# Colorado River Basin
# Ten Tribes Partnership Tribal Water Study

## Study Report


December 2018

# Mission Statements

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The mission of the Colorado River Basin Tribes Partnership is to assist in developing, protecting, and maximizing the water rights of the member Tribes. To that end, the Partnership Tribes shall:

- **Consult, Collaborate, and Coordinate** with each other, the United States, and other affected governmental agencies and user groups on matters concerning Tribal water rights, including but not limited to proposed legislative, administrative, or other actions that may affect the water supplies and demands of the Colorado River Basin, its management, or the administration of Colorado River water entitlements.
- **Educate** the United States, state and local agencies, and the public as to the nature and extent of Tribal water rights and the concerns of the Partnership with respect to matters affecting such rights.

# Colorado River Basin
# Ten Tribes Partnership Tribal Water Study

## Study Report

**U.S. Department of the Interior** **Bureau of Reclamation** **Ten Tribes Partnership**

December 2018

# Commissioner of Reclamation Foreword

Traveling over 1,400 miles from its headwaters in Wyoming and Colorado to the Gulf of California, the Colorado River is a lifeline to seven states within the United States, 29 Native American Reservations, and two states in northern Mexico.

Within the Colorado River Basin, ten tribes have come together to form the Ten Tribes Partnership. The Partnership Tribes[1] have reserved water rights, including unresolved claims, to the Colorado River and its tributaries. In many cases, these rights are senior to other uses. Recognizing the importance of furthering the understanding of tribal water (both currently and in the decades ahead), the Bureau of Reclamation and the Ten Tribes Partnership collaborated in this Study to document Partnership Tribes' water use and potential future water development to better facilitate planning and decision-making throughout the Basin.

The comprehensive, Basin-wide analysis of tribal water in the Colorado River Basin Ten Tribes Partnership Tribal Water Study builds on the 2012 Colorado River Basin Study, and allows each of the tribes to provide, from their own perspective, their views on the challenges and opportunities ahead. The Tribal Water Study strengthens a Department of the Interior commitment to address water issues facing tribes and recognizes that the Colorado River is an essential foundation for the physical, economic, and cultural sustenance of tribes in the Basin.

Today, we face a prolonged drought that represents one of the driest 20-year periods in the last 1,200 years. This Study is an important next step in understanding the Colorado River, its resources, and the demands that will likely be placed on it. In addition, this Study explores ways to provide a wide range of benefits to both Partnership Tribes and other water users. The partnerships forged and strengthened during this Study will prove to be critical as we collaboratively address the significant challenges ahead.

Brenda Burman

Commissioner, Bureau of Reclamation

[1] Chemehuevi Indian Tribe, Cocopah Indian Tribe, Colorado River Indian Tribes, Fort Mojave Indian Tribe, Jicarilla Apache Nation, Navajo Nation, Quechan Indian Tribe, Southern Ute Indian Tribe, Ute Indian Tribe, Ute Mountain Ute Tribe

# Ten Tribes Partnership Foreword

The concepts and values conveyed by the well-known phrase “water is life” are neither unique to tribes, nor to this century:

> In the debate leading to approval of the first congressional appropriation for irrigation of the Colorado River Indian Reservation, the delegate from the Territory of Arizona made this statement: “Irrigating canals are essential to the prosperity of these Indians. Without water, there can be no production, no life.”[1]

The Colorado River Basin Tribes Partnership (a.k.a. Ten Tribes Partnership) and the Bureau of Reclamation (Reclamation) initially undertook the Colorado River Basin Tribal Water Study to augment the data produced for the Colorado River Basin Supply and Demand Study of 2012. With five tribes in the Upper Basin and five tribes in the Lower Basin, and between us, holding rights to more than 2.8 million acre-feet per year of water from the Colorado River and its tributaries, the Ten Tribes Partnership was uniquely positioned to explore these issues. However, in so doing, we learned that the effort would also serve to facilitate a broader and, we hope, a better understanding of the role tribal water plays, and will play, in the Colorado River Basin over the coming decades.

In addition to producing technical information, the Tribes had other goals. First, we wanted to better understand how, at present, each of our individual water use scenarios fits into the overall scheme of Colorado River Basin management. Second, we wanted to know how future development of tribal water resources will alter Basin operations and affect other water users who are now using water to which a tribe may hold legal title, but which the title-holding tribe has not yet developed for its own use. Finally, we wanted to assess – to the extent present information allows – the role future development of tribal water rights will have on Basin operations.

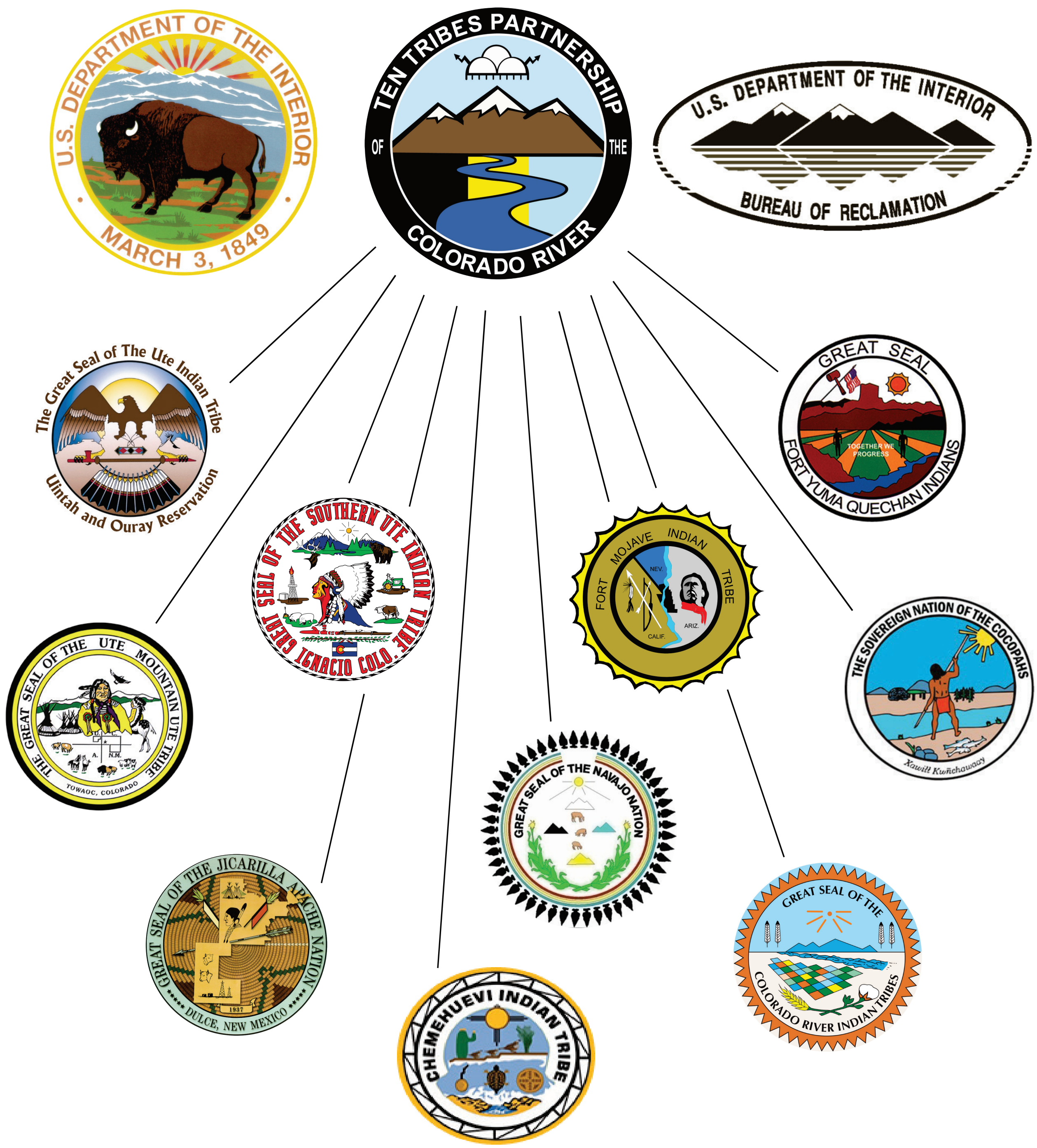
Along the way, we encountered data gaps, modeling limitations, and uncertainties, but nonetheless, with the support of Reclamation, we managed to address those issues sufficiently that we now provide this Report. If there is a ‘take-away’ that was surprising, it is that, even under the most favorable of circumstances for rapid tribal water development, the amount of water that will be used by the Tribes is dramatically overshadowed by the effect of climatic conditions on the overall supply of water in the Basin. Nature is still in charge.

Challenges remain, but opportunities are in the offing. We hope this Report informs, resolves some uncertainty about how tribes perceive the future for their water uses, and establishes a baseline for discussions and development of relationships among tribes, states, the federal government, water managers, and water users throughout the Basin.

[1] Cong.Globe, 38th Cong., 2d Sess. 1321 (1865). *Arizona v. California,* 373 U.S. 546, 598-599 (1963).

# Acknowledgement

Funding, time, and expertise provided by the Department of Interior, the Bureau of Reclamation, and the member Tribes of the Ten Tribes Partnership made the Colorado River Basin Ten Tribes Partnership Tribal Water Study possible.

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## Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development



## Chapter 6 – Assessment of System Effects Resulting from Development of Tribal Water



## Chapter 7 – Challenges and Opportunities Related to Development of Tribal Water

## Chapter 8 – Study Limitations



## Chapter 9 – Future Considerations and Next Steps

## Disclaimer

## References

## Glossary

# Acronyms and Abbreviations

| | |
|---|---|
| ADWR | Arizona Department of Water Resources |
| AF | acre-foot (feet) |
| AFY | acre-foot (feet) per year |
| AG | irrigated agriculture and livestock |
| A-LP | Animas-La Plata |
| Basin | Colorado River Basin |
| Basin States | Colorado River Basin States |
| Basin Study | Colorado River Basin Water Supply and Demand Study |
| BIA | Bureau of Indian Affairs |
| cfs | cubic foot (feet) per second |
| CHIA | Cumulative Hydrologic Impact Assessment |
| CRIP | Colorado River Irrigation Project |
| CRIR | Colorado River Indian Reservation |
| CRIT | Colorado River Indian Tribes |
| CRSS | Colorado River Simulation System |
| CUP | Central Utah Project |
| CUPCA | Central Utah Project Completion Act |
| CUWCD | Central Utah Water Conservancy District |
| CWCB | Colorado Water Conservation Board |
| DCMI | domestic, commercial, municipal, and industrial |
| DNR | Department of Natural Resources |
| DOI | U.S. Department of the Interior |
| DWCD | Dolores Water Conservancy District |
| ENV | environmental, cultural, and recreational |
| EPA | Environmental Protection Agency |
| EQIP | Environmental Quality Incentives Program |
| ESA | U.S. Endangered Species Act |
| °F | degree(s) Fahrenheit |

| | |
|---|---|
| FRE | Farm and Ranch Enterprise |
| GCM | Global Climate Model |
| gpm | gallons per minute |
| ICS | Intentionally Created Surplus |
| IHS | Indian Health Service |
| KAF | thousand acre-feet |
| KAFY | thousand acre-feet per year |
| kWh | kilowatt-hours |
| LCR MSCP | Lower Colorado River Multi-Species Conservation Program |
| MAF | million acre-feet |
| MAFY | million acre-feet per year |
| Mexico | United Mexican States |
| mg/L | milligrams per liter |
| msl | above mean sea level |
| MVIC | Montezuma Valley Irrigation Company |
| MWD | Metropolitan Water District of Southern California |
| M&I | municipal and industrial |
| NAPI | Navajo Agricultural Products Industry |
| NAWMAs | Native American Water Masters Associations |
| NDOH | Navajo Department of Health |
| NDWR | Navajo Department of Water Resources |
| NEPA | National Environmental Policy Act |
| NGWSP | Navajo-Gallup Water Supply Project |
| NIIP | Navajo Indian Irrigation Project |
| NMISC | New Mexico Interstate Stream Commission |
| NNDA | Navajo Nation Department of Agriculture |
| NNEPA | Navajo Nation Environmental Protection Agency |
| NPS | National Park Service |
| NRCS | Natural Resources Conservation Service |
| NTUA | Navajo Tribal Utility Authority |

| | |
|---|---|
| ONF | Observed Natural Flow |
| O&M | operation & maintenance |
| Partnership | Colorado River Basin Tribes Partnership |
| PNM | Public Service Company of New Mexico |
| PPR | Present Perfected Right |
| PRIIP | Pine River Indian Irrigation Project |
| PWCC | Peabody Western Coal Company |
| Reclamation | Bureau of Reclamation |
| ROD | Record of Decision |
| SCADA | Supervisory Control and Data Acquisition |
| SCS | Soil Conservation Service |
| SJRBRIP | San Juan River Basin Recovery Implementation Program |
| TTP | Ten Tribes Partnership |
| TRAN | transfers, leases, and exchanges |
| Tribal Water Study | Colorado River Basin Ten Tribes Partnership Tribal Water Study |
| UCRC | Upper Colorado River Commission |
| UIIP | Uintah Indian Irrigation Project |
| USACE | U.S. Army Corps of Engineers |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |

# 1 Introduction

In 2012, the Bureau of Reclamation (Reclamation), in partnership with the seven Colorado River Basin States[1] (Basin States) and in collaboration with a wide spectrum of Colorado River Basin (Basin) stakeholders, published the most comprehensive study of future Basin water supply and demand ever undertaken. The Colorado River Basin Water Supply and Demand Study (Basin Study) defined current and future imbalances in water supply and demand in the Basin over the next 50 years and developed and analyzed options and strategies to resolve those imbalances. The Basin Study confirmed that, in the absence of timely action, there are likely to be significant shortfalls between projected water supplies and demands in the Basin in coming decades that are likely to affect each sector (for example, agricultural, municipal, industrial, and environmental) dependent on the Colorado River and its tributaries. The Basin Study also confirmed that a wide range of solutions are needed to mitigate and adapt to such shortfalls (Reclamation, 2012a).

In response to the findings of the Basin Study, in 2014, Reclamation's Upper and Lower Colorado Regions, in collaboration with member tribes of the Ten Tribes Partnership[2] (Partnership Tribes), undertook the Colorado River Basin Ten Tribes Partnership Tribal Water Study (Tribal Water Study). The Tribal Water Study built on the technical foundation of the Basin Study and advanced critical information beyond the limited assessment of tribal water in the Basin Study. In recognition of the importance of bringing tribal[3] perspectives to bear in addressing Colorado River planning and management challenges, Reclamation and the Ten Tribes Partnership committed to completion of the Tribal Water Study as documented in the *Agreement Regarding the Importance of the Colorado River Basin Tribal Water Study* provided in *Appendix 1A, Plan of Study*.

The Colorado River Basin Tribes Partnership, also known as the Ten Tribes Partnership (Partnership), is an organization formed in 1992 by ten federally recognized tribes with federal Indian reserved water rights in the Colorado River or its tributaries (Figure 1-A). Not all federally recognized tribes in the Basin are members of the Partnership. Partnership Tribes have reserved water rights, including unresolved claims, to divert nearly 2.8 million acre-feet of water per year from the Colorado River and its tributaries.

**Colorado River Ten Tribes Partnership Vision Statement**

Water is life. Water is the giver and sustainer of life. Water is a sacred and spiritual element to the Tribes of the Partnership. The Creator instilled in the First Peoples the responsibility of protecting the delicate, beautiful balance of Mother Earth for the benefit of all living creatures. The Partnership will embrace and own the stewardship of the Colorado River and lead from a spiritual mandate to ensure that this sacred water will always be protected, available and sufficient.

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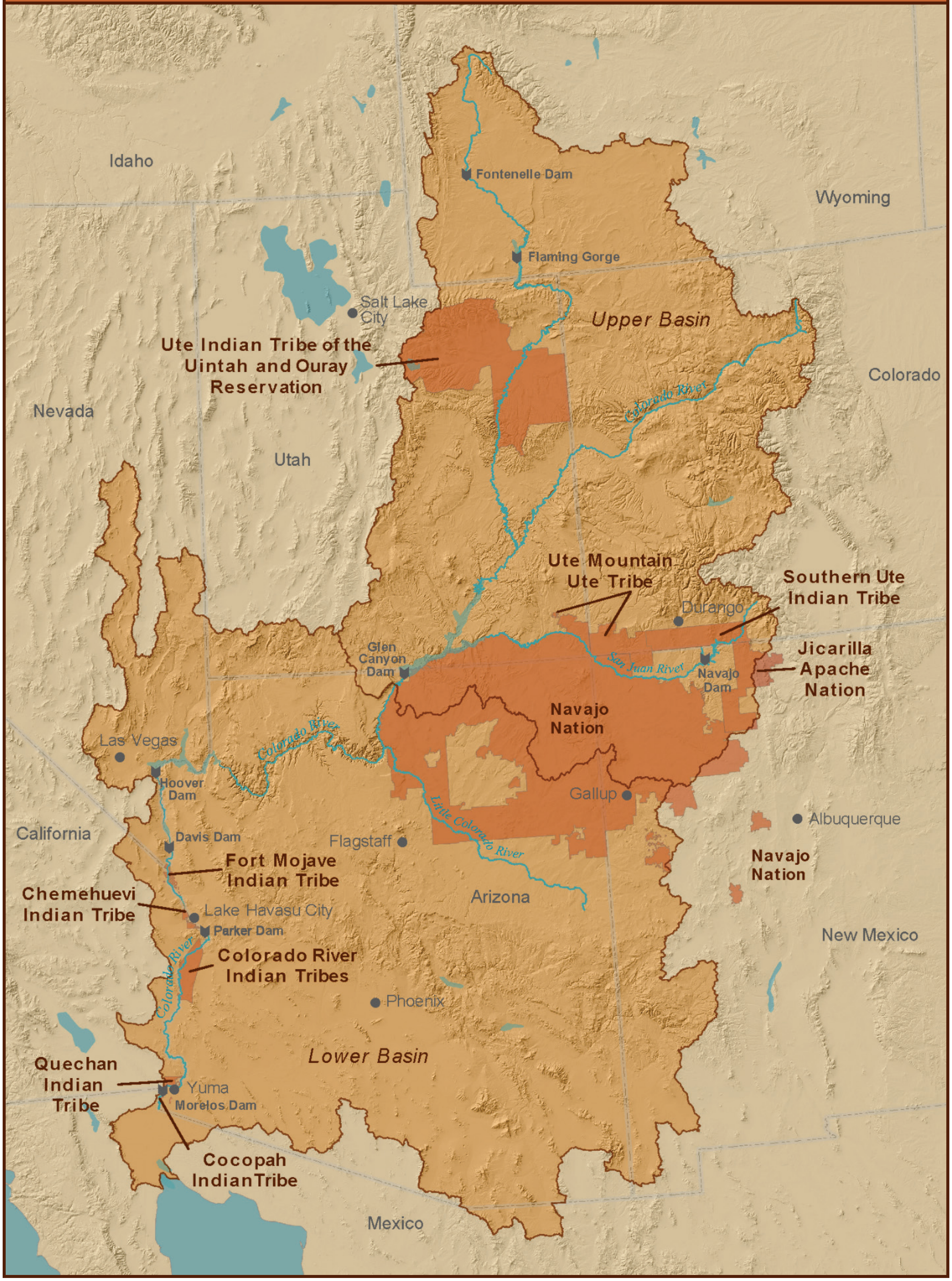
1 Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming

2 Chemehuevi Indian Tribe, Cocopah Indian Tribe, Colorado River Indian Tribes, Fort Mojave Indian Tribe, Jicarilla Apache Nation, Navajo Nation, Quechan Indian Tribe, Southern Ute Indian Tribe, Ute Indian Tribe, Ute Mountain Ute Tribe

3 For purposes of the Study, "tribal" generally refers to the member tribes of the Ten Tribes Partnership, unless the context expresses otherwise.

**FIGURE 1-A**
Map of the Colorado River Basin Showing Reservations of the Members of the Ten Tribes Partnership



The United States has a trust responsibility to protect federal Indian reserved water rights. Each tribe's water rights are unique; the information provided in this report is not intended to provide an interpretation of the water rights of any tribe or to establish federal policy related to federal Indian reserved water rights.

This report provides the outcomes of Tribal Water Study efforts conducted between January 2014 and November 2017. Information in this report was developed and written jointly by Reclamation and the Partnership Tribes. Both Reclamation and the Partnership Tribes went to great effort to present information that is accurate and descriptive of the views of the Partnership Tribes. Neither the United States nor the Partnership Tribes are bound or foreclosed by the views stated in this report. This report consists of the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Background on Federal Indian Reserved Water Rights
- Chapter 3 – The Tribes of the Ten Tribes Partnership
- Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development
- Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development
- Chapter 6 – Assessment of System Effects Resulting from Development of Tribal Water
- Chapter 7 – Challenges and Opportunities Related to Development of Tribal Water
- Chapter 8 – Study Limitations
- Chapter 9 – Future Considerations and Next Steps

## 1.0 Overview of Colorado River Basin

Today, between 35 and 40 million people in the seven Basin States rely on the Colorado River and its tributaries for some, if not all, of their municipal water needs. These same water sources irrigate nearly 4.5 million acres of land in the Basin and the adjacent areas that receive Colorado River water, generating many billions of dollars a year in agricultural and economic benefits (Reclamation, 2015). The Colorado River and its tributaries are essential physical, economic, and cultural resources to all of the federally recognized tribes in the Basin (see *Appendix 1B, Federally Recognized Tribes in the Colorado River Basin*). In addition, the Colorado River is vital to the United Mexican States (Mexico).

The Colorado River and its tributaries provide habitat for a wide range of species, including several federally endangered species, and flows through seven national wildlife refuges and 11 National Park Service (NPS) units[4]. Throughout the Basin, the Colorado River and its tributaries provide a range of recreational opportunities such as boating, fishing, and hiking, all of which significantly benefit regional economies. Hydropower facilities in the Basin can supply more than 4,200 megawatts of vitally important electrical capacity to assist in meeting the power needs of western states.

Total consumptive use and loss in the Basin has averaged approximately 15 million acre-feet per year (MAFY)[5] over the past decade. Agriculture is the dominant use of Colorado River water,

[4] While there are more NPS units within the Basin, 11 are included in the NPS' Colorado River Program.

[5] Basin-wide consumptive use and losses estimated over the period 2003 to 2012, including the 1944 Treaty delivery to Mexico, reservoir evaporation, and other losses due to native vegetation and operational inefficiencies.

with approximately 70 percent of total Colorado River water used to support agriculture. Of the total consumptive use, 40 percent is exported outside the Basin's hydrologic boundaries for use in adjacent areas, including major metropolitan areas located outside the Basin's hydrologic boundaries that receive Colorado River water: Albuquerque, Denver, Los Angeles, Salt Lake City, and San Diego.

The Colorado River System is administered in accordance with the Law of the River[6] and, of particular relevance to the Tribal Water Study, the federal Indian reserved water rights doctrine. Apportioned water in the Basin exceeds the average long-term (1906 to 2015) historical natural flow of approximately 16.1 MAFY. Up to this point, the imbalance has been managed, and all requested deliveries were met in the Lower Basin as a result of the considerable amount of reservoir storage capacity in the System (approximately 60 MAF or nearly four years of average natural flow of the river). This is due in part to the fact that tribes are still developing into their water rights. Another factor is that Upper Basin States are still developing into their apportionments. In addition, some of the Lower Basin States have been relying on unused tribal water. Finally, Basin States are continuing to reduce their demand for Colorado River water.

Drought conditions have been experienced in the Basin since 2000. Although Basin inflow in 2017 was above average, it was one of only four years with above average inflow since 2000. The average inflow over this 19-year period is approximately 15 percent below the long-term average. The Colorado River reservoir System was near full at the start of this drought but declined to approximately 50 percent capacity in the first five years, and has continued to hover around 50 percent full over the past 12 years. The duration of this ongoing, extended drought is unknown. This uncertainty coupled with a marked decline in System storage poses significant challenges to Basin water users.

Over the past twenty years, collaboration between Reclamation, federally recognized tribes, the Basin States, and others has resulted in significant success in collaboratively addressing water resources challenges across the Basin. The Tribal Water Study is an important next step in the understanding of Colorado River uncertainties and the exploration of opportunities that provide a wide-range of benefits to both Partnership Tribes and water users to help meet the significant challenges ahead.

