shall always be allowed sufficient time for any increase in flow (less permissible diversions) to pass down the river and be recorded at the Interstate Station.

ARTICLE III

The waters of Lodgepole Creek, a tributary of the South Platte River flowing through Nebraska and entering said river within Colorado, hereafter shall be divided and apportioned between the signatory States as follows: (1) The point of division of the waters of Lodgepole Creek shall be located on said creek two miles north of the boundary line common to the signatory States. (2) Nebraska shall have the full and unmolested use and benefit of all waters flowing in Lodgepole Creek above the point of division and Colorado waives all present and future claims to the use of said waters. Colorado shall have the exclusive use and benefit of all waters flowing at or below the point of division. (3) Nebraska may use the channel of Lodgepole Creek below the point of division and the channel of the South Platte River between the mouth of Lodgepole Creek and the Interstate Station, for the carriage of any waters of Lodgepole Creek which may be stored in Nebraska above the point of division and which Nebraska may desire to deliver to ditches from the South Platte River in Nebraska, and any such waters so carried shall be free from interference by diversions in Colorado and shall not be included as a part of the flow of the South Platte River to be delivered by Colorado at the Interstate Station in compliance with Article IV of this compact; **Provided, however,** that such runs of stored water shall be made in amounts of not less than ten cubic feet per second of time and for periods of not less than twenty four hours.

ARTICLE IV

The waters of the South Platte River hereafter shall be divided and apportioned between the signatory States as follows: (1) At all times between the fifteenth day of October of any year and the first day of April of the next succeeding year, Colorado shall have the full and uninterrupted use and benefit of the waters of the river flowing within the boundaries of the State, except as otherwise provided by Article VI. (2) Between the first day of April and the fifteenth day of October of each year, Colorado shall not permit diversions from the Lower Section of the river, to supply Colorado appropriations having adjudicated dates of priority subsequent to the fourteenth day of June, 1897, to an extent that will diminish the flow of the river at the Interstate Station, on any day, below a meanflow of 120 cubic feet of water per second of time, except as limited in paragraph three (3) of this Article. (3) Nebraska shall not be entitled to receive and Colorado shall not be required to deliver, on any day, any part of the flow of the river to pass the Interstate Station, as provided by paragraph two (2) of this Article, not then necessary for beneficial use by those entitled to divert water from said river within Nebraska. (4) The flow of the river at the Interstate Station shall be used by Nebraska to supply the needs of present perfected rights to the use of water from the river within said State before permitting diversions from the river by other claimants. (5) It is recognized that variable climatic conditions, the regulation and administration of the stream in Colorado, and other causes, will produce diurnal and other unavoidable variations and fluctuations in the flow of the river at the Interstate Station, and it is agreed that, in the performance of the provisions of said paragraph two (2), minor or compensating irregularities and fluctuations in the flow at the Interstate Station shall be permitted; but where any deficiency of the mean daily flow at the Interstate Station may have been occasioned by neglect, error or failure in the performance of duty by the Colorado water officials having charge of the administration or diversions from the Lower Section of the river in that state, each such deficiency shall be made up, within the next succeeding period of seventy two hours, by delivery of additional flow at the Interstate Station, over and above the amount specified in paragraph two (2) of this article, sufficient to compensate for such deficiency. (6) Reductions in diversions from the Lower Section of the river, necessary to the performance of paragraph two (2) of this Article by Colorado, shall not impair the rights of appropriators in Colorado (not to include the proposed Nebraska canal described in Article VI), whose supply has been so reduced, to demand and receive equivalent amounts of water from other parts of the stream in that State according to its Constitution, laws, and the decisions of its courts. (7) Subject to compliance with the provisions of this Article, Colorado shall have and enjoy the otherwise full and uninterrupted use and benefit of the waters of the river which hereafter may flow within the boundaries of that State from the first day of April to the fifteenth day of October in each year, but Nebraska shall be permitted to divert, under the subject to the provisions and conditions of Article VI, any surplus waters which otherwise would flow past the Interstate Station.

ARTICLE V

(1) Colorado shall have the right to maintain, operate, and extend, within Nebraska, the Peterson Canal and other canals of The Julesburg Irrigation District which now are or may hereafter be used for the carriage of water from the South Platte River for the irrigation of lands in both States, and Colorado shall continue to exercise control and jurisdiction of said canals and the carriage and delivery of water thereby. This Article shall not excuse Nebraska water users from making reports to Nebraska officials in compliance with the Nebraska laws. (2) Colorado waives any objection to the delivery of water for irrigation of lands in Nebraska by the canals mentioned in paragraph one (1) of this Article, and agrees that all interests in said canals and the use of waters carried thereby, now or hereafter acquired by owners of lands in Nebraska, shall be afforded the same recognition and protection as are the interests of similar land owners served by said canals within Colorado; **Provided, however,** that Colorado reserves to those in control of said canals the right to enforce the collection of charges or assessments, hereafter levied or made against such interests of owners of the lands in Nebraska, by withholding the delivery of water until the payment of such charges or assessments; **Provided, however,** such charges or assessments shall be the same as those levied against similar interests of owners of lands in Colorado. (3) Nebraska grants to Colorado the right to acquire by purchase, prescription, or the exercise of eminent domain, such rights of way, easements or lands as may be necessary for the construction, maintenance, operation, and protection of those parts of the above mentioned canals which now or hereafter may extend into Nebraska.

ARTICLE VI

It is the desire of Nebraska to permit its citizens to cause a canal to be constructed and operated for the diversion of water from the South Platte River within Colorado, for irrigation of lands in Nebraska; that said canal may commence on the South bank of said river at a point southwesterly from the town of Ovid, Colorado, and may run thence easterly through Colorado along or near the line of survey of the formerly proposed "Perkins County Canal" (sometimes known as the "South Divide Canal") and into Nebraska, and that said project shall be permitted to divert waters of the river as hereinafter provided. With respect to such proposed canal it is agreed: (1) Colorado consents that Nebraska and its citizens may hereafter construct, maintain, and operate such a canal and thereby may divert water from the South Platte River within Colorado for use in Nebraska, in the manner and at the time in this article provided, and grants to Nebraska and its citizens the right to acquire by purchase, prescription, or the exercise of eminent domain such rights of way, easements or lands as may be necessary for the construction, maintenance, and operation of said canal; subject, however, to the reservations and limitations and upon the conditions expressed in this Article which are and shall be limitations upon and reservations and conditions running with the rights and privileges hereby granted, and which shall be expressed in all permits issued by Nebraska with respect to said canal. (2) The net future flow of the Lower Section of the South Platte River, which may remain after supplying all present and future appropriations from the Upper Section, and after supplying all appropriations from the Lower Section perfected prior to the seventeenth day of December, 1921, and after supplying the additional future appropriations in the Lower Section for the benefit of which a prior and preferred use of Thirty-five thousand acre feet of water is reserved by subparagraph (a) of this article, may be diverted by said canal between the fifteenth day of October of any year and the first day of April of the next succeeding year subject to the following reservations, limitations and conditions: (a) In addition to the water now diverted from the Lower Section of the river by present perfected appropriations, Colorado hereby reserves the prior, preferred and superior right to store, use and to have in storage in readiness for use on and after the first day of April in each year, an aggregate of thirty-five thousand acre feet of water to be diverted from the flow of the river in the Lower Section between the fifteenth day of October of each year and the first day of April of the next succeeding year, without regard to the manner or time of making such future uses, and diversions of water by said Nebraska canal shall in no manner impair or interfere with the exercise by Colorado of the right of future use of the water hereby reserved. (b) Subject at all times to the reservation made by subparagraph (a) and to the other provisions of this Article, said proposed canal shall be entitled to direct five hundred cubic feet of water per second time from the flow of the river in the Lower Section, as of priority of appropriation of date December 17th, 1921, only between the fifteenth day of October of any year and the first day of April of the next succeeding year upon the express condition that the right to so divert water is and shall be limited exclusively to said annual period and shall not constitute the basis for any claim to water necessary to supply all present and future appropriations in the Upper Section or present appropriations in the Lower Section and those hereafter to be made therein as provided in subparagraph (a). (3) Neither this compact nor the construction and operation of such a canal nor the diversion, carriage and application of water thereby shall vest in Nebraska, or in those in charge or control of said canal or in the users of water therefrom, any prior, preferred or superior servitude upon or claim or right to the use of any water of the South Platte River in Colorado from the first day of April to the fifteenth day of October of any year or against any present or future appropriator or user of water from said river in Colorado during said period of every year, and Nebraska specifically waives any such claims and agrees that the same shall never be made or asserted. Any surplus waters of the river, which otherwise would flow past the Interstate Station during such period of any year after supplying all present and future diversions by Colorado, may be diverted by such a canal, subject to the other provisions and conditions of this Article. (4) Diversions of water by said canal shall not diminish the flow necessary to pass the Interstate Station to satisfy superior claims of users of water from the river in Nebraska. (5) No appropriations of water from the South Platte River by any other canal within Colorado shall be transferred to said canal or be claimed or asserted for diversion and carriage for use on lands in Nebraska. (6) Nebraska shall have the right to regulate diversions of water by said canal for the purposes of protecting other diversions from the South Platte River within Nebraska and of avoiding violations of the provisions of Article IV; but Colorado reserves the right at all times to regulate and control the diversions by said canal to the extent necessary for the protection of all appropriations and diversions within Colorado or necessary to maintain the flow at the Interstate Station as provided by Article IV of this Compact.

ARTICLE VII

Nebraska agrees that compliance by Colorado with the provisions of this compact and the delivery of water in accordance with its terms shall relieve Colorado from any further or additional demand or claim by Nebraska upon the waters of the South Platte River within Colorado.

ARTICLE VIII

Whenever any official of either State is designated herein to perform any duty under this compact, such designation shall be interpreted to include the State official or officials upon whom the duties now performed by such official may hereafter devolve, and it shall be the duty of the officials of the State of Colorado charged with the duty of the distribution of the waters of the South Platte River for irrigation purposes, to make deliveries of water at the Interstate Station in compliance with this compact without necessity of enactment of special statutes for such purposes by the General Assembly of the State of Colorado.

ARTICLE IX

The physical and other conditions peculiar to the South Platte River and to the territory drained and served thereby constitute the basis for this compact and neither of the signatory States hereby concedes the establishment of any general principle or precedent with respect to other interstate streams.

ARTICLE X

This compact may be modified or terminated at any time by mutual consent of the signatory States, but, if so terminated and Nebraska or its citizens shall seek to enforce any claims of vested rights in the waters of the South Platte River, the statutes of limitation shall not run in favor of Colorado or its citizens with reference to claims of the Western Irrigation District to the water of the South Platte River from the sixteenth day of April, 1916, and as to all other present claims from the date of the approval of this compact to the date of such termination and the State of Colorado and its citizens may be made defendants in any action brought for such purpose shall not be permitted to plead the Statutes of Limitation for such periods of time.

ARTICLE XI

This compact shall become operative when approved by the Legislature of each of the signatory States and by the Congress of the United States. Notice of approval by the Legislature shall be given by the Governor of each State to the Governor of the other State and to the President of the United States, and the President of the United States is requested to give notice to the Governors of the signatory States of the approval by Congress of the United States.

IN WITNESS WHEREOF, the Commissioners have signed this compact in duplicate originals, one of which shall be deposited with the Secretary of State of each of the signatory States.

DONE at Lincoln, in the State of Nebraska, this 27th day of April, in the year of our Lord, One Thousand Nine Hundred Twenty-Three.

(Signed) Delph E. Carpenter.

Robert H. Willis.

Sec. 2. **Not to Bind State Until Approved by Other State.** That said Compact shall not bind either of the signatory States unless and until the same shall have been approved by the Legislature of each of the signatory States and the Congress of the United States shall have given its consent thereto and approval thereof.

Sec. 3. **The Governor to Notify Governor of Colorado.** The Governor of the State of Nebraska shall notify the Governor of the State of Colorado and the President of the United States of the passage of this Act, and the President is requested to notify the Governors of said States of the consent to and approval of said Compact by the Congress and to make proclamation thereof.

Sec. 4. **Emergency.** WHEREAS, an emergency exists, this Act shall take effect and be in force from and after its passage and approval.

(2) Appointment of the Commission of 1939

AN ACT providing for the appointment of a commissioner to act on behalf of the State of Nebraska to negotiate a compact between the States of Colorado and Nebraska respecting the use of and distribution of the waters of the South Platte River and the rights of said states thereto.

Section 1. The Governor of Nebraska shall appoint a commissioner who shall represent the State of Nebraska upon a joint commission to be composed of commissioners representing the States of Colorado and Nebraska, to be constituted by said states for the purpose of negotiating and entering into a compact or agreement between said states, with the consent of Congress, relative to the utilization and disposition of the waters of the South Platte River and all streams tributary thereto, and fixing and determining the rights of each of said states to the use, benefit and disposition of the waters of said streams; **Provided,** that any compact or agreement made on behalf of said states shall not be binding or obligatory upon either of said states or the citizens thereof, unless and until the same shall have been ratified and approved by the Legislatures of both states. Said commissioner shall have complete authority to consider and include in any compact between the said states, provisions for the construction of such works as may be necessary to conserve the waters in the aforesaid river and to store said waters in the State of Colorado for use in the State of Nebraska.

Sec. 2. Upon appointment of said commissioner by the Governor, the said commissioner shall proceed as soon as possible to meet with the commissioner for the State of Colorado for the purpose of negotiating the compact referred to in Section 1 hereof.

Source: (1) Laws 1923, c. 125, p. 299; (2) Laws 1939, c. 53, p. 223.

Appendix B

Monthly Canal Diversions for Period of Record

(Alternative 1 and Alternative 2)