## 2.0 Study Objectives and Approach

The *Plan of Study*, provided in Appendix 1A, states that the purpose of the Tribal Water Study is to conduct a comprehensive study that would assess, for Partnership Tribes, their tribal water supplies, document current tribal water use on Partnership Tribe Reservations, project future development of tribal water, and identify tribal challenges and opportunities associated with the development of tribal water considering the future projected water supply and demand imbalances documented in the Basin Study. Specific objectives of the Study include:

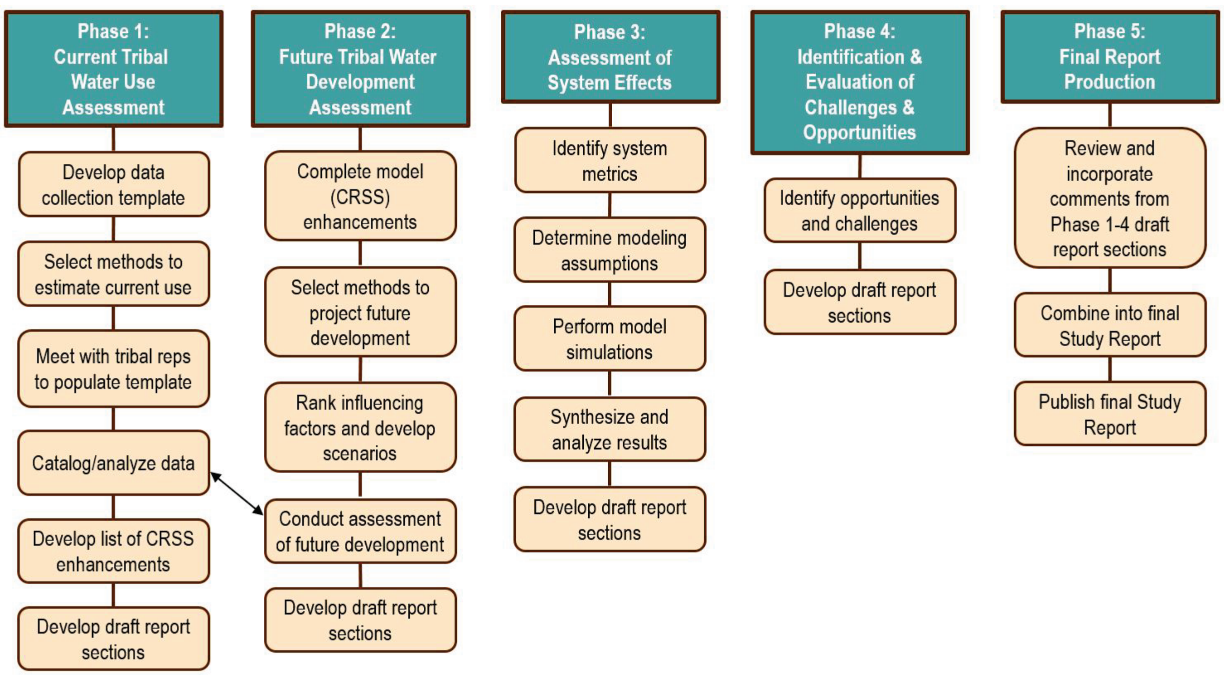
- Improve the understanding of the role of tribal water throughout the Colorado River System using existing data

[6] The treaties, compacts, decrees, statutes, regulations, contracts and other legal documents and agreements applicable to the allocation, appropriation, development, exportation and management of the waters of the Colorado River Basin are often collectively referred to as the Law of the River. There is no single, universally agreed upon definition of the Law of the River, but it is useful as a shorthand reference to describe this longstanding and complex body of legal agreements governing the Colorado River.

- Enhance the Colorado River Simulation System (CRSS) to improve its simulation of tribal water use
- Characterize current tribal water use by each Partnership Tribe
- Characterize a range of future tribal water development for each Partnership Tribe
- Identify potential future effects to specific users, or groups of users, presently relying on unused tribal water
- Identify tribal water development challenges both specific to Partnership Tribes and in general Basin-wide
- Identify opportunities for Partnership Tribes that can help reduce future uncertainty and future water imbalances

The Tribal Water Study was conducted in four major phases: 1) Current Tribal Water Use Assessment; 2) Future Tribal Water Development Assessment; 3) Assessment of System Effects Resulting from the Development of Tribal Water; and 4) Identification and Evaluation of Challenges and Opportunities Related to the Development of Tribal Water. Figure 1-B illustrates these phases and some of their inter-relationships. Although the Tribal Water Study identified potential legal and policy issues related to tribal water development and potential opportunities related to the future development of tribal water and future Colorado River uncertainties, the Study viewed tribal water in the context of the current Law of the River.

**FIGURE 1-B**
Study Phases and Tasks




## 2.1 Study Organization

As envisioned by the *Plan of Study*, a Study Team led and was responsible for the overall direction and management of the Tribal Water Study. Members of the Study Team provided the expertise, experience, and knowledge that related to the Tribal Water Study's scope and objectives. Study Team members included the members of the Partnership's Legal/Technical Committee and designated Reclamation staff from the Upper Colorado and Lower Colorado Regions. Study Team members were responsible for communicating the Tribal Water Study's progress and issues to, and receiving input from, their respective Partnership Tribes and organizations. Members of the Study Team are listed in *Appendix 1C – Study Team Members.*

# Appendix 1A
# Plan of Study

# Appendix 1A – Plan of Study

# Colorado River Basin Ten Tribes Partnership Tribal Water Study Plan of Study

**(Finalized March 2014)**

## 1.0 Introduction

The Bureau of Reclamation's (Reclamation) Upper and Lower Colorado Regions (UC and LC Regions), in collaboration with representatives of the Ten Tribes Partnership[1] (Partnership) are undertaking the Colorado River Basin Ten Tribes Partnership Tribal Water Study (Study) to build on the technical foundation of the Colorado River Basin Water Supply and Demand Study (Basin Study) and advance critical information beyond the limited assessment of tribal water in that study. The estimated cost for the Study is $500,000 which consists of a $100,000 grant to the Partnership from Reclamation and $400,000 for Reclamation's participation. In addition, the Partnership is expected to contribute to the Study beyond the anticipated $500,000 cost through staff time contributions in excess of what may be covered by the $100,000 grant. The Study will be conducted over a period of approximately two years with an anticipated completion by December 2015.

The tribes of the Ten Tribes Partnership hold a significant amount of quantified and unquantified Federal reserved water rights to the Colorado River and its tributaries. In addition, there are unresolved reserved rights claims and many tribes hold water rights that are not Federal reserved water rights. Reclamation did not intend that the Basin Study be used to assess the future impacts to tribal water use in the Basin, and it did not fully account for tribal water demand, reflect the potential use of used tribal water by others, or show the potential impact on the Basin water supply if a substantial amount of the presently unused or unquantified tribal water is used by the tribal water rights holders prior to 2060. In recognition of the importance in bringing the tribal perspective to bear in furthering the understanding of these important matters, Reclamation and the Ten Tribes Partnership are committed to the thorough development and timely completion of the Study as documented in the *Agreement Regarding the Importance of the Colorado River Basin Tribal Water Study* provided in Appendix 1.

This Plan of Study contains: the Study's purpose and objectives; a description of the Study management structure; a description of the major phases of the Study and a breakdown of the major tasks and estimated timeline in each phase.

## 2.0 Study Purpose and Objectives

The purpose of the Study is to conduct a comprehensive study that will assess, for the tribes of the Ten Tribes Partnership, tribal[2] water supplies, document current tribal water use on

[1] Chemehuevi Indian Tribe, Cocopah Indian Tribe, Colorado River Indian Tribes, Fort Mojave Indian Tribe, Jicarilla Apache Nation, Navajo Nation, Quechan Indian Tribe, Southern Ute Indian Tribe, Ute Indian Tribe of the Uintah and Ouray Reservation, Ute Mountain Ute Tribe

[2] For purposes of this plan of study "tribal" refers collectively to the tribes and only those tribes of the Ten Tribes Partnership

Partnership reservations, project future water demand on Partnership reservations, document use of unused tribal water by others, and identify tribal opportunities and challenges associated with the development of tribal water considering the future projected water supply and demand imbalances documented in the Basin Study. Specific objectives of the Study include:

- Improve the understanding of the role of tribal water throughout the Colorado River system using existing data
- Enhance the Colorado River Simulation System (CRSS) to improve its simulation of tribal water use
- Characterize current tribal water use by each of the tribes in the Partnership
- Characterize a range of future tribal water demand for each of the tribes in the Partnership
- Identify potential future impacts to specific users, or groups of users, presently relying on unused tribal water
- Identify tribal water development challenges both specific to the tribes in the Partnership and in general Basin-wide
- Identify opportunities for tribes to participate in potential opportunities that can help reduce future uncertainty and future water imbalances

The Study will be conducted collaboratively with involvement by the seven Colorado River Basin States and other interested stakeholders. Although the Study may identify potential legal and policy issues related to tribal water development and potential solutions to water imbalances, the Study is intended to view tribal water in the context of the current Law of the River[3].

# 3.0 Study Management

Management of the Study will be accomplished as described in the following sections.

## 3.1 Study Team

The Study Team will ensure that the tasks that related to the Study are completed in an effective, efficient manner, are technically sound, and are within the Study's financial and time constraints. Members of the Study Team provide the expertise, experience, and knowledge that relate to the Study's scope and objectives. Study Team members include the members of the Partnership's Legal/Technical Committee and designated Reclamation staff from the Upper Colorado (UC) and Lower Colorado (LC) Regions. Study Team members will be responsible for communicating Study progress and issues to their respective management such as the Partnership and Reclamation management. Representatives of individual tribes are expected to participate in the study as part of sub-teams in areas where information specific to the individual tribes is critical.

[3] The treaties, compacts, decrees, statutes, regulations, contracts and other legal documents and agreements applicable to the allocation, appropriation, development, exportation and management of the waters of the Colorado River Basin are often collectively referred to as the Law of the River. There is no single, universally agreed upon definition of the Law of the River, but it is useful as a shorthand reference to describe this longstanding and complex body of legal agreements governing the Colorado River.

### 3.2 Sub-Teams

Various sub-teams may be formed as needed to perform certain tasks. Sub-team members would provide the specific expertise required to perform those tasks. The Study Team will determine when a specific sub-team should be formed, that sub-team's tasks, and the expertise required of that sub-team. Members may include Study Team members, additional staff from the UC and LC Regions, tribal representatives, and representatives from other groups with a particular expertise sought by the Study Team.

## 4.0 Study Schedule, Phases, & Products

The Study will build from the analysis done in the Basin Study to advance the knowledge of tribal water resources in the Basin.

### 4.1 Schedule

The Study will be conducted over a period of two years with an anticipated completion of December 2015. The Study will consist of five major phases: Current Tribal Water Use Assessment, Future Tribal Water Demand Assessment, Assessment of System Impacts resulting from the development of tribal water, Evaluation of Opportunities and Challenges related to the development of tribal water. A draft report will be developed for each phase and will be combined into a final report in a fifth phase. The projected timeline for these phases and the major Study milestones are displayed in the following tables.

***Table 1***
***Projected Study Timeline***

| | 2013 | 2014 | | | | | | | | | | | | 2015 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase Name | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N |
| 1. Current Tribal Water Use Assessment | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. Future Tribal Water Demand Assessment | | | | | | | | | | | | | | | | | | | | | | | | |
| 3. Assessment of System Impacts resulting from the development of tribal water | | | | | | | | | | | | | | | | | | | | | | | | |
| 4. Identification and Evaluation of Opportunities and Challenges related to the development of tribal water | | | | | | | | | | | | | | | | | | | | | | | | |
| 5. Final Report Production | | | | | | | | | | | | | | | | | | | | | | | | |

***Table 2***
***Projected Study Milestones & Products***

| Phase Name | Milestones | | Products |
|---|---|---|---|
| 1. Current Tribal Water Use Assessment | 2014 | Feb | Completion of data and information collection meetings with each of the Ten Tribes |
| | | Apr | Draft report describing findings from the assessment of current tribal water use and workplan for CRSS enhancements |
| 2. Future Tribal Water Demand Assessment | 2014 | Dec | Draft report describing findings from the assessment of future tribal demand |
| | | Dec | Completion of CRSS enhancments |
| 3. Assessment of System Impacts resulting from the development of tribal water | 2015 | May | Draft report describing findings from system dependence assessment |
| 4. Identification and Evaluation of Opportunities and Challenges related to the development of tribal water | | Jul | Draft report describing findings from opportunities/challenges evaluation |
| 5. Final Report Production | 2015 | Oct | Draft final report that combines reports from previous phases |
| | | Dec | Final report |

## 4.2 Phases

The following sections describe the work to be completed in each of the five major Study phases.

### *Phase 1. Current Tribal Water Use Assessment*

For each of the tribes in the Partnership, an assessment of current water use will be conducted. The assessment will include a description of the amount of water currently used by the tribe, the locations and types of use, additional water supplies beyond Colorado River water (e.g. groundwater), and any major diversions or infrastructure. For the purpose of the Study, current use may include analysis of multiple years of use data and is intended to provide a baseline of use rather than to quantify an absolute amount of current use. This information will be used to develop recommendations for CRSS enhancements as well as serve as the base information for which the future demand assessment will be conducted in Phase 2. Tribal background information that includes a description of each of the tribes in the Partnership will also be collected. Major tasks and sub-tasks for this phase are as follows.

**Tasks:**

Task 1: Develop template for data collection including, but not limited to:
- a. Nature and priority of water rights
- b. Current water use
- c. Shortages if known
- d. Type of use
- e. Additional water supplies other than Colorado River surface water
- f. Major diversion or infrastructure
  - i. Location
  - ii. Operating constraints

Task 2: Review and select methods to estimate current use

Task 3: Meet with representatives from each of tribe in the Partnership to populate template developed in Task 1

Task 4: Catalog/analyze data
- a. Develop maps for locations of diversions/uses

Task 5: Develop prioritized list of enhancements for CRSS guided by Task 4

Task 6: Develop draft report
- a. Present findings from the assessment of current tribal water use including tribal background information
- b. Include workplan for CRSS enhancements

Task 7: Develop draft final report
- a. Incorporate and address comments on draft report

### *Phase 2. Future Tribal Water Demand Assessment*

Two major activities will be conducted in this phase simultaneously. In the first activity, enhancements to CRSS will be performed such that tribal water use can be more accurately simulated, which will be performed in Phase 3. In the second activity, for each of the tribes in the Partnership, future tribal water demand scenarios will be developed that better reflect likely tribal development scenarios than those developed and used in the Basin Study.

**Tasks:**

Task 1: Complete CRSS enhancements identified in Phase 1

Task 2: Review and select methods to project future demands

Task 3: Conduct assessment of future demands

a. Identify and address discrepancies with demands of non-tribal entities from the Basin Study resulting from any changes in tribal demand

Task 4: Develop draft report

a. Present findings from the assessment of future tribal demand

Task 5: Develop draft final report

a. Incorporate and address comments on draft report

### *Phase 3. Assessment of System Impacts resulting from the development of tribal water*

In this phase, using the modified version of CRSS developed in Phase 2, a series of modeling simulations will be performed in order to quantify system impacts resulting from a range of future tribal water demand scenarios. A set of system metrics (e.g. key reservoir elevations, water deliveries to non-tribal entities) will be identified that will be used to indicate the Basin effects resulting from the future development of water by the tribes.

**Tasks:**

Task 1: Identify system metrics

a. Incorporate system metrics in CRSS or as post-processing tool

Task 2: Determine modeling assumptions to support assessment

a. Input modeling assumptions into CRSS

b. Input future demand scenarios developed in Phase 2 into CRSS

Task 3: Perform model simulations

Task 4: Synthesize and analyze simulation results

Task 5: Develop draft report

a. Present findings and results of assessment

Task 6: Develop draft final report

a. Incorporate and address comments on draft report

### *Phase 4. Identification and Evaluation of Opportunities and Challenges related to the development of tribal water*

This phase will consist of a discussion of issues related to future use and/or development of tribal water and may include additional CRSS assessments that build on the findings in Phase 3. Current arrangements such as transfers, leases, exchanges, forbearance, etc. that tribes or others currently have in place and the opportunities and challenges associated with those arrangements will be discussed.

Potential future opportunities, and the associated challenges, for tribes will also be discussed. The opportunities may include, but are not limited to:

- Transfers, leases, water banking, exchanges, forbearance, or other arrangements that offer potential opportunities for tribes
- Funding for infrastructure development
- Funding for infrastructure rehabilitation
- Storage projects
- Improved efficiencies and re-use
- Additional stream gaging on Colorado River tributaries

**Tasks:**

Task 1: Review Phase 3 findings and modify Phase 4 tasks as appropriate

Task 2: Develop draft final report

a. Describe findings from opportunities/challenges evaluation

### *Phase 5. Final Report Production*

This phase will consist of the development of the final Study report. Draft reports from each of the previous phases will be finalized and combined to result in a final Study report.

**Tasks:**

Task 1: Review and incorporate comments on draft final reports from Phases 1-4

Task 2: Combine reports from Phases 1-4 into final Study report

a. Develop any supporting documents, e.g. executive summary

Task 3: Publish final Study report

### 4.3 Products

The primary products of the Study will be draft reports of each phase's activities that will be synthesized into a final report including the following elements:

- Assessment of current tribal water use
- Assessment of future tribal demand
- Findings from the system impacts assessment
- Findings from opportunities/challenges evaluation

A work plan for enhancements to CRSS and a modified version of CRSS will be additional Study products.

## 5.0 References

Bureau of Reclamation, 2012. *Colorado River Basin Water Supply and Demand Study – Study Report*

## 6.0 Appendices

Appendix 1 - *Agreement Regarding the Importance of the Colorado River Basin Ten Tribes Partnership Tribal Water Study*

## Agreement Regarding Importance of the Colorado River Basin Tribal Water Study As Identified in the Colorado River Basin Water Supply and Demand Study

**Whereas**, As part of its implementation of the SECURE Water Act of 2009, Subtitle F, The Omnibus Public Land Management Act of 2009 (Public Law 111-11, March 30, 2009), the Bureau of Reclamation (Reclamation) has established a program of Basin Studies within the western United States to address the growing need for information and tools to aid water resource managers; and,

**Whereas**, the purpose of this effort is to undertake comprehensive water studies that define options for meeting future water demands in river basins in the western United States where imbalances in water supply and demand exist or are projected; and,

**Whereas**, the studies performed under the SECURE Water Act (P.L. 111-11) should include consideration of actions to address the projected impacts of drought and climate change; and,

**Whereas**, one of the first basins examined under the Basin Study Program was the Colorado River Basin; and,

**Whereas**, during the development and preparation of the Colorado River Basin Water Supply and Demand Study (Study), Reclamation and participating tribal representatives recognized that:

The Indian Reserved Water Rights of the tribes of the Colorado River Basin are unique and have attributes that must be recognized under federal law and distinguished from state law water rights; and,

The Indian Reserved Water Rights of the tribes of the Colorado River Basin account for approximately 2.9 million acre-feet of annual diversion rights of the total apportionment of the Colorado River in the United States; and,

The Study does not fully account for tribal water demand nor reflect the potential use of tribal water by others nor show the potential impact on Colorado River Basin water supply if a substantial amount of the presently unused or unquantified tribal water is used by the tribal water rights holders prior to 2060; and,

**Whereas**, In the final Study Report, Reclamation and the Colorado River Basin Tribes Partnership (Ten Tribes Partnership) identified their commitment to joint future planning efforts that build on the scientific foundation of the Study and advance critical information beyond the limited assessment of tribal water in the Study.

**Therefore, the undersigned representatives of the Department of the Interior and Ten Tribes Partnership state and agree,**

In recognition of the aforementioned, the Department of the Interior (acting through Reclamation) and the Ten Tribes Partnership agree to undertake the Colorado River Basin Tribal Water Study. Both parties acknowledge the importance of prompt initiation, thorough development, and timely completion of this study. Work on the study will begin in 2013 with anticipated completion by December 2015. Reclamation and the Ten Tribes Partnership commit to work together in this endeavor in the spirit of collaboration and partnership. By doing so, Reclamation and the Ten Tribes Partnership hope to bring the tribal perspective to bear in identifying, analyzing, and documenting these important matters.

**T. Darryl Vigil**
**Chairman**
**Colorado River Basin Tribes Partnership**

**Anne J. Castle**
**Assistant Secretary - Water and Science**
**U.S. Department of the Interior**

# Appendix 1B
# Federally Recognized Tribes in the Colorado River Basin

# Appendix 1B – Federally Recognized Tribes in the Colorado River Basin

The Indian lands of federally recognized tribes in the Colorado River Basin are presented in Figure 1B-A.

**FIGURE 1B-A**
Map of Federally Recognized Tribes in the Colorado River Basin


| ID | Tribe Name |
|---|---|
| 1 | Ute Indian Tribe of the Uintah and Ouray Reservation |
| 2 | Southern Ute Indian Tribe |
| 3 | Ute Mountain Ute Tribe |
| 4 | Jicarilla Apache Nation |
| 5 | Navajo Nation |
| 6 | Zuni Tribe |
| 7 | Hopi Tribe |
| 8 | Kaibab Band of Paiute Indians |
| 9 | Havasupai Tribe |
| 10 | Hualapai Indian Tribe |
| 11 | Shivwits Band of Paiute Indian Tribe |
| 12 | Moapa Band of Paiute Indians |
| 13 | Las Vegas Tribe of Paiute Indians |
| 14 | Fort Mojave Indian Tribe |
| 15 | Chemehuevi Indian Tribe |
| 16 | Colorado River Indian Tribes |
| 17 | Yavapai-Apache Nation |
| 18 | Yavapai-Prescott Indian Tribe |
| 19 | Tonto Apache Tribe |
| 20 | White Mountain Apache Tribe |
| 21 | San Carlos Apache Tribe |
| 22 | Fort McDowell Yavapai Nation |
| 23 | Salt River Pima-Maricopa Indian Community |
| 24 | Gila River Indian Community |
| 25 | Ak-Chin Indian Community |
| 26 | Quechan Indian Tribe |
| 27 | Cocopah Indian Tribe |
| 28 | Tohono O'odham Nation |
| 29 | Pascua Yaqui Tribe |

# Appendix 1C
# Study Team Members

# Appendix 1C – Study Team Members

A list of Study Members and their affiliation is listed in Table 1.3-A.

**TABLE 1.3-A**
Study Team Members

| Affiliation | Study Team Member |
|---|---|
| Ute Indian Tribe of the Uintah and Ouray Reservations | Ute Tribal Business Committee |
| | Ute Indian Tribe Water Rights Commission |
| | Duane Moss, Director of Water Rights |
| | Joanne Curry, General Counsel |
| | Dr. Wold Mesghinna, Tribal Water Engineer |
| Southern Ute Indian Tribe | Southern Ute Indian Tribal Council |
| | Lena Atencio, Director, Department of Natural Resources |
| | Peter Waugh, Water Resources Division Head |
| | Andrew Straub-Heidke, Water Resources Specialist |
| | Catherine Condon, Special Counsel for Water |
| | Erin Wilson, Civil Engineer |
| | Theresa Ancell, Water Resources Division Head (former) |
| | Chuck Lawler, Water Resources Division Head (former) |
| | Travis Wheeler, Water Resources Specialist (former) |
| Ute Mountain Ute Tribe | Ute Mountain Ute Tribal Council |
| | Leland Begay, Associate General Counsel |
| | Peter Foster, Engineer |
| | Celene Hawkins, Associate General Counsel (former) |
| Jicarilla Apache Nation | Jicarilla Apache Nation Tribal Council |
| | Jicarilla Apache Nation Water Commission |
| | Darryl Vigil, Water Administrator |
| | Jenny Dumas, Attorney |
| Navajo Nation | Navajo Nation Council |
| | Jason John, Navajo Department of Water Resources |
| | Ray Benally, Director, Navajo Department of Water Resources |
| | Lisa Yellow Eagle, Attorney, Navajo Department of Justice |
| | Stanley Pollack, Assistant Attorney General, Navajo Department of Justice (former) |
| Fort Mojave Indian Tribe | Fort Mojave Indian Tribal Council |
| | Russell Ray, Land Use Planner |
| Chemehuevi Indian Tribe | Chemehuevi Indian Tribal Council |
| | Steven Escobar, Director, Environmental Program |
| Colorado River Indian Tribes | CRIT Tribal Council |
| | Margaret Vick, Special Counsel for Water |
| | Doug Bonamici, Law Clerk |
| | Marty Pretends Eagle, GIS Specialist |
| | Maria De Los Angeles Ingram, Water Resources Acting Director |

**TABLE 1.3-A**
Study Team Members

| | |
|---|---|
| | Rebecca Loudbear, Attorney General |
| | Grant Buma, Director, Water Resources Department (former) |
| Quechan Indian Tribe | Quechan Indian Tribal Council |
| | Jay Weiner, Attorney |
| | Mason Morisset, Attorney (former) |
| Cocopah Indian Tribe | Cocopah Indian Tribal Council |
| | W. Michael Smith, Attorney |
| Bureau of Reclamation | Pam Adams |
| | Alan Butler |
| | Carly Jerla |
| | KayLee Nelson |
| | James Prairie |
| | Jessica Khaya |

# 2 | Background on Federal Indian Reserved Water Rights

## 2.0 Introduction

This section presents a short description of the legal basis for and characteristics of Indian water rights, and the important differences between those rights and state law-based water rights. This background section includes the general principles of federal Indian water law and western prior appropriation law and is not intended to describe or affect any particular tribe's water rights.

### 2.1 The Origin of Federal Indian Reserved Water Rights

The seminal Indian reserved water rights case is *Winters v. United States*.[1] In *Winters*, the United States initiated a lawsuit to restrain settlers from constructing and maintaining water works to divert water from the Milk River which would prevent water from flowing to irrigate Indian lands on the Fort Belknap Indian Reservation in Montana. The Court found that the agreement creating the Fort Belknap Reservation sought to transition the Gros Ventre and Assiniboine Indians from a pastoral to an agrarian lifestyle, but that the reservation lands "were arid, and, without irrigation, were practically valueless."[2] Accordingly, the Court held that the establishment of the reservation impliedly reserved the amount of water necessary to irrigate its lands and to provide water for other purposes.[3] The Court also held that these reserved waters are exempted from appropriation under state law.[4] Federal Indian reserved water rights are often referred to as *Winters* rights.

As the trustee and holder of title to federal Indian reserved water rights, the United States has an obligation to protect Indian water rights and water resources for each beneficiary tribe.

### 2.2 Basic Characteristics of Federal Indian Reserved Water Rights

#### *2.2.1 Priority Date: Date of Reservation or Time Immemorial*

Federal Indian reserved water rights generally have one of two priority dates: date of reservation or time immemorial. Where the reserved rights are necessary to fulfill purposes created by the establishing document,[5] the priority date is the date of establishment of the reservation.[6] If, however, water is reserved so a tribe can continue its aboriginal uses, such water may have a time immemorial priority date.[7]

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1 207 U.S. 564 (1908).

2 *Id.* at 576.

3 *Id.* at 576-77.

4 *Id.*; *see also United States v. Rio Grande Dam & Irrigation Dist.*, 174 U.S. 690, 703 (1899) (holding that the states' power to create water rights is subject to two limitations: (1) a state cannot "destroy the right of the United States, as the owner of lands bordering on a stream, to the continued flow of the waters. . . ."; and (2) a state is limited by the federal navigation servitude).

5 All reservations possess *Winters* rights whether established by treaty, statute, or executive order. *Arizona v. California,* 373 U.S. 546, 595-601 (1963) (*Arizona I)*.

6 *See Winters*; *Arizona I*.

7 *See, e.g. United States v. Adair*, 723 F.2d 1394, 1412-15 (9th Cir. 1983), *Joint Board of Control v. United States*, 832 F.2d 1127, 1131-32 (9th Cir. 1987).

#### *2.2.2 Quantification: The Amount Necessary to Fulfill the Reservation's Purposes*

Federal Indian reserved water rights entitle tribes to the amount of water that is necessary to fulfill their reservation's purposes.[8] This includes a right to surface water and groundwater sources.[9] Various approaches are used to quantify federal Indian reserved water rights. In *Arizona v. California*, the United States Supreme Court established the "practicably irrigable acreage" (PIA) standard.[10] Under this standard, if land within a reservation can be cultivated through irrigation and if such irrigation is practicable applying relevant economic measures, then the tribe is entitled to the amount of water necessary for such irrigation. Another prominent measure for quantifying federal Indian reserved water rights is the "homeland" standard.[11] Under this standard, federal Indian reserved water rights are quantified based on the tribe's past, present, and future water needs, not just those needs tied to agriculture.[12] This can include water for a wide range of purposes, including hunting and fishing and commercial and other economic development purposes.[13] The Supreme Court rejected an "equitable apportionment" standard, used in some water cases, to allocate water between states, and adopted a "variable" standard of quantification based upon "reasonably foreseeable needs."[14]

## 2.3 Reserved Water Rights are Not Subject to State Law

Federal Indian reserved water rights are defined primarily by federal common law. Indian "[r]eserved water rights are 'federal water rights' and 'are not dependent upon state law or state procedures.'"[15] Although federal Indian reserved water rights are often adjudicated in state courts, state courts must apply federal law.[16]

These rights differ from state water rights in several respects. Water rights based on state law are largely fixed by the date and quantity of the landowner's initial use or appropriation of water. Laws of the western states (and the federal Reclamation laws) also require the "beneficial use" of

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[8] *In re the General Adjudication of All Rights to Use Water in the Gila River System and Source*, 201 Ariz. 307, 320, 35 P.3d 68, 81 (2001) ("*Gila V*") ("When an Indian reservation is created, the government impliedly reserves water to carry out its purpose as a permanent homeland. *See Winters*, 207 U.S. at 566-67, 577.").

[9] *Agua Caliente Band v. Coachella Valley Water Dist.*, 849 F.3d 1262, 1271 (9th Cir. 2017), *cert. denied*, 138 S.Ct. 468 (2017) ("We hold that the Winters doctrine encompasses both surface water and groundwater appurtenant to reserved land."); *In re the General Adjudication of All Rights to Use Water in the Gila River System and Source,* 989 P.2d 739, 750 (Ariz. 1999) ("We have held that the federal reserved right extends to groundwater when groundwater is necessary to accomplish the purpose of a federal reservation."); COHEN'S HANDBOOK OF FEDERAL INDIAN LAW § 19.03[2][a] ("Reserved rights presumably attach to all water sources—groundwater, streams, lakes, and springs—that arise on, border, traverse, underlie, or are encompassed within Indian reservations."). The Supreme Court specifically held that "the United States can protect its water from subsequent diversion, whether the diversion is of surface or groundwater." *Cappaert v. United States*, 426 U.S. 128, 143 (1976).

[10] *Arizona I*, 373 U.S. at 595-601.

[11] See *Gila V*, 201 Ariz.at 318, 35 P.3d at 79 ("[W]e decline to approve the use of PIA as the exclusive quantification measure for determining water rights on Indian lands.").

[12] *See id.* at 79-80 (identifying a multitude of factors to be considered in this analysis including history, culture, geography, natural resources, economic base, past water use, and present and projected future population).

[13] *See id.* at 80 (". . . the court should look to a tribe's economic base in determining its water rights . . . [e]conomic development and its attendant water use must be tied, in some manner, to a tribe's current economic station.").

[14] *Arizona I,* 373 U.S. at 597-601.

[15] *Colville Confederated Tribes v. Walton* (*Walton III*), 752 F.2d 397, 400 (9th Cir. 1985) (quoting *Cappaert,* 426 U.S. at 145 and citing *Adair*, 723 F.2d at 1411 n. 19).

[16] *Arizona v. San Carlos Apache Tribe*, 463 U.S. 545, 571 (1983) ("State courts, as much as federal courts, have a solemn obligation to follow federal law.")

water (for example, for mining, irrigation, domestic, municipal, industrial, power production, stock watering, wildlife preservation, and recreation) and typically require the water to be diverted from its source. Failure to use the water for a period of time could result in loss of the right under state forfeiture or abandonment laws.

Conversely, federal Indian reserved water rights are quantified based on what is needed to accomplish the reservation's purposes, including past, present, and future uses, not on initial or current use of water.[17] These rights may be used for any lawful purpose on the reservation.[18] Federal Indian reserved water rights also cannot be lost because of non-use under state-law concepts such as abandonment and forfeiture.[19]

## 2.4 The Colorado River Compact

The 1922 Colorado River Compact apportioned the Colorado River between the Upper and Lower Colorado River Basins. The extent to which the Compact affects the rights of the Tribes is unclear. The Compact recognized and protected present perfected rights in the Colorado River system declaring such rights as unimpaired by the Compact.[20] The priority dates of most of the water rights of the Tribes predate the Compact and should be considered "present perfected rights" as that term is used in the Compact. In addition, the Compact also provided that "[n]othing in this compact shall be construed as affecting the obligations of the United States of America to Indian tribes."[21]

[17] *Arizona I*, 373 U.S. at 598, 600-01, 605; *Colville Confederated Tribes v. Walton* (*Walton II*), 647 F.2d 42, 47 (9th Cir. 1981).

[18] *Arizona v. California* (*Arizona II*), 439 U.S. 419, 422 (1979); *Walton II*, 647 F.2d at 48-49; *but see In re General Adjudication of the Big Horn River System*, 835 P.2d 273, 278-80, 285 (Wyo. 1992) (plurality and concurring opinion held 3-2 that tribes cannot devote *Winters* water for agricultural purposes instream to support fish).

[19] *Winters*, 207 U.S. at 577; *Hackford v. Babbitt*, 14 F.3d 1457, 1461 n.3 (10th Cir. 1994); *Walton II*, 647 F.2d at 51. Only Congress can diminish Indian rights. *Minnesota v. Mille Lacs Band of Chippewa Indians*, 526 U.S. 172, 202-03 (1999); *United States v. Dion,* 476 U.S. 734, 738-40 (1986); *Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n,* 443 U.S. 658, 690 (1979).

[20] Colorado River Compact, 1922, Nov. 24, 1922, Art. VIII.

[21] *Id*. at Art. VII.

# 3 The Tribes of the Ten Tribes Partnership

## 3.0 Introduction

The Colorado River Basin Tribes Partnership, also known as the Ten Tribes Partnership (Partnership), is an organization formed in 1992 by ten federally recognized tribes with federal Indian reserved water rights in the Basin. The member tribes, listed in order from north to south in the Basin, are: Ute Indian Tribe, Southern Ute Indian Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation, Navajo Nation, Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe.

Partnership Tribes have reserved water rights, including unresolved claims, to divert nearly 2.8 million acre-feet of water per year from the Colorado River and its tributaries. In the Upper Basin, Partnership Tribes have Federal Indian reserved diversion rights of 1,060,781 AFY and unresolved diversion claims of 762,345 AFY. In the Lower Basin, the Partnership Tribes have decreed diversion rights to Colorado River water of 952,190 AFY and unresolved diversion claims of 22,928 AFY. For additional detail, see Section 5.11 of *Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development.*

The ten tribes formed the Partnership for the purpose of strengthening tribal influence among the seven Basin States over the management and utilization of Colorado River water resources. Specifically, the Partnership supports Partnership Tribes in their efforts to develop and protect tribal water resources and to address technical, legal, economic, and practical issues related to the management and operation of the Colorado River. The Partnership joined the Colorado River Water Users Association in 1996 in an effort to more actively participate with the seven Basin States and the federal government with policy and management decisions for the Colorado River.

### 3.1 Overview of Partnership Tribes' Reserved Water Rights

The federal Indian reserved water rights for the five tribes with direct mainstream diversions below Hoover Dam were decreed in *Arizona v. California*. The five tribes are: the Fort Mojave Indian Tribe; the Chemehuevi Indian Tribe; the Colorado River Indian Tribes; the Quechan Indian Tribe; and the Cocopah Indian Tribe.[1] In that case, the Supreme Court found that the Secretary of the Interior had a statutory duty to respect the present perfected rights established prior to the date Congress passed the Boulder Canyon Project Act. The reserved water rights of these Tribes are included as present perfected rights and have priority based on the establishment date of each reservation and on subsequent dates of related boundary adjustments.[2]

[1] The Court first determined the federal Indian reserved rights of the five Lower Basin Tribes in *Arizona v California*, 373 U.S. 546 (1963) and quantified the rights in the first Decree, *Arizona v. California,* 376 U.S. 340 (1964). Subsequent decisions by the Supreme Court altered the original 1964 Decree. All rights are currently set forth in the 2006 Consolidated Decree, *Arizona v. California,* 574 U.S. 150 (2006).

[2] *Arizona v. California*, 373 U.S. 546, 600 (1963). *Arizona v. California,* 574 U.S. 150 (2006).

A portion of the Ute Indian Tribe's reserved water rights was decreed in 1923[3] with a senior priority date of 1861, based on the establishment date of the Uintah Valley Reservation, pursuant to *Winters v. United States*.[4] In 1965, the United States, the Central Utah Water Conservancy District, the State of Utah (by Joint Resolution of the Legislature), and the Ute Indian Tribe agreed to the quantification of the remainder of the Tribe's reserved water rights by contractual agreement. The state and federal governments are currently in negotiations with the Tribe to complete the Ute Indian Water Compact.

The reserved water rights for the four remaining Partnership Tribes have been determined to a certain extent through various settlements; however, not all Indian water rights claims have been resolved. The 1988 Colorado Ute Settlement Act, as amended by the 2000 Amendments and the Colorado state court consent decrees, quantified the water rights of the Southern Ute Indian Tribe and the Ute Mountain Ute Tribe in the state of Colorado. The 1992 Jicarilla Apache Tribe Water Rights Settlement Act represents a full and final settlement of the future use water rights claims of the Jicarilla Apache Nation to the water of the Colorado River. In 2009, Congress approved the Navajo Nation's settlement of its San Juan River federal Indian reserved water rights that was reached with the state of New Mexico and the United States. However, the Navajo Nation has not resolved its water rights claims in the states of Arizona and Utah, or outside of the San Juan River basin in New Mexico. The Ute Mountain Ute Tribe has not resolved its water rights claims in the states of New Mexico and Utah.

Detailed information regarding each Partnership Tribe's water rights is available in *Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development*.

### 3.2 Partnership Objectives

The Partnership's objectives are to ensure that, within the next decade:

(1) Each Partnership Tribe has settled or otherwise resolved its Indian reserved water rights claims;

(2) Each Partnership Tribe has the ability to maximize its on-reservation use of water and the flexibility to explore, facilitate and implement off-reservation use and transfers;

(3) Each Partnership Tribe benefits from water infrastructure projects promised or obtained through Congressional actions and/or settlements with state and federal governments and partners in a timely fashion; and

(4) The federal government firmly asserts and exercises its trust responsibility to protect the Partnership Tribes' reserved water rights in all its management actions related to the Colorado River.

[3] *United States v. Cedarview Irrigation Company et al.*, No. 4427 (D. Utah 1923), and *United States v. Dry Gulch Irrigation Company, et al.*, No. 4418 (D. Utah 1923).

[4] 207 U.S. 564 (1908).

# 4 Methodology for Assessing Current Tribal Water Use and Projected Future Water Development

## 4.0 Introduction

This chapter describes the methodology used to assess the Partnership Tribes' current water use and potential future water development. The current water use assessment includes the Partnership Tribes' water or unresolved claims; the amount, types and locations of current use; additional water supplies beyond Colorado River water; and major diversions or infrastructure that deliver water to the Tribes' reservations. The current water use assessment served as a foundation from which future water development was analyzed. Four scenarios for future tribal water development were created to provide a range of possible future outcomes. Each step of the methodology is explained in detail below.

> **Key Terms**
>
> Key terms used in this chapter are defined below.
>
> **Colorado River System** – The portion of the Colorado River and its tributaries within the United States.
>
> **Importance** – Being of great significance or value. Used to rate the importance of an influencing factor to tribal development and the use of water from the Colorado River and its tributaries relative to the remaining influencing factors.
>
> **Influencing factor** – Factors that will likely have the greatest influence on the future of tribal development and use of water from the Colorado River and its tributaries over time.
>
> **Key influencing factors** – The key driving forces that are identified as both highly uncertain and highly important.
>
> **Uncertainty** – Imperfect or unknown information. Used to rate the uncertainty of an influencing factor to tribal development and the use of water from the Colorado River and its tributaries relative to the remaining influencing factors.

### 4.1 Approach for Assessing Current Tribal Water Use

Each Partnership Tribe provided information on the current use and management of water on its reservation. This information included, as appropriate: water supplies; the amount, types and location of use; infrastructure components; operations, including efficiencies and conservation activities; and historical use and cultural importance of water. Because of the differences among the Partnership Tribes in the availability and quality of data, current water use was considered either as an average water use of five recent years or a single recent representative year. This methodology did not provide a lengthy historical record of tribal water use, but is a good snapshot of recent water use, by sector, for each Partnership Tribe and advances the understanding of tribal water use in the Basin.

The Partnership Tribes in the Upper Basin provided water supply and use information primarily at the tributary or sub-basin level, depending on the tribe's reserved water rights or unresolved claims. Water use data for some of the Upper Basin Partnership Tribes is sporadic and of low quality, which led the Navajo Nation to report a one-year "snapshot" of uses. The Southern Ute Indian Tribe used 2009 through 2013 data as a guide to provide updated current water use information. For Partnership Tribes in the Lower Basin, records of diversions, return flows, and consumptive use of water diverted from the mainstream of the Colorado River below Lee Ferry are compiled by Reclamation in the Colorado River Accounting and Water Use Reports: Arizona, California, and Nevada (Water Accounting Report) (Reclamation, 2017). The Water Accounting Reports for 2009 through 2013 were averaged and used for the Lower Basin Partnership Tribes, except for the Chemehuevi Indian Tribe, which averaged the years 2010 through 2013. Existing Reclamation data were supplemented with additional information provided by each of the tribes.

For purposes of the Tribal Water Study, water use was grouped into four categories:

- Domestic, Commercial, Municipal, and Industrial (DCMI);
- Irrigated Agriculture and Livestock (AG);
- Environmental, Cultural, and Recreational (ENV); and
- Transfers, Leases, and Exchanges (TRAN).

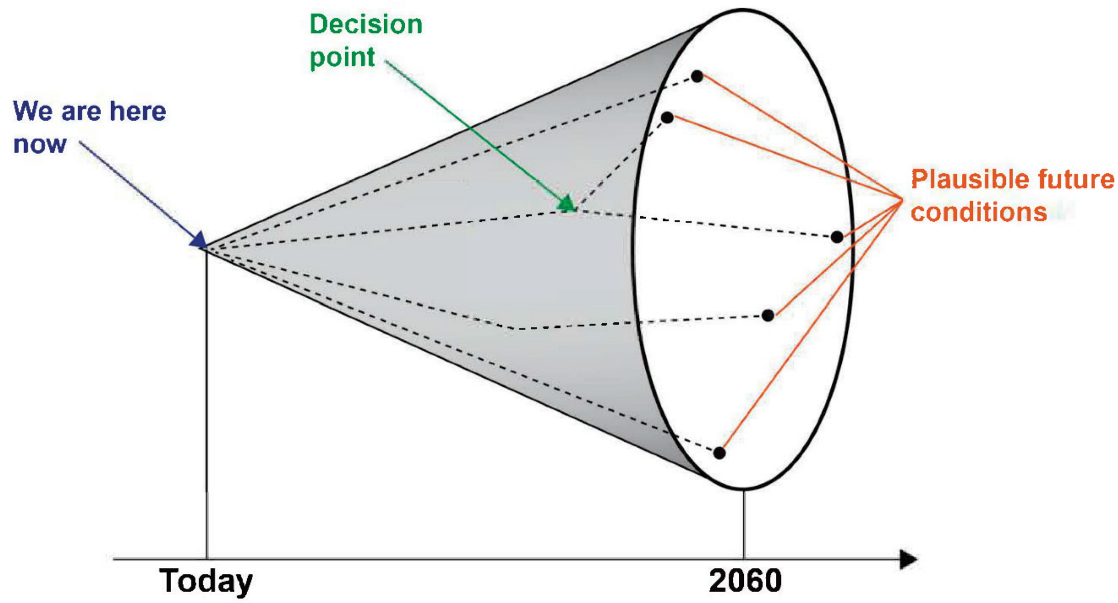
Each Partnership Tribe prepared a description of the water supply and use on its reservation, which is presented in *Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development.*

## 4.2 Approach for Assessing Future Tribal Water Development

There is an extensive understanding of the current hydrology of the Colorado River System and water use by tribal and other water users. However, there is much uncertainty related to future Basin conditions and no single estimate of a future that can account for the System's complexity or provide flexibility to address future challenges. By adopting a scenario planning approach, a broad range of plausible futures was evaluated using a manageable number of scenarios depicting alternative views of how the future might unfold. The scenarios are not predictions or forecasts of the future; rather they represent a range of plausible futures that assisted in assessing future risks when considering long-term planning options. Figure 4-A represents a range of plausible futures. Nevertheless, it is important to recognize that under federal law, Indian reserved water rights are perfected water rights and include the future use of those water rights in perpetuity. In reality, the Partnership Tribes' water use planning is not bound by an approach that considers water development up to a specific point in time.

The Basin Study (Reclamation, 2012) used a scenario planning approach to project future water demand in the Basin. However, feedback from Partnership Tribes during the Basin Study process highlighted the concern that the scenarios used in the Basin Study did not capture how the Partnership Tribes will fully develop and use their reserved water rights. The Partnership Tribes voiced concern that the factors that drive non-tribal demand, such as population growth, are not the same factors that influence tribal water development. A similar scenario planning approach, focused on tribal water development factors, was used in the Tribal Water Study to develop a range of how the Partnership Tribes may develop and use water through 2060. Throughout the scenario planning process, the Partnership Tribes were substantially involved in determining the factors that influence future tribal water development. The scenario planning process and its outcomes reflect the perspectives that the Partnership Tribes determined are critical to their future water development.

**FIGURE 4-A**
Conceptual Representation of the Uncertain Future of a System, also known as “The Scenario Funnel” (adapted from Timpe and Scheepers, 2003)

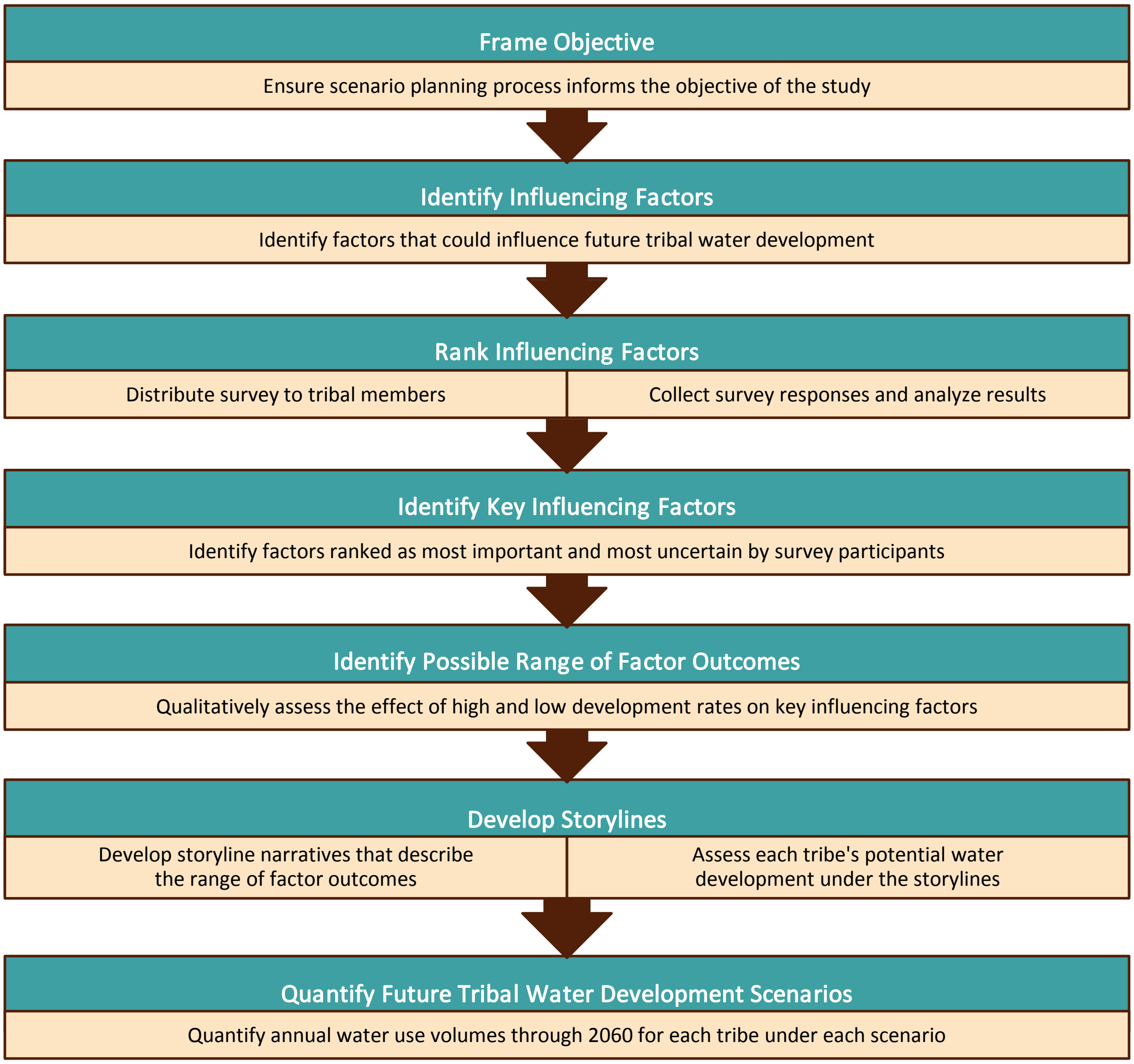



The scenario planning process is shown in Figure 4-B and described below. The process began by framing or identifying the objectives of the planning process. Influencing factors, or factors that drive the development of tribal water were then identified and ranked in terms of importance and uncertainty. The range of outcomes for the key factors was explored and woven into plausible storylines about future tribal water development. The final step in the process was to “quantify” the storylines to estimate how tribal water use may change according to each storyline. The following sections describe each of these steps and their outcomes in more detail.