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1924 - 1925	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,833 AF (241 cfs)	14,665 AF (239 cfs)	14,498 AF (236 cfs)	13,995 AF (228 cfs)
	Jan	24,697 AF (402 cfs)	24,155 AF (393 cfs)	23,246 AF (378 cfs)	20,302 AF (330 cfs)
	Feb	27,652 AF (498 cfs)	27,619 AF (497 cfs)	27,536 AF (496 cfs)	25,457 AF (458 cfs)
	Mar	9,528 AF (155 cfs)	9,317 AF (152 cfs)	9,105 AF (148 cfs)	8,469 AF (138 cfs)
	Non-Irrigation Season	**76,710 AF (232 cfs)**	**75,756 AF (229 cfs)**	**74,385 AF (225 cfs)**	**68,224 AF (206 cfs)**
1925 - 1926	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	17,190 AF (280 cfs)	17,036 AF (277 cfs)	16,883 AF (275 cfs)	16,422 AF (267 cfs)
	Jan	21,518 AF (350 cfs)	21,373 AF (348 cfs)	21,228 AF (345 cfs)	20,793 AF (338 cfs)
	Feb	22,489 AF (405 cfs)	22,189 AF (400 cfs)	21,888 AF (394 cfs)	20,378 AF (367 cfs)
	Mar	4,526 AF (74 cfs)	4,397 AF (72 cfs)	4,267 AF (69 cfs)	3,883 AF (63 cfs)
	Non-Irrigation Season	**65,723 AF (198 cfs)**	**64,994 AF (196 cfs)**	**64,266 AF (194 cfs)**	**61,476 AF (186 cfs)**
1926 - 1927	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	16,227 AF (264 cfs)	16,072 AF (261 cfs)	15,916 AF (259 cfs)	15,450 AF (251 cfs)
	Jan	23,428 AF (381 cfs)	23,139 AF (376 cfs)	22,850 AF (372 cfs)	21,626 AF (352 cfs)
	Feb	22,303 AF (402 cfs)	21,937 AF (395 cfs)	21,570 AF (388 cfs)	19,894 AF (358 cfs)
	Mar	27,469 AF (447 cfs)	26,903 AF (438 cfs)	25,873 AF (421 cfs)	21,971 AF (357 cfs)
	Non-Irrigation Season	**89,427 AF (270 cfs)**	**88,050 AF (266 cfs)**	**86,209 AF (260 cfs)**	**78,941 AF (238 cfs)**
1927 - 1928	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	16,083 AF (262 cfs)	15,865 AF (258 cfs)	15,646 AF (254 cfs)	14,991 AF (244 cfs)
	Jan	22,634 AF (368 cfs)	22,146 AF (360 cfs)	21,635 AF (352 cfs)	19,937 AF (324 cfs)
	Feb	27,586 AF (497 cfs)	27,138 AF (489 cfs)	26,680 AF (480 cfs)	24,667 AF (444 cfs)
	Mar	17,121 AF (278 cfs)	16,275 AF (265 cfs)	15,454 AF (251 cfs)	12,694 AF (206 cfs)
	Non-Irrigation Season	**83,424 AF (252 cfs)**	**81,423 AF (246 cfs)**	**79,415 AF (240 cfs)**	**72,289 AF (218 cfs)**
1928 - 1929	Oct	131 AF (4 cfs)	11 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	30 AF (1 cfs)	18 AF (0 cfs)	7 AF (0 cfs)	0 AF (0 cfs)
	Dec	19,732 AF (321 cfs)	19,336 AF (314 cfs)	18,940 AF (308 cfs)	17,752 AF (289 cfs)
	Jan	29,318 AF (477 cfs)	29,203 AF (475 cfs)	29,037 AF (472 cfs)	28,495 AF (463 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	28,861 AF (469 cfs)	28,458 AF (463 cfs)	28,023 AF (456 cfs)	24,954 AF (406 cfs)
	Non-Irrigation Season	**105,842 AF (320 cfs)**	**104,795 AF (316 cfs)**	**103,775 AF (313 cfs)**	**98,970 AF (299 cfs)**
1929 - 1930	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	10,714 AF (180 cfs)	9,465 AF (159 cfs)	8,128 AF (137 cfs)	4,158 AF (70 cfs)
	Dec	28,816 AF (469 cfs)	28,395 AF (462 cfs)	28,120 AF (457 cfs)	26,315 AF (428 cfs)
	Jan	24,911 AF (405 cfs)	24,458 AF (398 cfs)	23,767 AF (387 cfs)	21,115 AF (343 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	16,226 AF (264 cfs)	15,984 AF (260 cfs)	15,687 AF (255 cfs)	14,795 AF (241 cfs)
	Non-Irrigation Season	**108,435 AF (327 cfs)**	**106,070 AF (320 cfs)**	**103,471 AF (312 cfs)**	**94,152 AF (284 cfs)**
1930 - 1931	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	4,444 AF (75 cfs)	3,818 AF (64 cfs)	3,206 AF (54 cfs)	1,831 AF (31 cfs)
	Dec	25,847 AF (420 cfs)	25,354 AF (412 cfs)	24,798 AF (403 cfs)	22,933 AF (373 cfs)
	Jan	21,566 AF (351 cfs)	21,064 AF (343 cfs)	20,562 AF (334 cfs)	19,057 AF (310 cfs)
	Feb	23,744 AF (428 cfs)	23,378 AF (421 cfs)	23,011 AF (414 cfs)	21,149 AF (381 cfs)
	Mar	20,568 AF (335 cfs)	20,263 AF (330 cfs)	19,867 AF (323 cfs)	17,716 AF (288 cfs)
	Non-Irrigation Season	**96,169 AF (290 cfs)**	**93,876 AF (283 cfs)**	**91,444 AF (276 cfs)**	**82,686 AF (250 cfs)**
1931 - 1932	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,080 AF (229 cfs)	13,695 AF (223 cfs)	13,309 AF (216 cfs)	12,153 AF (198 cfs)
	Jan	25,302 AF (411 cfs)	24,622 AF (400 cfs)	23,992 AF (390 cfs)	21,752 AF (354 cfs)
	Feb	21,773 AF (392 cfs)	21,226 AF (382 cfs)	20,680 AF (372 cfs)	19,041 AF (343 cfs)
	Mar	3,970 AF (65 cfs)	3,845 AF (63 cfs)	3,720 AF (60 cfs)	3,345 AF (54 cfs)
	Non-Irrigation Season Total	**65,125 AF (197 cfs)**	**63,388 AF (191 cfs)**	**61,701 AF (186 cfs)**	**56,289 AF (170 cfs)**
1932 - 1933	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	3,772 AF (61 cfs)	3,685 AF (60 cfs)	3,599 AF (59 cfs)	3,339 AF (54 cfs)
	Jan	11,480 AF (187 cfs)	11,387 AF (185 cfs)	11,294 AF (184 cfs)	11,015 AF (179 cfs)
	Feb	14,124 AF (254 cfs)	14,022 AF (252 cfs)	13,921 AF (251 cfs)	13,618 AF (245 cfs)
	Mar	5,707 AF (93 cfs)	5,542 AF (90 cfs)	5,378 AF (87 cfs)	4,928 AF (80 cfs)
	Non-Irrigation Season Total	**35,083 AF (106 cfs)**	**34,637 AF (105 cfs)**	**34,192 AF (103 cfs)**	**32,899 AF (99 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1933 - 1934	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	12,666 AF (206 cfs)	12,612 AF (205 cfs)	12,558 AF (204 cfs)	12,395 AF (202 cfs)
	Jan	14,674 AF (239 cfs)	14,598 AF (237 cfs)	14,522 AF (236 cfs)	14,295 AF (232 cfs)
	Feb	9,321 AF (168 cfs)	9,079 AF (163 cfs)	8,836 AF (159 cfs)	8,039 AF (145 cfs)
	Mar	3,878 AF (63 cfs)	3,797 AF (62 cfs)	3,717 AF (60 cfs)	3,475 AF (57 cfs)
	Non-Irrigation Season Total	**40,539 AF (122 cfs)**	**40,086 AF (121 cfs)**	**39,632 AF (120 cfs)**	**38,204 AF (115 cfs)**
1934 - 1935	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	4,836 AF (79 cfs)	4,701 AF (76 cfs)	4,565 AF (74 cfs)	4,159 AF (68 cfs)
	Jan	6,697 AF (109 cfs)	6,617 AF (108 cfs)	6,536 AF (106 cfs)	6,294 AF (102 cfs)
	Feb	1,073 AF (19 cfs)	1,023 AF (18 cfs)	974 AF (18 cfs)	848 AF (15 cfs)
	Mar	1,240 AF (20 cfs)	1,213 AF (20 cfs)	1,185 AF (19 cfs)	1,102 AF (18 cfs)
	Non-Irrigation Season Total	**13,847 AF (42 cfs)**	**13,553 AF (41 cfs)**	**13,260 AF (40 cfs)**	**12,404 AF (37 cfs)**
1935 - 1936	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	9,844 AF (160 cfs)	9,793 AF (159 cfs)	9,743 AF (158 cfs)	9,590 AF (156 cfs)
	Jan	12,362 AF (201 cfs)	12,300 AF (200 cfs)	12,237 AF (199 cfs)	12,048 AF (196 cfs)
	Feb	13,015 AF (234 cfs)	12,934 AF (233 cfs)	12,853 AF (231 cfs)	12,608 AF (227 cfs)
	Mar	1,549 AF (25 cfs)	1,533 AF (25 cfs)	1,519 AF (25 cfs)	1,478 AF (24 cfs)
	Non-Irrigation Season Total	**36,771 AF (111 cfs)**	**36,560 AF (110 cfs)**	**36,351 AF (110 cfs)**	**35,725 AF (108 cfs)**
1936 - 1937	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	3,087 AF (50 cfs)	3,036 AF (49 cfs)	2,985 AF (49 cfs)	2,832 AF (46 cfs)
	Jan	5,675 AF (92 cfs)	5,608 AF (91 cfs)	5,541 AF (90 cfs)	5,339 AF (87 cfs)
	Feb	12,909 AF (232 cfs)	12,842 AF (231 cfs)	12,776 AF (230 cfs)	12,575 AF (226 cfs)
	Mar	1,299 AF (21 cfs)	1,267 AF (21 cfs)	1,234 AF (20 cfs)	1,137 AF (18 cfs)
	Non-Irrigation Season Total	**22,971 AF (69 cfs)**	**22,753 AF (69 cfs)**	**22,536 AF (68 cfs)**	**21,883 AF (66 cfs)**
1937 - 1938	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	4,624 AF (75 cfs)	4,506 AF (73 cfs)	4,387 AF (71 cfs)	4,032 AF (66 cfs)
	Jan	6,991 AF (114 cfs)	6,914 AF (112 cfs)	6,836 AF (111 cfs)	6,605 AF (107 cfs)
	Feb	11,098 AF (200 cfs)	11,039 AF (199 cfs)	10,980 AF (198 cfs)	10,802 AF (195 cfs)
	Mar	78 AF (1 cfs)	74 AF (1 cfs)	70 AF (1 cfs)	58 AF (1 cfs)
	Non-Irrigation Season Total	**22,791 AF (69 cfs)**	**22,532 AF (68 cfs)**	**22,273 AF (67 cfs)**	**21,497 AF (65 cfs)**
1938 - 1939	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	24,583 AF (400 cfs)	24,527 AF (399 cfs)	24,471 AF (398 cfs)	24,254 AF (394 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,662 AF (498 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,356 AF (494 cfs)
	Non-Irrigation Season Total	**113,840 AF (344 cfs)**	**113,784 AF (344 cfs)**	**113,728 AF (343 cfs)**	**113,016 AF (341 cfs)**
1939 - 1940	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	3,682 AF (60 cfs)	3,251 AF (53 cfs)	2,826 AF (46 cfs)	1,584 AF (26 cfs)
	Jan	4,206 AF (68 cfs)	4,109 AF (67 cfs)	4,012 AF (65 cfs)	3,721 AF (61 cfs)
	Feb	10,576 AF (190 cfs)	10,490 AF (189 cfs)	10,403 AF (187 cfs)	10,143 AF (183 cfs)
	Mar	3,931 AF (64 cfs)	3,847 AF (63 cfs)	3,764 AF (61 cfs)	3,512 AF (57 cfs)
	Non-Irrigation Season Total	**22,395 AF (68 cfs)**	**21,697 AF (66 cfs)**	**21,004 AF (63 cfs)**	**18,960 AF (57 cfs)**
1940 - 1941	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	1,146 AF (19 cfs)	1,119 AF (18 cfs)	1,092 AF (18 cfs)	1,010 AF (16 cfs)
	Jan	3,336 AF (54 cfs)	3,281 AF (53 cfs)	3,225 AF (52 cfs)	3,060 AF (50 cfs)
	Feb	6,504 AF (117 cfs)	6,461 AF (116 cfs)	6,418 AF (116 cfs)	6,290 AF (113 cfs)
	Mar	160 AF (3 cfs)	153 AF (2 cfs)	146 AF (2 cfs)	125 AF (2 cfs)
	Non-Irrigation Season Total	**11,146 AF (34 cfs)**	**11,013 AF (33 cfs)**	**10,881 AF (33 cfs)**	**10,484 AF (32 cfs)**
1941 - 1942	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	11,780 AF (192 cfs)	11,600 AF (189 cfs)	11,421 AF (186 cfs)	10,882 AF (177 cfs)
	Jan	14,329 AF (233 cfs)	14,150 AF (230 cfs)	13,970 AF (227 cfs)	13,431 AF (218 cfs)
	Feb	13,239 AF (238 cfs)	13,055 AF (235 cfs)	12,870 AF (232 cfs)	12,318 AF (222 cfs)
	Mar	24,531 AF (399 cfs)	24,436 AF (397 cfs)	24,360 AF (396 cfs)	23,825 AF (387 cfs)
	Non-Irrigation Season Total	**63,879 AF (193 cfs)**	**63,241 AF (191 cfs)**	**62,621 AF (189 cfs)**	**60,455 AF (183 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1942 - 1943	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	29,846 AF (485 cfs)	29,727 AF (483 cfs)	29,607 AF (482 cfs)	28,785 AF (468 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	25,805 AF (465 cfs)	25,515 AF (459 cfs)	25,237 AF (454 cfs)	23,899 AF (430 cfs)
	Mar	30,269 AF (492 cfs)	30,039 AF (489 cfs)	29,778 AF (484 cfs)	27,272 AF (444 cfs)
	Non-Irrigation Season Total	**116,663 AF (352 cfs)**	**116,024 AF (350 cfs)**	**115,366 AF (348 cfs)**	**110,700 AF (334 cfs)**
1943 - 1944	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,561 AF (139 cfs)	8,478 AF (138 cfs)	8,395 AF (137 cfs)	8,146 AF (132 cfs)
	Jan	12,948 AF (211 cfs)	12,855 AF (209 cfs)	12,763 AF (208 cfs)	12,485 AF (203 cfs)
	Feb	18,530 AF (334 cfs)	18,047 AF (325 cfs)	17,564 AF (316 cfs)	16,115 AF (290 cfs)
	Mar	5,653 AF (92 cfs)	5,539 AF (90 cfs)	5,425 AF (88 cfs)	5,083 AF (83 cfs)
	Non-Irrigation Season Total	**45,692 AF (138 cfs)**	**44,919 AF (136 cfs)**	**44,146 AF (133 cfs)**	**41,828 AF (126 cfs)**
1944 - 1945	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	15,123 AF (246 cfs)	15,015 AF (244 cfs)	14,907 AF (242 cfs)	14,584 AF (237 cfs)
	Jan	17,798 AF (289 cfs)	17,631 AF (287 cfs)	17,464 AF (284 cfs)	16,963 AF (276 cfs)
	Feb	14,371 AF (259 cfs)	14,280 AF (257 cfs)	14,188 AF (255 cfs)	13,913 AF (251 cfs)
	Mar	3,942 AF (64 cfs)	3,870 AF (63 cfs)	3,798 AF (62 cfs)	3,584 AF (58 cfs)
	Non-Irrigation Season Total	**51,234 AF (155 cfs)**	**50,795 AF (153 cfs)**	**50,356 AF (152 cfs)**	**49,043 AF (148 cfs)**
1945 - 1946	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	1,064 AF (18 cfs)	884 AF (15 cfs)	703 AF (12 cfs)	223 AF (4 cfs)
	Dec	26,621 AF (433 cfs)	26,448 AF (430 cfs)	26,276 AF (427 cfs)	25,347 AF (412 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	26,045 AF (469 cfs)	25,800 AF (465 cfs)	25,543 AF (460 cfs)	24,570 AF (442 cfs)
	Mar	24,667 AF (401 cfs)	23,808 AF (387 cfs)	23,031 AF (375 cfs)	19,473 AF (317 cfs)
	Non-Irrigation Season Total	**109,140 AF (329 cfs)**	**107,684 AF (325 cfs)**	**106,297 AF (321 cfs)**	**100,357 AF (303 cfs)**
1946 - 1947	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,546 AF (237 cfs)	14,384 AF (234 cfs)	14,222 AF (231 cfs)	13,736 AF (223 cfs)
	Jan	19,714 AF (321 cfs)	19,187 AF (312 cfs)	18,561 AF (302 cfs)	16,675 AF (271 cfs)
	Feb	17,641 AF (318 cfs)	17,229 AF (310 cfs)	16,833 AF (303 cfs)	15,499 AF (279 cfs)
	Mar	21,959 AF (357 cfs)	21,636 AF (352 cfs)	21,260 AF (346 cfs)	19,650 AF (320 cfs)
	Non-Irrigation Season Total	**73,860 AF (223 cfs)**	**72,435 AF (219 cfs)**	**70,876 AF (214 cfs)**	**65,560 AF (198 cfs)**
1947 - 1948	Oct	1,761 AF (55 cfs)	1,164 AF (37 cfs)	647 AF (20 cfs)	0 AF (0 cfs)
Above Average	Nov	6,685 AF (112 cfs)	5,911 AF (99 cfs)	5,137 AF (86 cfs)	2,880 AF (48 cfs)
	Dec	28,706 AF (467 cfs)	27,805 AF (452 cfs)	27,265 AF (443 cfs)	24,888 AF (405 cfs)
	Jan	27,947 AF (455 cfs)	27,536 AF (448 cfs)	27,323 AF (444 cfs)	26,268 AF (427 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Non-Irrigation Season Total	**124,603 AF (376 cfs)**	**121,920 AF (368 cfs)**	**119,875 AF (362 cfs)**	**113,541 AF (343 cfs)**
1948 - 1949	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,816 AF (241 cfs)	14,680 AF (239 cfs)	14,544 AF (237 cfs)	14,134 AF (230 cfs)
	Jan	28,797 AF (468 cfs)	28,634 AF (466 cfs)	28,465 AF (463 cfs)	27,704 AF (451 cfs)
	Feb	26,936 AF (485 cfs)	26,873 AF (484 cfs)	26,809 AF (483 cfs)	26,532 AF (478 cfs)
	Mar	11,092 AF (180 cfs)	10,942 AF (178 cfs)	10,791 AF (176 cfs)	10,340 AF (168 cfs)
	Non-Irrigation Season Total	**81,642 AF (246 cfs)**	**81,128 AF (245 cfs)**	**80,609 AF (243 cfs)**	**78,711 AF (238 cfs)**
1949 - 1950	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,251 AF (232 cfs)	14,157 AF (230 cfs)	14,064 AF (229 cfs)	13,784 AF (224 cfs)
	Jan	16,221 AF (264 cfs)	16,131 AF (262 cfs)	16,041 AF (261 cfs)	15,772 AF (257 cfs)
	Feb	20,873 AF (376 cfs)	20,497 AF (369 cfs)	20,071 AF (361 cfs)	18,825 AF (339 cfs)
	Mar	24,683 AF (401 cfs)	23,939 AF (389 cfs)	23,206 AF (377 cfs)	19,306 AF (314 cfs)
	Non-Irrigation Season Total	**76,028 AF (230 cfs)**	**74,724 AF (226 cfs)**	**73,382 AF (222 cfs)**	**67,687 AF (204 cfs)**
1950 - 1951	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,121 AF (230 cfs)	14,040 AF (228 cfs)	13,960 AF (227 cfs)	13,719 AF (223 cfs)
	Jan	14,499 AF (236 cfs)	14,416 AF (234 cfs)	14,334 AF (233 cfs)	14,086 AF (229 cfs)
	Feb	12,915 AF (233 cfs)	12,806 AF (231 cfs)	12,697 AF (229 cfs)	12,369 AF (223 cfs)
	Mar	1,773 AF (29 cfs)	1,715 AF (28 cfs)	1,657 AF (27 cfs)	1,482 AF (24 cfs)
	Non-Irrigation Season Total	**43,308 AF (131 cfs)**	**42,978 AF (130 cfs)**	**42,648 AF (129 cfs)**	**41,657 AF (126 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1951 - 1952	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,161 AF (230 cfs)	14,103 AF (229 cfs)	14,045 AF (228 cfs)	13,871 AF (226 cfs)
	Jan	21,479 AF (349 cfs)	21,252 AF (346 cfs)	21,025 AF (342 cfs)	20,180 AF (328 cfs)
	Feb	26,736 AF (481 cfs)	26,687 AF (481 cfs)	26,638 AF (480 cfs)	25,807 AF (465 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,645 AF (498 cfs)	27,729 AF (451 cfs)
	Non-Irrigation Season Total	**93,119 AF (281 cfs)**	**92,786 AF (280 cfs)**	**92,353 AF (279 cfs)**	**87,587 AF (264 cfs)**
1952 - 1953	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,191 AF (231 cfs)	14,005 AF (228 cfs)	13,819 AF (225 cfs)	13,261 AF (216 cfs)
	Jan	18,574 AF (302 cfs)	18,442 AF (300 cfs)	18,288 AF (297 cfs)	17,727 AF (288 cfs)
	Feb	14,289 AF (257 cfs)	14,028 AF (253 cfs)	13,766 AF (248 cfs)	12,981 AF (234 cfs)
	Mar	5,929 AF (96 cfs)	5,872 AF (95 cfs)	5,815 AF (95 cfs)	5,658 AF (92 cfs)
	Non-Irrigation Season Total	**52,983 AF (160 cfs)**	**52,346 AF (158 cfs)**	**51,688 AF (156 cfs)**	**49,627 AF (150 cfs)**
1953 - 1954	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	13,055 AF (212 cfs)	12,988 AF (211 cfs)	12,920 AF (210 cfs)	12,718 AF (207 cfs)
	Jan	13,337 AF (217 cfs)	13,278 AF (216 cfs)	13,219 AF (215 cfs)	13,042 AF (212 cfs)
	Feb	9,451 AF (170 cfs)	9,406 AF (169 cfs)	9,361 AF (169 cfs)	9,225 AF (166 cfs)
	Mar	2,687 AF (44 cfs)	2,617 AF (43 cfs)	2,548 AF (41 cfs)	2,350 AF (38 cfs)
	Non-Irrigation Season Total	**38,530 AF (116 cfs)**	**38,289 AF (116 cfs)**	**38,048 AF (115 cfs)**	**37,335 AF (113 cfs)**
1954 - 1955	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	2,226 AF (36 cfs)	2,179 AF (35 cfs)	2,131 AF (35 cfs)	1,994 AF (32 cfs)
	Jan	3,498 AF (57 cfs)	3,440 AF (56 cfs)	3,382 AF (55 cfs)	3,207 AF (52 cfs)
	Feb	7,867 AF (142 cfs)	7,789 AF (140 cfs)	7,711 AF (139 cfs)	7,478 AF (135 cfs)
	Mar	3,055 AF (50 cfs)	3,024 AF (49 cfs)	2,994 AF (49 cfs)	2,901 AF (47 cfs)
	Non-Irrigation Season Total	**16,647 AF (50 cfs)**	**16,432 AF (50 cfs)**	**16,218 AF (49 cfs)**	**15,580 AF (47 cfs)**
1955 - 1956	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	2,743 AF (45 cfs)	2,714 AF (44 cfs)	2,687 AF (44 cfs)	2,605 AF (42 cfs)
	Jan	4,595 AF (75 cfs)	4,554 AF (74 cfs)	4,513 AF (73 cfs)	4,389 AF (71 cfs)
	Feb	6,631 AF (119 cfs)	6,582 AF (119 cfs)	6,532 AF (118 cfs)	6,384 AF (115 cfs)
	Mar	396 AF (6 cfs)	389 AF (6 cfs)	383 AF (6 cfs)	363 AF (6 cfs)
	Non-Irrigation Season Total	**14,364 AF (43 cfs)**	**14,239 AF (43 cfs)**	**14,114 AF (43 cfs)**	**13,741 AF (41 cfs)**
1956 - 1957	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	178 AF (3 cfs)	16 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	6,271 AF (102 cfs)	5,840 AF (95 cfs)	5,410 AF (88 cfs)	4,119 AF (67 cfs)
	Jan	7,567 AF (123 cfs)	6,984 AF (114 cfs)	6,400 AF (104 cfs)	4,649 AF (76 cfs)
	Feb	4,147 AF (75 cfs)	4,033 AF (73 cfs)	3,920 AF (71 cfs)	3,591 AF (65 cfs)
	Mar	602 AF (10 cfs)	431 AF (7 cfs)	266 AF (4 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**18,764 AF (57 cfs)**	**17,304 AF (52 cfs)**	**15,995 AF (48 cfs)**	**12,358 AF (37 cfs)**
1957 - 1958	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	850 AF (14 cfs)	698 AF (12 cfs)	546 AF (9 cfs)	161 AF (3 cfs)
	Dec	27,623 AF (449 cfs)	26,764 AF (435 cfs)	26,153 AF (425 cfs)	23,298 AF (379 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,719 AF (499 cfs)	27,395 AF (493 cfs)
	Mar	30,744 AF (500 cfs)	30,595 AF (498 cfs)	30,587 AF (497 cfs)	29,592 AF (481 cfs)
	Non-Irrigation Season Total	**117,729 AF (355 cfs)**	**116,570 AF (352 cfs)**	**115,749 AF (349 cfs)**	**111,190 AF (336 cfs)**
1958 - 1959	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,098 AF (229 cfs)	14,007 AF (228 cfs)	13,917 AF (226 cfs)	13,646 AF (222 cfs)
	Jan	13,150 AF (214 cfs)	13,056 AF (212 cfs)	12,961 AF (211 cfs)	12,679 AF (206 cfs)
	Feb	12,551 AF (226 cfs)	12,442 AF (224 cfs)	12,333 AF (222 cfs)	12,007 AF (216 cfs)
	Mar	16,021 AF (261 cfs)	15,695 AF (255 cfs)	15,320 AF (249 cfs)	13,643 AF (222 cfs)
	Non-Irrigation Season Total	**55,820 AF (169 cfs)**	**55,200 AF (167 cfs)**	**54,531 AF (165 cfs)**	**51,975 AF (157 cfs)**
1959 - 1960	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	11,561 AF (188 cfs)	11,491 AF (187 cfs)	11,420 AF (186 cfs)	11,208 AF (182 cfs)
	Jan	15,024 AF (244 cfs)	14,773 AF (240 cfs)	14,479 AF (235 cfs)	13,371 AF (217 cfs)
	Feb	22,112 AF (398 cfs)	21,613 AF (389 cfs)	21,058 AF (379 cfs)	18,892 AF (340 cfs)
	Mar	26,974 AF (439 cfs)	26,579 AF (432 cfs)	26,226 AF (427 cfs)	23,972 AF (390 cfs)
	Non-Irrigation Season Total	**75,672 AF (228 cfs)**	**74,455 AF (225 cfs)**	**73,183 AF (221 cfs)**	**67,443 AF (204 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1960 - 1961	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,174 AF (133 cfs)	8,113 AF (132 cfs)	8,051 AF (131 cfs)	7,865 AF (128 cfs)
	Jan	10,831 AF (176 cfs)	10,753 AF (175 cfs)	10,674 AF (174 cfs)	10,437 AF (170 cfs)
	Feb	8,743 AF (157 cfs)	8,663 AF (156 cfs)	8,584 AF (155 cfs)	8,345 AF (150 cfs)
	Mar	2,374 AF (39 cfs)	2,267 AF (37 cfs)	2,162 AF (35 cfs)	1,867 AF (30 cfs)
	Non-Irrigation Season Total	**30,122 AF (91 cfs)**	**29,796 AF (90 cfs)**	**29,470 AF (89 cfs)**	**28,514 AF (86 cfs)**
1961 - 1962	Oct	15,868 AF (500 cfs)	15,868 AF (500 cfs)	15,868 AF (500 cfs)	15,142 AF (477 cfs)
Above Average	Nov	29,752 AF (500 cfs)	29,752 AF (500 cfs)	29,752 AF (500 cfs)	27,353 AF (460 cfs)
	Dec	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,648 AF (498 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Non-Irrigation Season Total	**165,620 AF (500 cfs)**	**165,620 AF (500 cfs)**	**165,620 AF (500 cfs)**	**162,399 AF (490 cfs)**
1962 - 1963	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	13,674 AF (222 cfs)	13,533 AF (220 cfs)	13,391 AF (218 cfs)	12,966 AF (211 cfs)
	Jan	16,855 AF (274 cfs)	16,449 AF (268 cfs)	16,008 AF (260 cfs)	14,685 AF (239 cfs)
	Feb	26,136 AF (471 cfs)	25,921 AF (467 cfs)	25,706 AF (463 cfs)	24,461 AF (440 cfs)
	Mar	27,717 AF (451 cfs)	27,602 AF (449 cfs)	27,424 AF (446 cfs)	26,172 AF (426 cfs)
	Non-Irrigation Season Total	**84,382 AF (255 cfs)**	**83,505 AF (252 cfs)**	**82,529 AF (249 cfs)**	**78,285 AF (236 cfs)**
1963 - 1964	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,650 AF (141 cfs)	8,541 AF (139 cfs)	8,433 AF (137 cfs)	8,107 AF (132 cfs)
	Jan	11,543 AF (188 cfs)	11,461 AF (186 cfs)	11,380 AF (185 cfs)	11,136 AF (181 cfs)
	Feb	9,604 AF (173 cfs)	9,535 AF (172 cfs)	9,466 AF (170 cfs)	9,259 AF (167 cfs)
	Mar	1,341 AF (22 cfs)	1,315 AF (21 cfs)	1,288 AF (21 cfs)	1,208 AF (20 cfs)
	Non-Irrigation Season Total	**31,138 AF (94 cfs)**	**30,852 AF (93 cfs)**	**30,567 AF (92 cfs)**	**29,710 AF (90 cfs)**
1964 - 1965	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	1,047 AF (17 cfs)	1,013 AF (16 cfs)	983 AF (16 cfs)	909 AF (15 cfs)
	Jan	2,652 AF (43 cfs)	2,566 AF (42 cfs)	2,479 AF (40 cfs)	2,221 AF (36 cfs)
	Feb	4,991 AF (90 cfs)	4,913 AF (88 cfs)	4,836 AF (87 cfs)	4,602 AF (83 cfs)
	Mar	71 AF (1 cfs)	61 AF (1 cfs)	52 AF (1 cfs)	27 AF (0 cfs)
	Non-Irrigation Season Total	**8,761 AF (26 cfs)**	**8,554 AF (26 cfs)**	**8,349 AF (25 cfs)**	**7,760 AF (23 cfs)**
1965 - 1966	Oct	15,580 AF (491 cfs)	15,072 AF (475 cfs)	14,137 AF (445 cfs)	8,075 AF (254 cfs)
Above Average	Nov	25,915 AF (436 cfs)	25,014 AF (420 cfs)	24,076 AF (405 cfs)	20,720 AF (348 cfs)
	Dec	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,594 AF (497 cfs)
	Mar	16,420 AF (267 cfs)	16,134 AF (262 cfs)	15,748 AF (256 cfs)	14,173 AF (230 cfs)
	Non-Irrigation Season Total	**147,171 AF (444 cfs)**	**145,476 AF (439 cfs)**	**143,217 AF (432 cfs)**	**132,049 AF (399 cfs)**
1966 - 1967	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,747 AF (142 cfs)	8,695 AF (141 cfs)	8,642 AF (141 cfs)	8,486 AF (138 cfs)
	Jan	10,796 AF (176 cfs)	10,719 AF (174 cfs)	10,642 AF (173 cfs)	10,411 AF (169 cfs)
	Feb	8,148 AF (147 cfs)	8,100 AF (146 cfs)	8,052 AF (145 cfs)	7,909 AF (142 cfs)
	Mar	274 AF (4 cfs)	159 AF (3 cfs)	82 AF (1 cfs)	10 AF (0 cfs)
	Non-Irrigation Season Total	**27,965 AF (84 cfs)**	**27,673 AF (84 cfs)**	**27,418 AF (83 cfs)**	**26,815 AF (81 cfs)**
1967 - 1968	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	11,799 AF (192 cfs)	11,614 AF (189 cfs)	11,429 AF (186 cfs)	10,873 AF (177 cfs)
	Jan	20,713 AF (337 cfs)	20,229 AF (329 cfs)	19,804 AF (322 cfs)	18,237 AF (297 cfs)
	Feb	12,922 AF (233 cfs)	12,857 AF (232 cfs)	12,793 AF (230 cfs)	12,598 AF (227 cfs)
	Mar	16,667 AF (271 cfs)	15,835 AF (258 cfs)	14,720 AF (239 cfs)	11,012 AF (179 cfs)
	Non-Irrigation Season Total	**62,102 AF (187 cfs)**	**60,535 AF (183 cfs)**	**58,745 AF (177 cfs)**	**52,721 AF (159 cfs)**
1968 - 1969	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	9,725 AF (158 cfs)	9,634 AF (157 cfs)	9,542 AF (155 cfs)	9,268 AF (151 cfs)
	Jan	14,309 AF (233 cfs)	14,172 AF (230 cfs)	14,034 AF (228 cfs)	13,622 AF (222 cfs)
	Feb	9,974 AF (180 cfs)	9,914 AF (179 cfs)	9,854 AF (177 cfs)	9,675 AF (174 cfs)
	Mar	3,010 AF (49 cfs)	2,925 AF (48 cfs)	2,841 AF (46 cfs)	2,591 AF (42 cfs)