### *4.2.1 Frame the Objectives*

The Study Team reviewed the objectives of the Tribal Water Study to ensure that the scenario planning process would inform the Study. The specific objectives are outlined in the Plan of Study, which can be found in *Chapter 1 – Introduction, Appendix 1A – Plan of Study.* The Study Team also recalled these objectives when identifying the factors influencing tribal water development and throughout the scenario planning process.

**FIGURE 4-B**
Scenario Planning Process




### *4.2.2 Identify Influencing Factors to Tribal Water Development*

The Study Team identified 28 factors that could influence future tribal water development, presented in Table 4-A. These factors were organized into six categories:

- Demographic;
- Land Use and Natural Systems;
- Infrastructure Development;
- Economic Development;
- Social; and
- Governance.

During factor identification, it was recognized that the infrastructure development factors are dependent on both tribal and federal financial resources. Consequently, these factors were subdivided to allow for the consideration of the source of funds.

| **TABLE 4-A**<br>List of Factors Influencing Tribal Water Development | |
|---|---|
| **Demographic** | |
| 1 | Changes in reservation populations and their distribution |
| 2 | Changes in non-Indian populations adjacent to reservations |
| **Land Use and Natural Systems** | |
| 3 | Changes in agricultural land use (*e.g.,* irrigated agricultural areas, crop mixes, etc.) |
| 4 | Changes in agricultural irrigation practices<br>*Description: This factor could include changes in the irrigation of agricultural lands by the adoption of new methods or technologies to improve the efficiency of irrigation systems when using water.* |
| 5 | Changes in the needs of environmental resources that are dependent on water (*e.g.,* fish and aquatic wildlife, riparian habitat, etc.) including those related to Endangered Species Act (ESA)-listed species |
| 6 | Changes in water quality (including those that are physical, biological, and chemical in nature) |
| 7 | Changes in the resources and technology available to treat poor quality tribal water |
| 8 | Changes in patterns of use and/or water supply sources (*e.g.,* springs, groundwater, streams, etc.) due to drought and/or climate variability |
| **Infrastructure Development** | |
| 9 | Changes in tribal/federal financial resources available to expand tribal housing and related infrastructure<br>*Description: This factor could include changes in tribal housing and related municipal and domestic water delivery infrastructure serving users such as tribal members, schools, community centers, parks, etc.* |
| | 9a. Changes in tribal financial resources |
| | 9b. Changes in federal financial resources |
| 10 | Changes in tribal/federal financial resources available to operate and maintain existing water delivery systems and storage for irrigation purposes (includes repairing, rehabilitating, and replacing agricultural and storage infrastructure)<br>*Description: This factor could include influences such as the ability of the tribe to operate, maintain and improve on- and off-reservation irrigation and related water delivery systems, including storage facilities.* |
| | 10a. Changes in tribal financial resources |
| | 10b. Changes in federal financial resources |
| 11 | Changes in tribal/federal financial resources available to construct new water delivery systems and storage for irrigation purposes<br>*Description: This factor could include influences such as the ability of the tribe to construct new on- and off-reservation irrigation and related water delivery systems, including storage facilities.* |
| | 11a. Changes in tribal financial resources |
| | 11b. Changes in federal financial resources |
| 12 | Changes in tribal/federal financial resources available to operate and maintain existing water delivery systems and storage for domestic and municipal purposes (includes repairing, rehabilitating, and replacing delivery, distribution, and storage infrastructure)<br>*Description: This factor could include influences such as the ability of the tribe to operate, maintain and improve on- and off-reservation domestic and municipal delivery systems, including storage facilities.* |
| | 12a. Changes in tribal financial resources |
| | 12b. Changes in federal financial resources |

**TABLE 4-A**
List of Factors Influencing Tribal Water Development

| | |
|---|---|
| 13 | Changes in tribal/federal financial resources available to construct new water delivery systems and storage for domestic and municipal purposes<br>*Description: This factor could include influences such as the ability of the tribe to construct new domestic and municipal delivery systems, including storage facilities.* |
| | 13a. Changes in tribal financial resources |
| | 13b. Changes in federal financial resources |
| Economic Development | |
| 14 | Changes in water needs for energy generation (*e.g.,* solar, oil shale, thermal, nuclear, hydroelectric, etc.) |
| 15 | Changes in water needs to support tribal economic development (*e.g.,* eco and cultural tourism, commercial and business centers, etc.) |
| 16 | Changes in the local and regional market "value" (*i.e.*, cost) of water (as it relates to different uses, such as the cost of generating energy, commodity prices, cost to pump, leasing, municipal use, etc.) |
| Social | |
| 17 | Changes in cultural and spiritual uses of tribal water |
| 18 | Changes in tribal values affecting water use<br>*Description: This factor could include changes in tribal member priorities related to water use such as in-stream flows, recreation, domestic use, etc.* |
| Governance | |
| 19 | Changes in tribal water availability and use due to the resolution and settlement of tribal water rights claims<br>*Description: This factor could include changes in the time it takes to complete Indian water settlements and in tribal member support for these settlements and water development plans.* |
| 20 | Changes in the laws, policies, and/or regulations to provide increased flexibility to tribes to use tribal water<br>*Description: This factor could include changes to provide for increased use of water banking, water marketing, leasing, etc., and changes that further support and facilitate use of tribal water to support tribal economic development.* |
| 21 | Changes in federal, state, and/or regional water administration practices<br>*Description: This factor could include changes in the accounting of tribal water in the Colorado River System, and tracking and ensuring deliveries during all hydrologic conditions, and changes in the ability to ensure water is delivered to a specific entity or location.* |
| 22 | Changes in tribal expertise and resources available for tribal water use planning<br>*Description: This factor could include changes in tribal economic and other resources for tribal water resources planning and management, changes in Congressional appropriations to support water use development and planning, and changes in cooperative efforts with State and regional non-Indian water development planning.* |
| 23 | Changes in the understanding of tribal reserved water rights by federal, state, other governmental agencies and the public at large (*e.g.,* external education) |

### *4.2.3 Rank Influencing Factors*

The list of influencing factors was compiled and organized into a survey format, see *Appendix 4A – Influencing Factors Survey*. Study Team members facilitated the survey responses with their respective Partnership Tribe based upon tribal preferences. Respondents included Tribal Council members, tribal members, water and environmental resources staff, and tribal attorneys.

Survey respondents were asked to rank each factor in terms of relative importance and relative uncertainty, as described below:

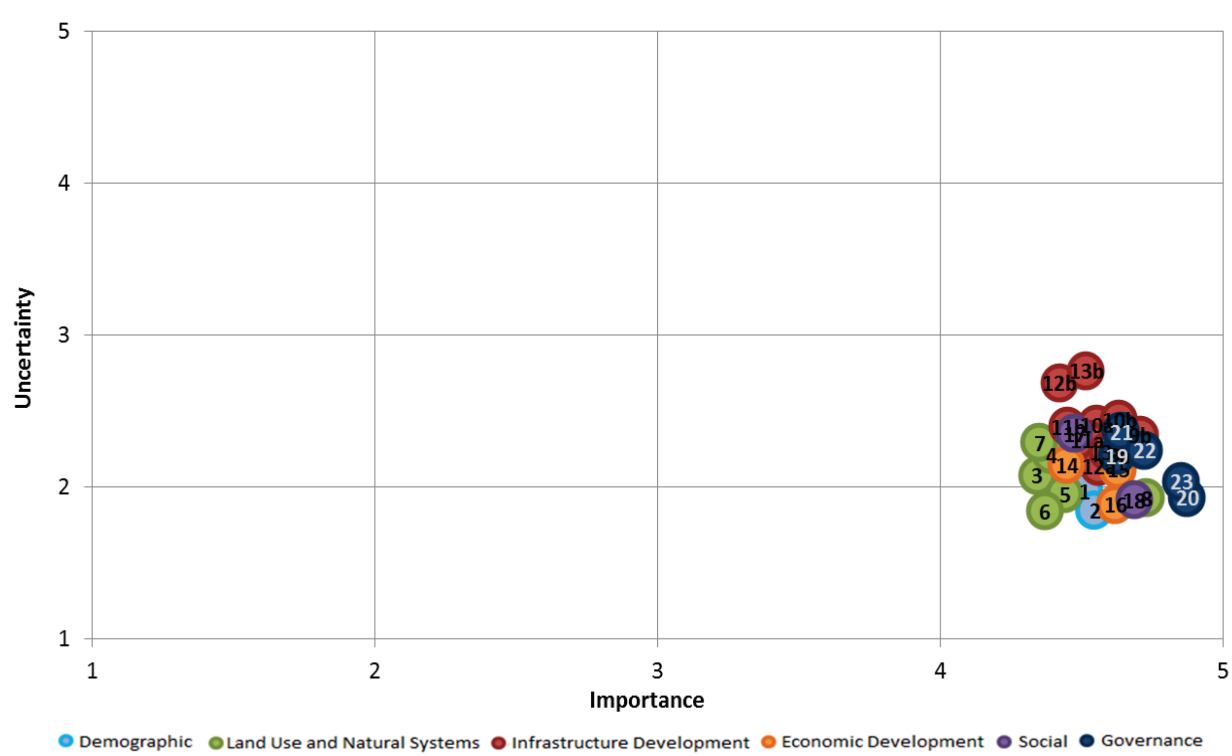
> **Importance** (1 through 5, with 5 being greatest importance): Rate how important the factor will be in influencing tribal development and use of water (from the Colorado River and its tributaries) through 2060.
>
> **Uncertainty** (1 through 5, with 5 being greatest uncertainty): Rate how certain you are regarding how that factor will change between now and 2060.

At least one survey was received from each Partnership Tribe for a total of 76 responses, 12 of which were incomplete and removed from the analysis. Multiple responses from a Partnership Tribe were averaged to produce a representative response from that Tribe. This process ensured that each Partnership Tribe received equal weight when analyzing the importance and uncertainty of the factors. The mean and standard deviation were computed for each influencing factor response. In general, all the factors ranked as important, while uncertainties ranked as moderate within a relatively narrow range. The Study Team discussed the clustered nature of the importance of the factors and concluded that the clustering reflects the process that was used to identify the list of factors. The Partnership Tribes recognized that every factor identified is inherently important when contemplating how tribal water will be developed in the future.

The survey results were averaged for the Lower Basin Partnership Tribes, the Upper Basin Partnership Tribes, and for all Partnership Tribes. The averages were plotted to illustrate the relative importance and relative uncertainty of the mean of each factor (see Table 4-A above for factor numbers). Influencing factors that plotted to the upper right of the graph were viewed to be highly important and highly uncertain, and those that plotted to the lower left were perceived to be of lesser importance and lower uncertainty. The influencing factors that plotted to the lower right were perceived to be of high importance, but with less uncertainty.

The averaged factor plots for the Upper Basin Partnership Tribes are presented in Figure 4-C. The factors clustered closely in the highly important, moderately uncertain range. Nonetheless, the governance factor related to future flexibility in laws, policies, and regulations (No. 20) and the factor related to the understanding of Indian reserved water rights by others plotted as the most important (No. 23). The infrastructure factors related to federal financial resources available to operate and maintain existing domestic and municipal infrastructure, as well as build new infrastructure, ranked as the most uncertain factors (Nos. 12b and 13b).

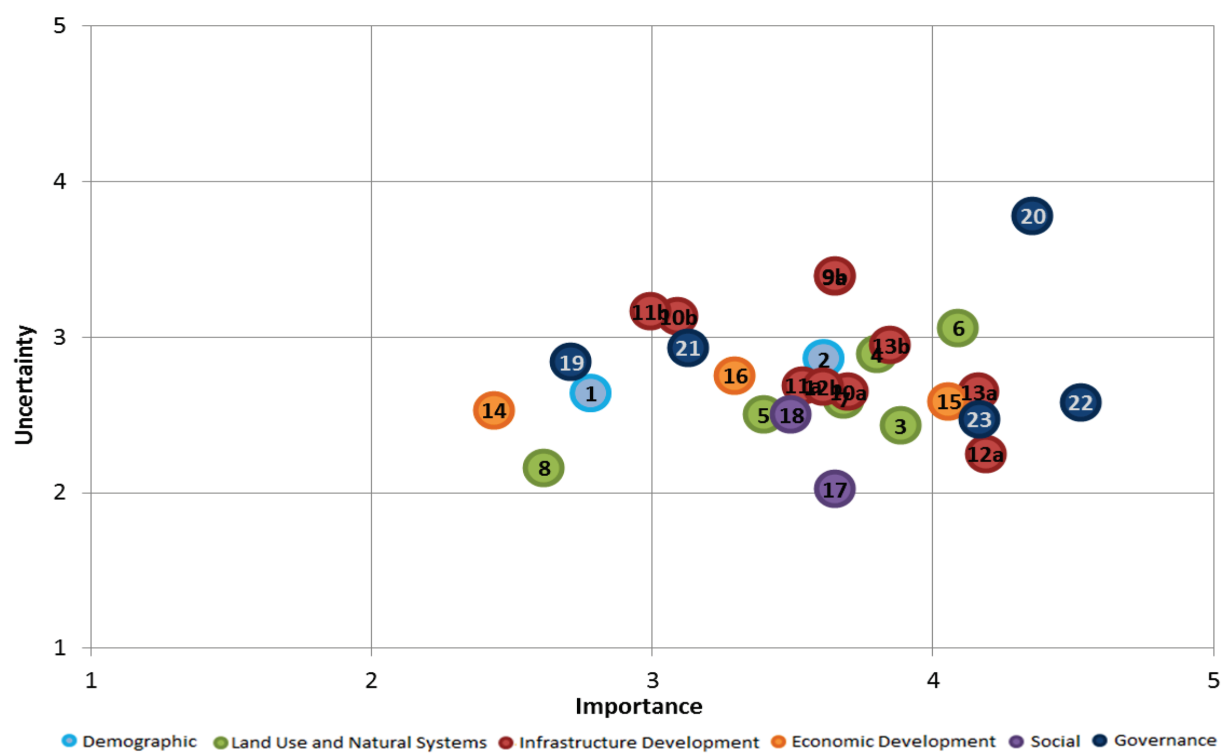
**FIGURE 4-C**
Influencing Factor Survey Results, Upper Basin Partnership Tribes[1, 2]




[1] Ute Indian Tribe, Southern Ute Indian Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation, and Navajo Nation.
[2] Each point corresponds with one of the influencing factor categories as indicated by the color of the point.

The factor survey results presented a wider range of importance and uncertainty for the Lower Basin Partnership Tribes (Figure 4-D); however, as in the Upper Basin, factors related to governance were most important (Nos. 20, 22, and 23), and those related to the availability of federal financial resources for infrastructure were most uncertain (Nos. 9b, 10b, and 11b).

**FIGURE 4-D**
Influencing Factor Survey Results, Lower Basin Partnership Tribes[1, 2]




[1] Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe.
[2] Each point corresponds with one of the influencing factor categories, indicated by the color of the point.

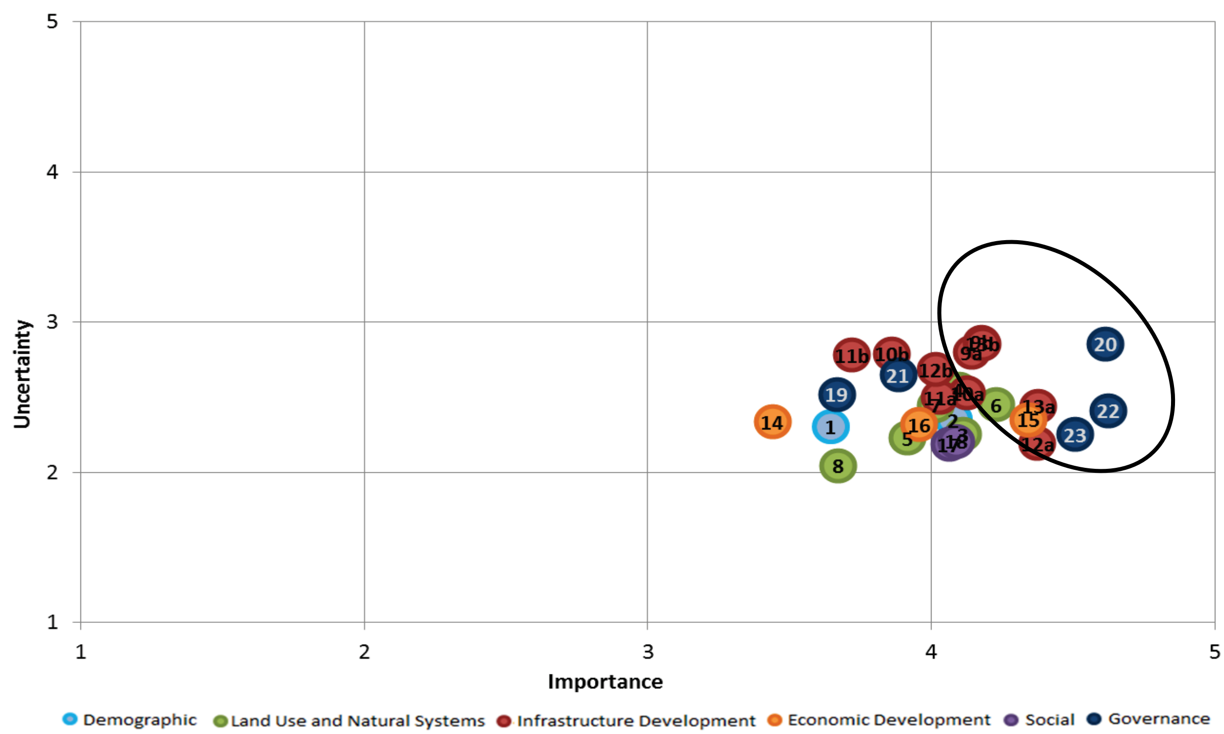
The commonalities between the Partnership Tribes' rankings in the Upper Basin and Lower Basin relate to governance factors (No. 20-23) and the availability of federal financial resources for infrastructure (No. 9-13). There were understandable differences in the key factors that influence tribal water development based on reservation geography and the status of infrastructure systems including:

- The Upper Basin Partnership Tribes consider irrigation infrastructure to be more important than domestic and municipal infrastructure; the Lower Basin Tribes consider the opposite.
- The Upper Basin Partnership Tribes consider federal funding for infrastructure to be more important than tribal financial resources; the Lower Basin Tribes consider the opposite.
- The Lower Basin Partnership Tribes consider non-tribal population growth adjacent to reservations more important than on-reservation population growth; the Upper Basin Tribes consider both to be equally important.
- The Upper Basin Partnership Tribes consider changes in patterns of use due to drought and/or climate variability more important than do the Lower Basin Tribes.

### *4.2.4 Identify Key Influencing Factors*

The Tribal Water Study's key influencing factors were those the survey participants considered most important and most uncertain. The averaged factor results for all Partnership Tribes were plotted (Figure 4-E) with those ranked as more important and more uncertain (located towards the upper right portion of the graph) selected as key influencing factors. These are represented within the black oval. For other factors that appeared to have similar relative rankings, the Study Team used its judgment and expertise to determine whether the factor should be considered as a key influencing factor. The key influencing factors selected for the Study are listed in Table 4-B.

**FIGURE 4-E**
Influencing Factor Survey Results, All Partnership Tribes[1, 2]




[1] Ute Indian Tribe, Southern Ute Indian Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation and Navajo Nation Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe.

[2] Each point corresponds with one of the influencing factor categories, indicated by the color of the point.

**TABLE 4-B**
Key Factors Influencing Future Tribal Water Development

| | |
|---|---|
| **Demographic** | |
| Changes in non-Indian populations adjacent to reservations [Factor No. 2] | |
| **Land Use and Natural Systems** | |
| Changes in agricultural irrigation practices [Factor No. 4] | |
| Changes in water quality (including those that are physical, biological, and chemical in nature) [No. 6] | |
| **Infrastructure Development** | |
| Changes in tribal/federal financial resources available to expand tribal housing and related infrastructure [Factor No. 9] | |
| | 9a. Changes in tribal financial resources |
| | 9b. Changes in federal financial resources |
| Changes in tribal/federal financial resources available to operate and maintain existing water delivery systems and storage for irrigation purposes (includes repairing, rehabilitating, and replacing agricultural and storage infrastructure) [Factor No. 10] | |
| | 10a. Changes in tribal financial resources |
| | 10b. Changes in federal financial resources |
| Changes in tribal/federal financial resources available to construct new water delivery systems and storage for irrigation purposes [Factor No. 11] | |
| | 11a. Changes in tribal financial resources |
| | 11b. Changes in federal financial resources |
| Changes in tribal/federal financial resources available to operate and maintain existing water delivery systems and storage for domestic and municipal purposes (includes repairing, rehabilitating, and replacing delivery, distribution, and storage infrastructure) [Factor No.12] | |
| | 12a. Changes in tribal financial resources |
| Changes in tribal/federal financial resources available to construct new water delivery systems and storage for domestic and municipal purposes [Factor No. 13] | |
| | 13a. Changes in tribal financial resources |
| | 13b. Changes in federal financial resources |
| **Economic Development** | |
| Changes in water needs to support tribal economic development (*e.g.*, eco and cultural tourism, commercial and business centers, etc.) [Factor No. 15] | |
| **Governance** | |
| Changes in tribal water availability and use due to the resolution and settlement of tribal water rights claims [Factor No. 19] | |
| Changes in the laws, policies, and/or regulations to provide increased flexibility to tribes to use tribal water [Factor No. 20] | |
| Changes in federal, state, and/or regional water administration practices [Factor No. 21] | |
| Changes in tribal expertise and resources available for tribal water use planning [Factor No. 22] | |
| Changes in the understanding of tribal reserved water rights by federal, state, other governmental agencies and the public at large (*e.g.*, external education) [Factor No. 23] | |

### 4.2.5 Identify Possible Range of Key Influencing Factor Outcomes

The Study Team considered a potential future range for each key influencing factor. Using current societal and governance trends, the Study Team discussed how tribal water development could unfold if these trends continue through 2060. For example, the current trend for one factor considers changes in agricultural irrigation practices (Factor No. 4) by accounting for the time it takes tribes to adopt new irrigation methods or technologies which may improve efficiencies. The Study Team also qualitatively assessed each key influencing factor to determine a fast (high) and slow (low) water development rate above and below the current trend. This effort provided a full range of potential future outcomes for each key influencing factor, see *Appendix 4B – Potential Ranges of Key Influencing Factor Outcomes.*

### 4.2.6 Develop Storylines

The Study Team developed storylines that capture the range of potential future water development for four scenarios. The storylines provide a narrative description of the effect on the key influencing factors under the scenario. The scenarios and associated themes are listed below, and the storylines are presented in *Appendix 4C – Tribal Water Development Scenario Storylines*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreased flexibility in governance of tribal water, decreased levels of funding, and slower resolution of tribal claims all slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

### 4.2.7 Quantify Future Tribal Water Development Scenarios

Each Partnership Tribe considered its reservation's water development through 2060 by reviewing its current water use and reflecting upon how it might change under the four scenarios. Through extensive communications with Reclamation, each Partnership Tribe prepared future water development schedules associated with the scenarios. During this effort, the Partnership Tribes were asked to consider such elements as the conditions described in the storyline narratives, current or future planned projects, anticipated changes in sector water use, and existing or new infrastructure needed to support water development on their reservations.