	Non-Irrigation Season Total	**37,017 AF (112 cfs)**	**36,644 AF (111 cfs)**	**36,272 AF (110 cfs)**	**35,157 AF (106 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1969 - 1970	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	27,636 AF (464 cfs)	27,464 AF (462 cfs)	27,170 AF (457 cfs)	20,776 AF (349 cfs)
	Dec	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,694 AF (499 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,719 AF (499 cfs)
	Mar	26,090 AF (424 cfs)	25,772 AF (419 cfs)	25,349 AF (412 cfs)	23,026 AF (374 cfs)
	Non-Irrigation Season Total	**142,982 AF (432 cfs)**	**142,491 AF (430 cfs)**	**141,775 AF (428 cfs)**	**132,959 AF (401 cfs)**
1970 - 1971	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	23,063 AF (388 cfs)	21,380 AF (359 cfs)	19,173 AF (322 cfs)	11,997 AF (202 cfs)
	Dec	30,600 AF (498 cfs)	30,495 AF (496 cfs)	30,375 AF (494 cfs)	29,659 AF (482 cfs)
	Jan	30,525 AF (496 cfs)	30,278 AF (492 cfs)	30,119 AF (490 cfs)	29,158 AF (474 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Non-Irrigation Season Total	**142,700 AF (431 cfs)**	**140,666 AF (425 cfs)**	**138,179 AF (417 cfs)**	**129,326 AF (390 cfs)**
1971 - 1972	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	3,190 AF (54 cfs)	2,622 AF (44 cfs)	2,079 AF (35 cfs)	644 AF (11 cfs)
	Dec	26,497 AF (431 cfs)	26,274 AF (427 cfs)	25,836 AF (420 cfs)	23,424 AF (381 cfs)
	Jan	29,515 AF (480 cfs)	29,341 AF (477 cfs)	29,187 AF (475 cfs)	28,098 AF (457 cfs)
	Feb	27,747 AF (500 cfs)	27,613 AF (497 cfs)	27,458 AF (494 cfs)	26,352 AF (475 cfs)
	Mar	24,443 AF (398 cfs)	23,500 AF (382 cfs)	22,591 AF (367 cfs)	18,630 AF (303 cfs)
	Non-Irrigation Season Total	**111,392 AF (336 cfs)**	**109,350 AF (330 cfs)**	**107,151 AF (323 cfs)**	**97,149 AF (293 cfs)**
1972 - 1973	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	21,885 AF (356 cfs)	21,214 AF (345 cfs)	20,419 AF (332 cfs)	17,916 AF (291 cfs)
	Jan	30,248 AF (492 cfs)	30,033 AF (488 cfs)	29,621 AF (482 cfs)	28,461 AF (463 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,346 AF (494 cfs)
	Non-Irrigation Season Total	**110,645 AF (334 cfs)**	**109,760 AF (331 cfs)**	**108,552 AF (328 cfs)**	**104,491 AF (315 cfs)**
1973 - 1974	Oct	15,868 AF (500 cfs)	15,868 AF (500 cfs)	15,868 AF (500 cfs)	10,139 AF (319 cfs)
Above Average	Nov	29,544 AF (496 cfs)	28,910 AF (486 cfs)	27,833 AF (468 cfs)	19,639 AF (330 cfs)
	Dec	30,645 AF (498 cfs)	30,595 AF (498 cfs)	30,422 AF (495 cfs)	28,711 AF (467 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,595 AF (498 cfs)	30,019 AF (488 cfs)
	Non-Irrigation Season Total	**165,312 AF (499 cfs)**	**164,629 AF (497 cfs)**	**163,231 AF (493 cfs)**	**147,020 AF (444 cfs)**
1974 - 1975	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	21,082 AF (343 cfs)	20,329 AF (331 cfs)	19,576 AF (318 cfs)	17,013 AF (277 cfs)
	Jan	29,721 AF (483 cfs)	29,505 AF (480 cfs)	29,187 AF (475 cfs)	27,538 AF (448 cfs)
	Feb	25,949 AF (467 cfs)	25,719 AF (463 cfs)	25,414 AF (458 cfs)	24,100 AF (434 cfs)
	Mar	8,057 AF (131 cfs)	7,832 AF (127 cfs)	7,544 AF (123 cfs)	6,202 AF (101 cfs)
	Non-Irrigation Season Total	**84,810 AF (256 cfs)**	**83,385 AF (252 cfs)**	**81,722 AF (247 cfs)**	**74,853 AF (226 cfs)**
1975 - 1976	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	26,374 AF (429 cfs)	25,883 AF (421 cfs)	25,161 AF (409 cfs)	22,625 AF (368 cfs)
	Jan	29,613 AF (482 cfs)	29,459 AF (479 cfs)	29,166 AF (474 cfs)	27,526 AF (448 cfs)
	Feb	22,060 AF (397 cfs)	21,659 AF (390 cfs)	21,218 AF (382 cfs)	19,704 AF (355 cfs)
	Mar	22,897 AF (372 cfs)	22,618 AF (368 cfs)	22,240 AF (362 cfs)	19,796 AF (322 cfs)
	Non-Irrigation Season Total	**100,944 AF (305 cfs)**	**99,619 AF (301 cfs)**	**97,786 AF (295 cfs)**	**89,651 AF (271 cfs)**
1976 - 1977	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	6,800 AF (111 cfs)	6,415 AF (104 cfs)	6,031 AF (98 cfs)	4,878 AF (79 cfs)
	Jan	11,905 AF (194 cfs)	11,309 AF (184 cfs)	10,713 AF (174 cfs)	8,925 AF (145 cfs)
	Feb	10,097 AF (182 cfs)	9,860 AF (178 cfs)	9,622 AF (173 cfs)	8,910 AF (160 cfs)
	Mar	17,054 AF (277 cfs)	16,470 AF (268 cfs)	15,832 AF (257 cfs)	12,783 AF (208 cfs)
	Non-Irrigation Season Total	**45,856 AF (138 cfs)**	**44,055 AF (133 cfs)**	**42,198 AF (127 cfs)**	**35,496 AF (107 cfs)**
1977 - 1978	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	2,842 AF (46 cfs)	2,754 AF (45 cfs)	2,667 AF (43 cfs)	2,408 AF (39 cfs)
	Jan	7,104 AF (116 cfs)	6,827 AF (111 cfs)	6,550 AF (107 cfs)	5,720 AF (93 cfs)
	Feb	7,044 AF (127 cfs)	6,886 AF (124 cfs)	6,727 AF (121 cfs)	6,253 AF (113 cfs)
	Mar	2,162 AF (35 cfs)	2,111 AF (34 cfs)	2,059 AF (33 cfs)	1,906 AF (31 cfs)
	Non-Irrigation Season Total	**19,152 AF (58 cfs)**	**18,577 AF (56 cfs)**	**18,004 AF (54 cfs)**	**16,287 AF (49 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1978 - 1979	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	5,070 AF (82 cfs)	4,755 AF (77 cfs)	4,439 AF (72 cfs)	3,493 AF (57 cfs)
	Jan	15,764 AF (256 cfs)	14,781 AF (240 cfs)	13,785 AF (224 cfs)	10,642 AF (173 cfs)
	Feb	23,832 AF (429 cfs)	23,312 AF (420 cfs)	22,733 AF (409 cfs)	20,789 AF (374 cfs)
	Mar	4,267 AF (69 cfs)	3,962 AF (64 cfs)	3,700 AF (60 cfs)	3,090 AF (50 cfs)
	Non-Irrigation Season Total	**48,934 AF (148 cfs)**	**46,810 AF (141 cfs)**	**44,657 AF (135 cfs)**	**38,014 AF (115 cfs)**
1979 - 1980	Oct	684 AF (22 cfs)	459 AF (14 cfs)	334 AF (11 cfs)	21 AF (1 cfs)
Above Average	Nov	19,135 AF (322 cfs)	17,284 AF (290 cfs)	15,247 AF (256 cfs)	9,136 AF (154 cfs)
	Dec	30,744 AF (500 cfs)	30,694 AF (499 cfs)	30,669 AF (499 cfs)	30,359 AF (494 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Non-Irrigation Season Total	**140,811 AF (425 cfs)**	**138,685 AF (419 cfs)**	**136,498 AF (412 cfs)**	**129,764 AF (392 cfs)**
1980 - 1981	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	7,629 AF (128 cfs)	6,596 AF (111 cfs)	5,590 AF (94 cfs)	2,781 AF (47 cfs)
	Dec	29,936 AF (487 cfs)	29,702 AF (483 cfs)	29,386 AF (478 cfs)	26,868 AF (437 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,545 AF (497 cfs)
	Feb	19,073 AF (343 cfs)	18,810 AF (339 cfs)	18,556 AF (334 cfs)	17,268 AF (311 cfs)
	Mar	13,692 AF (223 cfs)	12,808 AF (208 cfs)	11,924 AF (194 cfs)	9,282 AF (151 cfs)
	Non-Irrigation Season Total	**101,074 AF (305 cfs)**	**98,660 AF (298 cfs)**	**96,200 AF (290 cfs)**	**86,744 AF (262 cfs)**
1981 - 1982	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	9,120 AF (148 cfs)	8,914 AF (145 cfs)	8,707 AF (142 cfs)	8,088 AF (132 cfs)
	Jan	17,721 AF (288 cfs)	17,134 AF (279 cfs)	16,395 AF (267 cfs)	14,062 AF (229 cfs)
	Feb	18,498 AF (333 cfs)	18,305 AF (330 cfs)	18,061 AF (325 cfs)	17,164 AF (309 cfs)
	Mar	2,174 AF (35 cfs)	2,122 AF (35 cfs)	2,069 AF (34 cfs)	1,912 AF (31 cfs)
	Non-Irrigation Season Total	**47,514 AF (143 cfs)**	**46,474 AF (140 cfs)**	**45,233 AF (137 cfs)**	**41,225 AF (124 cfs)**
1982 - 1983	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	1,569 AF (26 cfs)	1,290 AF (22 cfs)	1,011 AF (17 cfs)	249 AF (4 cfs)
	Dec	30,115 AF (490 cfs)	30,016 AF (488 cfs)	29,917 AF (487 cfs)	29,434 AF (479 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,457 AF (495 cfs)
	Non-Irrigation Season Total	**120,941 AF (365 cfs)**	**120,563 AF (364 cfs)**	**120,185 AF (363 cfs)**	**118,652 AF (358 cfs)**
1983 - 1984	Oct	10,917 AF (344 cfs)	9,397 AF (296 cfs)	7,754 AF (244 cfs)	2,856 AF (90 cfs)
Above Average	Nov	29,507 AF (496 cfs)	29,098 AF (489 cfs)	28,625 AF (481 cfs)	23,452 AF (394 cfs)
	Dec	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,589 AF (497 cfs)
	Non-Irrigation Season Total	**161,416 AF (487 cfs)**	**159,487 AF (481 cfs)**	**157,371 AF (475 cfs)**	**147,145 AF (444 cfs)**
1984 - 1985	Oct	15,868 AF (500 cfs)	15,868 AF (500 cfs)	15,868 AF (500 cfs)	15,868 AF (500 cfs)
Above Average	Nov	29,752 AF (500 cfs)	29,752 AF (500 cfs)	29,752 AF (500 cfs)	29,752 AF (500 cfs)
	Dec	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	14,945 AF (243 cfs)	14,647 AF (238 cfs)	14,301 AF (233 cfs)	13,112 AF (213 cfs)
	Non-Irrigation Season Total	**149,821 AF (452 cfs)**	**149,523 AF (451 cfs)**	**149,178 AF (450 cfs)**	**147,988 AF (447 cfs)**
1985 - 1986	Oct	7,202 AF (227 cfs)	5,915 AF (186 cfs)	4,628 AF (146 cfs)	784 AF (25 cfs)
Above Average	Nov	17,800 AF (299 cfs)	16,603 AF (279 cfs)	15,353 AF (258 cfs)	10,806 AF (182 cfs)
	Dec	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,694 AF (499 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,080 AF (488 cfs)	27,038 AF (487 cfs)	26,996 AF (486 cfs)	26,591 AF (479 cfs)
	Mar	8,097 AF (132 cfs)	7,886 AF (128 cfs)	7,676 AF (125 cfs)	7,044 AF (115 cfs)
	Non-Irrigation Season Total	**121,667 AF (367 cfs)**	**118,930 AF (359 cfs)**	**116,140 AF (351 cfs)**	**106,663 AF (322 cfs)**
1986 - 1987	Oct	1,423 AF (45 cfs)	927 AF (29 cfs)	539 AF (17 cfs)	0 AF (0 cfs)
Above Average	Nov	24,630 AF (414 cfs)	22,567 AF (379 cfs)	20,142 AF (338 cfs)	12,611 AF (212 cfs)
	Dec	30,440 AF (495 cfs)	30,325 AF (493 cfs)	30,211 AF (491 cfs)	29,594 AF (481 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,719 AF (499 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Non-Irrigation Season Total	**145,748 AF (440 cfs)**	**143,075 AF (432 cfs)**	**140,148 AF (423 cfs)**	**131,412 AF (397 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1987 - 1988	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	710 AF (12 cfs)	478 AF (8 cfs)	276 AF (5 cfs)	0 AF (0 cfs)
	Dec	22,352 AF (364 cfs)	22,015 AF (358 cfs)	21,553 AF (351 cfs)	19,875 AF (323 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)
	Mar	30,744 AF (500 cfs)	30,248 AF (492 cfs)	29,820 AF (485 cfs)	25,519 AF (415 cfs)
	Non-Irrigation Season Total	**113,310 AF (342 cfs)**	**112,245 AF (339 cfs)**	**111,152 AF (336 cfs)**	**104,898 AF (317 cfs)**
1988 - 1989	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	22,765 AF (370 cfs)	22,403 AF (364 cfs)	21,959 AF (357 cfs)	20,560 AF (334 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,275 AF (492 cfs)
	Feb	27,671 AF (498 cfs)	27,562 AF (496 cfs)	27,379 AF (493 cfs)	25,860 AF (466 cfs)
	Mar	13,258 AF (216 cfs)	13,109 AF (213 cfs)	12,864 AF (209 cfs)	11,659 AF (190 cfs)
	Non-Irrigation Season Total	**94,439 AF (285 cfs)**	**93,817 AF (283 cfs)**	**92,946 AF (281 cfs)**	**88,353 AF (267 cfs)**
1989 - 1990	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	10,947 AF (178 cfs)	10,129 AF (165 cfs)	9,310 AF (151 cfs)	6,692 AF (109 cfs)
	Jan	30,694 AF (499 cfs)	30,694 AF (499 cfs)	30,595 AF (498 cfs)	29,423 AF (479 cfs)
	Feb	27,620 AF (497 cfs)	27,386 AF (493 cfs)	27,263 AF (491 cfs)	25,790 AF (464 cfs)
	Mar	30,391 AF (494 cfs)	30,115 AF (490 cfs)	29,806 AF (485 cfs)	28,045 AF (456 cfs)
	Non-Irrigation Season Total	**99,652 AF (301 cfs)**	**98,324 AF (297 cfs)**	**96,974 AF (293 cfs)**	**89,950 AF (272 cfs)**
1990 - 1991	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	18,508 AF (301 cfs)	18,154 AF (295 cfs)	17,744 AF (289 cfs)	16,522 AF (269 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,694 AF (499 cfs)	29,920 AF (487 cfs)
	Feb	27,256 AF (491 cfs)	26,951 AF (485 cfs)	26,499 AF (477 cfs)	24,740 AF (445 cfs)
	Mar	13,763 AF (224 cfs)	12,360 AF (201 cfs)	10,957 AF (178 cfs)	7,284 AF (118 cfs)
	Non-Irrigation Season Total	**90,271 AF (273 cfs)**	**88,209 AF (266 cfs)**	**85,894 AF (259 cfs)**	**78,466 AF (237 cfs)**
1991 - 1992	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	10,814 AF (176 cfs)	10,286 AF (167 cfs)	9,758 AF (159 cfs)	8,173 AF (133 cfs)
	Jan	30,694 AF (499 cfs)	30,645 AF (498 cfs)	30,541 AF (497 cfs)	29,461 AF (479 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)
	Mar	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,329 AF (493 cfs)
	Non-Irrigation Season Total	**101,012 AF (305 cfs)**	**100,434 AF (303 cfs)**	**99,803 AF (301 cfs)**	**96,723 AF (292 cfs)**
1992 - 1993	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	1,365 AF (23 cfs)	1,111 AF (19 cfs)	858 AF (14 cfs)	202 AF (3 cfs)
	Dec	30,619 AF (498 cfs)	30,472 AF (496 cfs)	30,331 AF (493 cfs)	29,523 AF (480 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,545 AF (497 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	30,301 AF (493 cfs)	29,943 AF (487 cfs)	29,523 AF (480 cfs)	27,187 AF (442 cfs)
	Non-Irrigation Season Total	**120,797 AF (365 cfs)**	**120,040 AF (362 cfs)**	**119,225 AF (360 cfs)**	**115,226 AF (348 cfs)**
1993 - 1994	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	5,352 AF (90 cfs)	4,931 AF (83 cfs)	4,507 AF (76 cfs)	3,016 AF (51 cfs)
	Dec	24,312 AF (395 cfs)	23,682 AF (385 cfs)	22,877 AF (372 cfs)	20,362 AF (331 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,001 AF (488 cfs)
	Feb	27,349 AF (492 cfs)	27,167 AF (489 cfs)	27,017 AF (486 cfs)	26,150 AF (471 cfs)
	Mar	20,923 AF (340 cfs)	20,097 AF (327 cfs)	19,282 AF (314 cfs)	15,391 AF (250 cfs)
	Non-Irrigation Season Total	**108,680 AF (328 cfs)**	**106,620 AF (322 cfs)**	**104,426 AF (315 cfs)**	**94,920 AF (287 cfs)**
1994 - 1995	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	7,778 AF (127 cfs)	7,471 AF (122 cfs)	7,164 AF (117 cfs)	6,241 AF (102 cfs)
	Jan	13,859 AF (225 cfs)	13,015 AF (212 cfs)	12,172 AF (198 cfs)	9,646 AF (157 cfs)
	Feb	11,278 AF (203 cfs)	10,774 AF (194 cfs)	10,207 AF (184 cfs)	8,483 AF (153 cfs)
	Mar	4,108 AF (67 cfs)	2,815 AF (46 cfs)	1,723 AF (28 cfs)	140 AF (2 cfs)
	Non-Irrigation Season Total	**37,023 AF (112 cfs)**	**34,076 AF (103 cfs)**	**31,266 AF (94 cfs)**	**24,510 AF (74 cfs)**
1995 - 1996	Oct	1,029 AF (32 cfs)	800 AF (25 cfs)	570 AF (18 cfs)	90 AF (3 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	23,871 AF (388 cfs)	23,484 AF (382 cfs)	22,919 AF (373 cfs)	20,637 AF (336 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,694 AF (499 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,458 AF (512 cfs)
	Mar	25,072 AF (408 cfs)	23,898 AF (389 cfs)	22,715 AF (369 cfs)	18,737 AF (305 cfs)
	Non-Irrigation Season Total	**109,477 AF (331 cfs)**	**107,685 AF (325 cfs)**	**105,708 AF (319 cfs)**	**98,616 AF (298 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1996 - 1997	Oct	2,271 AF (72 cfs)	1,637 AF (52 cfs)	1,003 AF (32 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	22,248 AF (362 cfs)	21,886 AF (356 cfs)	21,520 AF (350 cfs)	20,038 AF (326 cfs)
	Jan	30,694 AF (499 cfs)	30,694 AF (499 cfs)	30,645 AF (498 cfs)	29,993 AF (488 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	21,553 AF (351 cfs)	20,353 AF (331 cfs)	19,035 AF (310 cfs)	14,323 AF (233 cfs)
	Non-Irrigation Season Total	**104,535 AF (316 cfs)**	**102,338 AF (309 cfs)**	**99,972 AF (302 cfs)**	**92,122 AF (278 cfs)**
1997 - 1998	Oct	7,218 AF (227 cfs)	6,767 AF (213 cfs)	6,303 AF (199 cfs)	4,352 AF (137 cfs)
Above Average	Nov	29,752 AF (500 cfs)	29,752 AF (500 cfs)	29,752 AF (500 cfs)	27,815 AF (467 cfs)
	Dec	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)	27,769 AF (500 cfs)
	Mar	30,744 AF (500 cfs)	30,694 AF (499 cfs)	30,386 AF (494 cfs)	27,560 AF (448 cfs)
	Non-Irrigation Season Total	**156,970 AF (474 cfs)**	**156,469 AF (472 cfs)**	**155,697 AF (470 cfs)**	**148,984 AF (450 cfs)**
1998 - 1999	Oct	11,007 AF (347 cfs)	9,622 AF (303 cfs)	7,811 AF (246 cfs)	2,343 AF (74 cfs)
Above Average	Nov	10,385 AF (175 cfs)	9,107 AF (153 cfs)	7,927 AF (133 cfs)	4,544 AF (76 cfs)
	Dec	27,635 AF (449 cfs)	27,256 AF (443 cfs)	26,874 AF (437 cfs)	23,970 AF (390 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	27,769 AF (500 cfs)	27,719 AF (499 cfs)	27,719 AF (499 cfs)	27,292 AF (491 cfs)
	Mar	14,182 AF (231 cfs)	13,611 AF (221 cfs)	12,855 AF (209 cfs)	9,762 AF (159 cfs)
	Non-Irrigation Season Total	**121,721 AF (367 cfs)**	**118,059 AF (356 cfs)**	**113,931 AF (344 cfs)**	**98,654 AF (298 cfs)**
1999 - 2000	Oct	6,473 AF (204 cfs)	5,154 AF (162 cfs)	3,894 AF (123 cfs)	504 AF (16 cfs)
Above Average	Nov	20,536 AF (345 cfs)	18,352 AF (308 cfs)	16,126 AF (271 cfs)	9,375 AF (158 cfs)
	Dec	30,694 AF (499 cfs)	30,565 AF (497 cfs)	30,443 AF (495 cfs)	29,978 AF (488 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)
	Mar	30,744 AF (500 cfs)	30,694 AF (499 cfs)	30,622 AF (498 cfs)	27,222 AF (443 cfs)
	Non-Irrigation Season Total	**147,951 AF (447 cfs)**	**144,269 AF (436 cfs)**	**140,589 AF (424 cfs)**	**126,583 AF (382 cfs)**
2000 - 2001	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	16,399 AF (267 cfs)	15,556 AF (253 cfs)	14,521 AF (236 cfs)	10,883 AF (177 cfs)
	Jan	30,525 AF (496 cfs)	30,178 AF (491 cfs)	29,541 AF (480 cfs)	25,104 AF (408 cfs)
	Feb	27,620 AF (497 cfs)	27,535 AF (496 cfs)	27,267 AF (491 cfs)	25,140 AF (453 cfs)
	Mar	2,018 AF (33 cfs)	1,787 AF (29 cfs)	1,571 AF (26 cfs)	1,070 AF (17 cfs)
	Non-Irrigation Season Total	**76,561 AF (231 cfs)**	**75,056 AF (227 cfs)**	**72,901 AF (220 cfs)**	**62,196 AF (188 cfs)**
2001 - 2002	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	178 AF (3 cfs)	113 AF (2 cfs)	47 AF (1 cfs)	0 AF (0 cfs)
	Dec	11,659 AF (190 cfs)	11,062 AF (180 cfs)	10,465 AF (170 cfs)	8,675 AF (141 cfs)
	Jan	22,054 AF (359 cfs)	21,335 AF (347 cfs)	20,460 AF (333 cfs)	16,690 AF (271 cfs)
	Feb	14,308 AF (258 cfs)	13,837 AF (249 cfs)	13,317 AF (240 cfs)	11,526 AF (208 cfs)
	Mar	5,351 AF (87 cfs)	5,088 AF (83 cfs)	4,699 AF (76 cfs)	3,231 AF (53 cfs)
	Non-Irrigation Season Total	**53,551 AF (162 cfs)**	**51,435 AF (155 cfs)**	**48,989 AF (148 cfs)**	**40,122 AF (121 cfs)**
2002 - 2003	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Jan	1,802 AF (29 cfs)	1,529 AF (25 cfs)	1,256 AF (20 cfs)	493 AF (8 cfs)
	Feb	3,311 AF (60 cfs)	2,785 AF (50 cfs)	2,258 AF (41 cfs)	701 AF (13 cfs)
	Mar	382 AF (6 cfs)	150 AF (2 cfs)	26 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**5,495 AF (17 cfs)**	**4,464 AF (13 cfs)**	**3,540 AF (11 cfs)**	**1,194 AF (4 cfs)**
2003 - 2004	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	10 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Jan	1,535 AF (25 cfs)	1,270 AF (21 cfs)	1,027 AF (17 cfs)	395 AF (6 cfs)
	Feb	798 AF (14 cfs)	546 AF (10 cfs)	294 AF (5 cfs)	0 AF (0 cfs)
	Mar	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**2,344 AF (7 cfs)**	**1,815 AF (5 cfs)**	**1,321 AF (4 cfs)**	**395 AF (1 cfs)**
2004 - 2005	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	4,918 AF (80 cfs)	4,359 AF (71 cfs)	3,806 AF (62 cfs)	2,210 AF (36 cfs)
	Jan	11,581 AF (188 cfs)	10,388 AF (169 cfs)	9,201 AF (150 cfs)	5,796 AF (94 cfs)
	Feb	455 AF (8 cfs)	293 AF (5 cfs)	136 AF (2 cfs)	0 AF (0 cfs)
	Mar	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**16,954 AF (51 cfs)**	**15,041 AF (45 cfs)**	**13,144 AF (40 cfs)**	**8,006 AF (24 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
2005 - 2006	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	12,038 AF (196 cfs)	10,863 AF (177 cfs)	9,689 AF (158 cfs)	6,272 AF (102 cfs)
	Jan	507 AF (8 cfs)	476 AF (8 cfs)	445 AF (7 cfs)	360 AF (6 cfs)
	Feb	6,384 AF (115 cfs)	5,821 AF (105 cfs)	5,181 AF (93 cfs)	3,273 AF (59 cfs)
	Mar	160 AF (3 cfs)	63 AF (1 cfs)	8 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**19,089 AF (58 cfs)**	**17,223 AF (52 cfs)**	**15,323 AF (46 cfs)**	**9,905 AF (30 cfs)**
2006 - 2007	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	4,621 AF (75 cfs)	4,081 AF (66 cfs)	3,543 AF (58 cfs)	2,003 AF (33 cfs)
	Jan	9,504 AF (155 cfs)	8,431 AF (137 cfs)	7,357 AF (120 cfs)	4,137 AF (67 cfs)
	Feb	12,353 AF (222 cfs)	11,247 AF (203 cfs)	10,141 AF (183 cfs)	6,823 AF (123 cfs)
	Mar	6,315 AF (103 cfs)	4,717 AF (77 cfs)	3,141 AF (51 cfs)	640 AF (10 cfs)
	Non-Irrigation Season Total	**32,793 AF (99 cfs)**	**28,476 AF (86 cfs)**	**24,182 AF (73 cfs)**	**13,602 AF (41 cfs)**
2007 - 2008	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	10,058 AF (164 cfs)	9,069 AF (147 cfs)	8,079 AF (131 cfs)	5,123 AF (83 cfs)
	Jan	23,323 AF (379 cfs)	22,539 AF (367 cfs)	21,499 AF (350 cfs)	17,186 AF (280 cfs)
	Feb	12,412 AF (223 cfs)	12,043 AF (217 cfs)	11,623 AF (209 cfs)	10,227 AF (184 cfs)
	Mar	508 AF (8 cfs)	239 AF (4 cfs)	25 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**46,301 AF (140 cfs)**	**43,889 AF (133 cfs)**	**41,226 AF (124 cfs)**	**32,537 AF (98 cfs)**
2008 - 2009	Oct	853 AF (27 cfs)	188 AF (6 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,335 AF (136 cfs)	7,729 AF (126 cfs)	7,122 AF (116 cfs)	5,316 AF (86 cfs)
	Jan	9,527 AF (155 cfs)	9,013 AF (147 cfs)	8,453 AF (137 cfs)	6,773 AF (110 cfs)
	Feb	3,863 AF (70 cfs)	3,590 AF (65 cfs)	3,307 AF (60 cfs)	2,372 AF (43 cfs)
	Mar	1,188 AF (19 cfs)	743 AF (12 cfs)	425 AF (7 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**23,765 AF (72 cfs)**	**21,262 AF (64 cfs)**	**19,307 AF (58 cfs)**	**14,461 AF (44 cfs)**
2009 - 2010	Oct	5,164 AF (163 cfs)	4,323 AF (136 cfs)	3,548 AF (112 cfs)	1,097 AF (35 cfs)
Above Average	Nov	19,907 AF (335 cfs)	18,421 AF (310 cfs)	16,703 AF (281 cfs)	11,300 AF (190 cfs)
	Dec	30,562 AF (497 cfs)	30,489 AF (496 cfs)	30,416 AF (495 cfs)	29,808 AF (485 cfs)
	Jan	28,969 AF (471 cfs)	28,735 AF (467 cfs)	28,343 AF (461 cfs)	26,647 AF (433 cfs)
	Feb	14,146 AF (255 cfs)	13,641 AF (246 cfs)	13,136 AF (237 cfs)	11,622 AF (209 cfs)
	Mar	16,411 AF (267 cfs)	15,285 AF (249 cfs)	14,088 AF (229 cfs)	9,071 AF (148 cfs)
	Non-Irrigation Season Total	**115,159 AF (348 cfs)**	**110,894 AF (335 cfs)**	**106,235 AF (321 cfs)**	**89,545 AF (270 cfs)**
2010 - 2011	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,994 AF (146 cfs)	8,596 AF (140 cfs)	8,162 AF (133 cfs)	6,859 AF (112 cfs)
	Jan	29,481 AF (479 cfs)	29,088 AF (473 cfs)	28,613 AF (465 cfs)	25,758 AF (419 cfs)
	Feb	24,541 AF (442 cfs)	24,176 AF (435 cfs)	23,751 AF (428 cfs)	22,024 AF (397 cfs)
	Mar	1,860 AF (30 cfs)	1,614 AF (26 cfs)	1,381 AF (22 cfs)	758 AF (12 cfs)
	Non-Irrigation Season Total	**64,876 AF (196 cfs)**	**63,473 AF (192 cfs)**	**61,907 AF (187 cfs)**	**55,399 AF (167 cfs)**
2011 - 2012	Oct	71 AF (2 cfs)	7 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	2,695 AF (45 cfs)	2,204 AF (37 cfs)	1,728 AF (29 cfs)	467 AF (8 cfs)
	Dec	29,568 AF (481 cfs)	29,480 AF (479 cfs)	29,393 AF (478 cfs)	28,797 AF (468 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)
	Mar	13,814 AF (225 cfs)	13,213 AF (215 cfs)	12,712 AF (207 cfs)	9,826 AF (160 cfs)
	Non-Irrigation Season Total	**105,652 AF (319 cfs)**	**104,409 AF (315 cfs)**	**103,337 AF (312 cfs)**	**98,594 AF (298 cfs)**
2012 - 2013	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	294 AF (5 cfs)	186 AF (3 cfs)	92 AF (1 cfs)	0 AF (0 cfs)
	Jan	4,706 AF (77 cfs)	4,122 AF (67 cfs)	3,570 AF (58 cfs)	2,047 AF (33 cfs)
	Feb	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Mar	3,659 AF (60 cfs)	2,442 AF (40 cfs)	1,435 AF (23 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**8,658 AF (26 cfs)**	**6,750 AF (20 cfs)**	**5,096 AF (15 cfs)**	**2,047 AF (6 cfs)**
2013 - 2014	Oct	1,600 AF (50 cfs)	1,090 AF (34 cfs)	580 AF (18 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	27,859 AF (453 cfs)	27,558 AF (448 cfs)	26,934 AF (438 cfs)	23,926 AF (389 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,496 AF (496 cfs)
	Feb	25,816 AF (465 cfs)	25,698 AF (463 cfs)	25,564 AF (460 cfs)	25,069 AF (451 cfs)
	Mar	21,046 AF (342 cfs)	20,302 AF (330 cfs)	19,492 AF (317 cfs)	15,234 AF (248 cfs)
	Non-Irrigation Season Total	**107,065 AF (323 cfs)**	**105,392 AF (318 cfs)**	**103,315 AF (312 cfs)**	**94,725 AF (286 cfs)**