Each Partnership Tribe assessed future water development if current trends (Scenario A) continued through 2060. Because of complexities with reserved water rights and unresolved claims, the Upper Basin Partnership Tribes generally assessed their future development at the tributary or sub-basin level, while the Lower Basin Partnership Tribes did so at a state level.[1]

Working from the Current Water Development Trends (Scenario A) schedule, each Partnership Tribe prepared schedules to reflect how the other scenario storylines (Scenarios B, C1, and C2) could affect future water development. The future water development schedules were then modeled using Colorado River Simulation System (CRSS) to assess changes to the Colorado River System. The quantified future water development schedules and the supporting considerations are tribe-specific and documented for each Partnership Tribe in *Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development*.

[1] For additional information, see *Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development.*

# Appendix 4A
# Influencing Factors Survey

# Appendix 4A – Influencing Factors Survey

## Colorado River Basin Ten Tribes Partnership Tribal Water Study Influencing Factors Survey

**(Finalized January 2016)**

### Instructions and Guidance for Completing the Influencing Factors Survey

As part of the Colorado River Basin Ten Tribes Partnership Tribal Water Study (Study), the Study Team (the Bureau of Reclamation and the Ten Tribes Partnership) is undertaking a planning process to develop scenarios regarding how the tribes of the Ten Tribes Partnership may develop and use their water over the next approximately 50 years. Important steps in this process are to identify the key factors that are likely to impact how such development and use will occur (called "influencing factors"), and then to survey tribal representatives to identify those influencing factors that are both highly important and highly uncertain (known as "critical uncertainties"). These critical uncertainties will form the basis for the Study's tribal water development and use scenarios.

The Study is being conducted by both Reclamation and the Ten Tribes Partnership, and the list of influencing factors in the attached survey was jointly developed. The purpose of the survey is to receive input from tribal representatives on the relative "importance" (how important the factor will be in influencing future tribal development and use) and "uncertainty" (how certain the changes in the factor are over time) of each of the influencing factors through 2060. This input will be used to identify which influencing factors are critical uncertainties. Additionally, this input will help inform subsequent phases of the Study where issues related to future use and/or development of tribal water will be discussed.

The purpose of the Study is to identify, for the tribes of the Ten Tribes Partnership, tribal water supplies, document current tribal water use on Partnership reservations, project future water development on Partnership reservations, document use of unused tribal water by others, and identify tribal opportunities and challenges associated with the development of tribal water, considering the future projected water supply and demand imbalances documented in the Colorado River Basin Study. Specific objectives of the Study that will be addressed through the scenario planning process include:

- Characterize a range of future tribal water development and use for each of the tribes in the Partnership
- Identify potential future impacts to specific users, or groups of users, presently relying on unused tribal water
- Identify tribal water development challenges both specific to the tribes in the Partnership and in general Basin-wide

### Survey Format

The survey includes a list of factors that influence how tribal water will be developed and used in the future. Each respondent is requested to independently rate (using a scale of 1 through 5, with 5 being the highest) the relative "importance" and "uncertainty" associated with each factor with respect to the objectives of the Study being addressed through the scenario planning process:

> **Importance** (1 through 5): Rate how important the factor will be in influencing tribal development and use of its water (from the Colorado River and its tributaries) through 2060.
>
> **Uncertainty** (1 through 5): Rate how certain you are regarding how that factor will change between now and 2060.

Respondents are encouraged to provide comments related to each response. These comments will help the Study Team better analyze the input received, particularly for high and low ratings.

### Guidance for Completing the Survey

The list of influencing factors is intended to be relatively broad to capture the large-scale mechanisms that influence how tribal water will be developed and used in the future. Not every variation of influencing factors is necessary at this point, as details of the critical uncertainties will be explored in the next steps of the scenario planning process. However, please provide any comments you have that may help us better understand your views regarding a particular influencing factor. Some additional guidance may be helpful in the completion of the survey:

1. Relate all ratings to the relevant Study objectives:
    a. Characterize a range of future tribal water development and use for each of the tribes in the Partnership
    b. Identify potential future impacts to specific users, or groups of users, presently relying on unused tribal water
    c. Identify tribal water development challenges both specific to the tribes in the Partnership and in general Basin-wide
2. Consider the current impact of the influencing factors on tribal water development and use in addition to evolving trends and the range of effects of the factors through 2060
    a. How important is the influencing factor on development and use today? What are the current trends in these factors? Are the future trends likely to following the same trajectory? What is the magnitude of these influences? How may future changes in a factor impact development and use?
3. Keep your ratings of importance and uncertainty separate
    a. Importance is a relative measure of the magnitude of impact of the influencing factor on Tribal water development and use.
    b. Uncertainty is a relative measure of how certain you are regarding how the factor will change between now and 2060.
4. Keep in mind that the survey is a relative comparison of the listed influencing factors
    a. You may wish to make two or more passes through the survey—the first to gauge an initial response and baseline and subsequent passes to compare and identify the <u>relative</u> rating of all influencing factors.

**Influencing Factors Survey**

**Importance and Uncertainty of Factors Influencing Tribal Water Development and Use**

Please return completed survey by January 29, 2016

| | | | |
|---|---|---|---|
| **Name (optional):** | | **Title (optional):** | |
| **Tribe (optional):** | | | |
| **Importance** (1–5): Rate how important the factor will be in influencing tribal development and use of water from the Colorado River and its tributaries through 2060.<br>1=Unimportant, 3=Important, 5=Very Important | | | |
| **Uncertainty** (1–5): Rate how certain you are regarding how that factor will change between now and 2060.<br>1=Certain, 3=Uncertain, 5=Very Uncertain | | | |
| Enter "NA" if you are unfamiliar with the influencing factor (Note: will not be included in final rating) | | | |

| No. | Influencing Factors | Importance | Uncertainty | Comment |
|---|---|---|---|---|
| Demographic | | | | |
| 1. | Changes in reservation populations and their distribution | | | |
| 2. | Changes in non-Indian populations adjacent to reservations | | | |
| Land Use and Natural Systems | | | | |
| 3. | Changes in agricultural land use (e.g. irrigated agricultural areas, crop mixes, etc.) | | | |
| 4. | Changes in agricultural irrigation practices<br>*Description: This factor could include changes in the irrigation of agricultural lands by the adoption of new methods or technologies to improve the efficiency of irrigation systems when using water.* | | | |
| 5. | Changes in the needs of environmental resources that are dependent on water (e.g. fish and aquatic wildlife, riparian habitat, etc.) including those related to Endangered Species Act (ESA)-listed species | | | |
| 6. | Changes in water quality (including those that are physical, biological, and chemical in nature) | | | |

**Influencing Factors Survey**
**Importance and Uncertainty of Factors Influencing Tribal Water Development and Use**
Please return completed survey by January 29, 2016

| No. | Influencing Factors | Importance | Uncertainty | Comment |
|---|---|---|---|---|
| 7. | Changes in the resources and technology available to treat poor quality tribal water | | | |
| 8. | Changes in patterns of use and/or water supply sources (e.g. springs, groundwater, streams, etc.) due to drought and/or climate variability | | | |
| Infrastructure Development | | | | |
| 9. | Changes in tribal/federal financial resources available to expand Tribal housing and related infrastructure<br>*Description: This factor could include changes in Tribal housing and related municipal and domestic water delivery infrastructure serving users such as tribal members, schools, community centers, parks, etc.* | | | |
| | 9a. Changes in tribal financial resources | | | |
| | 9b. Changes in federal financial resources | | | |
| 10. | Changes in tribal/federal financial resources available to **operate and maintain existing** water delivery systems and storage for **irrigation purposes** (includes repairing, rehabilitating, and replacing agricultural and storage infrastructure)<br>*Description: This factor could include influences such as the ability of the tribe to operate, maintain and improve on-and off reservation irrigation and related water delivery systems, including storage facilities.* | | | |
| | 10a. Changes in tribal financial resources | | | |
| | 10b. Changes in federal financial resources | | | |
| 11. | Changes in tribal/federal financial resources available to **construct new** water delivery systems and storage for **irrigation purposes**<br>*Description: This factor could include influences such as the ability of the tribe to construct new on-and off reservation irrigation and related water delivery systems, including storage facilities.* | | | |
| | 11a. Changes in tribal financial resources | | | |
| | 11b. Changes in federal financial resources | | | |

| No. | Influencing Factors | Importance | Uncertainty | Comment |
|---|---|---|---|---|
| 12. | Changes in tribal/federal financial resources available to **operate and maintain existing** water delivery systems and storage for **domestic and municipal purposes** (includes repairing, rehabilitating, and replacing delivery, distribution, and storage infrastructure)<br>*Description: This factor could include influences such as the ability of the tribe to operate, maintain and improve on-and off reservation domestic and municipal delivery systems, including storage facilities.* | | | |
| | 12a. Changes in tribal financial resources | | | |
| | 12b. Changes in federal financial resources | | | |
| 13. | Changes in tribal/federal financial resources available to **construct new** water delivery systems and storage for **domestic and municipal purposes**<br>*Description: This factor could include influences such as the ability of the tribe to construct new domestic and municipal delivery systems, including storage facilities.* | | | |
| | 13a. Changes in tribal financial resources | | | |
| | 13b. Changes in federal financial resources | | | |
| Economic Development | | | | |
| 14. | Changes in water needs for energy generation (e.g. solar, oil shale, thermal, nuclear, hydroelectric, etc.) | | | |
| 15. | Changes in water needs to support tribal economic development (e.g. eco and cultural tourism, commercial and business centers, etc.) | | | |
| 16. | Changes in the local and regional market “value” (i.e., cost) of water (as it relates to different uses, such as the cost of generating energy, commodity prices, cost to pump, leasing, municipal use, etc.) | | | |
| Social | | | | |
| 17. | Changes in cultural and spiritual uses of tribal water | | | |
| 18. | Changes in tribal values affecting water use<br>*Description: This factor could include changes in tribal member priorities related to water use such as in-stream flows, recreation, domestic use, etc.* | | | |

**Influencing Factors Survey**

**Importance and Uncertainty of Factors Influencing Tribal Water Development and Use**

Please return completed survey by January 29, 2016

| No. | Influencing Factors | Importance | Uncertainty | Comment |
|---|---|---|---|---|
| Governance | | | | |
| 19. | Changes in tribal water availability and use due to the resolution and settlement of tribal water rights claims<br>*Description: This factor could include changes in the time it takes to complete Indian water settlements and in tribal member support for these settlements and water development plans.* | | | |
| 20. | Changes in the laws, policies, and/or regulations to provide increased flexibility to tribes to use tribal water<br>*Description: This factor could include changes to provide for increased use of water banking, water marketing, leasing, etc. and changes that further support and facilitate use of tribal water to support tribal economic development.* | | | |
| 21. | Changes in federal, state, and/or regional water administration practices<br>*Description: This factor could include changes in the accounting of tribal water in the Colorado River system, and tracking and ensuring deliveries during all hydrologic conditions, and changes in the ability to ensure water is delivered to a specific entity or location.* | | | |
| 22. | Changes in tribal expertise and resources available for tribal water use planning<br>*Description: This factor could include changes in tribal economic and other resources for tribal water resources planning and management, changes in Congressional appropriations to support water use development and planning, and changes in cooperative efforts with State and regional non-Indian water development planning.* | | | |
| 23. | Changes in the understanding of tribal reserved water rights by Federal, State, other governmental agencies and the public at large (e.g. external education) | | | |

# Appendix 4B
# Potential Ranges of Key Influencing Factor Outcomes

# Appendix 4B – Potential Ranges of Key Influencing Factor Outcomes

**(Finalized June 2016)**

A full range of potential future outcomes for each key influencing factor is presented in Table 4B-A.

**TABLE 4B-A**
Key Factors Influencing Future Tribal Water Development

| Influencing Factor Categories | TWS Critical Uncertainties Identified in Survey | Affected Water Use Category[1] | Description of Influencing Factors if Current Trends Continues | Plausible Low End of Range | Plausible High End of Range |
|---|---|---|---|---|---|
| Demographic | Changes in non-Indian populations adjacent to reservations [2] | AG: No<br>DCMI: Yes (Lower Basin focus)<br>ENV: Yes (Lower Basin focus)<br>TRAN: No | DCMI:<br>Steady growth along river corridors and gradual increase in demands for tribal water. | DCMI:<br>No or slow growth in off-reservation population would leave demand steady. | DCMI:<br>Rapid growth increasing demand, contamination, and environmental impact. |
| Land Use and Natural Systems | Changes in agricultural irrigation practices [4]<br><br>*Description: This factor could include changes in the irrigation of agricultural lands by the adoption of new methods or technologies to improve the efficiency of irrigation systems when using water.* | AG: Yes (Lower Basin focus)<br>DCMI: No<br>ENV: Yes (Lower Basin focus)<br>TRAN: Yes (Lower Basin focus) | AG:<br>Current trend is for slow adoption of new irrigation methods or technologies, which may improve efficiencies. | AG:<br>No change in AG irrigation practices. | AG:<br>Aggressive adoption of more efficient methods or technologies leading to increased productivity and potentially making water available for additional uses. |
| | Changes in water quality (including those that are physical, biological, and chemical in nature) [6] | All | Slow deterioration of water quality throughout the Basin from contamination leading to more regulation of drinking water and increasing treatment costs and impacts to ecosystems. | Rapid deterioration of water quality throughout the Basin from concentrated contamination leading to more regulation of drinking water and increasing treatment costs and impacts to ecosystems. | Improved water quality throughout the Basin possibly increasing efficiencies and reducing treatment costs and impacts to ecosystems. |

[1] AG – Irrigated Agriculture and Livestock; DCMI – Domestic, Commercial, Municipal, and Industrial; ENV – Environmental, Cultural, and Recreational; TRAN – Transfers, Leases, and Exchanges

**TABLE 4B-A**
Key Factors Influencing Future Tribal Water Development

| Influencing Factor Categories | TWS Critical Uncertainties Identified in Survey | Affected Water Use Category[1] | Description of Influencing Factors if Current Trends Continues | Plausible Low End of Range | Plausible High End of Range |
|---|---|---|---|---|---|
| Infrastructure Development | Changes in tribal financial resources available to expand Tribal housing and related infrastructure [9a]<br><br>*Description: This factor could include changes in Tribal housing and related municipal and domestic water delivery infrastructure serving users such as tribal members, schools, community centers, parks, etc.* | AG: No<br>DCMI: Yes<br>ENV: No<br>TRAN: No | DCMI:<br>Tribes maintain current funding levels. Tribes maintain current tribal housing trends – development of tribal homelands increases gradually over time. | DCMI:<br>Tribal funding stops. Development of tribal homelands decreases over time leading to an increase in multi-family housing and/or more families moving off reservation for housing. | DCMI:<br>Tribal funding increases. More housing projects funded. Rate of tribal water development increases as tribal homelands develop to provide more tribal housing and allowing an increased standard of living and higher per capita water use. |
| | Changes in federal financial resources available to expand Tribal housing and related infrastructure [9b]<br><br>*Description: This factor could include changes in Tribal housing and related municipal and domestic water delivery infrastructure serving users such as tribal members, schools, community centers, parks, etc.* | AG: No<br>DCMI: Yes<br>ENV: No<br>TRAN: No | DCMI:<br>Federal financial resources continue to decline. Development of tribal homelands continues to decline and families move off reservation for housing. | DCMI:<br>Federal funding stops. Development of tribal homelands declines at a faster rate leading to an increase in multi-family housing and/or more families moving off reservation for housing. | DCMI:<br>Increase in federal funds. More housing projects funded. Rate of tribal water development increases as tribal homelands develop to provide more tribal housing and allowing an increased standard of living and higher per capita water use. |
| | Changes in tribal financial resources available to operate and maintain existing water delivery systems and storage for irrigation purposes (includes repairing, rehabilitation, and replacing agricultural and storage infrastructure) [10a]<br><br>*Description: This factor could include influences such as the ability of the tribe to operate, maintain and improve on- and off-reservation irrigation and related water delivery systems, including storage facilities.* | AG: Yes<br>DCMI: No<br>ENV: No<br>TRAN: No | AG:<br>Tribes maintain current funding levels for OMR. Tribes maintain current water use trends. | AG:<br>Tribal funding decreases. Efficiencies and productivity decrease as systems decline. | AG:<br>Tribal funding increases leading to increased efficiencies and productivity. |

**TABLE 4B-A**
Key Factors Influencing Future Tribal Water Development

| Influencing Factor Categories | TWS Critical Uncertainties Identified in Survey | Affected Water Use Category[1] | Description of Influencing Factors if Current Trends Continues | Plausible Low End of Range | Plausible High End of Range |
|---|---|---|---|---|---|
| Infrastructure Development | Changes in federal financial resources available to operate and maintain existing water delivery systems and storage for irrigation purposes (includes repairing, rehabilitating, and replacing agricultural and storage infrastructure) [10b]<br><br>*Description: This factor could include influences such as the ability of the tribe to operate, maintain and improve on-and off reservation irrigation and related water delivery systems, including storage facilities.* | AG: Yes<br>DCMI: No<br>ENV: No<br>TRAN: No | AG:<br>Federal funding levels continue to decline leading to a gradual deterioration of irrigation systems and efficiency. | AG:<br>Federal funding stops leading to a deterioration of irrigation systems and a decrease in efficiency of water use leading to a potential decline in crop production. | AG:<br>Federal funding increases and irrigation systems become more efficient leading to improved crop production. |
| | Changes in tribal financial resources available to construct new water delivery systems and storage for irrigation purposes [11a]<br><br>*Description: This factor could include influences such as the ability of the tribe to construct new on- and off-reservation irrigation and related water delivery systems including storage facilities* | AG: Yes<br>DCMI: No<br>ENV: No<br>TRAN: No | AG:<br>Tribes maintain current funding levels for new construction. Tribes maintain current water use trends. | AG:<br>Tribal funding decreases or remains at $0. New construction activities remain stagnant or decline. | AG:<br>Tribal funding increases leading to an increase in new construction activities, increase water use and crop production. |
| | Changes in federal financial resources available to construct new water delivery systems and storage for irrigation purposes [11b]<br><br>*Description: This factor could include influences such as the ability of the tribe to construct new on- and off-reservation irrigation and related water delivery systems including storage facilities* | AG: Yes<br>DCMI: No<br>ENV: No<br>TRAN: No | AG:<br>Federal funding levels continue to decline leading to stagnant development. | AG:<br>Federal funding stops leading to no new development. | AG:<br>Federal funding levels increase leading to an increase in new construction activities, increase water use and crop production leading to robust development. |

**TABLE 4B-A**
Key Factors Influencing Future Tribal Water Development

| Influencing Factor Categories | TWS Critical Uncertainties Identified in Survey | Affected Water Use Category[1] | Description of Influencing Factors if Current Trends Continues | Plausible Low End of Range | Plausible High End of Range |
|---|---|---|---|---|---|
| Infrastructure Development | Changes in tribal financial resources available to operate and maintain existing water delivery systems and storage for domestic and municipal purposes (includes repairing, rehabilitating, and replacing delivery, distribution, and storage infrastructure) [12a]<br><br>*Description: This factor could include influences such as the ability of the tribe to operate, maintain and improve on-and off reservation domestic and municipal delivery systems, including storage facilities.* | AG: No<br>DCMI: Yes<br>ENV: No<br>TRAN: No | DCMI:<br>Tribes maintain current funding levels. Current tribal water development trends maintained. | DCMI:<br>Tribes' funding decreases or remains at $0. Deliveries decrease over time as systems deteriorate, emergency situations increase, reliance on private wells increases and per capita water use decreases. | DCMI:<br>Tribes' funding increases. Deliveries increase and systems improve over time leading to higher per capita water use. |
| | Changes in tribal financial resources available to construct new water delivery systems and storage for domestic and municipal purposes [13a]<br><br>*Description: This factor could include influences such as the ability of the tribe to construct new domestic and municipal delivery systems, including storage facilities.* | AG: No<br>DCMI: Yes (Upper Basin focus)<br>ENV: No<br>TRAN: No | DCMI:<br>Tribes maintain current funding levels. Current rate of tribal infrastructure projects and water development maintained. | DCMI:<br>Reduction in tribal financial resources or remain at $0; unable to fund water infrastructure projects. Reduced availability to safe and accessible water leading to decreased per capita water use, decreased standard of living, slower economic growth, and increased poverty. | DCMI:<br>Increase in tribal financial resources; more water infrastructure projects funded. Rate of tribal water development increases leading to higher per capita water use, increased standard of living, higher economic growth, and decreased poverty. |
| | Changes in federal financial resources available to construct new water delivery systems and storage for domestic and municipal purposes [13b]<br><br>*Description: This factor could include influences such as the ability of the tribe to construct new domestic and municipal delivery systems, including storage facilities.* | 1) AG: No<br>2) DCMI: Yes (Lower Basin focus)<br>3) ENV: No<br>4) TRAN: No | 2) DCMI:<br>Federal financial resources continue to decline. Tribal water development trends continue to decline. | 2) DCMI:<br>Federal financial resources are stopped; unable to fund water infrastructure projects. Reduced availability to safe and accessible water leading to decreased per capita water use, decreased standard of living, slower economic growth, and increased poverty. | 2) DCMI:<br>Increase in federal financial resources; more water infrastructure projects funded. Rate of tribal water development increases leading to higher per capita water use, increased standard of living, higher economic growth, and decreased poverty. |

**TABLE 4B-A**
Key Factors Influencing Future Tribal Water Development

| Influencing Factor Categories | TWS Critical Uncertainties Identified in Survey | Affected Water Use Category[1] | Description of Influencing Factors if Current Trends Continues | Plausible Low End of Range | Plausible High End of Range |
|---|---|---|---|---|---|
| Economic Development | Changes in water needs to support tribal economic development (e.g. eco and cultural tourism, commercial and business centers, etc.) [15] | 1) AG: Yes<br>2) DCMI: Yes (varied by tribe)<br>3) ENV: Yes<br>4) TRAN: No | 1) AG:<br>2) DCMI:<br>3) ENV:<br>Current water needs maintained – economic development trend slightly up leading to a slow increase in per capita water use, standard of living, economic growth. | 1) AG:<br>2) DCMI:<br>3) ENV:<br>Current water needs maintained – economic development trend slightly up leading to a slow increase in per capita water use, standard of living, economic growth. | 1) AG:<br>2) DCMI:<br>3) ENV:<br>Rate of water development increases leading to higher water use, increased standard of living, higher economic growth, and decreased poverty. |
| Governance | Changes in tribal water availability and use due to the resolution and settlement of tribal water rights claims [19]<br><br>*Description: This factor could include changes in the time it takes to complete Indian water settlements and in tribal member support for these settlements and water development plans.* | All (Upper Basin focus) | Current rate of progress in resolution and settlement of tribal water claims continues. | Decrease in rate of resolution and settlement of water right claims leaving tribes with uncertainty as to their ability to fully develop tribal economies. | Increase in rate of resolution and settlement of tribal water rights claims leaving tribes with more certainty as to their ability to fully develop tribal economies and improved system-wide understanding of delivery risks. |
| | Changes in the laws, policies, and/or regulations to provide increased flexibility to tribes to use tribal water [20]<br><br>*Description: This factor could include changes to provide for increased use of water banking, water marketing, leasing, etc. and changes that further support and facilitate use of tribal water to support tribal economic development.* | All | Gradual increase in flexibility; current water development trends maintained. | Decreased flexibility in existing policies and regulations limits off-reservation use of tribal water leading to increased on-reservation tribal water use. | Increased flexibility in existing policies and regulations leads to innovative uses and increased off-reservation development of tribal water throughout Basin. |

**TABLE 4B-A**
Key Factors Influencing Future Tribal Water Development

| Influencing Factor Categories | TWS Critical Uncertainties Identified in Survey | Affected Water Use Category[1] | Description of Influencing Factors if Current Trends Continues | Plausible Low End of Range | Plausible High End of Range |
|---|---|---|---|---|---|
| Governance | Changes in federal, state, and/or regional water administration practices [21]<br><br>*Description: This factor could include changes in the accounting of tribal water in the Colorado River System, and tracking and ensuring deliveries during all hydrologic conditions, and changes in the ability to ensure water is delivered to a specific entity or location.* | All (Upper Basin focus) | Current trends in administration of water use varies from stringent to minimal leading to challenges in coordinating administration among federal, state and tribal users and increased uncertainty and conflict. | Severe decrease in administration of water use leading to uncertainty in tribal water rights and increase in conflicts. | Upper Basin: Increase in cooperation and coordination in state and tribal water administration leads to less conflict and certainty in tribal water rights.<br><br>Lower Basin: Increase in cooperation and coordination in federal and tribal water administration leads to less conflict and certainty in tribal water rights. |
| | Changes in tribal expertise and resources available for tribal water use planning [22]<br><br>*Description: This factor could include changes in tribal economic and other resources for tribal water resources planning and management, changes in Congressional appropriations to support water use development and planning, and changes in cooperative efforts with State and regional non-Indian water development planning.* | All | Gradual increase in tribal expertise - gradual increase in tribal water planning and development. | Loss of tribal expertise; loss of federal funding to support tribal water resources planning - gradual decrease in tribal water planning and development. | More tribal expertise for water resources planning and management leads to faster increase in tribal water planning and development. |
| | Changes in the understanding of tribal reserved water rights by Federal, State, other governmental agencies and the public at large (e.g. external education) [23] | All | Current understanding is maintained leads to restricted water development. | Decreased understanding of tribal water rights leads to litigation and increased conflict. | Increased understanding of tribal reserved water rights leads to increased flexibility in Basin water development and use. |

# Appendix 4C
# Tribal Water Development Scenario Storylines

# Appendix 4C – Tribal Water Development Scenario Storylines

## Storyline for the Current Water Development Trends (Scenario A)

**(Finalized June 2016)**

**THEME:** *Current trends in on-Reservation water development, governance, funding, and resolution of Tribal claims remain the same.*

## Demographics

### Population Adjacent to Reservation (non-Tribal)

Recent decades have seen steady growth of non-Tribal populations along both the lower main stem Colorado River and tributary river corridors. Where these population centers adjoin or overlap Tribal communities, demand on Tribal water resources typically increases to service the needs of the additional residential, municipal and industrial or agricultural activity.

Despite the high current demand, certain legal, structural and social impediments prevent rapid increase of Tribal water usage by non-Tribal users. Legally, many Tribes are constrained from engaging in marketing and transfer opportunities enjoyed by other water rights holders in the Colorado River Basin.

## Land Use and Natural Systems

### Agricultural Irrigation Efficiencies

Current on-reservation development includes slow adoption of new irrigation methods and/or technologies, which may improve water efficiencies.

Traditional irrigation practices - ditch and turn-out ‘flood irrigation’ - remains the most common approach to large-scale agricultural enterprises on Tribal lands within the Colorado River Basin. Adoption of higher-efficiency delivery technologies (e.g., sprinkler and drip irrigation systems) may result in some additional quantities of water being made available for expansion of cropped acreage, and alternative uses.

### Water Quality

Slow deterioration of water quality from contamination leads to increasing regulation of drinking water, increasing treatment costs and adverse environmental impacts. Slow deterioration of water quality may also lead to a slow decrease in agricultural productivity.

A potential limiting factor for increased development of Tribal water resources is evident in the gradual deterioration of water quality within the Colorado River Basin. The current trend shows increasing contamination of system water as it cycles through the Basin to Mexico. As supplies now fall well short of demand, little system water passes through without being utilized multiple times. No ‘flushing’ or dilution water remains in the system to offset salt and contaminant loading that occurs both naturally and as a byproduct of current municipal, industrial and agricultural practices. Drought conditions exacerbate the water quality problems faced by users throughout the system.

## Infrastructure Development

Across the basin a decline in federal funding to support Tribal development is observed, leading to a higher dependency on Tribal funds to support water infrastructure development, operation and maintenance. Tribal funding is maintained at current levels, but is not enough to offset the loss of federal funding. Current infrastructure limitations also prevent economically viable use of full apportionments in many Tribal communities.

### Financial Resources Available to Expand Tribal Housing and Related Infrastructure

#### Tribal Funding

Tribal funding levels and housing trends are maintained continuing the gradual development of Tribal housing and related infrastructure over time. On-reservation Tribal population grows gradually, but is underserved generally, at present; thus demand exists for expanded Tribal-funded housing and related water infrastructure. Funds availability is a limiting factor in determining whether and at what rate Tribal-funded housing expands.

#### Federal Funding

Federal funding continues to decline, leading to a decrease in the development of Tribal housing and increasing inter-generational family housing and/or off-reservation housing. Tribes generally lack sufficient internal funds to keep pace with demand for housing. Without continued access to federal low-cost loans or grant funding, Tribal housing will slow to a rate dependent solely on Tribal economic sustainability. Water usage will remain similar to current patterns, as will existing efficiency values. Adoption of water-saving technologies is slowed.

### Financial Resources Available to Operate and Maintain Existing Irrigation Infrastructure

#### Tribal Funding

Tribal funding is maintained for the operation, maintenance, and repair of irrigation systems and storage facilities. Water use remains similar to present patterns, and costs of system maintenance, repairs, rehabilitation and replacement increase gradually over time or are deferred altogether where the cumulative costs of maintaining the system may begin to outweigh the benefits.

#### Federal Funding

Federal funding continues to decline, leading to continued deterioration of irrigation systems, storage facilities, and efficiency. Water use increases over time to the extent systems remain operable, but efficiency decreases as systems age without sufficient funding for maintenance, repairs, rehabilitation and replacement.

### Financial Resources Available to Construct New Irrigation Infrastructure

#### Tribal Funding

Tribal funding is maintained for construction of new irrigation systems and storage facilities. The ability of tribes to self-fund major irrigation infrastructure projects remains uncertain, but where possible, a gradual increase in developed water resources can be expected.

#### Federal Funding

Federal funding continues to decline, leading to minimal construction of new irrigation systems and storage. Tribes remain less able to develop their agricultural resources to improve the reservation economy. There may be a gradual increase in developed water resources where Tribal funds remain available to continue development.

### Tribal Funds to Operate and Maintain Existing Domestic and Municipal Infrastructure

Tribal funding is maintained to operate and maintain existing Domestic, Commercial, Municipal and Industrial (DCMI) infrastructure. No increase in usage, but efficiencies possible where O&M replacements adopt and utilize newer technologies. Lack of economic development puts pressure on existing domestic water customers to fund operation, maintenance and replacement costs.

### Financial Resources Available to Construct New Domestic and Municipal Infrastructure

Tribal Funding

Tribal funding is maintained for construction of new DCMI infrastructure. There is a gradual increase in water usage - depending on rate of population growth and economic factors. There is also the potential for improved efficiencies where new technologies can be utilized.

Federal Funding

Federal funding continues to decline, leading to a decrease in DCMI water development. Water usage remains at current levels, or gradually increases as population rises, or where Tribal funding is available for DCMI development. There is a strong possibility of increased usage as systems deteriorate due to inefficiencies.

## Economic Development

### Economic Development

Current water needs are maintained resulting in a slight increase in economic development and eco-tourism leading to a slow increase in per capita water use, and associated with a slow increase in the standard of living, and Tribal economic growth.

## Social

The cultural and spiritual values of water ranked consistently very important for all Tribes. These values also ranked consistently low on the uncertainty scale indicating highly important values that are not likely to change over time. Each Tribe and the Tribal members maintain their own relationship to water for religious, cultural and spiritual purposes. In general, Tribal societies uniformly revere water for its life-giving, life-sustaining properties. This goes beyond mere recognition of the role water plays in the physical processes of life. Further, they recognize that water is a finite resource. The cultural knowledge of the natural cycles of water relate to the Tribal identity and sense of place.

## Governance

### Resolution and Settlement of Tribal Water Rights Claims

Upper Basin: The current gradual rate of progress to resolve and settle Tribal water claims is maintained resulting in uncertainty towards fully developing Tribal economies. For most Tribes in the Upper Basin, full resolution and implementation of Tribal water rights involves quantification in numerous river basins, negotiations with multiple states, consultation on Endangered Species issues, and the development of new storage facilities.

Lower Basin: The water rights claims for the five Lower Basin Tribes who are members of the Ten Tribes Partnership[1] were decreed in *Arizona v. California* (2006).

### Flexibility in Utilization of Tribal Water

The current limited level of flexibility in existing policies and regulations leads to a gradual increase in Tribal water use. Some tribes in the upper and lower basins may provide water for off-reservation use in accordance with settlements but not all settlements and decrees provide the same flexibility within the Colorado River Basin.

[1] Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, Quechan Tribe and Cocopah Indian Tribe.

### Water Administration Practices

Current trends in the administration of water use by federal, state, and Tribal entities varies from stringent to minimal, leading to challenges in coordinated administration, contributing to uncertainty among users and increased potential for conflict.

### Expertise and Available Resources for Water Planning

Tribal expertise continues to gradually increase, which leads to an associated gradual increase in Tribal water planning, funding and development.

### Understanding of Tribal Reserved Water Rights

The differences in the characteristics of federal reserved Tribal water rights and state based water rights result in misunderstandings that affect the management of water and its development. Therefore, if the current limited understanding of Tribal reserved water rights is maintained, restricted Tribal water development can be expected.

# Storyline for the
# Slow Water Development Trends (Scenario B)

**(Finalized June 2016)**

**THEME:** *Decreases flexibility in governance of Tribal water, levels of funding, and resolution of Tribal claims slow Tribal economic development. This results in a decline in the standard of living and delays resolution of Tribal claims.*

## Demographics

### Population Adjacent to Reservation (non-Tribal)

No or slow growth in off-reservation population leads to no change in the trend of demand for Tribal water by non-Tribal users. If the present trend of brisk non-Tribal population growth adjacent to Tribal communities, and in nearby urban centers, subsides or stalls altogether, water usage patterns will likely remain unaffected, increasing very slowly. If circumstance causes that population to substantially lessen (e.g., due to environmental degradation, climate variations, regional economic slowdown), some decrease in demand, commensurate with the reduction in population would be expected.

## Land Use and Natural Systems

### Agricultural Irrigation Efficiencies

Decreased funding leads to a lack of investment in Tribal agricultural operations. No change is seen in irrigation methods or technologies, resulting in agricultural water demand staying the same.

### Water Quality

Rapid deterioration of water quality from contamination leads to increasing regulation of drinking water, increasing treatment costs, and adverse and longer term adverse environmental impacts. Rapid deterioration of water quality leads to a rapid decrease in agricultural productivity.

Deteriorating water quality results in increased costs of regulatory compliance, requiring enhanced treatment technologies to be employed in municipal and drinking water systems, and industrial water settings. Agricultural impacts include lower crop yield, and increased water use where it becomes necessary to dilute or leach contaminants from croplands. Overall economic efficiency is substantially lower, and water use is higher, as resources otherwise available for improvements to increase irrigation efficiency are instead siphoned off to address water quality problems.

## Infrastructure Development

Federal funding for water infrastructure development stops and Tribal funding declines. As a result, infrastructure development slows.

### Financial Resources Available to Expand Tribal Housing and Related Infrastructure

#### Tribal Funding

Tribal funding declines, leading to a decrease in the development of Tribal housing and related infrastructure, resulting in an increase in intergenerational family housing and/or off-reservation housing and related infrastructure.

Federal Funding

Federal funding stops, leading to a rapid decrease in the development of Tribal housing and related infrastructure and an increase in intergenerational family housing and/or off-reservation housing and related infrastructure.

#### Financial Resources Available to Operate and Maintain Existing Irrigation Infrastructure

Tribal Funding

Tribal funding decreases for operation, maintenance, and repair of irrigation systems and storage facilities leading to a deterioration of irrigation systems and storage facilities, a decrease in water use efficiency and a potential decline in crop production.

Federal Funding

Federal funding stops for operation, maintenance, and repair of irrigation systems and storage facilities, leading to a deterioration of irrigation systems and storage facilities, a decrease in water use efficiency and a potential decline in crop production.

#### Financial Resources Available to Construct New Irrigation Infrastructure

Tribal Funding

Tribal funding decreases and/or remains at $0.00, leading to stagnant or declining construction of new irrigation systems and storage facilities.

Federal Funding

Federal funding stops, leading to no new construction of irrigation systems and storage facilities. This further hinders the resolution and implementation of Tribal water settlements which often include large federal water projects.

#### Tribal Funds to Operate and Maintain Existing Domestic and Municipal Infrastructure

Tribal funding to operate and maintain existing Domestic, Commercial, Municipal and Industrial (DCMI) infrastructure decreases and/or remains at $0.00 leading to a decrease in deliveries as systems deteriorate, an increase in emergency situations, an increase in reliance on private wells, and a decrease in per capita water use.

#### Financial Resources Available to Construct New Domestic and Municipal Infrastructure

Tribal Funding

Tribal funding for construction of new DCMI infrastructure decreases and/or remains at $0.00, leading to a decrease in per capita water use, standard of living, and economic growth.

Federal Funding

Federal funding stops, leading to a decrease in the development of DCMI infrastructure projects resulting in a decrease in per capita water use, standard of living, and economic growth.

### Economic Development

#### Economic Development

With Tribal economic development slowing as a result of decreased funding levels, little to no growth is seen in per capita water use.

### Social

The cultural and spiritual values of water ranked consistently very important for all Tribes. These values also ranked consistently low on the uncertainty scale indicating highly important values that are not likely to change over time. Each Tribe and the Tribal members maintain their own relationship to water for religious, cultural and spiritual purposes. In general, Tribal societies uniformly revere water for its life-giving, life-sustaining properties. This goes beyond mere recognition of the role water plays in the physical processes of life. Further, they recognize that water is a finite resource. The cultural knowledge of the natural cycles of water relate to the Tribal identity and sense of place.

## Governance

### Resolution and Settlement of Tribal Water Rights Claims

Upper Basin: Rate of resolution and settlement of water rights claims decreases, leading to uncertainty as to the ability to fully develop Tribal economies. Slow resolution of Tribal water rights claims hinders the ability to create certainty for other water users in the Basin.

Lower Basin: Full implementation of settled water rights in the Lower Basin slows where federal and Tribal funding is restricted and development opportunities remain limited under the current and policy framework.

### Flexibility in Utilization of Tribal Water

Decreased flexibility in existing policies and regulations limits off-reservation use of Tribal water leading to a gradual increase in on-reservation Tribal water use.

### Water Administration Practices

A decrease in coordination and cooperation among water administrators leads to uncertainty in the implementation of Tribal water rights increasing the potential for conflicts over water.

### Expertise and Available Resources for Water Planning

Loss of Tribal expertise and funding to support Tribal planning leads to a gradual decrease in Tribal water planning efforts which makes it more difficult to access funding and increase development.

### Understanding of Tribal Reserved Water Rights

Decreased understanding of Tribal reserved water rights leads to litigation and increased conflict and uncertainty. This is most likely when there are changes in elected and appointed officials.

# Storyline for the Rapid Water Development Trends (Scenarios C1 and C2)

**(Finalized June 2016)**

**THEME:** *Increased flexibility in governance of Tribal water allows innovative water development opportunities and increased funding availability leads to Tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the Reservation as a homeland and supporting the future needs of Tribal communities. Scenario C1 (C1) considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 (C2) considers complete resolution of claims and implementation of decreed or settled rights.*

## Demographics

### Population Adjacent to Reservation (non-Tribal)

(C1) Moderate off-reservation population growth leads to increased use of Tribal water by non-Tribal users, but slower resolution of claims and settlement implementation also slows full development of Tribal water resources. As a result, the additional demand and development raises the potential for increasing contamination and adverse environmental impacts, while opportunities for Tribal economic development are missed.

(C2) Rapid off-reservation population growth leads to increased demand for Tribal water by non-Tribal users; rapid implementation of settlement rights provides broader opportunity for Tribal water development; however, because of this the potential for increasing contamination and adverse environmental impacts rises as utilization reaches maximum limits throughout the Colorado River Basin system.

## Land Use and Natural Systems

### Agricultural Irrigation Efficiencies

(C1) Moderate adoption of more efficient irrigation methods and/or technologies leads to moderate increase in productivity and the potential for some water to be made available for additional uses. This development will be slowed to the extent that Tribal water rights remain unsettled, and the current structure of laws and regulatory policies continues to impede access to marketing opportunities for Tribes.

(C2) Rapid water development and increased flexibility for Tribes to market water leads to the aggressive adoption of more efficient irrigation methods and/or technologies, which in turn leads to increased productivity or the potential for water to be made available for additional uses.

### Water Quality

(C1) Funding, flexibility, and economic development helps Tribes begin to address water quality issues, but slower resolution of claims and settlement implementation results in Tribes not having as many resources to dedicate to water quality issues. Somewhat improved water quality leads to moderately increased efficiencies, gradual increase in agricultural productivity, a decrease in treatment costs and fewer adverse environmental impacts.

(C2) Complete resolution and/or implementation of Tribal claims results in additional funding availability, increased governance flexibility, and stronger Tribal economies. This enables Tribes to have a more direct role in managing and regulating water quality. Improved water quality leads to increased efficiencies, gradual increase in agricultural productivity, a decrease in treatment costs and fewer adverse environmental impacts.

## Infrastructure Development

(C1) Moderate funding increase from both Tribal and federal sources are available. As a result, moderate growth is seen in infrastructure development, operation and maintenance. Funding opportunities for some infrastructure types are dependent on the resolution of water claims.

(C2) Significant funding increase from both Tribal and federal sources are available. As a result, rapid growth is seen in infrastructure development, operation and maintenance which leads to an increase in the standard of living of Tribal populations and economic growth.

### Financial Resources Available to Expand Tribal Housing and Related Infrastructure

#### Tribal Funding

(C1) Moderate increases in Tribal funding levels lead to moderate increases in housing trends providing moderate development of Tribal housing and related infrastructure over time.

(C2) Tribal funding increases rapidly which leads to rapid increase in housing resulting in development of Tribal housing and related infrastructure with an increased standard of living and higher per capita water use.

#### Federal Funding

(C1) Moderate increases in federal funding leads to moderate increases in housing trends providing a moderate development of Tribal housing resulting in a moderate increase in standard of living and somewhat higher per capita water use.

(C2) A significant increase in federal funding leads to rapid increases in housing trends and development of Tribal housing resulting in an increased standard of living and higher per capita water use.

### Financial Resources Available to Operate and Maintain Existing Irrigation Infrastructure

#### Tribal Funding

(C1) Moderate increase in Tribal funding leads to moderate improvement of irrigation systems and storage facilities, and moderately improved water utilization, water efficiency and crop production.

(C2) Tribal funding rapidly increases leading to rapid improvement of irrigation systems and storage facilities. This leads to significantly improved water utilization, water efficiency and crop production.

#### Federal Funding

(C1) Federal funding moderately increases which leads to moderate improvement of irrigation systems and storage facilities, and moderately improved water utilization, water efficiency and crop production.

(C2) Federal funding rapidly increases which leads to rapid improvement of irrigation systems and storage facilities. This leads to significantly improved water utilization, water efficiency and crop production.

### Financial Resources Available to Construct New Irrigation Infrastructure

Tribal Funding

(C1) Until claims are at least partially resolved, Tribes will likely not direct funding towards construction of new irrigation systems and storage facilities.

(C2) Tribal funding increases and the certainty provided by the full resolution of Tribal water claims leads to an increase in construction of new irrigation systems, and substantial increase in water utilization, water efficiency and crop production.

Federal Funding

(C1) Tribes will not receive federal funding for construction of new irrigation systems and storage facilities until at least partial resolution of water claims.

(C2) Federal funding increases and the certainty provided by the full resolution of Tribal water claims leads to an increase in construction of new irrigation systems and substantial increase in water utilization, water efficiency and crop production.

### Tribal Funds to Operate and Maintain Existing Domestic and Municipal Infrastructure

(C1) Tribal funding to operate and maintain existing Domestic, Commercial, Municipal, and Industrial (DCMI) infrastructure moderately increases which leads to a moderate increase in deliveries and system improvements resulting in slightly higher per capita water use.

(C2) Tribal funding to operate and maintain existing DCMI infrastructure rapidly increases which leads to a rapid increase in deliveries and system improvements resulting in higher per capita water use.

### Financial Resources Available to Construct New Domestic and Municipal Infrastructure

Tribal Funding

(C1) Tribal funding moderately increases which leads to a moderate increase in construction of new DCMI infrastructure and an increase in the rate of Tribal water development resulting in economic growth, higher per capita water use, increased standard of living, and decreased level of poverty.

(C2) Tribal funding rapidly increases which leads to a rapid increase in construction of new DCMI infrastructure and an increase in the rate of Tribal water development resulting in economic growth, higher per capita water use, increased standard of living, and decreased level of poverty.

Federal Funding

(C1) Federal funding moderately increases which leads to a moderate increase in development of DCMI infrastructure projects and a moderate increase in the rate of Tribal water development resulting in economic growth, slightly higher per capita water use, increased standard of living, and decreased level of poverty.

(C2) Federal funding rapidly increases which leads to a rapid increase in development of DCMI infrastructure projects and an increase in the rate of Tribal water development resulting in economic growth, higher per capita water use, increased standard of living, and decreased level of poverty.

# Economic Development

### Economic Development

(C1) Rate of water development moderately increases resulting in a moderate increase in the rate of economic development and eco-tourism which leads to slightly higher per capita water use, increased standard of living, and decreased level of poverty.

(C2) Rate of water development rapidly increases resulting in a rapid increase in the rate of economic development and eco-tourism which leads to higher per capita water use, increased standard of living, and decreased level of poverty.

# Social

The cultural and spiritual values of water ranked consistently very important for all Tribes. These values also ranked consistently low on the uncertainty scale indicating highly important values that are not likely to change over time. Each Tribe and the Tribal members maintain their own relationship to water for religious, cultural and spiritual purposes. In general, Tribal societies uniformly revere water for its life-giving, life-sustaining properties. This goes beyond mere recognition of the role water plays in the physical processes of life. Further, they recognize that water is a finite resource. The cultural knowledge of the natural cycles of water relate to the Tribal identity and sense of place.

# Governance

### Resolution and Settlement of Tribal Water Rights Claims

(C1) Upper Basin: The rate of resolution and settlement of Tribal water rights claims moderately increases, providing some increase in the certainty of Tribal water supplies and opportunities for economic development as well as potential improvements in Tribal standard of living with some improved system wide understanding of Tribal delivery needs. However, the difficulty of obtaining implementation funding for Tribal water settlements prevents Tribes from realizing the full potential for economic development.

(C1) Lower Basin: Implementation of settled water rights moderately increases where federal and Tribal funding is moderately increased and development opportunities expand. However, the difficulty of obtaining implementation funding for decreed Tribal water rights prevents Tribes from realizing the full potential for economic development.

(C2) Upper Basin: The rate of resolution and settlement of Tribal water rights claims rapidly increases which leads to the ability to use Tribal water and greater certainty for the development of Tribal economies and improved system-wide understanding of Tribal delivery needs and decreases uncertainty for non-Tribal users which increases the understanding of water availability risks. Full Tribal water development results in a rapid increase in Tribal standard of living and more rapidly decreasing incidence and levels of poverty.

(C2) Lower Basin: Full implementation of settled water rights rapidly increases where federal and Tribal funding increases and development opportunities expand.

### Flexibility in Utilization of Tribal Water

(C1) Increased flexibility in existing policies and regulations leads to gradual adoption of innovative development options such as water banking, water marketing, forbearance agreements and leasing which leads to increased utilization of Tribal water for off-reservation development and increased economic returns to Tribes. However, the slower resolution of Tribal claims prevents Tribes from realizing the full potential for economic growth.

(C2) The increased flexibility in existing policies and regulations leads to rapid adoption of innovative development options such as water banking, water marketing, forbearance agreements and leasing. This increased flexibility leads to increased utilization of Tribal water for off-reservation development and increased economic returns to Tribes, while also providing options for non-Tribal users to access more reliable water supplies.