Alternative 1 (500 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
2014 - 2015	Oct	4,340 AF (137 cfs)	3,195 AF (101 cfs)	2,182 AF (69 cfs)	0 AF (0 cfs)
Above Average	Nov	26,920 AF (452 cfs)	26,390 AF (443 cfs)	25,859 AF (435 cfs)	23,989 AF (403 cfs)
	Dec	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	25,479 AF (459 cfs)	25,421 AF (458 cfs)	25,195 AF (454 cfs)	24,044 AF (433 cfs)
	Mar	23,902 AF (389 cfs)	22,924 AF (373 cfs)	21,977 AF (357 cfs)	17,923 AF (291 cfs)
	Non-Irrigation Season Total	**142,129 AF (429 cfs)**	**139,418 AF (421 cfs)**	**136,701 AF (413 cfs)**	**127,444 AF (385 cfs)**
2015 - 2016	Oct	4,043 AF (127 cfs)	3,317 AF (105 cfs)	2,449 AF (77 cfs)	155 AF (5 cfs)
Above Average	Nov	24,347 AF (409 cfs)	23,518 AF (395 cfs)	22,234 AF (374 cfs)	14,578 AF (245 cfs)
	Dec	27,636 AF (449 cfs)	27,435 AF (446 cfs)	27,238 AF (443 cfs)	25,968 AF (422 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,760 AF (518 cfs)	28,711 AF (517 cfs)
	Mar	19,208 AF (312 cfs)	18,231 AF (296 cfs)	17,205 AF (280 cfs)	13,339 AF (217 cfs)
	Non-Irrigation Season Total	**134,738 AF (407 cfs)**	**132,005 AF (399 cfs)**	**128,629 AF (388 cfs)**	**113,494 AF (343 cfs)**
2016 - 2017	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	23,034 AF (375 cfs)	22,045 AF (359 cfs)	21,003 AF (342 cfs)	16,215 AF (264 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,280 AF (492 cfs)
	Feb	25,158 AF (453 cfs)	24,525 AF (442 cfs)	23,792 AF (428 cfs)	21,021 AF (379 cfs)
	Mar	128 AF (2 cfs)	86 AF (1 cfs)	44 AF (1 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**79,064 AF (239 cfs)**	**77,401 AF (234 cfs)**	**75,584 AF (228 cfs)**	**67,516 AF (204 cfs)**
2017 - 2018	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	34 AF (1 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	28,520 AF (464 cfs)	27,734 AF (451 cfs)	26,462 AF (430 cfs)	21,863 AF (356 cfs)
	Jan	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)	30,744 AF (500 cfs)
	Feb	23,567 AF (424 cfs)	23,021 AF (415 cfs)	22,322 AF (402 cfs)	19,907 AF (358 cfs)
	Mar	6,251 AF (102 cfs)	5,554 AF (90 cfs)	4,877 AF (79 cfs)	2,974 AF (48 cfs)
	Non-Irrigation Season Total	**89,116 AF (269 cfs)**	**87,053 AF (263 cfs)**	**84,406 AF (255 cfs)**	**75,488 AF (228 cfs)**
2018 - 2019	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	6,216 AF (101 cfs)	5,894 AF (96 cfs)	5,572 AF (91 cfs)	4,606 AF (75 cfs)
	Jan	23,476 AF (382 cfs)	22,091 AF (359 cfs)	20,658 AF (336 cfs)	15,738 AF (256 cfs)
	Feb	26,405 AF (475 cfs)	25,762 AF (464 cfs)	24,842 AF (447 cfs)	20,690 AF (373 cfs)
	Mar	26,592 AF (432 cfs)	25,777 AF (419 cfs)	24,534 AF (399 cfs)	18,824 AF (306 cfs)
	Non-Irrigation Season Total	**82,690 AF (250 cfs)**	**79,523 AF (240 cfs)**	**75,606 AF (228 cfs)**	**59,858 AF (181 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1924 - 1925	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	15,614 AF (254 cfs)	14,665 AF (239 cfs)	14,498 AF (236 cfs)	13,995 AF (228 cfs)
	Jan	26,195 AF (426 cfs)	24,155 AF (393 cfs)	23,246 AF (378 cfs)	20,302 AF (330 cfs)
	Feb	30,783 AF (554 cfs)	29,452 AF (530 cfs)	28,186 AF (508 cfs)	25,457 AF (458 cfs)
	Mar	10,030 AF (163 cfs)	9,317 AF (152 cfs)	9,105 AF (148 cfs)	8,469 AF (138 cfs)
	Non-Irrigation Season	**82,621 AF (249 cfs)**	**77,589 AF (234 cfs)**	**75,035 AF (227 cfs)**	**68,224 AF (206 cfs)**
1925 - 1926	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	18,094 AF (294 cfs)	17,036 AF (277 cfs)	16,883 AF (275 cfs)	16,422 AF (267 cfs)
	Jan	22,650 AF (368 cfs)	21,373 AF (348 cfs)	21,228 AF (345 cfs)	20,793 AF (338 cfs)
	Feb	24,256 AF (437 cfs)	22,882 AF (412 cfs)	22,169 AF (399 cfs)	20,378 AF (367 cfs)
	Mar	4,764 AF (77 cfs)	4,397 AF (72 cfs)	4,267 AF (69 cfs)	3,883 AF (63 cfs)
	Non-Irrigation Season	**69,765 AF (211 cfs)**	**65,687 AF (198 cfs)**	**64,547 AF (195 cfs)**	**61,476 AF (186 cfs)**
1926 - 1927	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	17,081 AF (278 cfs)	16,072 AF (261 cfs)	15,916 AF (259 cfs)	15,450 AF (251 cfs)
	Jan	26,062 AF (424 cfs)	24,483 AF (398 cfs)	23,720 AF (386 cfs)	21,640 AF (352 cfs)
	Feb	24,099 AF (434 cfs)	22,576 AF (407 cfs)	21,888 AF (394 cfs)	19,894 AF (358 cfs)
	Mar	28,526 AF (464 cfs)	26,981 AF (439 cfs)	25,873 AF (421 cfs)	21,971 AF (357 cfs)
	Non-Irrigation Season	**95,768 AF (289 cfs)**	**90,112 AF (272 cfs)**	**87,397 AF (264 cfs)**	**78,954 AF (238 cfs)**
1927 - 1928	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	16,930 AF (275 cfs)	15,865 AF (258 cfs)	15,646 AF (254 cfs)	14,991 AF (244 cfs)
	Jan	24,159 AF (393 cfs)	22,410 AF (364 cfs)	21,815 AF (355 cfs)	19,937 AF (324 cfs)
	Feb	34,824 AF (627 cfs)	32,348 AF (582 cfs)	30,458 AF (548 cfs)	24,958 AF (449 cfs)
	Mar	17,940 AF (292 cfs)	16,275 AF (265 cfs)	15,454 AF (251 cfs)	12,694 AF (206 cfs)
	Non-Irrigation Season	**93,852 AF (283 cfs)**	**86,898 AF (262 cfs)**	**83,373 AF (252 cfs)**	**72,580 AF (219 cfs)**
1928 - 1929	Oct	138 AF (4 cfs)	11 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	32 AF (1 cfs)	18 AF (0 cfs)	7 AF (0 cfs)	0 AF (0 cfs)
	Dec	20,771 AF (338 cfs)	19,336 AF (314 cfs)	18,940 AF (308 cfs)	17,752 AF (289 cfs)
	Jan	47,631 AF (775 cfs)	46,157 AF (751 cfs)	43,675 AF (710 cfs)	35,445 AF (576 cfs)
	Feb	51,985 AF (936 cfs)	50,419 AF (908 cfs)	47,441 AF (854 cfs)	36,984 AF (666 cfs)
	Mar	30,979 AF (504 cfs)	29,129 AF (474 cfs)	28,055 AF (456 cfs)	24,954 AF (406 cfs)
	Non-Irrigation Season	**151,536 AF (457 cfs)**	**145,071 AF (438 cfs)**	**138,119 AF (417 cfs)**	**115,135 AF (348 cfs)**
1929 - 1930	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	11,278 AF (190 cfs)	9,465 AF (159 cfs)	8,128 AF (137 cfs)	4,158 AF (70 cfs)
	Dec	33,656 AF (547 cfs)	31,731 AF (516 cfs)	30,385 AF (494 cfs)	26,469 AF (430 cfs)
	Jan	28,474 AF (463 cfs)	26,311 AF (428 cfs)	25,058 AF (408 cfs)	21,210 AF (345 cfs)
	Feb	54,053 AF (973 cfs)	53,202 AF (958 cfs)	52,169 AF (939 cfs)	47,205 AF (850 cfs)
	Mar	19,737 AF (321 cfs)	18,325 AF (298 cfs)	17,242 AF (280 cfs)	14,797 AF (241 cfs)
	Non-Irrigation Season	**147,197 AF (444 cfs)**	**139,034 AF (420 cfs)**	**132,983 AF (401 cfs)**	**113,840 AF (344 cfs)**
1930 - 1931	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	4,678 AF (79 cfs)	3,818 AF (64 cfs)	3,206 AF (54 cfs)	1,831 AF (31 cfs)
	Dec	27,181 AF (442 cfs)	25,391 AF (413 cfs)	24,818 AF (404 cfs)	22,933 AF (373 cfs)
	Jan	22,701 AF (369 cfs)	21,064 AF (343 cfs)	20,562 AF (334 cfs)	19,057 AF (310 cfs)
	Feb	26,891 AF (484 cfs)	25,059 AF (451 cfs)	23,955 AF (431 cfs)	21,156 AF (381 cfs)
	Mar	23,463 AF (382 cfs)	21,723 AF (353 cfs)	20,499 AF (333 cfs)	17,716 AF (288 cfs)
	Non-Irrigation Season	**104,914 AF (317 cfs)**	**97,056 AF (293 cfs)**	**93,040 AF (281 cfs)**	**82,693 AF (250 cfs)**
1931 - 1932	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,821 AF (241 cfs)	13,695 AF (223 cfs)	13,309 AF (216 cfs)	12,153 AF (198 cfs)
	Jan	26,828 AF (436 cfs)	24,826 AF (404 cfs)	24,067 AF (391 cfs)	21,752 AF (354 cfs)
	Feb	22,919 AF (413 cfs)	21,226 AF (382 cfs)	20,680 AF (372 cfs)	19,041 AF (343 cfs)
	Mar	4,179 AF (68 cfs)	3,845 AF (63 cfs)	3,720 AF (60 cfs)	3,345 AF (54 cfs)
	Non-Irrigation Season Total	**68,747 AF (208 cfs)**	**63,592 AF (192 cfs)**	**61,776 AF (186 cfs)**	**56,289 AF (170 cfs)**
1932 - 1933	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	3,971 AF (65 cfs)	3,685 AF (60 cfs)	3,599 AF (59 cfs)	3,339 AF (54 cfs)
	Jan	12,084 AF (197 cfs)	11,387 AF (185 cfs)	11,294 AF (184 cfs)	11,015 AF (179 cfs)
	Feb	14,867 AF (268 cfs)	14,022 AF (252 cfs)	13,921 AF (251 cfs)	13,618 AF (245 cfs)
	Mar	6,008 AF (98 cfs)	5,542 AF (90 cfs)	5,378 AF (87 cfs)	4,928 AF (80 cfs)
	Non-Irrigation Season Total	**36,929 AF (111 cfs)**	**34,637 AF (105 cfs)**	**34,192 AF (103 cfs)**	**32,899 AF (99 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1933 - 1934	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	13,332 AF (217 cfs)	12,612 AF (205 cfs)	12,558 AF (204 cfs)	12,395 AF (202 cfs)
	Jan	15,446 AF (251 cfs)	14,598 AF (237 cfs)	14,522 AF (236 cfs)	14,295 AF (232 cfs)
	Feb	9,760 AF (176 cfs)	9,079 AF (163 cfs)	8,836 AF (159 cfs)	8,039 AF (145 cfs)
	Mar	4,082 AF (66 cfs)	3,797 AF (62 cfs)	3,717 AF (60 cfs)	3,475 AF (57 cfs)
	Non-Irrigation Season Total	**42,620 AF (129 cfs)**	**40,086 AF (121 cfs)**	**39,632 AF (120 cfs)**	**38,204 AF (115 cfs)**
1934 - 1935	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	5,091 AF (83 cfs)	4,701 AF (76 cfs)	4,565 AF (74 cfs)	4,159 AF (68 cfs)
	Jan	7,050 AF (115 cfs)	6,617 AF (108 cfs)	6,536 AF (106 cfs)	6,294 AF (102 cfs)
	Feb	1,130 AF (20 cfs)	1,023 AF (18 cfs)	974 AF (18 cfs)	848 AF (15 cfs)
	Mar	1,305 AF (21 cfs)	1,213 AF (20 cfs)	1,185 AF (19 cfs)	1,102 AF (18 cfs)
	Non-Irrigation Season Total	**14,575 AF (44 cfs)**	**13,553 AF (41 cfs)**	**13,260 AF (40 cfs)**	**12,404 AF (37 cfs)**
1935 - 1936	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	10,362 AF (169 cfs)	9,793 AF (159 cfs)	9,743 AF (158 cfs)	9,590 AF (156 cfs)
	Jan	13,013 AF (212 cfs)	12,300 AF (200 cfs)	12,237 AF (199 cfs)	12,048 AF (196 cfs)
	Feb	13,700 AF (247 cfs)	12,934 AF (233 cfs)	12,853 AF (231 cfs)	12,608 AF (227 cfs)
	Mar	1,631 AF (27 cfs)	1,533 AF (25 cfs)	1,519 AF (25 cfs)	1,478 AF (24 cfs)
	Non-Irrigation Season Total	**38,707 AF (117 cfs)**	**36,560 AF (110 cfs)**	**36,351 AF (110 cfs)**	**35,725 AF (108 cfs)**
1936 - 1937	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	3,250 AF (53 cfs)	3,036 AF (49 cfs)	2,985 AF (49 cfs)	2,832 AF (46 cfs)
	Jan	5,974 AF (97 cfs)	5,608 AF (91 cfs)	5,541 AF (90 cfs)	5,339 AF (87 cfs)
	Feb	13,589 AF (245 cfs)	12,842 AF (231 cfs)	12,776 AF (230 cfs)	12,575 AF (226 cfs)
	Mar	1,367 AF (22 cfs)	1,267 AF (21 cfs)	1,234 AF (20 cfs)	1,137 AF (18 cfs)
	Non-Irrigation Season Total	**24,180 AF (73 cfs)**	**22,753 AF (69 cfs)**	**22,536 AF (68 cfs)**	**21,883 AF (66 cfs)**
1937 - 1938	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	4,868 AF (79 cfs)	4,506 AF (73 cfs)	4,387 AF (71 cfs)	4,032 AF (66 cfs)
	Jan	7,359 AF (120 cfs)	6,914 AF (112 cfs)	6,836 AF (111 cfs)	6,605 AF (107 cfs)
	Feb	11,682 AF (210 cfs)	11,039 AF (199 cfs)	10,980 AF (198 cfs)	10,802 AF (195 cfs)
	Mar	82 AF (1 cfs)	74 AF (1 cfs)	70 AF (1 cfs)	58 AF (1 cfs)
	Non-Irrigation Season Total	**23,990 AF (72 cfs)**	**22,532 AF (68 cfs)**	**22,273 AF (67 cfs)**	**21,497 AF (65 cfs)**
1938 - 1939	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	42,879 AF (697 cfs)	41,692 AF (678 cfs)	40,363 AF (656 cfs)	32,246 AF (524 cfs)
	Jan	58,962 AF (959 cfs)	57,974 AF (943 cfs)	56,632 AF (921 cfs)	47,669 AF (775 cfs)
	Feb	48,385 AF (871 cfs)	46,200 AF (832 cfs)	43,676 AF (786 cfs)	35,194 AF (634 cfs)
	Mar	55,596 AF (904 cfs)	54,935 AF (893 cfs)	54,214 AF (882 cfs)	52,427 AF (853 cfs)
	Non-Irrigation Season Total	**205,821 AF (621 cfs)**	**200,802 AF (606 cfs)**	**194,885 AF (588 cfs)**	**167,536 AF (506 cfs)**
1939 - 1940	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	3,875 AF (63 cfs)	3,251 AF (53 cfs)	2,826 AF (46 cfs)	1,584 AF (26 cfs)
	Jan	4,428 AF (72 cfs)	4,109 AF (67 cfs)	4,012 AF (65 cfs)	3,721 AF (61 cfs)
	Feb	11,133 AF (200 cfs)	10,490 AF (189 cfs)	10,403 AF (187 cfs)	10,143 AF (183 cfs)
	Mar	4,138 AF (67 cfs)	3,847 AF (63 cfs)	3,764 AF (61 cfs)	3,512 AF (57 cfs)
	Non-Irrigation Season Total	**23,574 AF (71 cfs)**	**21,697 AF (66 cfs)**	**21,004 AF (63 cfs)**	**18,960 AF (57 cfs)**
1940 - 1941	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	1,207 AF (20 cfs)	1,119 AF (18 cfs)	1,092 AF (18 cfs)	1,010 AF (16 cfs)
	Jan	3,511 AF (57 cfs)	3,281 AF (53 cfs)	3,225 AF (52 cfs)	3,060 AF (50 cfs)
	Feb	6,846 AF (123 cfs)	6,461 AF (116 cfs)	6,418 AF (116 cfs)	6,290 AF (113 cfs)
	Mar	168 AF (3 cfs)	153 AF (2 cfs)	146 AF (2 cfs)	125 AF (2 cfs)
	Non-Irrigation Season Total	**11,733 AF (35 cfs)**	**11,013 AF (33 cfs)**	**10,881 AF (33 cfs)**	**10,484 AF (32 cfs)**
1941 - 1942	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	12,400 AF (202 cfs)	11,600 AF (189 cfs)	11,421 AF (186 cfs)	10,882 AF (177 cfs)
	Jan	15,084 AF (245 cfs)	14,150 AF (230 cfs)	13,970 AF (227 cfs)	13,431 AF (218 cfs)
	Feb	13,936 AF (251 cfs)	13,055 AF (235 cfs)	12,870 AF (232 cfs)	12,318 AF (222 cfs)
	Mar	42,618 AF (693 cfs)	41,087 AF (668 cfs)	39,156 AF (637 cfs)	32,092 AF (522 cfs)
	Non-Irrigation Season Total	**84,037 AF (254 cfs)**	**79,892 AF (241 cfs)**	**77,417 AF (234 cfs)**	**68,722 AF (207 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1942 - 1943	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	44,248 AF (720 cfs)	41,827 AF (680 cfs)	39,396 AF (641 cfs)	32,327 AF (526 cfs)
	Jan	54,835 AF (892 cfs)	53,182 AF (865 cfs)	51,167 AF (832 cfs)	41,611 AF (677 cfs)
	Feb	29,290 AF (527 cfs)	27,765 AF (500 cfs)	27,040 AF (487 cfs)	24,603 AF (443 cfs)
	Mar	36,438 AF (593 cfs)	33,902 AF (551 cfs)	31,900 AF (519 cfs)	27,295 AF (444 cfs)
	Non-Irrigation Season Total	**164,812 AF (498 cfs)**	**156,676 AF (473 cfs)**	**149,503 AF (451 cfs)**	**125,836 AF (380 cfs)**
1943 - 1944	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	9,011 AF (147 cfs)	8,478 AF (138 cfs)	8,395 AF (137 cfs)	8,146 AF (132 cfs)
	Jan	13,630 AF (222 cfs)	12,855 AF (209 cfs)	12,763 AF (208 cfs)	12,485 AF (203 cfs)
	Feb	19,506 AF (351 cfs)	18,047 AF (325 cfs)	17,564 AF (316 cfs)	16,115 AF (290 cfs)
	Mar	5,950 AF (97 cfs)	5,539 AF (90 cfs)	5,425 AF (88 cfs)	5,083 AF (83 cfs)
	Non-Irrigation Season Total	**48,097 AF (145 cfs)**	**44,919 AF (136 cfs)**	**44,146 AF (133 cfs)**	**41,828 AF (126 cfs)**
1944 - 1945	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	15,918 AF (259 cfs)	15,015 AF (244 cfs)	14,907 AF (242 cfs)	14,584 AF (237 cfs)
	Jan	18,734 AF (305 cfs)	17,631 AF (287 cfs)	17,464 AF (284 cfs)	16,963 AF (276 cfs)
	Feb	15,128 AF (272 cfs)	14,280 AF (257 cfs)	14,188 AF (255 cfs)	13,913 AF (251 cfs)
	Mar	4,149 AF (67 cfs)	3,870 AF (63 cfs)	3,798 AF (62 cfs)	3,584 AF (58 cfs)
	Non-Irrigation Season Total	**53,930 AF (163 cfs)**	**50,795 AF (153 cfs)**	**50,356 AF (152 cfs)**	**49,043 AF (148 cfs)**
1945 - 1946	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	1,120 AF (19 cfs)	884 AF (15 cfs)	703 AF (12 cfs)	223 AF (4 cfs)
	Dec	41,671 AF (678 cfs)	39,754 AF (647 cfs)	37,908 AF (617 cfs)	30,505 AF (496 cfs)
	Jan	53,230 AF (866 cfs)	50,682 AF (824 cfs)	47,991 AF (780 cfs)	38,998 AF (634 cfs)
	Feb	33,450 AF (602 cfs)	31,590 AF (569 cfs)	30,232 AF (544 cfs)	26,149 AF (471 cfs)
	Mar	26,369 AF (429 cfs)	24,351 AF (396 cfs)	23,209 AF (377 cfs)	19,473 AF (317 cfs)
	Non-Irrigation Season Total	**155,839 AF (470 cfs)**	**147,260 AF (445 cfs)**	**140,043 AF (423 cfs)**	**115,348 AF (348 cfs)**
1946 - 1947	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	15,311 AF (249 cfs)	14,384 AF (234 cfs)	14,222 AF (231 cfs)	13,736 AF (223 cfs)
	Jan	20,779 AF (338 cfs)	19,187 AF (312 cfs)	18,561 AF (302 cfs)	16,675 AF (271 cfs)
	Feb	18,569 AF (334 cfs)	17,269 AF (311 cfs)	16,833 AF (303 cfs)	15,499 AF (279 cfs)
	Mar	32,482 AF (528 cfs)	29,677 AF (483 cfs)	27,145 AF (441 cfs)	19,907 AF (324 cfs)
	Non-Irrigation Season Total	**87,142 AF (263 cfs)**	**80,516 AF (243 cfs)**	**76,762 AF (232 cfs)**	**65,817 AF (199 cfs)**
1947 - 1948	Oct	1,854 AF (58 cfs)	1,164 AF (37 cfs)	647 AF (20 cfs)	0 AF (0 cfs)
Above Average	Nov	7,037 AF (118 cfs)	5,911 AF (99 cfs)	5,137 AF (86 cfs)	2,880 AF (48 cfs)
	Dec	29,867 AF (486 cfs)	28,094 AF (457 cfs)	27,316 AF (444 cfs)	24,888 AF (405 cfs)
	Jan	34,998 AF (569 cfs)	32,936 AF (536 cfs)	31,520 AF (513 cfs)	27,460 AF (447 cfs)
	Feb	57,521 AF (1036 cfs)	57,510 AF (1036 cfs)	57,215 AF (1030 cfs)	49,601 AF (893 cfs)
	Mar	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,324 AF (997 cfs)	51,974 AF (845 cfs)
	Non-Irrigation Season Total	**192,764 AF (582 cfs)**	**187,103 AF (565 cfs)**	**183,158 AF (553 cfs)**	**156,804 AF (473 cfs)**
1948 - 1949	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	15,596 AF (254 cfs)	14,680 AF (239 cfs)	14,544 AF (237 cfs)	14,134 AF (230 cfs)
	Jan	45,034 AF (732 cfs)	42,123 AF (685 cfs)	39,293 AF (639 cfs)	30,840 AF (502 cfs)
	Feb	40,744 AF (734 cfs)	38,417 AF (692 cfs)	36,368 AF (655 cfs)	30,212 AF (544 cfs)
	Mar	11,676 AF (190 cfs)	10,942 AF (178 cfs)	10,791 AF (176 cfs)	10,340 AF (168 cfs)
	Non-Irrigation Season Total	**113,050 AF (341 cfs)**	**106,162 AF (320 cfs)**	**100,996 AF (305 cfs)**	**85,526 AF (258 cfs)**
1949 - 1950	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	15,001 AF (244 cfs)	14,157 AF (230 cfs)	14,064 AF (229 cfs)	13,784 AF (224 cfs)
	Jan	17,074 AF (278 cfs)	16,131 AF (262 cfs)	16,041 AF (261 cfs)	15,772 AF (257 cfs)
	Feb	21,952 AF (395 cfs)	20,497 AF (369 cfs)	20,071 AF (361 cfs)	18,825 AF (339 cfs)
	Mar	25,408 AF (413 cfs)	23,939 AF (389 cfs)	23,206 AF (377 cfs)	19,306 AF (314 cfs)
	Non-Irrigation Season Total	**79,435 AF (240 cfs)**	**74,724 AF (226 cfs)**	**73,382 AF (222 cfs)**	**67,687 AF (204 cfs)**
1950 - 1951	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,864 AF (242 cfs)	14,040 AF (228 cfs)	13,960 AF (227 cfs)	13,719 AF (223 cfs)
	Jan	15,262 AF (248 cfs)	14,416 AF (234 cfs)	14,334 AF (233 cfs)	14,086 AF (229 cfs)
	Feb	13,595 AF (245 cfs)	12,806 AF (231 cfs)	12,697 AF (229 cfs)	12,369 AF (223 cfs)
	Mar	1,866 AF (30 cfs)	1,715 AF (28 cfs)	1,657 AF (27 cfs)	1,482 AF (24 cfs)
	Non-Irrigation Season Total	**45,587 AF (138 cfs)**	**42,978 AF (130 cfs)**	**42,648 AF (129 cfs)**	**41,657 AF (126 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1951 - 1952	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,906 AF (242 cfs)	14,103 AF (229 cfs)	14,045 AF (228 cfs)	13,871 AF (226 cfs)
	Jan	22,704 AF (369 cfs)	21,282 AF (346 cfs)	21,025 AF (342 cfs)	20,180 AF (328 cfs)
	Feb	34,270 AF (617 cfs)	32,460 AF (584 cfs)	30,862 AF (556 cfs)	26,201 AF (472 cfs)
	Mar	35,411 AF (576 cfs)	33,714 AF (548 cfs)	32,078 AF (522 cfs)	27,729 AF (451 cfs)
	Non-Irrigation Season Total	**107,291 AF (324 cfs)**	**101,558 AF (307 cfs)**	**98,010 AF (296 cfs)**	**87,981 AF (266 cfs)**
1952 - 1953	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,938 AF (243 cfs)	14,005 AF (228 cfs)	13,819 AF (225 cfs)	13,261 AF (216 cfs)
	Jan	19,856 AF (323 cfs)	18,699 AF (304 cfs)	18,478 AF (301 cfs)	17,763 AF (289 cfs)
	Feb	15,041 AF (271 cfs)	14,028 AF (253 cfs)	13,766 AF (248 cfs)	12,981 AF (234 cfs)
	Mar	6,241 AF (101 cfs)	5,872 AF (95 cfs)	5,815 AF (95 cfs)	5,658 AF (92 cfs)
	Non-Irrigation Season Total	**56,076 AF (169 cfs)**	**52,603 AF (159 cfs)**	**51,878 AF (157 cfs)**	**49,663 AF (150 cfs)**
1953 - 1954	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	13,742 AF (224 cfs)	12,988 AF (211 cfs)	12,920 AF (210 cfs)	12,718 AF (207 cfs)
	Jan	14,039 AF (228 cfs)	13,278 AF (216 cfs)	13,219 AF (215 cfs)	13,042 AF (212 cfs)
	Feb	9,948 AF (179 cfs)	9,406 AF (169 cfs)	9,361 AF (169 cfs)	9,225 AF (166 cfs)
	Mar	2,828 AF (46 cfs)	2,617 AF (43 cfs)	2,548 AF (41 cfs)	2,350 AF (38 cfs)
	Non-Irrigation Season Total	**40,558 AF (122 cfs)**	**38,289 AF (116 cfs)**	**38,048 AF (115 cfs)**	**37,335 AF (113 cfs)**
1954 - 1955	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	2,343 AF (38 cfs)	2,179 AF (35 cfs)	2,131 AF (35 cfs)	1,994 AF (32 cfs)
	Jan	3,682 AF (60 cfs)	3,440 AF (56 cfs)	3,382 AF (55 cfs)	3,207 AF (52 cfs)
	Feb	8,281 AF (149 cfs)	7,789 AF (140 cfs)	7,711 AF (139 cfs)	7,478 AF (135 cfs)
	Mar	3,216 AF (52 cfs)	3,024 AF (49 cfs)	2,994 AF (49 cfs)	2,901 AF (47 cfs)
	Non-Irrigation Season Total	**17,523 AF (53 cfs)**	**16,432 AF (50 cfs)**	**16,218 AF (49 cfs)**	**15,580 AF (47 cfs)**
1955 - 1956	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	2,887 AF (47 cfs)	2,714 AF (44 cfs)	2,687 AF (44 cfs)	2,605 AF (42 cfs)
	Jan	4,837 AF (79 cfs)	4,554 AF (74 cfs)	4,513 AF (73 cfs)	4,389 AF (71 cfs)
	Feb	6,980 AF (126 cfs)	6,582 AF (119 cfs)	6,532 AF (118 cfs)	6,384 AF (115 cfs)
	Mar	416 AF (7 cfs)	389 AF (6 cfs)	383 AF (6 cfs)	363 AF (6 cfs)
	Non-Irrigation Season Total	**15,120 AF (46 cfs)**	**14,239 AF (43 cfs)**	**14,114 AF (43 cfs)**	**13,741 AF (41 cfs)**
1956 - 1957	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	187 AF (3 cfs)	16 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	6,601 AF (107 cfs)	5,840 AF (95 cfs)	5,410 AF (88 cfs)	4,119 AF (67 cfs)
	Jan	7,966 AF (130 cfs)	6,984 AF (114 cfs)	6,400 AF (104 cfs)	4,649 AF (76 cfs)
	Feb	4,365 AF (79 cfs)	4,033 AF (73 cfs)	3,920 AF (71 cfs)	3,591 AF (65 cfs)
	Mar	633 AF (10 cfs)	431 AF (7 cfs)	266 AF (4 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**19,752 AF (60 cfs)**	**17,304 AF (52 cfs)**	**15,995 AF (48 cfs)**	**12,358 AF (37 cfs)**
1957 - 1958	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	894 AF (15 cfs)	698 AF (12 cfs)	546 AF (9 cfs)	161 AF (3 cfs)
	Dec	28,961 AF (471 cfs)	26,997 AF (439 cfs)	26,232 AF (427 cfs)	23,298 AF (379 cfs)
	Jan	60,446 AF (983 cfs)	59,744 AF (972 cfs)	58,467 AF (951 cfs)	45,943 AF (747 cfs)
	Feb	42,678 AF (768 cfs)	40,357 AF (727 cfs)	38,023 AF (685 cfs)	31,067 AF (559 cfs)
	Mar	42,608 AF (693 cfs)	39,096 AF (636 cfs)	35,724 AF (581 cfs)	29,592 AF (481 cfs)
	Non-Irrigation Season Total	**175,587 AF (530 cfs)**	**166,892 AF (504 cfs)**	**158,993 AF (480 cfs)**	**130,062 AF (393 cfs)**
1958 - 1959	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,840 AF (241 cfs)	14,007 AF (228 cfs)	13,917 AF (226 cfs)	13,646 AF (222 cfs)
	Jan	13,842 AF (225 cfs)	13,056 AF (212 cfs)	12,961 AF (211 cfs)	12,679 AF (206 cfs)
	Feb	13,211 AF (238 cfs)	12,442 AF (224 cfs)	12,333 AF (222 cfs)	12,007 AF (216 cfs)
	Mar	18,895 AF (307 cfs)	17,305 AF (281 cfs)	16,183 AF (263 cfs)	13,643 AF (222 cfs)
	Non-Irrigation Season Total	**60,788 AF (184 cfs)**	**56,810 AF (172 cfs)**	**55,394 AF (167 cfs)**	**51,975 AF (157 cfs)**
1959 - 1960	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	12,170 AF (198 cfs)	11,491 AF (187 cfs)	11,420 AF (186 cfs)	11,208 AF (182 cfs)
	Jan	15,820 AF (257 cfs)	14,782 AF (240 cfs)	14,479 AF (235 cfs)	13,371 AF (217 cfs)
	Feb	23,389 AF (421 cfs)	21,650 AF (390 cfs)	21,058 AF (379 cfs)	18,892 AF (340 cfs)
	Mar	36,409 AF (592 cfs)	34,862 AF (567 cfs)	33,581 AF (546 cfs)	26,999 AF (439 cfs)
	Non-Irrigation Season Total	**87,788 AF (265 cfs)**	**82,784 AF (250 cfs)**	**80,538 AF (243 cfs)**	**70,470 AF (213 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1960 - 1961	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,605 AF (140 cfs)	8,113 AF (132 cfs)	8,051 AF (131 cfs)	7,865 AF (128 cfs)
	Jan	11,401 AF (185 cfs)	10,753 AF (175 cfs)	10,674 AF (174 cfs)	10,437 AF (170 cfs)
	Feb	9,203 AF (166 cfs)	8,663 AF (156 cfs)	8,584 AF (155 cfs)	8,345 AF (150 cfs)
	Mar	2,499 AF (41 cfs)	2,267 AF (37 cfs)	2,162 AF (35 cfs)	1,867 AF (30 cfs)
	Non-Irrigation Season Total	**31,708 AF (96 cfs)**	**29,796 AF (90 cfs)**	**29,470 AF (89 cfs)**	**28,514 AF (86 cfs)**
1961 - 1962	Oct	25,371 AF (799 cfs)	21,512 AF (678 cfs)	17,789 AF (561 cfs)	15,142 AF (477 cfs)
Above Average	Nov	46,455 AF (781 cfs)	45,041 AF (757 cfs)	41,242 AF (693 cfs)	27,474 AF (462 cfs)
	Dec	60,158 AF (978 cfs)	59,924 AF (975 cfs)	59,797 AF (973 cfs)	54,834 AF (892 cfs)
	Jan	61,209 AF (995 cfs)	61,115 AF (994 cfs)	61,021 AF (992 cfs)	56,146 AF (913 cfs)
	Feb	55,537 AF (1000 cfs)	55,537 AF (1000 cfs)	55,445 AF (998 cfs)	50,129 AF (903 cfs)
	Mar	57,852 AF (941 cfs)	55,300 AF (899 cfs)	51,615 AF (839 cfs)	36,397 AF (592 cfs)
	Non-Irrigation Season Total	**306,583 AF (926 cfs)**	**298,430 AF (901 cfs)**	**286,908 AF (866 cfs)**	**240,123 AF (725 cfs)**
1962 - 1963	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	14,394 AF (234 cfs)	13,533 AF (220 cfs)	13,391 AF (218 cfs)	12,966 AF (211 cfs)
	Jan	17,742 AF (289 cfs)	16,449 AF (268 cfs)	16,008 AF (260 cfs)	14,685 AF (239 cfs)
	Feb	34,427 AF (620 cfs)	32,457 AF (584 cfs)	30,833 AF (555 cfs)	26,130 AF (471 cfs)
	Mar	37,577 AF (611 cfs)	34,537 AF (562 cfs)	31,795 AF (517 cfs)	26,172 AF (426 cfs)
	Non-Irrigation Season Total	**104,140 AF (314 cfs)**	**96,976 AF (293 cfs)**	**92,028 AF (278 cfs)**	**79,954 AF (241 cfs)**
1963 - 1964	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	9,105 AF (148 cfs)	8,541 AF (139 cfs)	8,433 AF (137 cfs)	8,107 AF (132 cfs)
	Jan	12,150 AF (198 cfs)	11,461 AF (186 cfs)	11,380 AF (185 cfs)	11,136 AF (181 cfs)
	Feb	10,109 AF (182 cfs)	9,535 AF (172 cfs)	9,466 AF (170 cfs)	9,259 AF (167 cfs)
	Mar	1,412 AF (23 cfs)	1,315 AF (21 cfs)	1,288 AF (21 cfs)	1,208 AF (20 cfs)
	Non-Irrigation Season Total	**32,777 AF (99 cfs)**	**30,852 AF (93 cfs)**	**30,567 AF (92 cfs)**	**29,710 AF (90 cfs)**
1964 - 1965	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	1,102 AF (18 cfs)	1,013 AF (16 cfs)	983 AF (16 cfs)	909 AF (15 cfs)
	Jan	2,792 AF (45 cfs)	2,566 AF (42 cfs)	2,479 AF (40 cfs)	2,221 AF (36 cfs)
	Feb	5,254 AF (95 cfs)	4,913 AF (88 cfs)	4,836 AF (87 cfs)	4,602 AF (83 cfs)
	Mar	74 AF (1 cfs)	61 AF (1 cfs)	52 AF (1 cfs)	27 AF (0 cfs)
	Non-Irrigation Season Total	**9,222 AF (28 cfs)**	**8,554 AF (26 cfs)**	**8,349 AF (25 cfs)**	**7,760 AF (23 cfs)**
1965 - 1966	Oct	15,879 AF (500 cfs)	15,072 AF (475 cfs)	14,137 AF (445 cfs)	8,075 AF (254 cfs)
Above Average	Nov	33,543 AF (564 cfs)	29,250 AF (492 cfs)	25,587 AF (430 cfs)	20,720 AF (348 cfs)
	Dec	56,643 AF (921 cfs)	53,458 AF (869 cfs)	49,846 AF (811 cfs)	39,077 AF (636 cfs)
	Jan	60,078 AF (977 cfs)	58,041 AF (944 cfs)	54,183 AF (881 cfs)	42,176 AF (686 cfs)
	Feb	51,737 AF (932 cfs)	50,862 AF (916 cfs)	49,547 AF (892 cfs)	40,116 AF (722 cfs)
	Mar	17,879 AF (291 cfs)	16,767 AF (273 cfs)	16,163 AF (263 cfs)	14,173 AF (230 cfs)
	Non-Irrigation Season Total	**235,760 AF (712 cfs)**	**223,449 AF (675 cfs)**	**209,463 AF (632 cfs)**	**164,337 AF (496 cfs)**
1966 - 1967	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	9,207 AF (150 cfs)	8,695 AF (141 cfs)	8,642 AF (141 cfs)	8,486 AF (138 cfs)
	Jan	11,364 AF (185 cfs)	10,719 AF (174 cfs)	10,642 AF (173 cfs)	10,411 AF (169 cfs)
	Feb	8,577 AF (154 cfs)	8,100 AF (146 cfs)	8,052 AF (145 cfs)	7,909 AF (142 cfs)
	Mar	289 AF (5 cfs)	159 AF (3 cfs)	82 AF (1 cfs)	10 AF (0 cfs)
	Non-Irrigation Season Total	**29,437 AF (89 cfs)**	**27,673 AF (84 cfs)**	**27,418 AF (83 cfs)**	**26,815 AF (81 cfs)**
1967 - 1968	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	12,420 AF (202 cfs)	11,614 AF (189 cfs)	11,429 AF (186 cfs)	10,873 AF (177 cfs)
	Jan	21,894 AF (356 cfs)	20,368 AF (331 cfs)	19,827 AF (322 cfs)	18,237 AF (297 cfs)
	Feb	13,602 AF (245 cfs)	12,857 AF (232 cfs)	12,793 AF (230 cfs)	12,598 AF (227 cfs)
	Mar	17,387 AF (283 cfs)	15,835 AF (258 cfs)	14,720 AF (239 cfs)	11,012 AF (179 cfs)
	Non-Irrigation Season Total	**65,304 AF (197 cfs)**	**60,674 AF (183 cfs)**	**58,769 AF (177 cfs)**	**52,721 AF (159 cfs)**
1968 - 1969	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	10,237 AF (166 cfs)	9,634 AF (157 cfs)	9,542 AF (155 cfs)	9,268 AF (151 cfs)
	Jan	15,062 AF (245 cfs)	14,172 AF (230 cfs)	14,034 AF (228 cfs)	13,622 AF (222 cfs)
	Feb	10,498 AF (189 cfs)	9,914 AF (179 cfs)	9,854 AF (177 cfs)	9,675 AF (174 cfs)
	Mar	3,168 AF (52 cfs)	2,925 AF (48 cfs)	2,841 AF (46 cfs)	2,591 AF (42 cfs)
	Non-Irrigation Season Total	**38,966 AF (118 cfs)**	**36,644 AF (111 cfs)**	**36,272 AF (110 cfs)**	**35,157 AF (106 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1969 - 1970	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	28,196 AF (474 cfs)	27,464 AF (462 cfs)	27,170 AF (457 cfs)	20,776 AF (349 cfs)
	Dec	59,556 AF (969 cfs)	58,724 AF (955 cfs)	57,509 AF (935 cfs)	45,620 AF (742 cfs)
	Jan	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	59,595 AF (969 cfs)
	Feb	51,515 AF (928 cfs)	50,510 AF (909 cfs)	49,454 AF (890 cfs)	42,562 AF (766 cfs)
	Mar	31,669 AF (515 cfs)	29,359 AF (477 cfs)	27,323 AF (444 cfs)	23,026 AF (374 cfs)
	Non-Irrigation Season Total	**232,424 AF (702 cfs)**	**227,545 AF (687 cfs)**	**222,944 AF (673 cfs)**	**191,579 AF (578 cfs)**
1970 - 1971	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	24,016 AF (404 cfs)	21,380 AF (359 cfs)	19,173 AF (322 cfs)	11,997 AF (202 cfs)
	Dec	47,884 AF (779 cfs)	45,002 AF (732 cfs)	42,173 AF (686 cfs)	33,956 AF (552 cfs)
	Jan	53,719 AF (874 cfs)	52,563 AF (855 cfs)	51,487 AF (837 cfs)	42,456 AF (690 cfs)
	Feb	55,017 AF (991 cfs)	54,781 AF (986 cfs)	54,272 AF (977 cfs)	43,465 AF (783 cfs)
	Mar	48,194 AF (784 cfs)	44,059 AF (717 cfs)	39,923 AF (649 cfs)	30,744 AF (500 cfs)
	Non-Irrigation Season Total	**228,830 AF (691 cfs)**	**217,784 AF (657 cfs)**	**207,028 AF (625 cfs)**	**162,618 AF (491 cfs)**
1971 - 1972	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	3,358 AF (56 cfs)	2,622 AF (44 cfs)	2,079 AF (35 cfs)	644 AF (11 cfs)
	Dec	30,592 AF (498 cfs)	28,795 AF (468 cfs)	27,332 AF (445 cfs)	23,494 AF (382 cfs)
	Jan	46,937 AF (763 cfs)	44,454 AF (723 cfs)	42,093 AF (685 cfs)	32,750 AF (533 cfs)
	Feb	41,992 AF (756 cfs)	39,263 AF (707 cfs)	36,877 AF (664 cfs)	29,589 AF (533 cfs)
	Mar	26,640 AF (433 cfs)	24,424 AF (397 cfs)	22,986 AF (374 cfs)	18,630 AF (303 cfs)
	Non-Irrigation Season Total	**149,519 AF (451 cfs)**	**139,558 AF (421 cfs)**	**131,366 AF (397 cfs)**	**105,107 AF (317 cfs)**
1972 - 1973	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	26,446 AF (430 cfs)	24,341 AF (396 cfs)	22,866 AF (372 cfs)	18,499 AF (301 cfs)
	Jan	50,472 AF (821 cfs)	49,063 AF (798 cfs)	47,614 AF (774 cfs)	38,646 AF (629 cfs)
	Feb	53,958 AF (972 cfs)	52,031 AF (937 cfs)	49,428 AF (890 cfs)	38,574 AF (695 cfs)
	Mar	46,876 AF (762 cfs)	42,925 AF (698 cfs)	38,939 AF (633 cfs)	30,512 AF (496 cfs)
	Non-Irrigation Season Total	**177,752 AF (537 cfs)**	**168,360 AF (508 cfs)**	**158,846 AF (480 cfs)**	**126,230 AF (381 cfs)**
1973 - 1974	Oct	15,885 AF (501 cfs)	15,868 AF (500 cfs)	15,868 AF (500 cfs)	10,139 AF (319 cfs)
Above Average	Nov	29,867 AF (502 cfs)	28,919 AF (486 cfs)	27,833 AF (468 cfs)	19,639 AF (330 cfs)
	Dec	43,261 AF (704 cfs)	41,644 AF (677 cfs)	39,879 AF (649 cfs)	32,641 AF (531 cfs)
	Jan	59,657 AF (970 cfs)	58,753 AF (956 cfs)	57,478 AF (935 cfs)	51,637 AF (840 cfs)
	Feb	55,463 AF (999 cfs)	54,706 AF (985 cfs)	52,615 AF (947 cfs)	41,084 AF (740 cfs)
	Mar	51,307 AF (834 cfs)	48,607 AF (791 cfs)	45,076 AF (733 cfs)	33,723 AF (548 cfs)
	Non-Irrigation Season Total	**255,440 AF (771 cfs)**	**248,498 AF (750 cfs)**	**238,749 AF (721 cfs)**	**188,862 AF (570 cfs)**
1974 - 1975	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	22,562 AF (367 cfs)	20,664 AF (336 cfs)	19,719 AF (321 cfs)	17,013 AF (277 cfs)
	Jan	37,444 AF (609 cfs)	35,277 AF (574 cfs)	33,446 AF (544 cfs)	28,142 AF (458 cfs)
	Feb	35,615 AF (641 cfs)	33,388 AF (601 cfs)	31,642 AF (570 cfs)	26,269 AF (473 cfs)
	Mar	8,745 AF (142 cfs)	7,989 AF (130 cfs)	7,544 AF (123 cfs)	6,202 AF (101 cfs)
	Non-Irrigation Season Total	**104,366 AF (315 cfs)**	**97,318 AF (294 cfs)**	**92,352 AF (279 cfs)**	**77,626 AF (234 cfs)**
1975 - 1976	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	30,240 AF (492 cfs)	28,191 AF (458 cfs)	26,783 AF (436 cfs)	22,797 AF (371 cfs)
	Jan	42,542 AF (692 cfs)	40,180 AF (653 cfs)	37,853 AF (616 cfs)	31,037 AF (505 cfs)
	Feb	25,570 AF (460 cfs)	23,859 AF (430 cfs)	22,984 AF (414 cfs)	20,323 AF (366 cfs)
	Mar	26,836 AF (436 cfs)	24,830 AF (404 cfs)	23,369 AF (380 cfs)	19,796 AF (322 cfs)
	Non-Irrigation Season Total	**125,187 AF (378 cfs)**	**117,060 AF (353 cfs)**	**110,989 AF (335 cfs)**	**93,954 AF (284 cfs)**
1976 - 1977	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	7,158 AF (116 cfs)	6,415 AF (104 cfs)	6,031 AF (98 cfs)	4,878 AF (79 cfs)
	Jan	12,532 AF (204 cfs)	11,309 AF (184 cfs)	10,713 AF (174 cfs)	8,925 AF (145 cfs)
	Feb	10,629 AF (191 cfs)	9,860 AF (178 cfs)	9,622 AF (173 cfs)	8,910 AF (160 cfs)
	Mar	17,536 AF (285 cfs)	16,470 AF (268 cfs)	15,832 AF (257 cfs)	12,783 AF (208 cfs)
	Non-Irrigation Season Total	**47,854 AF (144 cfs)**	**44,055 AF (133 cfs)**	**42,198 AF (127 cfs)**	**35,496 AF (107 cfs)**
1977 - 1978	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	2,992 AF (49 cfs)	2,754 AF (45 cfs)	2,667 AF (43 cfs)	2,408 AF (39 cfs)
	Jan	7,478 AF (122 cfs)	6,827 AF (111 cfs)	6,550 AF (107 cfs)	5,720 AF (93 cfs)
	Feb	7,414 AF (134 cfs)	6,886 AF (124 cfs)	6,727 AF (121 cfs)	6,253 AF (113 cfs)
	Mar	2,276 AF (37 cfs)	2,111 AF (34 cfs)	2,059 AF (33 cfs)	1,906 AF (31 cfs)
	Non-Irrigation Season Total	**20,160 AF (61 cfs)**	**18,577 AF (56 cfs)**	**18,004 AF (54 cfs)**	**16,287 AF (49 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1978 - 1979	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	5,337 AF (87 cfs)	4,755 AF (77 cfs)	4,439 AF (72 cfs)	3,493 AF (57 cfs)
	Jan	16,600 AF (270 cfs)	14,803 AF (241 cfs)	13,785 AF (224 cfs)	10,642 AF (173 cfs)
	Feb	33,290 AF (599 cfs)	31,337 AF (564 cfs)	29,561 AF (532 cfs)	23,750 AF (428 cfs)
	Mar	4,492 AF (73 cfs)	3,962 AF (64 cfs)	3,700 AF (60 cfs)	3,090 AF (50 cfs)
	Non-Irrigation Season Total	**59,719 AF (180 cfs)**	**54,857 AF (166 cfs)**	**51,485 AF (155 cfs)**	**40,975 AF (124 cfs)**
1979 - 1980	Oct	720 AF (23 cfs)	459 AF (14 cfs)	334 AF (11 cfs)	21 AF (1 cfs)
Above Average	Nov	20,142 AF (338 cfs)	17,284 AF (290 cfs)	15,247 AF (256 cfs)	9,136 AF (154 cfs)
	Dec	58,247 AF (947 cfs)	56,738 AF (923 cfs)	54,593 AF (888 cfs)	42,393 AF (689 cfs)
	Jan	58,373 AF (949 cfs)	58,074 AF (944 cfs)	57,696 AF (938 cfs)	47,318 AF (770 cfs)
	Feb	56,901 AF (1025 cfs)	56,709 AF (1021 cfs)	56,517 AF (1018 cfs)	54,368 AF (979 cfs)
	Mar	60,579 AF (985 cfs)	59,310 AF (965 cfs)	57,209 AF (930 cfs)	43,983 AF (715 cfs)
	Non-Irrigation Season Total	**254,962 AF (770 cfs)**	**248,574 AF (750 cfs)**	**241,595 AF (729 cfs)**	**197,219 AF (595 cfs)**
1980 - 1981	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	8,031 AF (135 cfs)	6,596 AF (111 cfs)	5,590 AF (94 cfs)	2,781 AF (47 cfs)
	Dec	36,437 AF (593 cfs)	34,200 AF (556 cfs)	32,538 AF (529 cfs)	27,370 AF (445 cfs)
	Jan	55,179 AF (897 cfs)	52,721 AF (857 cfs)	49,496 AF (805 cfs)	39,330 AF (640 cfs)
	Feb	20,704 AF (373 cfs)	19,508 AF (351 cfs)	18,886 AF (340 cfs)	17,268 AF (311 cfs)
	Mar	14,412 AF (234 cfs)	12,808 AF (208 cfs)	11,924 AF (194 cfs)	9,282 AF (151 cfs)
	Non-Irrigation Season Total	**134,763 AF (407 cfs)**	**125,833 AF (380 cfs)**	**118,434 AF (358 cfs)**	**96,030 AF (290 cfs)**
1981 - 1982	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	9,600 AF (156 cfs)	8,914 AF (145 cfs)	8,707 AF (142 cfs)	8,088 AF (132 cfs)
	Jan	19,002 AF (309 cfs)	17,415 AF (283 cfs)	16,581 AF (270 cfs)	14,062 AF (229 cfs)
	Feb	22,873 AF (412 cfs)	21,410 AF (386 cfs)	20,501 AF (369 cfs)	17,906 AF (322 cfs)
	Mar	2,289 AF (37 cfs)	2,122 AF (35 cfs)	2,069 AF (34 cfs)	1,912 AF (31 cfs)
	Non-Irrigation Season Total	**53,765 AF (162 cfs)**	**49,861 AF (151 cfs)**	**47,858 AF (144 cfs)**	**41,967 AF (127 cfs)**
1982 - 1983	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	1,652 AF (28 cfs)	1,290 AF (22 cfs)	1,011 AF (17 cfs)	249 AF (4 cfs)
	Dec	56,290 AF (915 cfs)	55,799 AF (907 cfs)	55,379 AF (901 cfs)	46,450 AF (755 cfs)
	Jan	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	60,536 AF (985 cfs)
	Feb	55,537 AF (1000 cfs)	55,378 AF (997 cfs)	54,950 AF (989 cfs)	46,559 AF (838 cfs)
	Mar	57,130 AF (929 cfs)	56,518 AF (919 cfs)	55,849 AF (908 cfs)	49,908 AF (812 cfs)
	Non-Irrigation Season Total	**232,097 AF (701 cfs)**	**230,473 AF (696 cfs)**	**228,678 AF (690 cfs)**	**203,702 AF (615 cfs)**
1983 - 1984	Oct	11,439 AF (360 cfs)	9,397 AF (296 cfs)	7,754 AF (244 cfs)	2,856 AF (90 cfs)
Above Average	Nov	32,494 AF (546 cfs)	30,119 AF (506 cfs)	28,830 AF (485 cfs)	23,452 AF (394 cfs)
	Dec	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,225 AF (996 cfs)	54,813 AF (891 cfs)
	Jan	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	60,565 AF (985 cfs)
	Feb	57,521 AF (1036 cfs)	57,521 AF (1036 cfs)	57,521 AF (1036 cfs)	55,143 AF (993 cfs)
	Mar	55,672 AF (905 cfs)	52,624 AF (856 cfs)	48,963 AF (796 cfs)	35,519 AF (578 cfs)
	Non-Irrigation Season Total	**280,102 AF (846 cfs)**	**272,637 AF (823 cfs)**	**265,780 AF (802 cfs)**	**232,347 AF (701 cfs)**
1984 - 1985	Oct	31,736 AF (1000 cfs)	31,736 AF (1000 cfs)	31,736 AF (1000 cfs)	31,736 AF (1000 cfs)
Above Average	Nov	59,504 AF (1000 cfs)	59,205 AF (995 cfs)	58,083 AF (976 cfs)	46,131 AF (775 cfs)
	Dec	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	52,597 AF (855 cfs)
	Jan	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	55,860 AF (908 cfs)
	Feb	55,122 AF (993 cfs)	54,897 AF (988 cfs)	54,446 AF (980 cfs)	49,111 AF (884 cfs)
	Mar	16,631 AF (270 cfs)	15,421 AF (251 cfs)	14,666 AF (239 cfs)	13,112 AF (213 cfs)
	Non-Irrigation Season Total	**285,967 AF (863 cfs)**	**284,234 AF (858 cfs)**	**281,905 AF (851 cfs)**	**248,546 AF (750 cfs)**
1985 - 1986	Oct	7,581 AF (239 cfs)	5,915 AF (186 cfs)	4,628 AF (146 cfs)	784 AF (25 cfs)
Above Average	Nov	20,662 AF (347 cfs)	17,790 AF (299 cfs)	15,750 AF (265 cfs)	10,806 AF (182 cfs)
	Dec	60,383 AF (982 cfs)	60,047 AF (977 cfs)	59,253 AF (964 cfs)	53,134 AF (864 cfs)
	Jan	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	57,573 AF (936 cfs)
	Feb	44,019 AF (793 cfs)	42,512 AF (765 cfs)	40,871 AF (736 cfs)	33,528 AF (604 cfs)
	Mar	8,523 AF (139 cfs)	7,886 AF (128 cfs)	7,676 AF (125 cfs)	7,044 AF (115 cfs)
	Non-Irrigation Season Total	**202,655 AF (612 cfs)**	**195,637 AF (591 cfs)**	**189,665 AF (573 cfs)**	**162,869 AF (492 cfs)**
1986 - 1987	Oct	1,498 AF (47 cfs)	927 AF (29 cfs)	539 AF (17 cfs)	0 AF (0 cfs)
Above Average	Nov	25,561 AF (430 cfs)	22,567 AF (379 cfs)	20,142 AF (338 cfs)	12,611 AF (212 cfs)
	Dec	54,027 AF (879 cfs)	53,116 AF (864 cfs)	52,222 AF (849 cfs)	43,625 AF (709 cfs)
	Jan	58,813 AF (957 cfs)	57,574 AF (936 cfs)	55,923 AF (910 cfs)	44,912 AF (730 cfs)
	Feb	46,632 AF (840 cfs)	45,119 AF (812 cfs)	42,963 AF (774 cfs)	33,990 AF (612 cfs)
	Mar	59,701 AF (971 cfs)	58,971 AF (959 cfs)	57,963 AF (943 cfs)	47,708 AF (776 cfs)
	Non-Irrigation Season Total	**246,231 AF (743 cfs)**	**238,273 AF (719 cfs)**	**229,751 AF (694 cfs)**	**182,846 AF (552 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1987 - 1988	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	747 AF (13 cfs)	478 AF (8 cfs)	276 AF (5 cfs)	0 AF (0 cfs)
	Dec	37,092 AF (603 cfs)	35,515 AF (578 cfs)	33,242 AF (541 cfs)	23,781 AF (387 cfs)
	Jan	61,488 AF (1000 cfs)	61,322 AF (997 cfs)	60,463 AF (983 cfs)	53,019 AF (862 cfs)
	Feb	57,521 AF (1036 cfs)	57,521 AF (1036 cfs)	57,445 AF (1034 cfs)	55,467 AF (999 cfs)
	Mar	41,904 AF (681 cfs)	38,697 AF (629 cfs)	35,711 AF (581 cfs)	25,788 AF (419 cfs)
	Non-Irrigation Season Total	**198,751 AF (600 cfs)**	**193,532 AF (584 cfs)**	**187,137 AF (565 cfs)**	**158,055 AF (477 cfs)**
1988 - 1989	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	36,123 AF (587 cfs)	33,742 AF (549 cfs)	31,248 AF (508 cfs)	23,766 AF (387 cfs)
	Jan	52,545 AF (855 cfs)	50,086 AF (815 cfs)	47,152 AF (767 cfs)	36,335 AF (591 cfs)
	Feb	46,922 AF (845 cfs)	45,244 AF (815 cfs)	43,464 AF (783 cfs)	34,851 AF (628 cfs)
	Mar	17,797 AF (289 cfs)	16,229 AF (264 cfs)	14,740 AF (240 cfs)	11,659 AF (190 cfs)
	Non-Irrigation Season Total	**153,387 AF (463 cfs)**	**145,300 AF (439 cfs)**	**136,604 AF (412 cfs)**	**106,611 AF (322 cfs)**
1989 - 1990	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	15,048 AF (245 cfs)	13,385 AF (218 cfs)	11,867 AF (193 cfs)	7,470 AF (121 cfs)
	Jan	46,740 AF (760 cfs)	44,434 AF (723 cfs)	41,833 AF (680 cfs)	33,425 AF (544 cfs)
	Feb	40,349 AF (727 cfs)	38,076 AF (686 cfs)	35,621 AF (641 cfs)	28,316 AF (510 cfs)
	Mar	49,680 AF (808 cfs)	46,228 AF (752 cfs)	42,386 AF (689 cfs)	29,669 AF (483 cfs)
	Non-Irrigation Season Total	**151,817 AF (458 cfs)**	**142,122 AF (429 cfs)**	**131,708 AF (398 cfs)**	**98,880 AF (299 cfs)**
1990 - 1991	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	23,363 AF (380 cfs)	21,666 AF (352 cfs)	20,465 AF (333 cfs)	16,969 AF (276 cfs)
	Jan	51,653 AF (840 cfs)	48,619 AF (791 cfs)	45,208 AF (735 cfs)	35,037 AF (570 cfs)
	Feb	39,666 AF (714 cfs)	37,864 AF (682 cfs)	35,769 AF (644 cfs)	28,512 AF (513 cfs)
	Mar	14,488 AF (236 cfs)	12,360 AF (201 cfs)	10,957 AF (178 cfs)	7,284 AF (118 cfs)
	Non-Irrigation Season Total	**129,170 AF (390 cfs)**	**120,508 AF (364 cfs)**	**112,400 AF (339 cfs)**	**87,801 AF (265 cfs)**
1991 - 1992	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	11,383 AF (185 cfs)	10,286 AF (167 cfs)	9,758 AF (159 cfs)	8,173 AF (133 cfs)
	Jan	55,330 AF (900 cfs)	54,364 AF (884 cfs)	52,573 AF (855 cfs)	39,554 AF (643 cfs)
	Feb	54,490 AF (981 cfs)	51,879 AF (934 cfs)	48,597 AF (875 cfs)	36,709 AF (661 cfs)
	Mar	56,873 AF (925 cfs)	54,908 AF (893 cfs)	52,432 AF (853 cfs)	38,660 AF (629 cfs)
	Non-Irrigation Season Total	**178,077 AF (538 cfs)**	**171,437 AF (518 cfs)**	**163,359 AF (493 cfs)**	**123,097 AF (372 cfs)**
1992 - 1993	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	1,437 AF (24 cfs)	1,111 AF (19 cfs)	858 AF (14 cfs)	202 AF (3 cfs)
	Dec	54,526 AF (887 cfs)	51,812 AF (843 cfs)	48,057 AF (782 cfs)	36,036 AF (586 cfs)
	Jan	57,250 AF (931 cfs)	55,600 AF (904 cfs)	53,022 AF (862 cfs)	41,211 AF (670 cfs)
	Feb	50,361 AF (907 cfs)	47,974 AF (864 cfs)	45,446 AF (818 cfs)	35,082 AF (632 cfs)
	Mar	44,485 AF (723 cfs)	40,241 AF (654 cfs)	36,222 AF (589 cfs)	27,371 AF (445 cfs)
	Non-Irrigation Season Total	**208,059 AF (628 cfs)**	**196,738 AF (594 cfs)**	**183,605 AF (554 cfs)**	**139,900 AF (422 cfs)**
1993 - 1994	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	6,177 AF (104 cfs)	5,278 AF (89 cfs)	4,507 AF (76 cfs)	3,016 AF (51 cfs)
	Dec	29,471 AF (479 cfs)	27,167 AF (442 cfs)	25,607 AF (416 cfs)	20,991 AF (341 cfs)
	Jan	45,856 AF (746 cfs)	43,081 AF (701 cfs)	40,306 AF (656 cfs)	32,075 AF (522 cfs)
	Feb	45,946 AF (827 cfs)	43,148 AF (777 cfs)	40,117 AF (722 cfs)	31,022 AF (559 cfs)
	Mar	25,533 AF (415 cfs)	22,743 AF (370 cfs)	20,364 AF (331 cfs)	15,391 AF (250 cfs)
	Non-Irrigation Season Total	**152,983 AF (462 cfs)**	**141,417 AF (427 cfs)**	**130,901 AF (395 cfs)**	**102,495 AF (309 cfs)**
1994 - 1995	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,188 AF (133 cfs)	7,471 AF (122 cfs)	7,164 AF (117 cfs)	6,241 AF (102 cfs)
	Jan	14,588 AF (237 cfs)	13,015 AF (212 cfs)	12,172 AF (198 cfs)	9,646 AF (157 cfs)
	Feb	11,901 AF (214 cfs)	10,774 AF (194 cfs)	10,207 AF (184 cfs)	8,483 AF (153 cfs)
	Mar	4,324 AF (70 cfs)	2,815 AF (46 cfs)	1,723 AF (28 cfs)	140 AF (2 cfs)
	Non-Irrigation Season Total	**39,001 AF (118 cfs)**	**34,076 AF (103 cfs)**	**31,266 AF (94 cfs)**	**24,510 AF (74 cfs)**
1995 - 1996	Oct	1,083 AF (34 cfs)	800 AF (25 cfs)	570 AF (18 cfs)	90 AF (3 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	27,823 AF (452 cfs)	25,841 AF (420 cfs)	24,572 AF (400 cfs)	20,752 AF (338 cfs)
	Jan	58,151 AF (946 cfs)	55,816 AF (908 cfs)	52,608 AF (856 cfs)	39,559 AF (643 cfs)
	Feb	50,664 AF (912 cfs)	48,667 AF (876 cfs)	46,330 AF (834 cfs)	37,603 AF (677 cfs)
	Mar	31,486 AF (512 cfs)	28,074 AF (457 cfs)	25,438 AF (414 cfs)	18,744 AF (305 cfs)
	Non-Irrigation Season Total	**169,207 AF (511 cfs)**	**159,196 AF (481 cfs)**	**149,519 AF (451 cfs)**	**116,749 AF (352 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
1996 - 1997	Oct	2,390 AF (75 cfs)	1,637 AF (52 cfs)	1,003 AF (32 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	33,653 AF (547 cfs)	32,038 AF (521 cfs)	30,077 AF (489 cfs)	23,359 AF (380 cfs)
	Jan	56,435 AF (918 cfs)	54,019 AF (879 cfs)	51,166 AF (832 cfs)	39,555 AF (643 cfs)
	Feb	48,277 AF (869 cfs)	45,077 AF (812 cfs)	41,793 AF (753 cfs)	31,939 AF (575 cfs)
	Mar	24,194 AF (393 cfs)	21,478 AF (349 cfs)	19,517 AF (317 cfs)	14,323 AF (233 cfs)
	Non-Irrigation Season Total	**164,950 AF (498 cfs)**	**154,249 AF (466 cfs)**	**143,556 AF (433 cfs)**	**109,177 AF (330 cfs)**
1997 - 1998	Oct	9,009 AF (284 cfs)	7,604 AF (240 cfs)	6,521 AF (205 cfs)	4,352 AF (137 cfs)
Above Average	Nov	41,144 AF (691 cfs)	35,757 AF (601 cfs)	31,693 AF (533 cfs)	27,815 AF (467 cfs)
	Dec	61,210 AF (995 cfs)	60,712 AF (987 cfs)	59,549 AF (968 cfs)	46,634 AF (758 cfs)
	Jan	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,298 AF (997 cfs)
	Feb	54,416 AF (980 cfs)	53,666 AF (966 cfs)	52,885 AF (952 cfs)	45,829 AF (825 cfs)
	Mar	46,285 AF (753 cfs)	44,306 AF (721 cfs)	41,644 AF (677 cfs)	29,454 AF (479 cfs)
	Non-Irrigation Season Total	**273,551 AF (826 cfs)**	**263,533 AF (796 cfs)**	**253,779 AF (766 cfs)**	**215,382 AF (650 cfs)**
1998 - 1999	Oct	11,377 AF (358 cfs)	9,622 AF (303 cfs)	7,811 AF (246 cfs)	2,343 AF (74 cfs)
Above Average	Nov	10,932 AF (184 cfs)	9,107 AF (153 cfs)	7,927 AF (133 cfs)	4,544 AF (76 cfs)
	Dec	39,208 AF (638 cfs)	36,865 AF (600 cfs)	34,830 AF (566 cfs)	26,605 AF (433 cfs)
	Jan	55,605 AF (904 cfs)	53,972 AF (878 cfs)	52,215 AF (849 cfs)	42,399 AF (690 cfs)
	Feb	44,914 AF (809 cfs)	41,972 AF (756 cfs)	39,135 AF (705 cfs)	30,407 AF (548 cfs)
	Mar	14,946 AF (243 cfs)	13,629 AF (222 cfs)	12,855 AF (209 cfs)	9,762 AF (159 cfs)
	Non-Irrigation Season Total	**176,982 AF (534 cfs)**	**165,169 AF (499 cfs)**	**154,774 AF (467 cfs)**	**116,059 AF (350 cfs)**
1999 - 2000	Oct	6,814 AF (215 cfs)	5,154 AF (162 cfs)	3,894 AF (123 cfs)	504 AF (16 cfs)
Above Average	Nov	21,565 AF (362 cfs)	18,352 AF (308 cfs)	16,126 AF (271 cfs)	9,375 AF (158 cfs)
	Dec	59,368 AF (966 cfs)	59,056 AF (960 cfs)	57,952 AF (943 cfs)	48,191 AF (784 cfs)
	Jan	61,364 AF (998 cfs)	60,611 AF (986 cfs)	58,177 AF (946 cfs)	46,394 AF (755 cfs)
	Feb	56,097 AF (1010 cfs)	55,148 AF (993 cfs)	54,048 AF (973 cfs)	43,996 AF (792 cfs)
	Mar	41,663 AF (678 cfs)	37,986 AF (618 cfs)	35,242 AF (573 cfs)	27,222 AF (443 cfs)
	Non-Irrigation Season Total	**246,871 AF (745 cfs)**	**236,308 AF (713 cfs)**	**225,438 AF (681 cfs)**	**175,683 AF (530 cfs)**
2000 - 2001	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	17,302 AF (281 cfs)	15,634 AF (254 cfs)	14,534 AF (236 cfs)	10,883 AF (177 cfs)
	Jan	36,368 AF (591 cfs)	33,910 AF (551 cfs)	31,692 AF (515 cfs)	25,148 AF (409 cfs)
	Feb	35,193 AF (634 cfs)	33,040 AF (595 cfs)	30,946 AF (557 cfs)	25,183 AF (453 cfs)
	Mar	2,124 AF (35 cfs)	1,787 AF (29 cfs)	1,571 AF (26 cfs)	1,070 AF (17 cfs)
	Non-Irrigation Season Total	**90,986 AF (275 cfs)**	**84,372 AF (255 cfs)**	**78,743 AF (238 cfs)**	**62,283 AF (188 cfs)**
2001 - 2002	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	188 AF (3 cfs)	113 AF (2 cfs)	47 AF (1 cfs)	0 AF (0 cfs)
	Dec	12,273 AF (200 cfs)	11,062 AF (180 cfs)	10,465 AF (170 cfs)	8,675 AF (141 cfs)
	Jan	24,835 AF (404 cfs)	22,591 AF (367 cfs)	21,088 AF (343 cfs)	16,690 AF (271 cfs)
	Feb	15,780 AF (284 cfs)	14,495 AF (261 cfs)	13,730 AF (247 cfs)	11,526 AF (208 cfs)
	Mar	5,775 AF (94 cfs)	5,188 AF (84 cfs)	4,699 AF (76 cfs)	3,231 AF (53 cfs)
	Non-Irrigation Season Total	**58,851 AF (178 cfs)**	**53,449 AF (161 cfs)**	**50,030 AF (151 cfs)**	**40,122 AF (121 cfs)**
2002 - 2003	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Jan	1,897 AF (31 cfs)	1,529 AF (25 cfs)	1,256 AF (20 cfs)	493 AF (8 cfs)
	Feb	3,485 AF (63 cfs)	2,785 AF (50 cfs)	2,258 AF (41 cfs)	701 AF (13 cfs)
	Mar	402 AF (7 cfs)	150 AF (2 cfs)	26 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**5,784 AF (17 cfs)**	**4,464 AF (13 cfs)**	**3,540 AF (11 cfs)**	**1,194 AF (4 cfs)**
2003 - 2004	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Below Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	11 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Jan	1,616 AF (26 cfs)	1,270 AF (21 cfs)	1,027 AF (17 cfs)	395 AF (6 cfs)
	Feb	840 AF (15 cfs)	546 AF (10 cfs)	294 AF (5 cfs)	0 AF (0 cfs)
	Mar	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**2,467 AF (7 cfs)**	**1,815 AF (5 cfs)**	**1,321 AF (4 cfs)**	**395 AF (1 cfs)**
2004 - 2005	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	5,177 AF (84 cfs)	4,359 AF (71 cfs)	3,806 AF (62 cfs)	2,210 AF (36 cfs)
	Jan	12,191 AF (198 cfs)	10,388 AF (169 cfs)	9,201 AF (150 cfs)	5,796 AF (94 cfs)
	Feb	479 AF (9 cfs)	293 AF (5 cfs)	136 AF (2 cfs)	0 AF (0 cfs)
	Mar	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**17,847 AF (54 cfs)**	**15,041 AF (45 cfs)**	**13,144 AF (40 cfs)**	**8,006 AF (24 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
2005 - 2006	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	12,671 AF (206 cfs)	10,863 AF (177 cfs)	9,689 AF (158 cfs)	6,272 AF (102 cfs)
	Jan	534 AF (9 cfs)	476 AF (8 cfs)	445 AF (7 cfs)	360 AF (6 cfs)
	Feb	6,720 AF (121 cfs)	5,821 AF (105 cfs)	5,181 AF (93 cfs)	3,273 AF (59 cfs)
	Mar	169 AF (3 cfs)	63 AF (1 cfs)	8 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**20,094 AF (61 cfs)**	**17,223 AF (52 cfs)**	**15,323 AF (46 cfs)**	**9,905 AF (30 cfs)**
2006 - 2007	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	4,864 AF (79 cfs)	4,081 AF (66 cfs)	3,543 AF (58 cfs)	2,003 AF (33 cfs)
	Jan	10,004 AF (163 cfs)	8,431 AF (137 cfs)	7,357 AF (120 cfs)	4,137 AF (67 cfs)
	Feb	13,003 AF (234 cfs)	11,247 AF (203 cfs)	10,141 AF (183 cfs)	6,823 AF (123 cfs)
	Mar	6,647 AF (108 cfs)	4,717 AF (77 cfs)	3,141 AF (51 cfs)	640 AF (10 cfs)
	Non-Irrigation Season Total	**34,519 AF (104 cfs)**	**28,476 AF (86 cfs)**	**24,182 AF (73 cfs)**	**13,602 AF (41 cfs)**
2007 - 2008	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	10,588 AF (172 cfs)	9,069 AF (147 cfs)	8,079 AF (131 cfs)	5,123 AF (83 cfs)
	Jan	26,524 AF (431 cfs)	24,027 AF (391 cfs)	22,239 AF (362 cfs)	17,186 AF (280 cfs)
	Feb	13,086 AF (236 cfs)	12,089 AF (218 cfs)	11,640 AF (210 cfs)	10,227 AF (184 cfs)
	Mar	535 AF (9 cfs)	239 AF (4 cfs)	25 AF (0 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**50,733 AF (153 cfs)**	**45,423 AF (137 cfs)**	**41,982 AF (127 cfs)**	**32,537 AF (98 cfs)**
2008 - 2009	Oct	898 AF (28 cfs)	188 AF (6 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	8,774 AF (143 cfs)	7,729 AF (126 cfs)	7,122 AF (116 cfs)	5,316 AF (86 cfs)
	Jan	10,030 AF (163 cfs)	9,013 AF (147 cfs)	8,453 AF (137 cfs)	6,773 AF (110 cfs)
	Feb	4,052 AF (73 cfs)	3,590 AF (65 cfs)	3,307 AF (60 cfs)	2,372 AF (43 cfs)
	Mar	1,250 AF (20 cfs)	743 AF (12 cfs)	425 AF (7 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**25,004 AF (75 cfs)**	**21,262 AF (64 cfs)**	**19,307 AF (58 cfs)**	**14,461 AF (44 cfs)**
2009 - 2010	Oct	5,383 AF (170 cfs)	4,323 AF (136 cfs)	3,548 AF (112 cfs)	1,097 AF (35 cfs)
Above Average	Nov	24,104 AF (405 cfs)	20,769 AF (349 cfs)	17,884 AF (301 cfs)	11,300 AF (190 cfs)
	Dec	56,169 AF (914 cfs)	54,448 AF (886 cfs)	51,902 AF (844 cfs)	38,948 AF (633 cfs)
	Jan	41,596 AF (676 cfs)	38,975 AF (634 cfs)	36,641 AF (596 cfs)	29,513 AF (480 cfs)
	Feb	14,891 AF (268 cfs)	13,641 AF (246 cfs)	13,136 AF (237 cfs)	11,622 AF (209 cfs)
	Mar	17,844 AF (290 cfs)	15,421 AF (251 cfs)	14,088 AF (229 cfs)	9,071 AF (148 cfs)
	Non-Irrigation Season Total	**159,987 AF (483 cfs)**	**147,578 AF (446 cfs)**	**137,200 AF (414 cfs)**	**101,550 AF (307 cfs)**
2010 - 2011	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	9,468 AF (154 cfs)	8,596 AF (140 cfs)	8,162 AF (133 cfs)	6,859 AF (112 cfs)
	Jan	40,528 AF (659 cfs)	37,660 AF (612 cfs)	35,140 AF (572 cfs)	27,262 AF (443 cfs)
	Feb	33,297 AF (600 cfs)	30,860 AF (556 cfs)	28,773 AF (518 cfs)	22,587 AF (407 cfs)
	Mar	1,958 AF (32 cfs)	1,614 AF (26 cfs)	1,381 AF (22 cfs)	758 AF (12 cfs)
	Non-Irrigation Season Total	**85,250 AF (257 cfs)**	**78,730 AF (238 cfs)**	**73,455 AF (222 cfs)**	**57,465 AF (173 cfs)**
2011 - 2012	Oct	75 AF (2 cfs)	7 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	2,837 AF (48 cfs)	2,204 AF (37 cfs)	1,728 AF (29 cfs)	467 AF (8 cfs)
	Dec	56,558 AF (920 cfs)	55,925 AF (910 cfs)	54,858 AF (892 cfs)	42,057 AF (684 cfs)
	Jan	61,488 AF (1000 cfs)	60,865 AF (990 cfs)	57,605 AF (937 cfs)	44,110 AF (717 cfs)
	Feb	55,350 AF (997 cfs)	53,843 AF (969 cfs)	52,034 AF (937 cfs)	41,028 AF (739 cfs)
	Mar	15,073 AF (245 cfs)	13,632 AF (222 cfs)	12,860 AF (209 cfs)	9,826 AF (160 cfs)
	Non-Irrigation Season Total	**191,381 AF (578 cfs)**	**186,475 AF (563 cfs)**	**179,085 AF (541 cfs)**	**137,489 AF (415 cfs)**
2012 - 2013	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	309 AF (5 cfs)	186 AF (3 cfs)	92 AF (1 cfs)	0 AF (0 cfs)
	Jan	4,953 AF (81 cfs)	4,122 AF (67 cfs)	3,570 AF (58 cfs)	2,047 AF (33 cfs)
	Feb	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Mar	3,851 AF (63 cfs)	2,442 AF (40 cfs)	1,435 AF (23 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**9,114 AF (28 cfs)**	**6,750 AF (20 cfs)**	**5,096 AF (15 cfs)**	**2,047 AF (6 cfs)**
2013 - 2014	Oct	1,684 AF (53 cfs)	1,090 AF (34 cfs)	580 AF (18 cfs)	0 AF (0 cfs)
Above Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	36,116 AF (587 cfs)	33,586 AF (546 cfs)	31,371 AF (510 cfs)	24,539 AF (399 cfs)
	Jan	56,890 AF (925 cfs)	54,737 AF (890 cfs)	51,934 AF (845 cfs)	38,470 AF (626 cfs)
	Feb	45,248 AF (815 cfs)	43,673 AF (786 cfs)	41,520 AF (748 cfs)	31,974 AF (576 cfs)
	Mar	24,294 AF (395 cfs)	21,792 AF (354 cfs)	20,015 AF (326 cfs)	15,234 AF (248 cfs)
	Non-Irrigation Season Total	**164,232 AF (496 cfs)**	**154,877 AF (468 cfs)**	**145,421 AF (439 cfs)**	**110,217 AF (333 cfs)**