### Water Administration Practices

(C1 and C2) Upper Basin: Increase in cooperation and coordination in state and Tribal water administration leads to less conflict and greater certainty in Tribal water rights and Tribal water development. Potential opportunities for innovative water development expand under these consistent and coordinated administration practices. However, varying water administration practices continue to prevent Tribes from realizing the full potential for economic development.

(C1 and C2) Lower Basin: Increase in cooperation and coordination in federal and Tribal water administration leads to less conflict and greater certainty in Tribal water rights and Tribal water development. Potential opportunities for innovative water development expand under these consistent and coordinated administration practices. However, varying water administration practices continue to prevent Tribes from realizing the full potential for economic development.

### Expertise and Available Resources for Water Planning

(C1 and C2) Steady increase in Tribal expertise leads to an increase in Tribal water planning and development, providing support for the implementation of Tribal water settlements and increasing opportunities for Tribal economic growth.

### Understanding of Tribal Reserved Water Rights

(C1 and C2) An increased understanding of Tribal reserved water rights leads to increased flexibility in basin water development, reduced conflict over supply and increased economic opportunities for on and off-reservation development.

# 5 | Assessment of Current Tribal Water Use and Projected Future Water Development

## Contents

**5.6 Fort Mojave Indian Tribe**



**5.7 Chemehuevi Indian Tribe**

## 5.8 Colorado River Indian Tribes



## 5.9 Quechan Indian Tribe

# 5 Assessment of Current Tribal Water Use and Projected Future Water Development

## 5.0 Introduction

Partnership Tribes assessed how they currently use water and how the future development of their reserved water rights and unresolved claims may occur. This chapter presents each Partnership Tribe's description of its current and historical water use and analysis of its projected future water development through 2060. The chapter is organized by the location of the Partnership Tribes' reservations from north to south in the Basin. Current tribal water use and future water development are also summarized for both the Upper and Lower Basins. Although this chapter is based, in part, on information jointly developed during the Tribal Water Study and through collaboration with Reclamation, much of the information was provided by the individual Partnership Tribes. This collaboration does not constitute an endorsement by Reclamation or the Department of the Interior of either the Partnership Tribes' positions or the information contained in this report.

Each Partnership Tribe provided a description of its reservation, a summary of how it currently uses and manages water, and the challenges to using its reserved water rights and unresolved claims. This information includes, as appropriate: water rights; water supplies; the amount, type and location of use; infrastructure components; operations, including efficiencies and conservation activities; and historical use and cultural importance of water. Because of the differences among the Partnership Tribes in the availability and quality of data, current water use was considered either as an average water use over recent years or a single recent representative year (for additional information, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*). The Tribal Water Study focused on four categories of water use: Irrigated Agriculture and Livestock Water Use; Domestic, Commercial, Municipal, and Industrial Water Use; Environmental, Cultural, and Recreational Water Use; and Transfers, Leases, and Exchanges. This methodology did not provide a lengthy historical record of tribal water use, but is a good snapshot of recent water use, by category, for each Partnership Tribe and advances the understanding of tribal water use in the Basin. The current water use information was used to develop recommendations for Colorado River model enhancements, as well as serving as the basis for conducting the future water development assessment.

In coordination with Reclamation, Partnership Tribes assessed future tribal water development using a scenario planning process to envision a range of how tribal water could be developed through 2060. The scenario planning process and its outcomes reflect the priorities that the Partnership Tribes identified as critical to their future water development (see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*).

## 5.1 Ute Indian Tribe of the Uintah and Ouray Reservation (Ute Indian Tribe)

### 5.1.1 Introduction

The Ute Indian Tribe is located on the Uintah and Ouray Reservation (Reservation) in northeastern Utah, approximately 150 miles east of Salt Lake City, Utah. The Reservation lies within the drainage of the Upper Colorado River Basin. The Ute Indian Tribe consists of three bands: Uintah, White River, and Uncompahgre. They once lived in an area from the Wasatch Front all the way to the Colorado Front Range – from present-day Salt Lake City to Denver.

The Uintah Band is indigenous to what is now known as the State of Utah and has lived in the area since time immemorial. Under the early federal government policy of removing Indian tribes from their homelands for white settlements, the original 2,080,000-acre Uintah Valley Reservation was established for the Uintah Band by President Abraham Lincoln by Executive Order of October 3, 1861, and ratified by the United States Congress in 1864.

The Uncompahgre Reservation was approved by the United States Congress by the Act of June 15, 1880, and was set apart as a reservation by President Chester A. Arthur's Executive Order of January 5, 1882. Commissioner of Indian Affairs Eugene E. White characterized the Uncompahgre Reservation as a desert, with the exception of small areas of farmland on the White River and Willow Creek. The White River and the Uncompahgre Bands were moved by the federal government from what is now Colorado to the Uintah Valley and Uncompahgre Reservations, respectively. In 1934, the three Bands organized pursuant to the provisions of the Indian Reorganization Act of June 18, 1934 (48 Stat. 984, as amended), and formed the Ute Indian Tribe of the Uintah and Ouray Reservation.


Life on the Uintah Valley Reservation, circa 1874
*Used by permission, Utah State Historical Society*

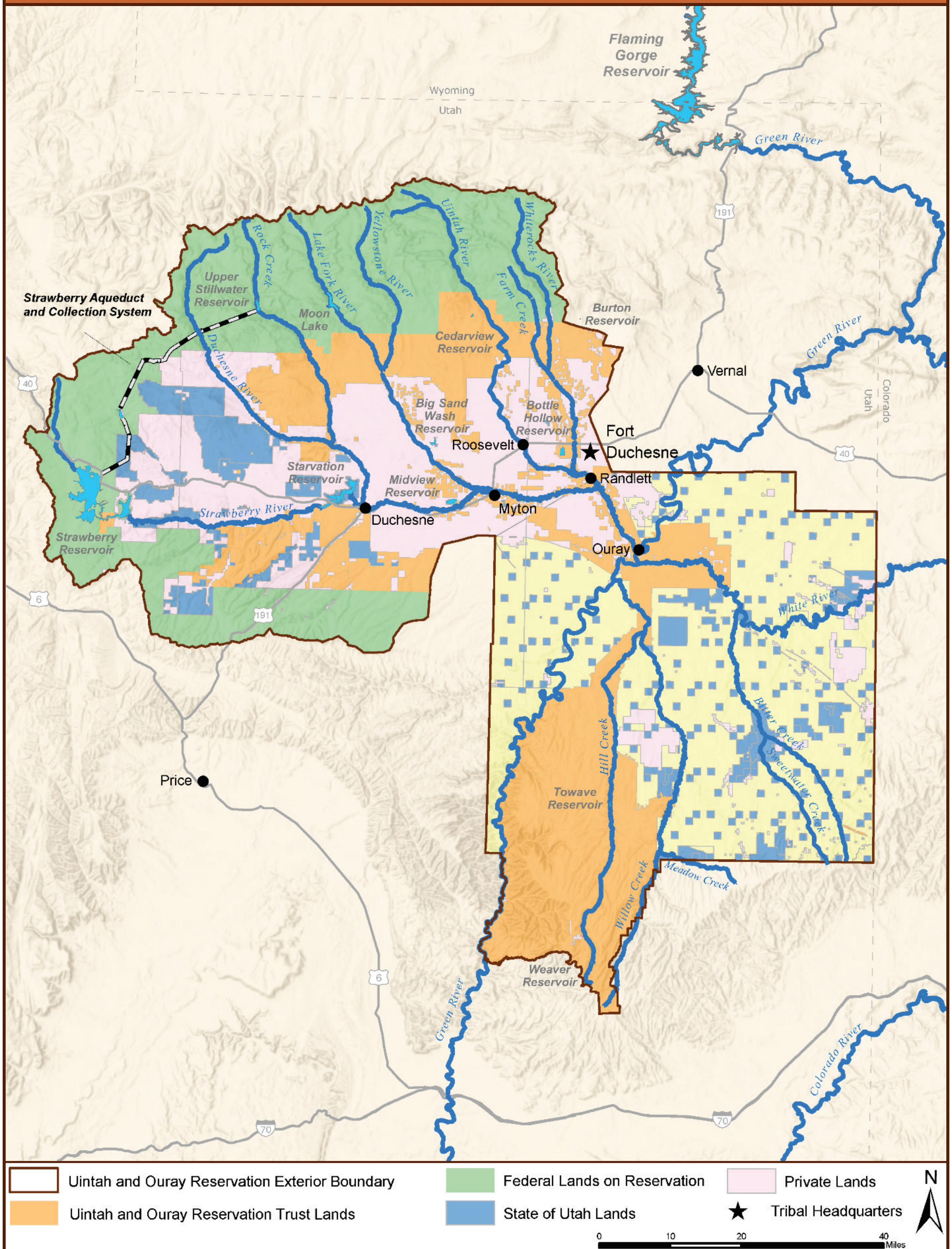
Federal policy shifted to assimilating the Indian tribes into the mainstream culture with the Indian General Allotment Act of February 8, 1887. The Act promoted the breakup of Indian reservations into individual allotments (that is, Indian homesteads) on which Congress expected the Indians to farm and become self-sufficient. Following the distribution of allotments to members of the Indian bands, the Commissioner of Indian Affairs described the conditions on the reservations in his annual report for 1905:

> The future of these Indians depends upon a successful irrigation scheme, for without water their lands are valueless, and starvation or extermination will be their fate.

Today, the Reservation is the second largest Indian reservation in the United States, covering more than 4.5 million acres. The Ute Indian Tribe has a tribal membership of almost 4,000 individuals, a majority of whom live within the exterior boundaries of the Reservation. The Act of Jun 7, 1897, first opened the Uncompahgre Reservation for location and entry to non-tribal settlement on April 1, 1898. In 1905, the federal government opened the Uintah Valley Reservation to non-tribal settlement. Land ownership within the boundaries of the Reservation, therefore, is complicated due to both the checkerboard surface land ownership and differing sub-surface ownership (for example, mineral rights).

Figure 5.1-A presents a general location map with Reservation boundaries, communities, and other important features.

**FIGURE 5.1-A**
Ute Indian Tribe Map




Indian Country jurisdiction of individual parcels will be depicted in Bureau of Indian Affairs mapping, which is to be determined.

### 5.1.2 Physical Setting

The Uintah Valley portion of the Reservation lies within the Uinta Basin, a bowl-shaped basin framed by the Uinta Mountains to the north and the Wasatch Range to the west. The Uncompahgre portion of the Reservation also lies within the Uinta Basin and the Green River drainage, extending south and east from the Uinta Valley to the Utah-Colorado border. The terrain of the Reservation varies from high alpine forest in the north and west to fertile agricultural land between about 5,000 and 6,500 feet in the center to remote semi-arid desert hills and canyons in the south. The elevation of the Reservation varies from 4,400 feet at the southern tip to over 13,000 feet in the northern mountains.

Tribally-owned lands on the Reservation encompass a variety of geographic regions, as shown in the photographs on this page. These include the lower alpine forests of the Uinta Mountains, fertile floodplains of the Duchesne River and its tributaries, arid highlands south of the Strawberry River, and desert canyons and drainages stretching east along the White River and south along the Green River.

#### *5.1.2.1 Watersheds*

The northwestern area of the Reservation consists of five major river drainages with seven contributing rivers that generally flow southeast and east into the Green River. The Duchesne River system to the west drains from the Wasatch and Uinta Mountains through major tributaries that include Rock Creek, the Strawberry River, the Lake Fork River (with its major tributary the Yellowstone River), and the Uinta River (with its major tributary, the Whiterocks River). The White River and other desert tributaries, including Willow Creek and Bitter Creek, drain the southeastern area of the Reservation into the Green River.

Desert valleys in the south of the Reservation near the Green River.
*Source: Ute Indian Tribe*

Agricultural lowlands below the Uinta Mountains.
*Source: Ute Indian Tribe*

The Uinta River flowing in a glacial valley of the Uinta Mountains.
*Source: Ute Indian Tribe*

#### *5.1.2.2 Hydrogeology*

The shallowest aquifers in the Uinta Basin are the alluvial aquifers. Much of the alluvium in the stream valleys is too thin, narrow, and discontinuous to be considered a major aquifer; however, some of the larger alluvial deposits in the Uinta Basin are locally important sources of water, providing an estimated safe yield of approximately 32,000 acre-feet per year (AFY). The quality of water in the alluvial aquifers is generally better than the other aquifers in the region because of its primary origin as snowmelt and relatively short residence time in the aquifer.

In addition to alluvial aquifers, three principal aquifer systems of regional extent are present in the Uinta Basin: the Uinta-Animas Aquifer, the Mesaverde Aquifer, and the Dakota-Glen Canyon Aquifer system (Table 5.1-A). Safe yield from the Uinta-Animas Aquifer is estimated to be about 207,062 AFY. Groundwater in the aquifer generally contains high levels of salinity, ranging from 500 to over 6,000 milligrams per liter (mg/L), and reaching 10,000 mg/L in some of the deeper areas. Yield and storage in the Mesaverde Aquifer has yet to be quantified. Water quality in the aquifer is extremely variable, with dissolved solids ranging from about 1,000 mg/L in narrow basin-margin areas of the aquifer that are recharged by infiltration from surface-water sources to more than 35,000 mg/L in the central part of the Uinta Basin.

The State of Utah performed a water balance for the Uinta Basin and estimated approximately 630,000 AFY of groundwater recharge, with roughly 21,060 AFY being withdrawn from wells and springs.

**TABLE 5.1-A**
Groundwater Basins in the Uinta Basin

| Basin Name | Useable Capacity (AF) | Safe Yield (AFY) |
|---|---|---|
| Alluvial Aquifers | 200,000 (est.) | 32,000 (est.) |
| Uinta-Animas Aquifer | Not Quantified | 207,062 (est.) |
| Mesaverde Aquifer | Not Quantified | Not Quantified |
| Dakota-Glen Canyon Aquifer | Not Quantified | Not Quantified |

#### *5.1.2.3 Climate*

The climate on the Reservation varies geographically. Average annual precipitation varies from less than 10 inches in the central and southeastern parts of the Reservation to upwards of 30 inches in the high mountains of the northwestern part of the Reservation. Temperature varies similarly, with average annual highs ranging from 52 °F near Moon Lake to 64 °F in Ouray and average annual lows ranging from 24 °F near Moon Lake to 34 °F near Bonanza. Extreme temperatures vary from a low of -43 °F, measured at Ouray in January 1979, to a high of 108 °F, measured at Ouray in July 2001.

The Uinta River flowing in a glacial valley of the Uinta Mountains.
*Source: Ute Indian Tribe*

Drought has been a common occurrence on the Reservation throughout history, and the future impacts of climate change present concerns for the future livelihood and health of the region. Tribal lands suffer during frequent drought cycles that reduce available water supplies, especially since tribal water storage has not been developed. Due to current and expected future water shortages, significant changes in water storage and use practices will become critical, as increased regional temperatures would raise crop irrigation requirements and alter precipitation cycles.

## 5.1.3 Historical Use and Cultural Importance of Water

### *5.1.3.1 Early Tribal Water Use (to 1906)*

Prior to the Reservation's establishment, the Ute Indian Tribe's ancestors utilized water for all purposes necessary to sustain their nomadic hunting and gathering-based lives. In particular, they valued wildlife habitat areas as hunting and fishing grounds, and natural flowing streams and springs played a part in religious and cultural practices.

Irrigation has been practiced by the Ute Indians for many years since the Uintah Valley and Uncompahgre Reservations were established. Because the United States government, acting through Indian agents, had the expectation that the members of the Ute Indian Tribe would cultivate crops and farm Reservation lands, several small irrigation ditches and farmlands totaling close to 6,000 acres of land were cultivated and irrigated on the Uintah Valley Reservation in the Lake Fork River and Uinta River Basins as part of the "old irrigation project" around 1890. In 1899, the United States Congress directed the Secretary to secure a quantity of water necessary for the present and prospective wants of the Indians on the Uintah Valley Reservation and to protect their Indian reserved water rights and interests. The much more extensive Uintah Indian Irrigation Project (UIIP or Project), a system constructed to serve 78,950 acres of allotted lands, was authorized under the 1906 Congressional Indian Department Appropriation Act (34 Stat. 375). Construction continued through about 1922, at which time it was essentially completed, with the exception of storage facilities. There was also some early irrigation outside the UIIP, but with little oversight and development. In the early 1900s, various private irrigation companies formed, constructed canals and storage, and started to utilize the rivers of the Uinta Basin for irrigation.

A Ute farmer, date unknown.
*Used by permission, Utah State Historical Society*


*See the Disclaimer and Introduction to Chapter 5.0.*

Irrigation on the Uncompahgre Reservation has occurred with very little assistance in the construction of irrigation works. Early irrigation activities were authorized for individual allotments in 1897, principally on Willow Creek, Hill Creek, Meadow Creek, Bitter Creek, and White River, where small ditches were dug with headings and small structures to irrigate strips of land bordering the streams. It was recommended at that time that the Indian reserved water rights to these water sources on the Uncompahgre Reservation be established to ensure a sufficient water source for the Indians' irrigation efforts, but this did not occur.

#### *5.1.3.2 First Tribal Water Rights Decrees (1905 to 1923)*

Wheat farming on the UIIP Deep Creek Canal, circa 1919.
*Source: Library of Congress*

The United States, through the United States Indian Irrigation Service, made application on behalf of the Ute Indian Tribe to the Utah State Engineer in 1905 to appropriate water within the Reservation for the UIIP. Utah issued water right certificates for the Project to the United States as trustee for the Ute Indian Tribe. Other water rights were also approved by the Utah State Engineer between 1906 and 1915, and by 1916 there were increasing conflicts between the Ute Indians and their neighbors over the water allocations in the Lake Fork, Yellowstone, Whiterocks, and Uinta Rivers, which provided water for the UIIP. The United States initiated litigation in federal court in 1916 to protect the Ute Indian Tribe's reserved water rights and enjoin various private irrigation companies from interfering with the Indians' use of these waters. See *United States v. Dry Gulch Irrigation Company*, No. 4418, slip op. (D. Utah 1923); *United States v. Cedarview Irrigation Company,* No. 4427, slip op. (D. Utah 1923).

In its Bill of Complaint, the United States attested to the court that

> [t]he water supply of said Uinta River, except when said river is at stages of high flow, is and at all times has been insufficient to supply the needs of the United States and said Indians for the irrigation of the irrigated lands . . . with the consequence that the waters of said river, unless conserved by storage, will become progressively less able to supply the needs of the United States and of said Indians. . . .

In 1923, the federal district court issued two decrees awarding the Ute Indian Tribe reserved water rights and recognizing the federal Indian water rights as reserved or "Winters" water rights under the 1908 United States Supreme Court decision, *Winters v. United States*, 207 U.S. 564 (1908), with a priority date that predates October 3, 1861, the date of the establishment of the Uintah Valley Reservation. The *Winters* Indian reserved water rights are federally created and are based on the federal government's reservation of lands for Indian tribes, with a primary purpose in many cases of requiring the Indians to become productive farmers, a government policy intended to promote Indian self-sufficiency. Therefore, the 1923 federal decrees established senior Indian reserved water rights for the Ute Indian Tribe, with the United States as the trustee of the Indian reserved water rights and the Ute Indian Tribe as the beneficial owner.

The Lake Fork River Decree provided reserved water rights for 25,071 acres and the Uinta River Decree provided reserved water rights for 34,700 acres, for a total irrigated acreage of 59,771 acres of lands. The decrees also established a direct diversion limit of one cubic foot per second (cfs) per 70 acres and an annual diversion limit of three acre-feet (AF) per acre in these basins, amounting to a total reserved water right of 179,315 AFY: 75,215 AFY in the Lake Fork River Basin and 104,100 AFY in the Uinta River Basin. In addition, the court awarded the Ute Indian Tribe the reserved right to divert water for domestic, culinary, and stock-watering purposes throughout the entire year.

A drop structure on the UIIP Dry Gulch Canal, circa 1930.
*Source: Library of Congress*

#### *5.1.3.3 Federal Non-Tribal Water Projects and Tribal Water Rights Studies (1900 to 1965)*

Between the early 1900s and the 1950s, several non-tribal water projects were planned and constructed by Reclamation and other water users to utilize the water resources of the Uinta Basin. In 1906 the Strawberry Valley Project, including Strawberry Reservoir at the west end of the Reservation, was developed to divert water out of the Uinta Basin west to the Wasatch Front for irrigation along the Spanish Fork River. Planning for the Moon Lake Project began by 1918, with the purpose of relieving severe water shortages on private lands along the Lake Fork River by diverting surplus water from the Duchesne River to Indian lands, designated to receive Lake Fork River reserved water rights. This made it possible for the Moon Lake Project's State water users to divert a like quantity of Indian reserved water in the Lake Fork River by exchange with the Moon Lake Project water users. The Moon Lake Project facilities include the Moon Lake storage reservoir on the Lake Fork River, the trans-basin Yellowstone Feeder Canal that diverts water from the Yellowstone River east to the Uinta River Basin, and the Midview Reservoir to store water from the Duchesne River for use in the lower Lake Fork Basin on the Indian reserved water rights lands. The Provo River Project was constructed in 1938 to divert water from the North Fork of the Duchesne River and convey it west through the Duchesne Tunnel to the Provo River on the Wasatch Front for irrigation and municipal uses.

A much larger project aimed at transferring water out of the Colorado River Basin, including the Uinta Basin, to the Bonneville Basin and Wasatch Front was developed by Reclamation and the State of Utah, known as the Central Utah Project (CUP). In 1956, the Colorado River Storage Project Act (70 Stat. 105) was passed by Congress and authorized the Bonneville, Upalco, Vernal, and Jensen Units (Initial Phase) of the CUP, see Figure 5.1-B. In 1968, Congress passed the Colorado River Basin Project Act, authorizing the Uintah Unit as a part of the Initial Phase of the CUP, and directing that a feasibility study be conducted for the Ute Indian Unit. These units were to have provided storage benefits to the Ute Indian Tribe and the UIIP. The Vernal and Jensen Units provide supplemental water outside the Reservation and were completed in 1962 and 1980, respectively. The Bonneville Unit was the largest and most extensive of the CUP units, diverting flows from Rock Creek and eight other Duchesne River tributaries within the

Reservation into an enlarged Strawberry Reservoir and west to the Wasatch Front. Starvation Reservoir on the lower Strawberry River serves as a supplemental reservoir to preserve the water supply for irrigation water users on the Duchesne River, including the Ute Indian Tribe. Construction on the Bonneville Unit started in 1968 and is nearing completion with some of the final features now under construction. The Upalco Unit was intended to provide storage on the Lake Fork and Yellowstone Rivers for both tribal and other water users, and the Uintah Unit was intended to do the same on the Uinta and Whiterocks Rivers. The Ute Indian Unit was supposed to bring water from the Green River west to the Reservation to make up for the water the CUP diverted to the Wasatch Front. However, due to the CUP's complex history, including escalating costs, new environmental requirements, and Congressional intervention to contain the costs of the CUP, the projects that would have benefited the Ute Indian Tribe were never constructed and benefits to the Tribe never materialized.