Alternative 2 (1,000 cfs Canal) - All Years

Delivery Year (Year Type)	Month	Canal Take (no change)	Canal Take (10% Reduced)	Canal Take (20% Reduced)	Canal Take (50% Reduced)
		Acre-Feet (cfs)			
2014 - 2015	Oct	4,569 AF (144 cfs)	3,195 AF (101 cfs)	2,182 AF (69 cfs)	0 AF (0 cfs)
Above Average	Nov	48,473 AF (815 cfs)	46,060 AF (774 cfs)	40,572 AF (682 cfs)	23,989 AF (403 cfs)
	Dec	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	59,208 AF (963 cfs)
	Jan	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,284 AF (997 cfs)
	Feb	42,033 AF (757 cfs)	40,984 AF (738 cfs)	40,130 AF (723 cfs)	34,998 AF (630 cfs)
	Mar	31,630 AF (514 cfs)	28,095 AF (457 cfs)	25,089 AF (408 cfs)	17,923 AF (291 cfs)
	Non-Irrigation Season Total	**249,680 AF (754 cfs)**	**241,309 AF (729 cfs)**	**230,949 AF (697 cfs)**	**197,402 AF (596 cfs)**
2015 - 2016	Oct	4,204 AF (132 cfs)	3,317 AF (105 cfs)	2,449 AF (77 cfs)	155 AF (5 cfs)
Above Average	Nov	25,964 AF (436 cfs)	24,087 AF (405 cfs)	22,339 AF (375 cfs)	14,578 AF (245 cfs)
	Dec	44,883 AF (730 cfs)	43,751 AF (712 cfs)	42,799 AF (696 cfs)	34,097 AF (555 cfs)
	Jan	61,488 AF (1000 cfs)	61,437 AF (999 cfs)	60,531 AF (984 cfs)	46,811 AF (761 cfs)
	Feb	54,863 AF (988 cfs)	53,666 AF (966 cfs)	52,207 AF (940 cfs)	42,009 AF (756 cfs)
	Mar	25,681 AF (418 cfs)	23,952 AF (390 cfs)	22,664 AF (369 cfs)	15,986 AF (260 cfs)
	Non-Irrigation Season Total	**217,082 AF (655 cfs)**	**210,210 AF (635 cfs)**	**202,989 AF (613 cfs)**	**153,635 AF (464 cfs)**
2016 - 2017	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	26,369 AF (429 cfs)	23,773 AF (387 cfs)	21,856 AF (355 cfs)	16,215 AF (264 cfs)
	Jan	56,791 AF (924 cfs)	55,754 AF (907 cfs)	54,188 AF (881 cfs)	42,414 AF (690 cfs)
	Feb	35,440 AF (638 cfs)	32,588 AF (587 cfs)	30,160 AF (543 cfs)	22,975 AF (414 cfs)
	Mar	135 AF (2 cfs)	86 AF (1 cfs)	44 AF (1 cfs)	0 AF (0 cfs)
	Non-Irrigation Season Total	**118,736 AF (358 cfs)**	**112,201 AF (339 cfs)**	**106,248 AF (321 cfs)**	**81,603 AF (246 cfs)**
2017 - 2018	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Above Average	Nov	36 AF (1 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	42,429 AF (690 cfs)	40,022 AF (651 cfs)	37,431 AF (609 cfs)	27,080 AF (440 cfs)
	Jan	61,488 AF (1000 cfs)	61,488 AF (1000 cfs)	61,378 AF (998 cfs)	49,911 AF (812 cfs)
	Feb	27,748 AF (500 cfs)	25,974 AF (468 cfs)	24,670 AF (444 cfs)	20,814 AF (375 cfs)
	Mar	6,580 AF (107 cfs)	5,554 AF (90 cfs)	4,877 AF (79 cfs)	2,974 AF (48 cfs)
	Non-Irrigation Season Total	**138,281 AF (417 cfs)**	**133,038 AF (402 cfs)**	**128,358 AF (388 cfs)**	**100,779 AF (304 cfs)**
2018 - 2019	Oct	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
Average	Nov	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)	0 AF (0 cfs)
	Dec	6,543 AF (106 cfs)	5,894 AF (96 cfs)	5,572 AF (91 cfs)	4,606 AF (75 cfs)
	Jan	25,052 AF (407 cfs)	22,358 AF (364 cfs)	20,726 AF (337 cfs)	15,738 AF (256 cfs)
	Feb	29,838 AF (537 cfs)	27,450 AF (494 cfs)	25,896 AF (466 cfs)	20,732 AF (373 cfs)
	Mar	32,463 AF (528 cfs)	30,005 AF (488 cfs)	27,481 AF (447 cfs)	19,065 AF (310 cfs)
	Non-Irrigation Season Total	**93,896 AF (283 cfs)**	**85,708 AF (259 cfs)**	**79,675 AF (241 cfs)**	**60,141 AF (182 cfs)**

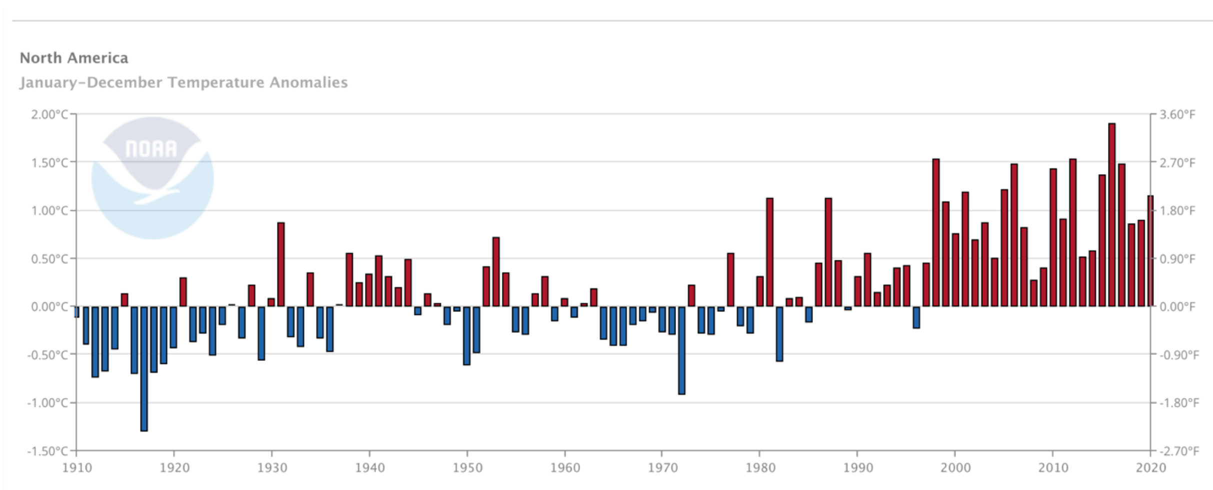
Appendix C

Hydrologic Variability Discussion

HISTORICAL VARIABILITY AND IMPACTS ON SUPPLY

Climate variability is a recurring theme in the South Platte River basin's history and is traceable through modern measurement techniques and historical records derived from soil profiles and dendrochronology. Recent observed data shows that the annual temperature for North America has increased at an average rate of 0.13°C (0.23°F) per decade since 1910. This rate is less than the average temperature rate increase since 1981 (+0.29°C / +0.52°F per decade).[1] The North American temperature variability from 1910 – 2020 is shown in **Figure C-1**. The temperature anomaly (or variability) is the difference from an average, or baseline, temperature. A positive anomaly indicates the observed temperature was warmer than the baseline, while a negative anomaly indicates the observed temperature was cooler than the baseline.[2]

Figure C-1[3] - North America Temperature Anomaly, 1910-2020



[1] NOAA National Centers for Environmental Information, State of the Climate: Monthly Global Climate Report for Annual 2020, published online January 2021, retrieved on August 20, 2022 from https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202013.

[2] Baselines are most often calculated over a 30-year period and updated each decade, in agreement with World Meteorological Organization (WMO) standards. Meteorological providers who use the standard 30-year normal include the NOAA National Climatic Data Center; Regional Climate Centers (RCCs; climate monitoring); the NRCS Colorado Snow Survey (snowpack monitoring and water supply forecasts), and the Colorado Basin River Forecast Center (CBRFC; hydrologic monitoring and streamflow forecasts), among others. Standard baseline temperature is calculated by averaging 30 or more years of temperature data.

[3] NOAA National Centers for Environmental information, Climate at a Glance: Global Time Series, published August 2022, retrieved on August 20, 2022 from https://www.ncei.noaa.gov/cag/

The South Platte River Basin and surrounding region has experienced notable climate events over the past century, including the Dust Bowl drought years in the 1930s, a warm period in the 1950s, relatively cool periods in the 1960s and 1970s, intermittent catastrophic floods, and the relatively warm and dry period since 2000.[4] The observed record has had pronounced annual swings, which led to tangible impacts on hydrology, but corresponds with larger trends against the 30-year baseline. In May 2021, the National Oceanic and Atmospheric Administration (NOAA) updated its 30-year climate normals, and the newest 30-year normal reflects warmer temperatures than previous iterations and also reflects changing precipitation patterns.

Historical Temperature Variability

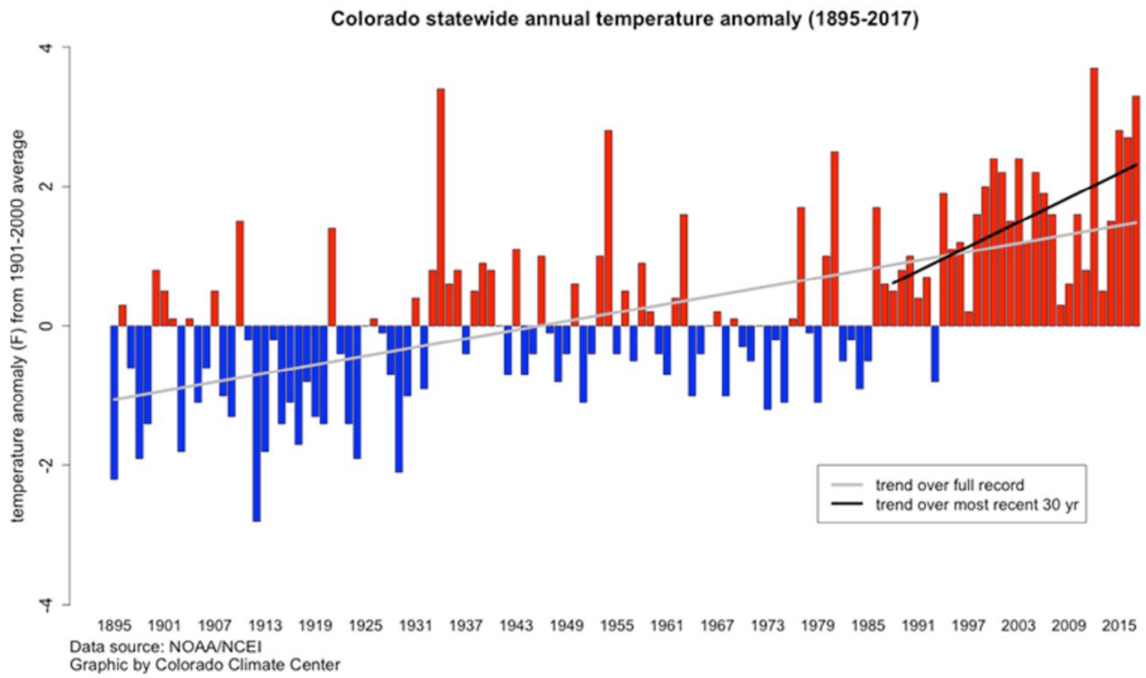
Temperature has a direct effect on hydrology. Increased temperature influences water supply availability through greater evapotranspiration, earlier snowmelt and peak runoff, prolonged droughts, and drier soils while cooler temperature trends tend to produce the opposite effects by slowing evapotranspiration, increasing the duration of the snowpack storage, and shifting peak runoff to later in the runoff season. The observed record of Colorado and Nebraska's climate has trended towards higher temperatures, particularly over the last 30 years. Colorado statewide annual average temperatures have increased by 2.0ºF over the past 30 years and 2.5ºF over the past 50 years.[5] Warming trends have been observed over these periods in most parts of the state, and temperatures have increased in all seasons, recording the largest warming trend in summer. Daily minimum temperatures in Colorado have warmed more than daily maximum temperatures during the past 30 years.[6] Figure C-2 depicts these temperature trends in Colorado.

[4] Climate Change in Colorado, A Synthesis to Support Water Resources Management and Adaptation Second Edition, p. 12 - August 2014

[5] Climate Change in Colorado, A Synthesis to Support Water Resources Management and Adaptation Second Edition, p. 11 - August 2014.

[6] Climate Change in Colorado, A Synthesis to Support Water Resources Management and Adaptation Second Edition, p. 11 - August 2014.

Figure C-2: Colorado Historical Temperature Trends[7]



Since 1895 Nebraska has seen minimal overall warming trend of about 1.0°F (~0.1°F per decade). Nighttime lows show a greater trend in rising temperatures than daytime highs, with the winter months (Dec, Jan, Feb) showing the greatest warming of 2.0°F at night. Summer months show a mean temperature trend increase of 1.0°F during that historical period of record.[8] However, the minimum or low temperatures is double the mean temperature increase, at 2.0°F (~0.2°F per decade), shown in Figure C-3.[9] These trends show a general warming, that is most pronounced for nighttime lows, and are consistent with the changes observed across the Plains states.[10]

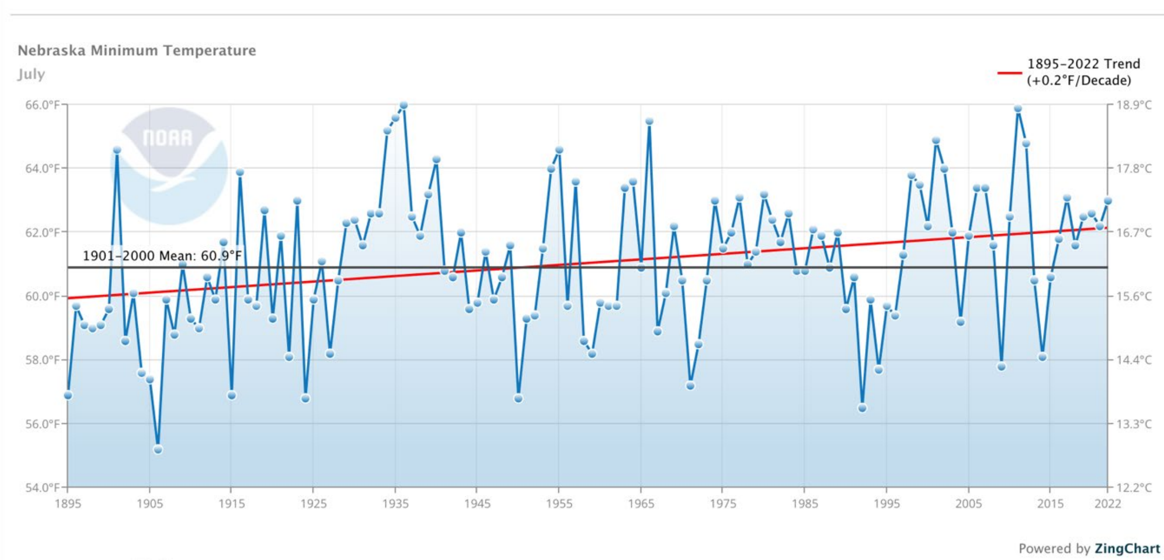
[7] Source: 2023 Colorado Water Plan, 2022 Draft, Colorado Department of Natural Resources – p. 3-9

[8] Understanding and Assessing Climate Change, Implications for Nebraska, University of Nebraska, Lincoln - ES - p. XI - September 2014

[9] NOAA National Centers for Environmental information, Climate at a Glance: Statewide Time Series, published August 2022, retrieved on August 23, 2022 from https://www.ncei.noaa.gov/cag/

[10] Understanding and Assessing Climate Change, Implications for Nebraska, University of Nebraska, Lincoln - ES - p. XI - September 2014

Figure C-3: Nebraska Historical Minimum Temperature and Trendline[11]



The trend of higher temperatures over the past 30 years has extended the frost-free season length.[12] Since 1895, the length of the frost-free season has increased by 5 to 25 days across Nebraska, and on average more than one week statewide.[13] Colorado has seen similar increases in the length of the frost-free season. Twelve long-term observing stations across Colorado show significant increases in 100-year and 30-year trends that are consistent with the warming trend of annual temperatures.[14] A longer frost-free season can mean longer growing season for crops and other vegetation. It can also lead to loss of moisture due to increased evapotranspiration and drier soils.[15]

[11] NOAA National Centers for Environmental information, Climate at a Glance: Statewide Time Series, Average Temperature, published August 2022, retrieved on August 30, 2022 from https://www.ncdc.noaa.gov/cag/

[12] 2012: Climate Change Indicators in the United States, 2nd Edition. 84 pp., U.S. Environmental Protection Agency, Washington, D.C.

[13] p. XI - Understanding and Assessing Climate Change, Implications for Nebraska, University of Nebraska, Lincoln, September 2014

[14] pp. 38-39, Climate Change in Colorado, A Synthesis to Support Water Resources Management and Adaptation
Second Edition - August 2014

[15] p. 12 - Understanding and Assessing Climate Change, Implications for Nebraska, University of Nebraska, Lincoln, September 2014

HISTORICAL PRECIPITATION VARIABILITY

Variance in annual precipitation directly influences annual water supply. Most of the precipitation that contributes to the flow of the South Platte River falls as snow throughout the winter in the Rocky Mountains. The westerly dominated winds bring moisture laden air from both the north and south Pacific when the jet stream is positioned over or near Colorado in the winter. The frequency and intensity of the mountain storms with this winter weather pattern is usually greater than storms at other times of the year. Areas above 9,000 feet receive the most winter precipitation.[16] During spring, periodic storms bring moisture from the Gulf of Mexico into Colorado from the south and east. A small number of these spring events drop upslope snow that contribute a large fraction of the annual precipitation to the eastern side of the Continental Divide, especially the northern Front Range[17] in the headwaters of the South Platte River watershed.

Rain tends to fall in lower elevations in the plains in the late spring and late fall in eastern Colorado and western Nebraska. And summer precipitation, often in the form of thunderstorms, is common but the activity varies considerably from year to year. The average October-April precipitation in the Basin varies from 3 inches in the lower plains to 22 inches in the mountains, and 6 and 15 inches, respectively, for the plains and mountains during May-September.[18] Annual precipitation, which has high natural variability, has not seen a statewide trend in Colorado over the period from the 1980s through present.

The spring and summer rainfall that dominates the Lower Section's precipitation patterns typically originate as lower-level atmospheric moisture traveling from the east and south from the Gulf of Mexico. Convective processes caused by warm temperatures and the moisture laden air that combines with dry and cooler air from the north generates most of these storms. The typical upper-level jet stream pattern that brings moisture from the Pacific Ocean in the late fall, winter, and early spring is weaker in the summer, and the strongest westerly jet stream winds tend to sit in

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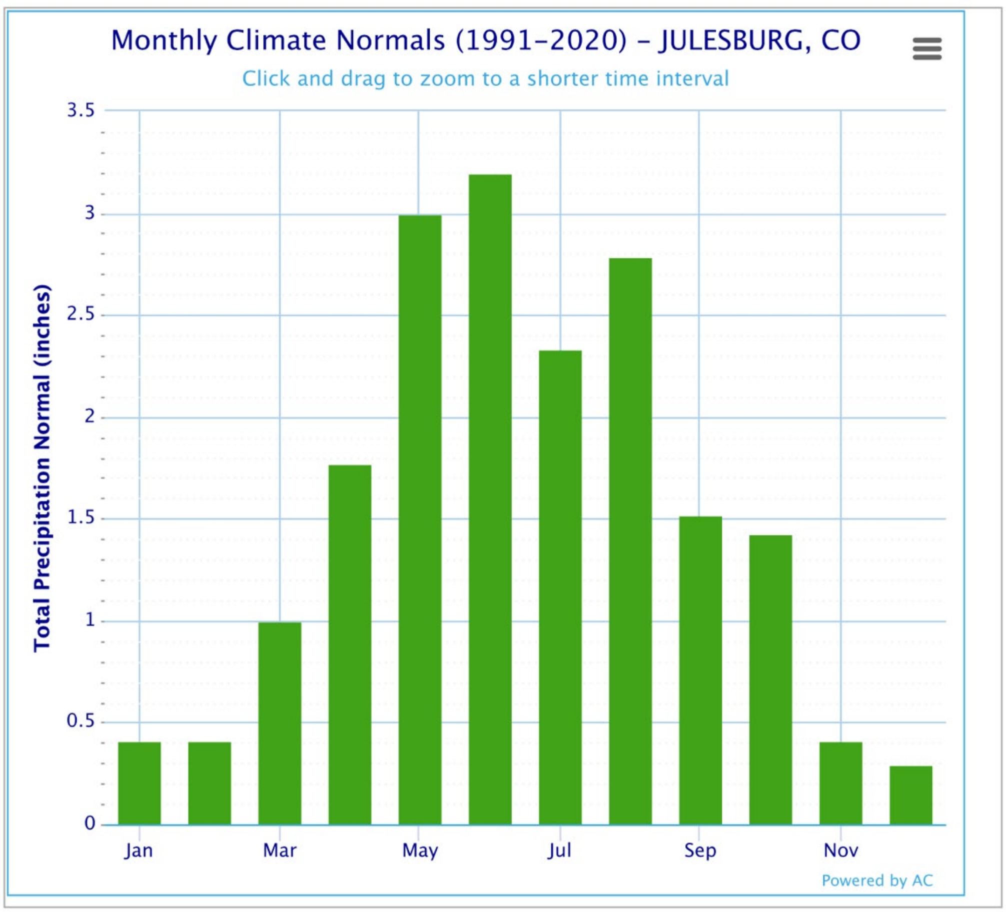
[16] p. 13 Climate Change in Colorado, A Synthesis to Support Water Resources Management and Adaptation
Second Edition - August 2014
[17] p. 14 - Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition - August 2014
[18] Section 4, p. 47 - 2023 Colorado Water Plan, 2022 Draft, Colorado DNR

latitudes well to the north allowing this intrusion of moisture from the south and east.[19] Very little precipitation tends to fall in winter in the eastern Colorado high plains regions due to the topographical influence the Rocky Mountains on storms originating in the west. When moisture reaches the state from the west, orographic lift produces clouds and precipitation which favors more precipitation on the windward western slopes of the Rocky Mountains and high elevation leeward slopes. The eastern downslopes and high plains generally remain in dry rain shadows and receive very little cold season precipitation.[20] Figure C-4 below shows the historical monthly precipitation normals in the Lower Section.

Figure C-4: Historical Precipitation in Julesburg, CO[21]



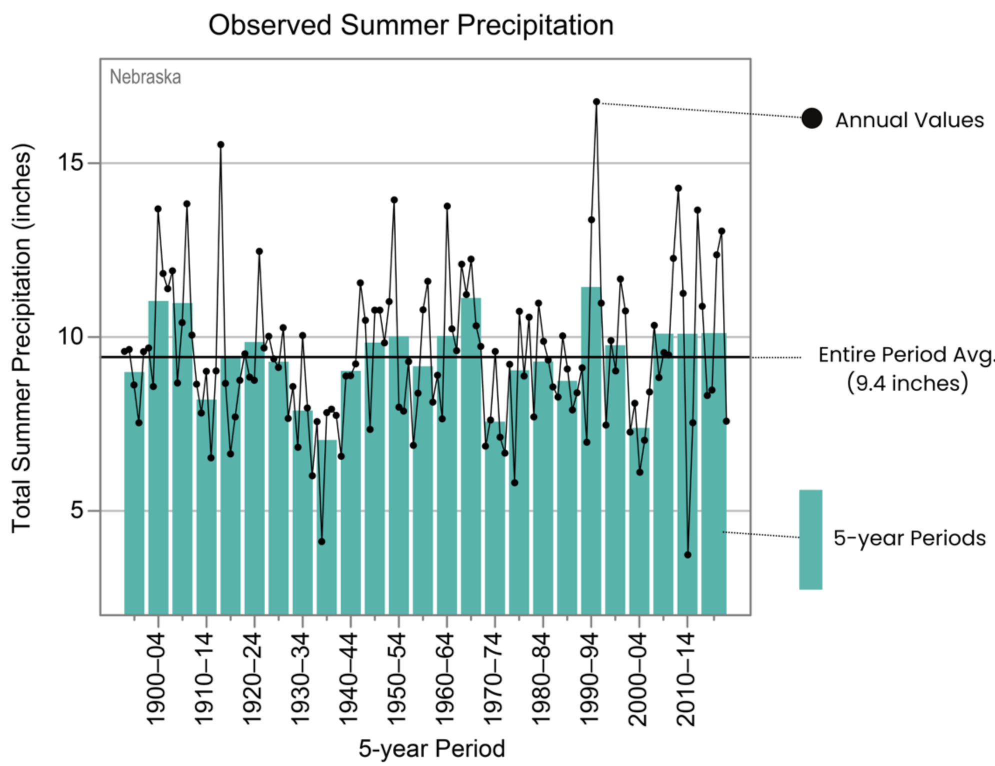
[19] p. 15 - Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition - August 2014

[20] p. 12 - Climate Change in Colorado A Synthesis to Support Water Resources Management and Adaptation, Second Edition - August 2014

[21] (weather.gov - Applied Climate Information System (ACIS), NOAA Regional Climate Centers)

Nebraska's precipitation patterns are inherently varied and the climate differs considerably from east to west across the state. The eastern half of the state receives far more moisture from the southerly winds coming from the Gulf of Mexico and average annual precipitation ranges from 36 inches in the southeast to less than 15 inches in the Panhandle in the northwest. Precipitation across the state is highly variable from year to year, but unlike temperature, there are no observed annual precipitation trends over the last century statewide in Nebraska.[22] However, since 2005, precipitation during the summer months for the entire state has been above average. Figure C-5 shows the Observed Summer Precipitation trends.

Figure C-5: Nebraska Observed Summer Precipitation (1895-2020)[23]



[22] p. XI - Understanding and Assessing Climate Change, Implications for Nebraska, University of Nebraska, Lincoln, September 2014
[23] (https://statesummaries.ncics.org/chapter/ne/ - Sources: CISESS and NOAA NCEI. Data: nClimDiv)

SNOW WATER EQUIVALENT

Snow Water Equivalent (SWE) is an indicator of temperature change and precipitation residency. SWE trends indicate the temperature change impacts that affect water supply availability. Figure C-6 shows the Station Index for purposes of characterizing SWE in this document.

Figure C-6: Station Index for SWE in South Platte Basin

Station List for Data Set - Snow Water Equivilent in South Platte Basin
https://www.nrcs.usda.gov/Internet/WCIS/AWS_PLOTS/basinCharts/POR/WTEQ/assocHUCco_8/south_platte.html

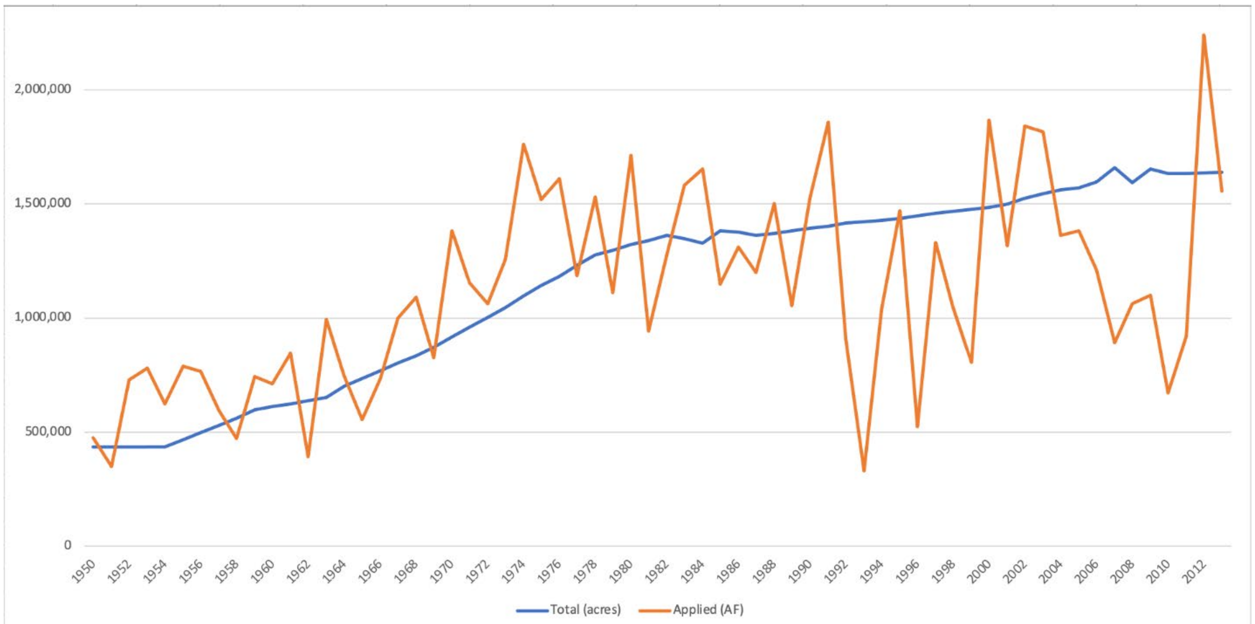
As of: Tue Aug 23 12:25:30 GMT-08:00 2022)
Provisional data, subject to revision

Station Id	State Cod	Network Code	Station Name	Elevation	Latitude	Longitude	County Name	HUC8 (8-digit)	HUC8 Name	Start Date	End Date
322	CO	SNTL	Bear Lake	9522	40.31176	-105.6467	Larimer	10190006	Big Thompson	10/1/79	1/1/00
335	CO	SNTL	Berthoud Summit	11314	39.80364	-105.77786	Grand	14010001	Colorado Headwaters	9/1/63	1/1/00
1161	CO	SNTL	Black Mountain	8980	40.8879	-105.66404	Larimer	10190007	Cache La Poudre	10/1/10	1/1/00
938	CO	SNTL	Buckskin Joe	11166	39.30378	-106.11316	Park	10190001	South Platte Headwaters	8/10/98	1/1/00
412	CO	SNTL	Copeland Lake	8555	40.20733	-105.5695	Boulder	10190005	St. Vrain	10/1/79	1/1/00
438	CO	SNTL	Deadman Hill	10239	40.80572	-105.77018	Larimer	10190007	Cache La Poudre	10/1/78	1/1/00
936	CO	SNTL	Echo Lake	10694	39.65539	-105.59358	Clear Creek	10190002	Upper South Platte	8/10/98	1/1/00
531	CO	SNTL	Hoosier Pass	11611	39.36092	-106.05999	Summit	14010002	Blue	10/1/79	1/1/00
1122	CO	SNTL	Hourglass Lake	9417	40.57717	-105.62584	Larimer	10190007	Cache La Poudre	10/1/08	1/1/00
935	CO	SNTL	Jackwhacker Gulch	11054	39.57096	-105.80355	Clear Creek	10190002	Upper South Platte	8/1/98	1/1/00
551	CO	SNTL	Joe Wright	10158	40.53285	-105.88747	Larimer	10190007	Cache La Poudre	10/1/78	1/1/00
564	CO	SNTL	Lake Eldora	9728	39.93659	-105.59031	Boulder	10190005	St. Vrain	10/1/78	1/1/00
565	CO	SNTL	Lake Irene	10682	40.41446	-105.81941	Grand	14010001	Colorado Headwaters	10/1/78	1/1/00
1123	CO	SNTL	Long Draw Resv	10008	40.51154	-105.7654	Larimer	10190007	Cache La Poudre	10/16/08	1/1/00
602	CO	SNTL	Loveland Basin	11427	39.67428	-105.90264	Clear Creek	10190004	Clear	10/1/91	1/1/00
937	CO	SNTL	Michigan Creek	10702	39.43579	-105.91072	Park	10190001	South Platte Headwaters	8/10/98	1/1/00
663	CO	SNTL	Niwot	9979	40.03581	-105.5452	Boulder	10190005	St. Vrain	10/1/79	1/1/00
939	CO	SNTL	Rough And Tumble	10432	39.02611	-106.08063	Park	10190001	South Platte Headwaters	8/10/98	1/1/00
838	CO	SNTL	University Camp	10360	40.03307	-105.57562	Boulder	10190005	St. Vrain	10/1/78	1/1/00
1042	CO	SNTL	Wild Basin	9439	40.201	-105.6025	Boulder	10190005	St. Vrain	12/13/02	1/1/00
870	CO	SNTL	Willow Park	10732	40.43397	-105.73588	Larimer	10190006	Big Thompson	10/1/79	1/1/00

WATER USE

Water use throughout the study area has continued to increase. Importantly, a subcategory of water use – applied irrigation water – has grown significantly since the 1950's. As noted in the main document, applied irrigation has plateaued and remains relative constant into the current period. Figure C-7 shows the change in applied irrigation water form 1950 through 2013.

Figure C-7: Study Area 1950 – 2013 Irrigated Acreage and Applied Water



Other agricultural-related water uses – including industrial uses – rely upon diversions from surface water systems and groundwater systems throughout Nebraska. Animal processing is an important component of Nebraska's farm-related economy. Figure C-8 shows lists the animal processing plants in Nebraska.

*Figure C-8: Animal Processing Plants In Study Area / Water Consumption Processing**

Plant/Company Name	City	County
JBS Beef Plant	Grand Island	Hall
American Foods Group	Gibbon	Buffalo
Cargill Protein	Columbus	Platte
Cargill	Schulyer	Colfax
Henningsen Foods Inc	David City	Butler
Nebraska Prime	Hastings	Adams
Darling International	Lexington	Dawson
Tyson Foods	Lexington	Dawson
Grant Packing	Grant	Perkins
Lincoln Premium Poultry (Costco)	Fremont	Dodge
Wholestone Farms	Fremont	Dodge
J.F. O'Neill Packing	Omaha	Douglas
Greater Omaha Packing Co., Inc.	Omaha	Douglas
Nebraska Beef, Ltd.	Omaha	Douglas
Typical Water Consumption for Processing (gallons per head)		
Beef	150 - 450	
Turkey	11 - 23	
Broiler	3.5 - 10	

*Consumption figures from Northwest Food Processors Association (NWFPA)

Figure C-9: Study Area Industrial Self-Supplied Water Withdrawals by County, 2015

County	Industrial Self-Supplied Groundwater Withdrawals (mgd)	Industrial Self-Supplied Surface-Water Withdrawals (mgd)	Industrial Self-Supplied Groundwater Withdrawals (AFY)
Douglas County	0.65	0	728
Lancaster County	0.15	0	168
Sarpy County	0.05	0	56
Hall County	2.35	0	2,632
Buffalo County	2.11	0	2,364
Dodge County	1.69	0	1,893
Lincoln County	0.33	0	370
Platte County	7.86	0	8,804
Dawson County	0.66	0	739
Saunders County	0	0	0
Colfax County	2.56	0	2,868
Phelps County	0	0	0
Hamilton County	2.09	0	2,341
Keith County	0	0	0
Butler County	0	0	0
Merrick County	0	0	0
Kearney County	0.7	0	784
Polk County	0	0	0
Nance County	0	0	0
Perkins County	0.46	0	515
Gosper County	0	0	0
Deuel County	0	0	0
Total	21.66	0	**24,262**

(Water Use Data for Nebraska, USGS - https://waterdata.usgs.gov/ne/nwis/water_use/)

Appendix D

Cost Estimate and Benefit Tables

(Alternative 1 and Alternative 2)

Alternative 1 (500 cfs Canal) - Summary of Estimated Costs

Description	Notes	Total Field Costs	Other Costs	Total Costs
Dams and Reservoirs				
Ovid Diversion Dam (500 cfs capacity)		$ 22,400,000	$ 5,600,000	$ 28,000,000
Riverview West (Gravity)		$ 53,600,000	$ 13,400,000	$ 67,000,000
Roscoe Draw (High)		$ 153,000,000	$ 38,000,000	$ 191,000,000
Canals				
South Divide Canal, 1st Section, 500 cfs, Concrete Lined, 24.0 mi.		$ 76,600,000	$ 30,600,000	$ 107,200,000
South Divide Canal, 2nd Section, 500 cfs, Earth, 32.0 mi.		$ 71,100,000	$ 28,400,000	$ 99,500,000
Roscoe, 500 cfs, Concrete Lined, 13.0 mi.		$ 45,900,000	$ 18,400,000	$ 64,300,000
Agency Approvals				
Permitting, licensing, environmental mitigation, and water rights.				$ 10,000,000

Total Estimated Costs $ 567,000,000

Alternative 1 (500 cfs Canal) - Summary of Estimated Project Costs
Ovid Diversion Dam

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Sluiceway						
1.1	Sluiceway	1	LS	$ 250,000	3.26	$ 815,000
				Item Subtotal:		*$ 815,000*
Canal Outlet Works						
2.1	Canal Outlet Works	1	LS	$ 380,000	3.36	$ 1,276,800
				Item Subtotal:		*$ 1,276,800*
Diversion Dam						
3.1	Diversion Dam	1	LS	$ 2,600,000	3.16	$ 8,216,000
				Item Subtotal:		*$ 8,216,000*
Rights-of-Way						
4.1	Clearing, includes Dam	75	Acres	$ 1,044	3.52	$ 275,616
4.2	Fencing	2	Miles	$ 4,025	3.52	$ 28,336
4.3	Rights-of-Way	210	Acres	$ 1,000	3.62	$ 760,200
4.4	Erecting Gaging Shelter and Recorder	1	LS	$ 3,700	3.52	$ 13,024
4.5	Allowance for Unlisted Items (10%)	1	LS	$ 107,718		$ 107,718
				Item Subtotal:		*$ 1,184,894*
General Property						
5.1	O&M Headquarters, Equipment, Office, Shop, and Garage					$ 6,400,000
				Item Subtotal:		*$ 6,400,000*

Final Subtotal:	$ 17,892,694
Contingencies (~25%):	$ 4,500,000
Total Field Costs:	$ 22,400,000
Indirects (~25%):	$ 5,600,000
2022 Total	**$ 28,000,000**

Alternative 1 (500 cfs Canal) - Summary of Estimated Project Costs
South Divide Canal: 1st Section (500 cfs, Concrete Lined, 24 miles),

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Land and Rights						
1.1	ROW Acquisition	510	Acres	$ 400	3.62	$ 738,480
				Item Subtotal:		*$ 738,480*
Relocation of Property of Others						
2.1	Highway & County Road Bridges (x11)	10,560	SF	$ 60	3.49	$ 2,211,264
2.2	Farm Access Bridges (x8)	5,120	SF	$ 60	3.49	$ 1,072,128
2.3	State Highway, County Road, and Farm Drive relocations	18	EA	$ 5,000	3.89	$ 350,100
2.4	Unlisted Items (~10%)	1	LS	$ 363,349		$ 363,349
				Item Subtotal:		*$ 3,996,841*
Structures and Improvements						
3.1	Furnishing and Erecting 4-wire Barb Fence	48	Miles	$ 6,600	3.36	$ 1,064,448
3.2	Furnishing and Erecting Barb Wire Gates	48	Miles	$ 300	3.36	$ 48,384
3.3	Furnishing and Installing Cattle Guards	48	Miles	$ 3,500	3.36	$ 564,480
3.4	Unlisted Items (~10%)	1	LS	$ 167,731		$ 167,731
				Item Subtotal:		*$ 1,845,043*
Waterways						
4.1	Concrete Lined Canal 6" thick	24	Miles	$ 560,000	3.35	$ 45,024,000
4.2	Unlisted Items (~10%)	1	LS	$ 4,502,400		$ 4,502,400
				Item Subtotal:		*$ 49,526,400*
Waterway Structures						
5.1	Check Structures	5	EA	$ 70,000	3.35	$ 1,172,500
5.2	Siphons	1	EA	$ 220,000	3.35	$ 737,000
				Item Subtotal:		*$ 1,909,500*
Waterway Protective Works						
6.1	Cross Drainage Structures	1	EA	$ 970,000	3.35	$ 3,249,500
				Item Subtotal:		*$ 3,249,500*

Final Subtotal:	$ 61,265,764
Contingencies (~25%):	$ 15,300,000
Total Field Costs:	$ 76,600,000
Indirects (~40%):	$ 30,600,000
2022 Total	**$ 107,200,000**

NOTES

1.1	Assumes average width of 175 ft. for the 24 mile canal section
2.1	Count arrived using GIS. Assumes average width of 24 feet and length of 40 feet
2.2	Count arrived using GIS. Assumes average width of 16 feet and length of 40 feet
2.3	Count arrived using GIS
3.1	Assumes fencing on both sides of canal for the 24 mile canal section
5.1	Uses 1 Check Structure per every 5 miles
5.2	Siphon at Interstate 76
6.1	Count arrived using GIS

Alternative 1 (500 cfs Canal) - Summary of Estimated Project Costs
South Divide Canal: 2nd Section (500 cfs, Earth, 32 miles)

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Land and Rights						
1.1	ROW Acquisition	780	Acres	$ 550	4.88	$ 2,093,520
				Item Subtotal:		*$ 2,093,520*
Relocation of Property of Others						
2.1	Highway & County Road Bridges (x19)	29,184	SF	$ 60	3.49	$ 6,111,130
2.2	Farm Access Bridges (x32)	32,768	SF	$ 60	3.49	$ 6,861,619
2.3	State Highway, County Road, and Farm Drive relocations	25	EA	$ 5,000	3.89	$ 486,250
2.4	Unlisted Items (~10%)	1	LS	$ 1,345,900		$ 1,345,900
				Item Subtotal:		*$ 14,804,899*
Structures and Improvements						
3.1	Furnishing and Erecting 4-wire Barb Fence	64	Miles	$ 6,600	3.36	$ 1,419,264
3.2	Furnishing and Erecting Barb Wire Gates	64	EA	$ 300	3.36	$ 64,512
3.3	Furnishing and Installing Cattle Guards	64	EA	$ 3,500	3.36	$ 752,640
3.4	Unlisted Items (~10%)	1	LS	$ 223,642		$ 223,642
				Item Subtotal:		*$ 2,460,058*
Waterways						
4.1	Earth Canal	32	Miles	$ 240,000	3.41	$ 26,188,800
4.2	Unlisted Items (~10%)	1	LS	$ 2,618,880		$ 2,618,880
				Item Subtotal:		*$ 28,807,680*
Waterway Structures						
5.1	Check Structures	10	EA	$ 82,000	3.35	$ 2,747,000
5.2	Drop Structure from Canal to Reservoir	2	EA	$ 475,000	3.35	$ 3,182,500
				Item Subtotal:		*$ 5,929,500*
Waterway Protective Works						
6.1	Cross Drainage Structures (first 5 miles)	5	Miles	$ 110,000	5.15	$ 2,832,500
6.2	Cross Drainage Structures (final 27 miles)	27	Miles	$ 10,000	5.15	$ 1,390,500
6.3	Unlisted Items (~10%)	1	LS	$ 422,300		$ 422,300
				Item Subtotal:		*$ 2,832,500*

Final Subtotal:	$ 56,928,156
Contingencies (~25%):	$ 14,200,000
Total Field Costs:	$ 71,100,000
Indirects (~40%):	$ 28,400,000
2022 Total	**$ 99,500,000**

NOTES

1.1	Assumes average width of 200 ft. for the 32 mile canal section
2.1	Count arrived using GIS. Assumes average width of 24 feet and length of 64 feet
2.2	Count arrived using GIS. Assumes average width of 16 feet and length of 64 feet
2.3	Count arrived using GIS
3.1	Assumes fencing on both sides of canal for the 32 mile canal section
5.1	Uses 1 Check Structure per every 3 miles
5.2	1 Drop Structure for each Reservoir (Riverview West and Roscoe Draw)
6.1	Count arrived using GIS.

Alternative 1 (500 cfs Canal) - Summary of Estimated Project Costs
Roscoe Canal: 1st Section (500 cfs, Concrete Lined 13 miles)

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Land and Rights						
1.1	ROW Acquisition	280	Acres	$ 1,500	4.88	$ 2,049,600
				Item Subtotal:		*$ 2,049,600*
Relocation of Property of Others						
2.1	Highway & County Road Bridges (x9)	8,640	SF	$ 60	3.35	$ 1,736,640
2.2	Farm Access Bridges (x5)	3,200	SF	$ 60	3.35	$ 643,200
2.3	State Highway, County Road and Farm Drive	11	EA	$ 5,000	3.89	$ 213,950
2.4	Unlisted Items (~10%)	1	LS	$ 259,379		$ 259,379
				Item Subtotal:		*$ 2,853,169*
Structures and Improvements						
3.1	Furnishing and Erecting 4-wire Barb Fence	26	Miles	$ 6,600	3.36	$ 576,576
3.2	Furnishing and Erecting Barb Wire Gates	26	Miles	$ 300	3.36	$ 26,208
3.3	Furnishing and Installing Cattle Guards	26	Miles	$ 3,500	3.36	$ 305,760
3.4	Unlisted Items (~10%)	1	LS	$ 90,854		$ 90,854
				Item Subtotal:		*$ 999,398*
Waterways						
4.1	Concrete Lined Canal 6" thick	13	Miles	$ 560,000	3.35	$ 24,388,000
4.2	Unlisted Items (~10%)	1	LS	$ 2,438,800		$ 2,438,800
				Item Subtotal:		*$ 26,826,800*
Waterway Structures						
5.1	Canal Drop Structures	3	EA	$ 70,000	3.35	$ 703,500
5.2	Drop Structure from Canal to Sutherland Canal	1	EA	$ 220,000	3.35	$ 737,000
				Item Subtotal:		*$ 1,440,500*
Waterway Protective Works						
6.1	Cross Drainage Structures	1	LS	$ 525,000	5.15	$ 2,703,750
				Item Subtotal:		*$ 2,703,750*

Final Subtotal:	$ 36,873,217
Contingencies (~25%):	$ 9,000,000
Total Field Costs:	$ 45,900,000
Indirects (~40%):	$ 18,400,000
2022 Total	**$ 64,300,000**

NOTES

1.1	Assumes average width of 175 ft. for the 13 mile canal section
2.1	Assumes (x6) average width of 24 feet and length of 40 feet
2.2	Assume (x5) using average width of 16 feet and length of 40 feet
3.1	Assumes fencing on both sides of canal for the 13 mile canal section
5.1	Uses 1 Check Structure per every 5 miles
6.1	Count arrived using GIS

Alternative 2 (1,000 cfs Canal) - Summary of Estimated Costs

Description	Notes	Total Field Costs	Other Costs	Total Costs
Dams and Reservoirs				
Ovid Diversion Dam (1,000 cfs capacity)		$ 23,900,000	$ 6,000,000	$ 29,900,000
Riverview West (Gravity)		$ 53,600,000	$ 13,400,000	$ 67,000,000
Roscoe Draw (High)		$ 153,000,000	$ 38,000,000	$ 191,000,000
Canals				
South Divide Canal, 1st Section, 1,000 cfs, Concrete Lined, 24.0 mi.		$ 95,500,000	$ 38,200,000	$ 133,700,000
South Divide Canal, 2nd Section, 1,000 cfs, Earth, 32.0 mi.		$ 83,400,000	$ 33,400,000	$ 116,800,000
Roscoe, 1,000 cfs, Concrete Lined, 13.0 mi.		$ 57,000,000	$ 22,800,000	$ 79,800,000
Agency Approvals				
Permitting, licensing, environmental mitigation, and water rights.				$ 10,000,000

Total Estimated Costs $ 628,200,000

Alternative 2 (1,000 cfs Canal) - Summary of Estimated Project Costs
Ovid Diversion Dam

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Sluiceway						
1.1	Sluiceway	1	LS	$ 250,000	3.26	$ 815,000
				Item Subtotal:		*$ 815,000*
Canal Outlet Works						
2.1	Canal Outlet Works	1	LS	$ 750,000	3.36	$ 2,520,000
				Item Subtotal:		*$ 2,520,000*
Diversion Dam						
3.1	Diversion Dam	1	LS	$ 2,600,000	3.16	$ 8,216,000
				Item Subtotal:		*$ 8,216,000*
Rights-of-Way						
4.1	Clearing, includes Dam	75	Acres	$ 1,044	3.52	$ 275,616
4.2	Fencing	2	Miles	$ 4,025	3.52	$ 28,336
4.3	Rights-of-Way	210	Acres	$ 1,000	3.62	$ 760,200
4.4	Erecting Gaging Shelter and Recorder	1	LS	$ 3,700	3.52	$ 13,024
4.5	Allowance for Unlisted Items (10%)	1	LS	$ 107,718		$ 107,718
				Item Subtotal:		*$ 1,184,894*
General Property						
5.1	O&M Headquarters, Equipment, Office, Shop, and Garage					$ 6,400,000
				Item Subtotal:		*$ 6,400,000*

Final Subtotal:	$ 19,135,894
Contingencies (~25%):	$ 4,800,000
Total Field Costs:	$ 23,900,000
Indirects (~25%):	$ 6,000,000
2022 Total	**$ 29,900,000**

Alternative 2 (1,000 cfs Canal) - Summary of Estimated Project Costs
South Divide Canal: 1st Section (1,000 cfs, Concrete Lined, 24 miles)

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Land and Rights						
1.1	ROW Acquisition	585	Acres	$ 400	3.62	$ 847,080
				Item Subtotal:		*$ 847,080*
Relocation of Property of Others						
2.1	Highway & County Road Bridges (x11)	10,152	SF	$ 60	3.49	$ 2,125,829
2.2	Farm Access Bridges (x8)	6,768	SF	$ 60	3.49	$ 1,417,219
2.3	State Highway, County Road, and Farm Drive relocations	18	EA	$ 5,000	3.89	$ 350,100
2.4	Unlisted Items (~10%)	1	LS	$ 389,315		$ 389,315
				Item Subtotal:		*$ 4,282,463*
Structures and Improvements						
3.1	Furnishing and Erecting 4-wire Barb Fence	48	Miles	$ 6,600	3.36	$ 1,064,448
3.2	Furnishing and Erecting Barb Wire Gates	48	Miles	$ 300	3.36	$ 48,384
3.3	Furnishing and Installing Cattle Guards	48	Miles	$ 3,500	3.36	$ 564,480
3.4	Unlisted Items (~10%)	1	LS	$ 167,731		$ 167,731
				Item Subtotal:		*$ 1,845,043*
Waterways						
4.1	Concrete Lined Canal 6" thick	24	Miles	$ 715,000	3.35	$ 57,486,000
4.2	Unlisted Items (~10%)	1	LS	$ 5,748,600		$ 5,748,600
				Item Subtotal:		*$ 63,234,600*
Waterway Structures						
5.1	Check Structures	5	EA	$ 85,000	3.35	$ 1,423,750
5.2	Siphons	1	EA	$ 375,000	3.35	$ 1,256,250
				Item Subtotal:		*$ 2,680,000*
Waterway Protective Works						
6.1	Cross Drainage Structures	1	EA	$ 1,050,000	3.35	$ 3,517,500
				Item Subtotal:		*$ 3,517,500*

Final Subtotal:	$ 76,406,686
Contingencies (~25%):	$ 19,100,000
Total Field Costs:	$ 95,500,000
Indirects (~40%):	$ 38,200,000
2022 Total	**$ 133,700,000**

NOTES

1.1	Assumes average width of 200 ft. for the 24 mile canal section
2.1	Count arrived using GIS. Assumes average width of 24 feet and length of 47 feet
2.2	Count arrived using GIS. Assumes average width of 16 feet and length of 47 feet
2.3	Count arrived using GIS
3.1	Assumes fencing on both sides of canal for the 24 mile canal section
5.1	Uses 1 Check Structure per every 5 miles
5.2	Siphon at Interstate 76
6.1	Count arrived using GIS

Alternative 2 (1,000 cfs Canal) - Summary of Estimated Project Costs
South Divide Canal: 2nd Section (1,000 cfs, Earth, 32 miles)

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Land and Rights						
1.1	ROW Acquisition	855	Acres	$ 550	4.88	$ 2,294,820
				Item Subtotal:		*$ 2,294,820*
Relocation of Property of Others						
2.1	Highway & County Road Bridges (x19)	36,480	SF	$ 60	3.49	$ 7,638,912
2.2	Farm Access Bridges (x32)	40,960	SF	$ 60	3.49	$ 8,577,024
2.3	State Highway, County Road, and Farm Drive relocations	25	EA	$ 5,000	3.89	$ 486,250
2.4	Unlisted Items (~10%)	1	LS	$ 1,670,219		$ 1,670,219
				Item Subtotal:		*$ 18,372,405*
Structures and Improvements						
3.1	Furnishing and Erecting 4-wire Barb Fence	64	Miles	$ 6,600	3.36	$ 1,419,264
3.2	Furnishing and Erecting Barb Wire Gates	64	Miles	$ 300	3.36	$ 64,512
3.3	Furnishing and Installing Cattle Guards	64	Miles	$ 3,500	3.36	$ 752,640
3.4	Unlisted Items (~10%)	1	LS	$ 223,642		$ 223,642
				Item Subtotal:		*$ 2,460,058*
Waterways						
4.1	Earth Canal	32	Miles	$ 270,000	3.41	$ 29,462,400
4.2	Unlisted Items (~10%)	1	LS	$ 2,946,240		$ 2,946,240
				Item Subtotal:		*$ 32,408,640*
Waterway Structures						
5.1	Check Structures	10	EA	$ 105,000	3.35	$ 3,517,500
5.2	Drop Structure from Canal to Reservoir	2	EA	$ 600,000	3.35	$ 4,020,000
				Item Subtotal:		*$ 7,537,500*
Waterway Protective Works						
6.1	Cross Drainage Structures (first 5 miles)	5	Miles	$ 140,000	5.15	$ 3,605,000
6.2	Cross Drainage Structures (final 27 miles)	27	Miles	$ 15,000	5.15	$ 2,085,750
6.3	Unlisted Items (~10%)	1	LS	$ 569,075		$ 569,075
				Item Subtotal:		*$ 3,605,000*

Final Subtotal:	$ 66,678,422
Contingencies (~25%):	$ 16,700,000
Total Field Costs:	$ 83,400,000
Indirects (~40%):	$ 33,400,000
2022 Total	**$ 116,800,000**

NOTES

1.1	Assumes average width of 220 ft. for the 32 mile canal section
2.1	Count arrived using GIS. Assumes average width of 24 feet and length of 80 feet
2.2	Count arrived using GIS. Assumes average width of 16 feet and length of 80 feet
2.3	Count arrived using GIS
3.1	Assumes fencing on both sides of canal for the 32 mile canal section
5.1	Uses 1 Check Structure per every 3 miles
5.2	1 Drop Structure for each Reservoir (Riverview West and Roscoe Draw)
6.1	Count arrived using GIS

Alternative 2 (1,000 cfs Canal) - Summary of Estimated Project Costs
Roscoe Canal: 1st Section 1,000 cfs, Concrete Lined 13 miles)

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Land and Rights						
1.1	ROW Acquisition	320	Acres	$ 1,500	4.88	$ 2,342,400
				Item Subtotal:		*$ 2,342,400*
Relocation of Property of Others						
2.1	Highway & County Road Bridges (x9)	10,152	SF	$ 60	3.35	$ 2,040,552
2.2	Farm Access Bridges (x5)	3,760	SF	$ 60	3.35	$ 755,760
2.3	State Highway, County Road and Farm Drive	11	EA	$ 5,000	3.89	$ 213,950
2.4	Unlisted Items (~10%)	1	LS	$ 301,026		$ 301,026
				Item Subtotal:		*$ 3,311,288*
Structures and Improvements						
3.1	Furnishing and Erecting 4-wire Barb Fence	26	Miles	$ 6,600	3.36	$ 576,576
3.2	Furnishing and Erecting Barb Wire Gates	26	Miles	$ 300	3.36	$ 26,208
3.3	Furnishing and Installing Cattle Guards	26	Miles	$ 3,500	3.36	$ 305,760
3.4	Unlisted Items (~10%)	1	LS	$ 90,854		$ 90,854
				Item Subtotal:		*$ 999,398*
Waterways						
4.1	Concrete Lined Canal 6" thick	13	Miles	$ 715,000	3.35	$ 31,138,250
4.2	Unlisted Items (~10%)	1	LS	$ 3,113,825		$ 3,113,825
				Item Subtotal:		*$ 34,252,075*
Waterway Structures						
5.1	Canal Drop Structures	3	EA	$ 85,000	3.35	$ 854,250
5.2	Drop Structure from Canal to Sutherland Canal	1	EA	$ 375,000	3.35	$ 1,256,250
				Item Subtotal:		*$ 2,110,500*
Waterway Protective Works						
6.1	Cross Drainage Structures	1	LS	$ 570,000	5.15	$ 2,935,500
				Item Subtotal:		*$ 2,935,500*

Final Subtotal:	$ 45,951,162
Contingencies (~25%):	$ 11,000,000
Total Field Costs:	$ 57,000,000
Indirects (~40%):	$ 22,800,000
2022 Total	**$ 79,800,000**

NOTES

1.1	Assumes average width of 200 ft. for the 13 mile canal section
2.1	Assumes (x6) average width of 24 feet and length of 47 feet
2.2	Assumes (x5) average width of 16 feet and length of 47 feet
3.1	Assumes fencing on both sides of canal for the 13 mile canal section
5.1	Uses 1 Check Structure per every 5 miles
6.1	Count arrived using GIS

Alternative 1 (500 cfs Canal) and Alternative 2 (1,000 cfs Canal) - Summary of Estimated Project Costs
Riverview West Reservoir (Gravity)

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Riverview West Dam and Reservoir						
1.1	Riverview West Dam and Reservoir	1	LS	$ 11,500,000	3.06	$ 35,190,000
1.2	Riverview Outlet Works	1	LS	$ 1,600,000	3.36	$ 5,376,000
1.3	Spillway	1	LS	$ 2,000,000	3.16	$ 6,320,000
				Item Subtotal:		*$ 46,886,000*
Rights-of-Way						
2.1	Rights-of-Way (Rainfed Crop Lands)	370	Acres	$ 1,000	4.88	$ 1,805,600
2.2	Rights-of-Way (Irrigated Crop Lands)	130	Acres	$ 2,000	4.88	$ 1,268,800
2.3	Rights-of-Way (Pasture Lands)	1,420	Acres	$ 440	4.88	$ 3,049,024
2.4	Fencing	8	Miles	$ 9,075	3.36	$ 243,936
2.5	Relocation of Gravel Road	1	Miles	$ 90,750	3.89	$ 353,018
				Item Subtotal:		*$ 6,720,378*

Final Subtotal:	$ 53,606,378
Contingencies (~0%):	$ -
Total Field Costs:	$ 53,600,000
Indirects (~25%):	$ 13,400,000
2022 Total	**$ 67,000,000**

NOTES

1.1	Item has 25% contingency built into the unit cost
1.2	Item has 25% contingency built into the unit cost
1.3	Item has 25% contingency built into the unit cost
2.1	Item has 25% contingency built into the unit cost
2.2	Item has 25% contingency built into the unit cost
2.3	Item has 25% contingency built into the unit cost
2.4	Includes 10% allowance for unlisted items plus 25% contingency built into the unit cost
2.5	Includes 10% allowance for unlisted items plus 25% contingency built into the unit cost

Alternative 1 (500 cfs Canal) and Alternative 2 (1,000 cfs Canal) - Summary of Estimated Project Costs
Roscoe Draw Reservoir (High)

Item	Description	QTY	Unit	Unit Cost	Index	Final Costs
Roscoe Draw (High) Dam and Reservoir						
1.1	Roscoe Draw (High) Dam and Reservoir	1	LS	$ 24,375,000	3.06	$ 74,587,500
1.2	River Outlet Works	1	LS	$ 3,100,000	3.36	$ 10,416,000
1.3	Canal Outlet works	1	LS	$ 355,000	3.36	$ 1,192,800
1.4	Spillway	1	LS	$ 5,000,000	3.16	$ 15,800,000
				Item Subtotal:		*$ 101,996,300*
Transmission Line						
2.1	Relocate Transmission Line	2.5	Miles	$ 160,000	3.16	$ 400,000
2.2	Transmission Line	1.5	Miles	$ 320,000	3.16	$ 480,000
				Item Subtotal:		*$ 880,000*
Rights-of-Way						
3.1	Rights-of-Way (Rainfed Crop Lands)	1,900	Acres	$ 1,000	4.88	$ 9,272,000
3.2	Rights-of-Way (Irrigated Crop Lands)	2,600	Acres	$ 2,000	4.88	$ 25,376,000
3.3	Rights-of-Way (Pasture Lands)	6,100	Acres	$ 438	4.88	$ 13,038,384
3.4	Fencing	25	Miles	$ 9,075	3.36	$ 762,300
3.5	Relocation of Gravel Road	6	Miles	$ 82,500	3.89	$ 1,925,550
				Item Subtotal:		*$ 50,374,234*

Final Subtotal:	$ 153,250,534
Contingencies (~0%):	$ -
Total Field Costs:	$ 153,000,000
Indirects (~25%):	$ 38,000,000
2022 Total	**$ 191,000,000**

NOTES

1.1	Price for relocating farmsteds included in acqusition of ROW for reservoir area. 25% contingency in Unit cost
1.3	Added Canal Outlet Works at Cost of Siphon in Section 1 Canal
2.1	Item has 25% contingency built into the unit cost
2.2	Item has 25% contingency built into the unit cost
3.1	Item has 25% contingency built into the unit cost
3.2	Item has 25% contingency built into the unit cost
3.3	Includes 10% allowance for unlisted items plus 25% contingency built into the unit cost
3.4	Includes 10% allowance for unlisted items plus 25% contingency built into the unit cost

Alternative 1 (500 cfs Canal - Benefits)

Planning Horizon	50 Year		
	Water Available		
Reduction in Balzac Flow (%)	0%	50%	**Notes**
Water Supply (AF)	78,400	69,900	50-Year Benefit Analysis uses a Discount Rate = 3%
Loss (%)	5%	5%	Minus 5% Project losses (consumptive losses)
Net Water Supply (AF)	74,480	66,405	Volume used in 50-Year Benefits Analysis
Agriculture	$337.3	$300.7	Based on all water providing Agriculture, $176/AF. Expressed in $ millions
Municipal & Industrial	$95.8	$85.4	Based on 20% return flow providing benefits to Municipal & Industrial and unit value of $250/AF. Expressed in $ millions
Environmental	$191.9	$182.7	Value of Environmental is equal to Agriculture, so AG/ENV split is irrelevant. Includes volume for PRRIP pulse flows. Expressed in $ millions
Recreation	$125.5	$125.5	Uses surface area acreage from Riverview West and Roscoe Draw (High). Expressed in $ millions
Hydroelectric	$2.5	$2.3	Assumes 3:4 ratio between Project Water and Lake McConaughy. Expressed in $ millions
Water Quality	$1.0	$0.9	Assumed. Expressed in $ millions
Total Benefit =	**$754**	**$698**	Expressed in $ millions
Preliminary Costs (Alt 1)=	**$567**	**$567**	Perkins County Canal Project - Alternative 1 (diversion, canal, reservoirs, etc.) costs Expressed in $ millions
B/C Ratio =	**1.33**	**1.23**	Befits divided by Costs

Alternative 2 (1,000 cfs Canal - Benefits)

Planning Horizon	50 Year		
	Water Available		
Reduction in Balzac Flow (%)	0%	50%	**Notes**
Water Supply (AF)	113,300	85,600	50-Year Benefit Analysis uses a Discount Rate = 3%
Loss (%)	5%	5%	Minus 5% Project losses (consumptive losses)
Water (AF)	107,635	81,320	Volume used in 50-Year Benefits Analysis
Agriculture	$487.4	$368.3	Based on all water providing Agriculture, $176/AF. Expressed in $ millions
Municipal & Industrial	$138.5	$104.6	Based on 20% return flow providing benefits to Municipal & Industrial and unit value of $250/AF. Expressed in $ millions
Environmental	$229.4	$199.6	Value of Environmental is equal to Agriculture, so AG/ENV split is irrelevant. Includes volume for PRRIP pulse flows. Expressed in $ millions
Recreation	$125.5	$125.5	Uses surface area acreage from Riverview West and Roscoe Draw (High). Expressed in $ millions
Hydroelectric	$3.7	$2.8	Assumes 3:4 ratio between Project Water and Lake McConaughy. Expressed in $ millions
Water Quality	$1.1	$1.0	Assumed. Expressed in $ millions
Total Benefit =	**$986**	**$802**	Expressed in $ millions
Preliminary Costs (Alt 2)=	**$628**	**$628**	Perkins County Canal Project - Alternative 2 (diversion, canal, reservoirs, etc.) costs Expressed in $ millions
B/C Ratio =	**1.57**	**1.28**	Befits divided by Costs

Appendix E

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List of Source Materials Reviewed or Cited

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Addendum

Response to Appropriations Committee re: Evaluation of the Perkins County Canal and Alternatives

This addendum was developed in response to questions raised during the course of the December 2, 2022 Appropriations Committee hearing. The nature of those questions raised in the hearing have been summarized under the headings listed below.

ANNUAL OPERATING COSTS FOR THE PROJECT

The Study identified costs of completing the Perkins County Canal as outlined in the Compact per the Legislative directives in LB1012. In addition to these completion costs there will be annual operating and maintenance (O&M) costs associated with the Project. Operation and maintenance costs of the project would typically be determined upon development of the operations plan and assigned based on beneficiaries of the project. As these costs are assumed to be recovered by Project beneficiaries (end-users of water), they were excluded from the cost estimates presented in the Study. To provide an initial estimate of those operations and maintenance costs, similar irrigation project facilities in Nebraska were reviewed. For example, the Frenchman Cambridge Irrigation District's (FCID) annual operation and maintenance costs for 3 reservoirs storing 143,000 acre-feet of irrigation water, four canal systems with 156 miles of canals, and over 250 miles of laterals and drains paid approximately $1.4 M for annual operations and maintenance. FCID's costs likely would exceed the operations and maintenance costs for the Perkins County Canal Project since the canal length would be less than half that of FCID's canal systems, the project would not require maintenance of hundreds of miles of laterals and water delivery personnel would not be required to manage daily irrigation deliveries.

Again, it is expected that annual O&M costs will be paid by the end-users of the Project water. Table 1 presents the assumed annual O&M costs and required payment of end-users for cost recovery. These costs do not consider likely opportunities for increased hydropower generation resulting from the Project which may be another source of revenues to offset annual O&M costs.

Table 1: Operation and Maintenance (O&M) Cost Elements

O&M Cost Elements	O&M Metrics
Annual O&M Costs	$1,400,000/Yr
Water Sold	78,400 AF/Yr
End-User Costs ($/AF)	$18/AF

Operation within Existing Infrastructure

Existing infrastructure, without any additional costs, can facilitate Project flows allowing for the benefit of optimizing the use of existing facilities. The proposed alignment of the Project includes connection to the Sutherland Supply Canal (SCC), with an approximate existing capacity of 2,000 cfs. With coordinated operations with diversions from the North Platte River into the SCC, there remains ample capacity to accommodate releases from the Project (Roscoe Draw Reservoir) for both Alternatives. Water conveyed and stored at the existing Sutherland Reservoir could be transmitted to Lake Maloney by way of the Sutherland Reservoir's Outlet Canal (SR Outlet Canal). SR Outlet Canal has an approximate capacity of 1,900 cfs, which can accommodate flows associated with both Alternatives. From there, Lake Maloney's Outlet Canal (LM Outlet Canal) returns to the Platte River and has an approximate capacity of 1,800 cfs. Therefore, additional O&M costs of integrating the Project with existing water operations of the South Platte and Plate River Basins are not expected.

Impact on South Platte Flows Between The New Diversion and Reservoir Returns to The River

The Project will likely divert water near Ovid, CO and return water near Roscoe, NE. The non-irrigation season streamflows of the South Platte River are likely to improve over a No Project alternative since the No Project future flows will likely be zero during most periods as Colorado would have no obligation to deliver non-irrigation season flows to Nebraska. The With Project streamflows should benefit from local groundwater recharge and eventual return flows to the South Platte River in this reach.

Potential impacts on current irrigation water users between the proposed diversion and the South Platte River's confluence with the North Platte River are not considered substantial. This is primarily the case because the period for Project diversions occurs during the non-irrigation season (October 15 through April 1) while diversions for irrigation uses are minimal during this period. For example, the Western Irrigation District diverts water along this reach for irrigation purposes. As they do not currently have the ability to store water, they do not regularly divert

South Platte River water during the non-irrigation season. This situation is typical for irrigation users between the proposed diversion location and the confluence with the North Platte River.

It is also noted, there are no ecologically sensitive reaches for the Platte River Recovery Implementation Program (PRRIP) along the South Platte River. PRRIP sensitive reaches are identified along the reach between the cities of Lexington and Chapman of the Central Platte River.

Timeline Considerations

The Project timeline was developed through application of years of professional experience and consideration of the Project elements. The Project timeline will benefit from strong stakeholder support for the Project, established environmental compliance criteria (PRRIP), and the Compact's clear establishment of Nebraska's water right.

Transmission Losses

Transmission losses are expected to occur along the Project's proposed canal configuration, specifically along the 32-mile earth canal section (2nd Section, both Alternatives). The two primary types of losses associated with a typical canal include evaporation and seepage. Evaporation is considered a consumptive loss as this water is lost to the atmosphere. Seepage is not considered a consumptive loss. The 2nd Section would be subject to seepage. Although the canal (and associated reservoirs) "lose" access to this water, the local groundwater recharge associated with the seepage is considered a "benefit" as seepage of this water would promote and support increases in local groundwater levels as well as streamflows. Seepage was incorporated in the analysis, including quantification of benefits presented in Section 5.

Conceptual Reservoir Operations

A conceptual reservoir operations model was used to determine the fill frequency of the Project reservoirs. The model uses the daily canal diversions used to develop the information presented in Section 2 of the Study. This daily canal diversion is reduced by 10% to account for transmission losses (evaporation and seepage) and is used as the inflow to the Project's reservoir system. The total useable reservoir capacity is 163,480 AF and two (2) assumed scenarios for annual reservoir releases of 55,000 and 85,000 AF are utilized. The model is highly dependent on the reservoir release rate. Actual operations would work to optimize reservoir storage with the reservoir release rate to maintain certain minimum pool elevations.

Model results indicate the reservoir system fills during Year 3 of the analysis (with no demands during this period). Table 2 displays the results of the conceptual reservoir operations under both Alternatives and the supply scenarios described in the Study for the two (2) annual reservoir release rates.

Table 2: Results of Conceptual Reservoir Operations

Alternative	Inflow Scenario	Years Filled	Fill Frequency (% of Years)	Years Filled	Fill Frequency (% of Years)
		55,000 AF Reservoir Release		85,000 AF Reservoir Release	
Alt 1 (500 cfs Canal)	Baseline	45	48%	20	22%
	10% Reduction	45	48%	16	17%
	20% Reduction	43	46%	15	16%
	50% Reduction	37	40%	7	8%
Alt 2 (1,000 cfs Canal)	Baseline	52	56%	42	45%
	10% Reduction	51	55%	41	44%
	20% Reduction	51	55%	37	40%
	50% Reduction	43	46%	25	27%

Note: A total of 93 years included in analysis (does not include first 2 years of filling)

For Alternative 1, results from the conceptual reservoir operations model indicate the 55,000 AF of reservoir releases were fully met 85% of the years analyzed under the Baseline Inflow Scenario, compared to 48% of the years analyzed met the full 85,000 AF of reservoir releases. For Alternative 1's 50% Reduction Inflow Scenario, 82% of the years analyzed provided the full 55,000 AF of reservoir releases, compared to 41% of the years for the 85,000 AF of reservoir releases. For Alternative 2, results indicate the 55,000 AF of reservoir releases were fully met 87% of the years analyzed under the Baseline Inflow Scenario, compared to 63% of the years analyzed met the full 85,000 AF. For Alternative 2's 50% Reduction Inflow Scenario, 86% of the years analyzed provided the full 55,000 AF of reservoir releases, compared to 51% of the years met the full 85,000 AF of reservoir releases.

IDENTIFYING AND ADDRESSING THE PROJECT'S ENVIRONMENTAL IMPACTS

Every water project in Nebraska must address environmental impacts. The Perkins County Canal Project will reduce the land area affected, as compared to the 1982 analysis, and will comply with applicable environmental laws and regulations. More specifically, the Project reduces the total project footprint by four reservoirs and approximately 38 miles of canal. Moreover, the Project's environmental impacts will be analyzed in compliance with the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA).

NEPA established a national policy that ensures agencies consider significant environmental consequences of proposed federal actions.[1] The Project will conduct an Environmental

[1] National Environmental Policy Act. (2022). Phase 1 Rulemaking: Final Rule. https://ceq.doe.gov/

Assessment (EA) to identify environmental issues and determine the appropriate level of environmental documentation. The Project will likely require preparing an Environmental Impact Statement (EIS) that fully documents the impacts of the Project on the environment.

Nebraska has developed a cooperative approach to managing endangered and threatened species under the ESA in the Platte River Basin. The Platte River Recovery Implementation Program (PRRIP) was developed by Nebraska, Colorado and Wyoming in 2006 to address concerns with the following species: interior least tern (Sterna antillarum athalassos), pallid sturgeon (Scaphirhynchus albus), the piping plover (Charadrius melodus), and the whooping crane (Grus americana). The program was initiated as a shared approach to manage the Platte River and assist in improving habitat to protect the four target species through the process of Adaptive Management in the Central and Lower Platte Basins.[2] The PRRIP agreement addresses ESA compliance for existing and certain water-related activities for water users in the Platte River basin for any potential effects to the target species.[3] Project water supplies are anticipated to be used to support PRRIP objectives. Typically, these environmental reviews would be expected to be initiated once a final design has been established.

Also, it is important to understand that without the Project, streamflow in the Platte River system will decrease as Colorado moves forward with their plans to take additional water from the South Platte River. It is anticipated that the Project, by maintaining Nebraska water entitlement, will provide environmental enhancements to environmental flows.

Lincoln Water Supply Benefits

Municipal and Industrial (M&I) water use for the Study Area is concentrated in the eastern part of Nebraska at the far reach of the Lower Platte River. The most populous counties – Douglas, Sarpy and Lancaster – encompass the Omaha and Lincoln metro areas and comprise the majority of M&I demand in the state. Lancaster County and the Lincoln metro area depend almost entirely on the Platte Basin water supply. Water from the Project will provide recharge opportunities to the Ogallala groundwater basin allowing water availability benefits for the City of Lincoln. Additionally, without the Project, flows in the Platte River will decrease as Colorado moves forward with their plans to take additional water from the South Platte River, potentially impacting the City of Lincoln's water supply. The South Platte River provides seven

[2] Nebraska Department of Natural Resources. (2010). Platte River Recovery Implementation Program. https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/upper-platte/platte-river-recovery-implementation-program/program-discussion-brochure.pdf

[3] Platte River Recovery Implementation Program. (n.d.). Water Plan. Platte River Program. https://platteriverprogram.org/about/water-plan

percent of Lincoln's water supply during droughts.[4] The long-term yield of the City of Lincoln's raw water supply is correlated to the streamflow in the Platte River.[5] As such, water supplies from the South Platte River are integral to the long-term reliability for the City of Lincoln.

Statewide Economic Benefits

Because our charge for this effort was focused on the general costs and benefits of the project, we did not include several ancillary benefits that will likely result from the Project, and which may be of considerable magnitude. The benefit assessment in Section 5 identified the opportunities to capture additional benefits through the Project operations, including regional economic multiplier effects from securing the South Platte River water supply. A 2017 report published by the Department of Agricultural Economics at the University of Nebraska at Lincoln detailed the broad economic impacts of the state's agricultural production complex. Specifically, the report addressed "multiplier impacts" to businesses outside of Nebraska's agricultural production complex. The report concluded that "the economic multipliers calculated in this analysis suggest that these spillover effects result in direct economic effects being more than doubled.[6] Should such multiplier benefits be realized for the Project, the resulting range of benefits would be from approximately $1.4 to $2.0 Billion.

[4] Testimony of Elizabeth Elliot to Natural Resources Committee, February 9, 2022.

[5] p. 3-1, City of Lincoln Water System Facilities Master Plan, 2014.

[6] Thompson, E., et al. "The 2017 Economic Impact of the Nebraska Agricultural Production Complex," Department of Agricultural Economics, University of Nebraska, Lincoln (September 2020) at 44.