**FIGURE 5.1-B**
Conceptual Map of Central Utah Project Development

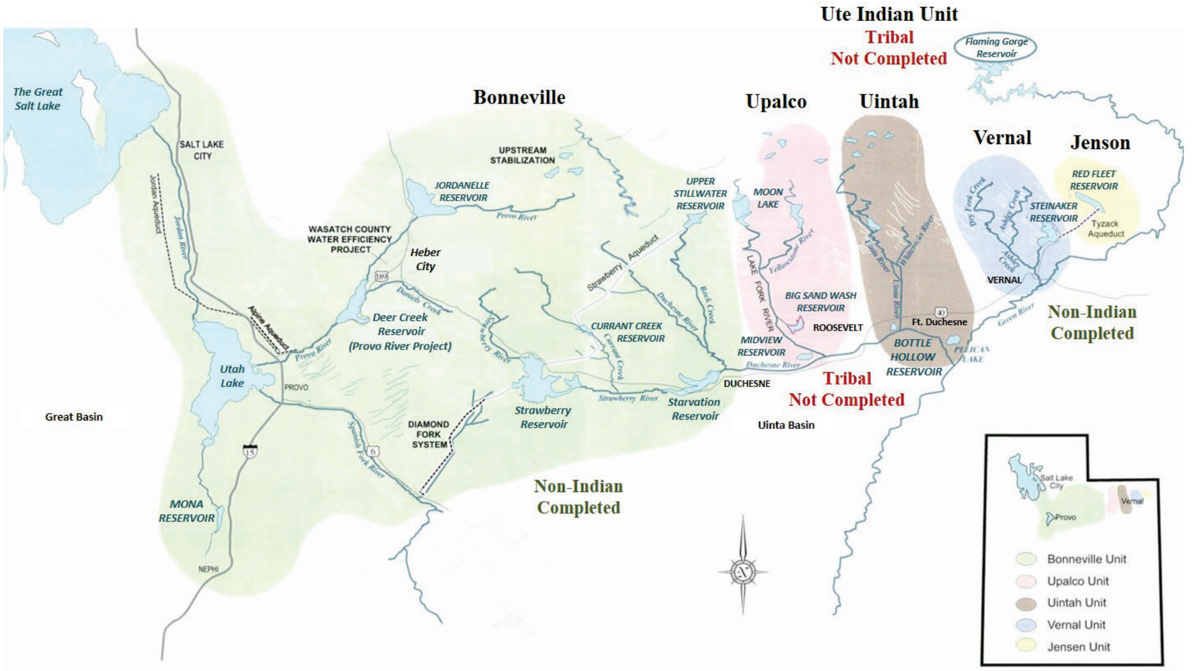



Figure from Central Utah Water Conservancy District (CUWCD). (2004). "Supplemental to the 1988 Definite Plan Report for the Bonneville Unit." Modified by NRCE.

The planned CUP presented significant concerns related to the Ute Indian Tribe's Indian water rights claims as to whether sufficient water supplies existed to satisfy both the federal trust responsibility to the Tribe and the CUP's demands. The Ute Indian Tribe hired engineering consultant E.L. Decker to represent its interests in resolving the Tribe's water rights claims. In 1960, Decker produced a report quantifying the Ute Indian Tribe's historically irrigated and practicably irrigable acres (PIA) on the Reservation (with some subsequent revisions/corrections). The Decker Report, including the reserved water rights recognized in the 1923 federal decrees and water rights claims in the Green and White River Basins, established the Ute Indian Tribe's practicably irrigable lands totaling 129,331 acres, providing the basis for the Tribe's reserved water rights.

The Decker Report divided the irrigable lands into seven groups, with Group 1 lands comprised of the Ute Indian Tribe's decreed reserved water rights in the Lake Fork and Uinta River basins. In a data collection effort for the CUP, the Duchesne River Area Study Committee (Committee) published a 1962 report that concluded, among other items, "…that successful operation of the Bonneville and Duchesne segments of the CUP's initial phase will depend upon an agreement by the Indians to limit the irrigation of Indian owned and Indian water right land of about 20,700 acres." The Bonneville Unit could not have been constructed without the participation and support from the Ute Indian Tribe. E.L. Decker was a member of the Committee and recommended that the Ute Indian Tribe enter into an agreement with the federal government, represented by the BIA and Reclamation, and the Central Utah Water Conservancy District (CUWCD) to defer the development of 15,242 acres of Tribal irrigable land (a portion of the Group 5 lands in Decker's report). The formal agreement is commonly known as the 1965 Deferral Agreement. As a measure of good will and with certain conditions that would benefit the Ute Indian Tribe, the Tribe signed the 1965 Deferral Agreement.

Under the 1965 Deferral Agreement, the Ute Indian Tribe agreed to defer its use of Tribal reserved water rights on 15,242 acres of land so that the federal government could certify to the United States Congress that it had an uncontested Indian reserved water right to support the request for funding of the Bonneville Unit of the CUP. In exchange, the United States promised future development of the Ute Indian Tribe's Indian reserved water rights under the CUP. The Ute Indian Tribe agreed to the Deferral Agreement with the understanding that all phases of the CUP would be diligently pursued in good faith to include satisfaction of the water development requirements of Groups 1-5 lands with Indian reserved water rights at the earliest possible date. In addition, the parties to the 1965 Deferral Agreement, subsequently approved by the State of Utah legislature, acknowledged, recognized, and confirmed the Ute Indian Tribe's Indian reserved water rights as described in the Decker Report, that is, for 129,331 acres.

#### *5.1.3.4 Tribal Water Compact Efforts (1965 to Present)*

The period after the Deferral Agreement can be characterized as featuring continued extensive development of non-tribal, State-based water uses through the CUP, while little progress was made on projects benefiting the Ute Indian Tribe. Definite plan reports and environmental impact statements were not issued for the Upalco and Uintah Units until 1979, and the projects continued to languish amid repeated financial analyses by Reclamation challenging their viability and poor dam site findings. Exploratory efforts continued on the Tribal CUP elements in the 1980s, but, ultimately, Reclamation determined that the Upalco Unit was unfeasible and it was reformulated. The Ute Indian Unit was de-authorized in 1992.

The State of Utah, the Ute Indian Tribe, and the United States entered into discussions in the late 1970s to complete the settlement of the Tribe's water rights claims through a Ute Indian Water Compact. Although a Ute Indian Water Compact was approved by the State Legislature in 1980 and by the Tribal membership in 1988, it never obtained the required Congressional approval and ratification.

In 1992, the Reclamation Projects Authorization and Adjustment Act (P.L. 102-575) was passed, which included the Central Utah Project Completion Act (CUPCA), of which Title V, the Ute Indian Rights Settlement, was included. Congress revised the proposed 1980 Ute Indian Water Compact and created the "Revised Ute Indian Compact of 1990" for the purpose of, notably, transferring 113,378 AF of annual diversion of reserved water rights, most of the designated practicably irrigable lands, out of the Uinta Basin to the Green River. Also, notably, with this change, Congress required re-ratification of the Ute Indian Water Compact by both the Ute Indian Tribe and the State of Utah. To date, a final agreement of the Ute Indian Tribe's Indian reserved water rights and completion of comprehensive water rights settlement through a Ute Indian Water Compact has not occurred, and the parties have had continued negotiations on the terms of such a Compact.

Today, the State of Utah has, by its own policy, fully appropriated its water rights in the Uinta Basin. The Ute Indian Tribe continues to put its available, federally-decreed natural flow water rights to use alongside the developed water infrastructure of State-based water users. The BIA regulates, enforces, manages, and supervises the distribution of the Tribal Indian reserved water rights under the UIIP. Non-UIIP irrigators have developed numerous off-stream storage facilities to impound seasonal flows, small-scale irrigation improvement projects have increased water carriage and application efficiency, and complex water exchange agreements have been put in place to allow users to share water throughout the Uinta Basin. Groundwater usage has become increasingly common, and industrial activities, such as oil and gas extraction, have increased regional water usage. The CUWCD and other local agencies still plan to utilize State water rights originating from the CUP to develop local water projects. Through all of this, the Ute Indian Tribe strives to assert its Indian reserved water rights and play a larger role in the administration of the resources of its homeland to ensure a better future for its members.

### 5.1.4 Ute Indian Tribe Water Supply

The Ute Indian Tribe uses surface water, groundwater, and other water supplies for irrigation, stock watering, domestic and industrial purposes.

#### *5.1.4.1 Surface Water Supply*

Although the Ute Indian Tribe has been negotiating a final Ute Indian Water Compact and is preparing a proposed Tribal Water Resources Ordinance, the Tribe continues to use a large portion of its reserved water rights for irrigation under the UIIP and smaller volumes for domestic and municipal purposes served from the Tribal Water System. Stock watering from various springs and creeks is also important. Under the 1965 Deferral Agreement, the Ute Indian Tribe has recognized water rights claims for 129,331 acres. This equates to an annual reserved water right by diversion of 549,685 AFY, of which 179,315 AFY were adjudicated in 1923. In addition, as part of the proposed Revised Ute Indian Compact of 1990, the Ute Indian Tribe would have 10,000 AFY of diversion/depletion water rights for domestic, municipal, commercial, and industrial uses. Priorities for these rights are dated 1861 for all historically and practicably irrigable lands of the Uintah Valley portion of the Reservation, including M&I water rights, and 1882 for all lands of the Uncompahgre portion of the Reservation.

The Ute Indian Tribe owns the highest priority water right to natural flows from all rivers within the exterior boundaries of the Reservation. However, the Ute Indian Tribe has very limited storage capacity. As such, water availability is primarily dependent on climate factors, and flows vary considerably from year-to-year and month-to-month. Abundant water is available in the spring, but in later months, when snowpack has melted and crops continue to require significant irrigation water, natural flow has diminished. During late summer, when natural flows diminish, Tribal water availability similarly diminishes. Non-tribal irrigators have developed water storage facilities to supplement their junior Utah State water rights during low flow periods. Direct diversion shortages to Tribal reserved water rights are common in late season, and shortages can be calculated for the UIIP relative to either Tribal reserved water rights or to crop water requirements on Tribal lands.

#### *5.1.4.2 Groundwater Supply*

Groundwater has not been extensively developed in the Uinta Basin. Groundwater wells on non-tribal lands within the exterior boundary of the Reservation have been developed under Utah State water rights to supply local municipalities, small-scale domestic water systems, and industrial uses. Groundwater supplies consist generally of alluvial aquifers and several deep aquifer systems. The great depth to the Dakota-Glen Canyon Aquifer (exceeding 12,000 feet in much of the Uinta Basin) and poor water quality makes this aquifer system unsuitable for development in much of the area.

The Tribal M&I reserved water right can be sourced from groundwater, though few groundwater sources have been developed. Some Tribal members live in rural areas and are served by domestic wells, but very little data is currently available for these water users.

#### *5.1.4.3 Other Water Supplies*

In an effort to mitigate some of the late season shortages, the BIA, responsible for the UIIP, has informal agreements with irrigators holding Utah State water rights for exchanges of water with irrigators under the UIIP using Tribal reserved water rights. These informal agreements allow State-based water right users to obtain water earlier in the season, such as for diversion to their storage facilities, and Tribal reserved water right irrigators to obtain water later in the season from the private storage facilities when natural flows have decreased. For the most part, however, these are informal agreements for which no known records exist and, therefore, are not legally binding.

Flood irrigation is widely practiced among the Ute Indian Tribal water users on the Reservation. Many other farmers have shifted to sprinkler irrigation, reducing the amount of discharge from agricultural operations. Current drainage discharge is neither monitored nor measured, and is, therefore, difficult to quantify.

### 5.1.5 Current Water Use and Operations

Almost all the Ute Indian Tribe's current water use is for the irrigation of agricultural lands and stock watering on the Reservation, although a small percentage is used for domestic, commercial, municipal, and industrial (DCMI) purposes.

#### *5.1.5.1 Irrigated Agriculture and Livestock Water Use Category*

The BIA-operated UIIP serves the vast majority of Tribal agricultural operations on the Reservation, with water sourced from the Duchesne, Lake Fork, and Uinta River systems. A maximum diversion rate of one cfs to 70 acres was established for direct natural flow diversions, with an annual allocation of three AF per acre in the Lake Fork and Uinta Basins (under the 1923 federally-decreed reserved water rights); four AF per acre in the Duchesne River, Bitter, Sweet Water, Willow, and Hill Creeks Basins; 4.8 AF per acre in the White River Basin, and 4.5 AF per acre in the Green River Basin. These flows are distributed according to a set diversion schedule that was originally intended to match anticipated crop water requirements, but ultimately causes crop water supply shortages. An additional 0.4 AFY per acre is available for tribal storage in the Lake Fork and Uinta Basins as part of the supplemental irrigation promised in the 1965 Deferral Agreement, and storage facilities to support this requirement are under negotiation.


A lateral of the UIIP Uintah Canal in the Uinta River Basin.
*Source: Ute Indian Tribe*

Irrigation water is delivered to Tribal land primarily through canals and laterals within the UIIP. Some of the river diversion structures are automated to allow real-time control of the system. The vast majority of the irrigated land held in trust on the Reservation is pasture or hay (both grass and alfalfa), with other crops making up only about three percent of the irrigated agriculture. The predominant irrigation type within the UIIP is flood irrigation, with sprinklers increasing in use. Sections of open channel within the UIIP are gradually being replaced by pipeline to reduce seepage, but the majority of the system remains unlined open channel.

There is small-scale irrigation of Tribal lands outside the UIIP via private ditch systems that are operated and maintained by local water users. Small-scale projects on the Uintah portion of the Reservation are supplied by the Duchesne River System and those on the Uncompahgre portion of the Reservation are supplied by the Green River System, which includes the White River and Willow, Bitter, Sweet Water, and Hill Creeks. Very little information is available about carriage systems, irrigation practices, and land uses in these non-UIIP areas.


The UIIP U.S. Lake Fork Canal in the Lake Fork River Basin.
*Source: Ute Indian Tribe*

There are several other significant private irrigation companies within the exterior boundaries of the Reservation, including Moon Lake Water Users Association, Dry Gulch Irrigation Company, Ouray Park Irrigation Company, and Whiterocks Irrigation Company. Although these companies supply irrigation water to a small area of Tribal land through exchange agreements with the BIA, they are operated by and for the benefit of other State-based water rights users.

Table 5.1-B presents the annual UIIP agricultural water use in the Lake Fork, Uinta, and Duchesne River Basins for the period from 2009 through 2013 based on River Commissioner Reports. The current average agricultural water use is 211,042 AFY. Table 5.1-C presents crop irrigation information for the 2012 irrigation season.


*See the Disclaimer and Introduction to Chapter 5.0.*

**TABLE 5.1-B**
UIIP Agricultural Water Use (2009 – 2013)

| Water Source | Year | | | | |
|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| Surface Water (AF) | 223,542 | 215,977 | 235,143 | 187,273 | 193,273 |
| Groundwater (AF) | minor | minor | minor | minor | minor |
| Total Irrigated Area in acres (appx.[1]) | 61,330 | 60,561 | 60,945 | 60,748 | 60,804 |

[1] River Commissioner Reports did not report irrigation acreages for the UIIP, so these acreages were estimated using known water duties. This assumption does not account for water shortages in any given water year, so these estimates are likely underestimates of the actual UIIP acreage served.

**TABLE 5.1-C**
UIIP Agricultural Crop Data for 2012

| Crop | Total Acreage (appx)[1] | Average Water Delivery Rate, AF/acre[2] | Percent of Acres | |
|---|---|---|---|---|
| | | | Flood | Sprinkler |
| Field Crops | 1,993 | 3.3 | 41% | 59% |
| Irrigated Pasture | 37,018 | 3.2 | 89% | 11% |
| Alfalfa | 12,150 | 3.3 | 31% | 69% |
| Grass Hay | 9,587 | 3.1 | 84% | 16% |

[1] Based on crop mix reported by CropScape in 2012 (Cropland Data Layer from the USDA NASS).
[2] Based on a 3.0 AFY duty per acre in the Lake Fork/Uinta Basins, and 4.0 AF per acre in the Duchesne Basin (the crop acreage from basins with larger allocations is negligible).

The Ute Indian Tribe also diverts water for livestock water use in the form of irrigated pastures, livestock feedlots, and grazing rangelands. Pastures are irrigated by the canals and laterals of the UIIP and, as permitted by the 1923 federal district court decrees in the Lake Fork and Uinta River systems, these canals also carry stock water year-round. Stock water diversion rights are not specified for the UIIP canals in the Duchesne River Basin, though several State-based water rights owned by the Ute Indian Tribe or by the United States in trust for the Tribe allow point-to-point stock watering on several tributary creeks and waterways of the Reservation. The BIA's Uintah and Ouray Agency also manages a rangeland permitting program for Tribal lands and permitted federal lands within the exterior boundaries of the Reservation. It is estimated that the Ute Indian Tribe currently diverts and depletes approximately 650 AFY of water for livestock use. The Ute Indian Tribe's total current average irrigated agricultural and livestock water use is 211,692 AFY.

#### *5.1.5.2 Domestic, Commercial, Municipal, and Industrial Water Use Category*

The Ute Indian Tribe provides water and sewer services for several communities for the benefit of Tribal members, as well as for Reservation industries, such as cattle raising and extraction of oil and natural gas. The Ute Indian Tribe also operates several businesses, including the Ute Plaza supermarket, two gas stations, Kapeeh Kah-ahn Coffee House, the Ute Crossing Grill and Bowling Alley, a Tribal feedlot, Ute Tribal Enterprises LLC, and the Ute Tribal Water System.

The Ute Tribal Water System, Whiterocks Spring collection system.
*Source: Ute Indian Tribe*

Domestic water is supplied to Tribal residences and commercial ventures by the Ute Tribal Water System, other public community water systems, and domestic or industrial groundwater wells in rural areas. The Tribal Water System provides DCMI water to Tribal members and to other water users in a service area that extends from Whiterocks to Ouray along the Uinta and Duchesne Rivers. Water delivered by the Tribal Water System is sourced from the Whiterocks and Uriah Heap Springs located north of Fort Duchesne, Utah. Intermittent data for the Tribal Water System has been collected by the State of Utah Division of Water Resources. Based on the available data, the Ute Tribal Water System is used primarily for residential indoor and outdoor use. Water is also used by commercial businesses and public institutions, but there is no water for industrial use supplied through the system. Data from 1995, 2003, and 2005 indicate that the Tribal Water System supplied an average 255 gallons per capita per day to an average population of 3,167 people. With additional commercial uses, the Ute Indian Tribe's average DCMI water use is 872 AFY (Table 5.1-D).

**TABLE 5.1-D**
Domestic, Municipal, Commercial, and Industrial Uses Supplied by the Ute Tribal Water System (1995, 2003, and 2005)

| | Year (AF) | | |
|---|---|---|---|
| **DCMI Use** | **1995** | **2003** | **2005** |
| Residential Indoor | 392 | 265 | 270 |
| Residential Outdoor | 502 | 180 | 230 |
| Commercial | 6 | 385 | 385 |
| **Total** | **900** | **830** | **885** |

Additional public municipal water systems, water improvement districts, and user-operated systems supply domestic, municipal, commercial, and light industrial water to Tribal members and other residents throughout the Reservation area. These include: Duchesne County Upper Country Water Improvement District, East Duchesne Culinary Water Improvement District, South Duchesne Improvement District, Duchesne City Water System, Cedarview/Montwell Special Service District, Neola Water and Sewer District, Roosevelt Municipal Water System, Myton Municipal Water System, Johnson Water District, Ballard Water Improvement District, and Tridell-LaPoint Water Improvement District. Several additional municipal water systems exist on the Reservation, but their service areas do not extend to Tribal land.

### *5.1.5.3 Environmental, Recreational, and Cultural Water Use Category*

Previous agreements or statutory obligations regarding the use of water for environmental purposes include the federal and State of Utah governments' obligations to provide minimum instream flow requirements in Rock Creek (a tributary to the Duchesne River) to mitigate the impact of the CUP on this Reservation water source; water rights to maintain a productive cold water fishery in Bottle Hollow Reservoir (an obligation of the federal government under CUPCA, Title V, and currently under negotiations); and the establishment of various Tribal fish ponds. The instream flow requirement in Rock Creek is equal to 29 cfs during summer months and 23 cfs during winter months. These flow rates result in a volumetric water requirement of about 19,000 AFY, though this is an instream flow requirement at a single point in the river and cannot be construed as a consumptive use. Furthermore, Rock Creek instream flows are required to be provided by the CUWCD from Upper Stillwater Reservoir as part of the State's mitigation requirements; these are State-based water rights and are not part of the Tribal reserved water right. Water demands associated with Bottle Hollow Reservoir and other fishing areas have not been quantified, and additional environmental water demands in the Reservation creeks and rivers have also not been quantified. Of particular note are minimum flow requirements for endangered fish species in the Green River and (through connection) in the Duchesne River and its tributaries.

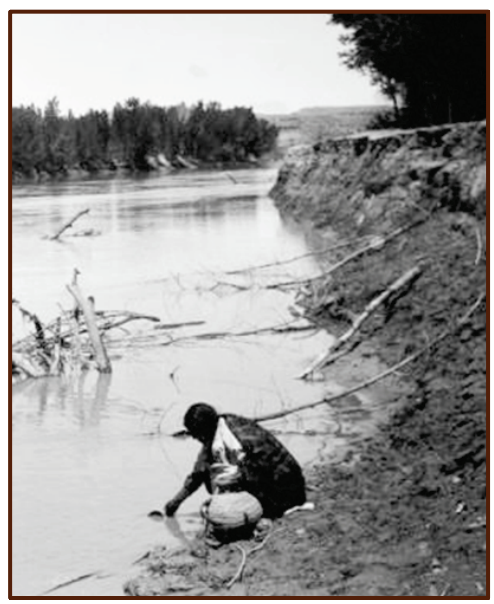
The Ute Tribal Water System Uriah Heap Springs treatment building.
*Source: Ute Indian Tribe*

Bottle Hollow Reservoir near Fort Duchesne, Utah.
*Source: Ute Indian Tribe*

Five reservoirs are regulated by the Ute Indian Tribe for recreational purposes. Bottle Hollow Reservoir is used for recreation, including fishing, boating, and camping. Additional storage uses are being studied. Cedarview Reservoir was also designed for both recreation and irrigation, but is used primarily for recreation and wildlife habitat. Towave and Weaver Reservoirs are also intended for irrigation and recreational uses, but are largely used only for recreation. Midview Reservoir is operated by the BIA for the Ute Indian Tribe primarily for irrigation supply, but is regulated by the Tribe for recreational uses such as boating and fishing. Several small fishing ponds are also operated on Tribal lands with negligible water uses.

Recreational water use rates are equivalent to annual evaporation rates and have been calculated for the five recreational reservoirs. On an annual basis, recreational water use is 976 acre-feet for Bottle Hollow, 346 acre-feet for Cedarview Reservoir, 892 acre-feet for Midview Reservoir, 129 acre-feet for Towave Reservoir, and 53 acre-feet for Weaver Reservoir, resulting in a total annual recreational water use of 2,396 AFY.

Tribal fishing permits, available to the general public, allow access to all Tribal waters on the Reservation. The Uinta, Whiterocks, Lake Fork, and Yellowstone Rivers, as well as Rock Creek and the Strawberry River, are all popular fishing destinations.



Ute woman gathering water from a river, date unknown.
*Source: Ute Indian Tribe*

The Ute Indian Tribe values all of the water on the Reservation for cultural and ceremonial uses. The Ute Indian Tribe does not wish to disclose the specific nature of any cultural activities or locations of sacred areas in order to protect and preserve their present conditions. The Ute Tribal Cultural Rights Protection Department and Tribal Water Commission advocate for the cultural rights and water uses of the Ute Indian Tribe's members and is involved as often as possible with development projects on the Reservation in order to protect Tribal cultural resources.

Generally, the Ute Indian Tribe values undeveloped water sources flowing in natural channels for cultural uses, such as undammed river streams and natural springs that discharge from the Uinta Mountains and the canyons of the Hill Creek Extension. Cultural practices that are indirectly related to water use include plant gathering and prayer offerings. The Ute Indian Tribe has conducted confidential inventories of springs and other water sources on Tribal lands and protects their future uses for cultural purposes. The Ute Indian Tribe believes in maintaining sufficient natural flow for instream cultural and wildlife habitat purposes, and plans to support and monitor the instream flows within the exterior boundary of the Reservation through cooperative river management plans.

Ute Tribal members at a Bear Dance celebration, circa 2012.
*Source: Ute Indian Tribe*

### *5.1.5.4 Transfers, Leases, and Exchanges Water Use Category*

The Ute Indian Tribe is involved with one water exchange program, known as the Midview Exchange Agreement. In 1967, the federal government, through Reclamation and the BIA, the Ute Indian Tribe, and the Moon Lake Water Users Association signed the Midview Exchange Agreement to exchange water between the Lake Fork and Duchesne Rivers. Under the terms of the Midview Exchange Agreement, Tribal reserved water rights on the Lake Fork River, decreed in 1923 in Federal District Court with a priority date of 1861, are used by the Moon Lake Water Users Association; in exchange, State-based water rights from the Duchesne River are used on lands under the UIIP. The exchange involves up to 10,000 acres of irrigated lands. This benefits the State-based water irrigators, members of the Moon Lake Water Users Association, by providing more natural flow on the Lake Fork River, ensuring an adequate water supply from this river source. The Duchesne River water, diverted as an alternate water supply for the Ute Indian Tribe's use

Midview Reservoir near Myton, Utah.
*Source: Ute Indian Tribe*


*See the Disclaimer and Introduction to Chapter 5.0.*

on UIIP lands, is stored in the Midview Reservoir, a 5,800 AF reservoir, which provides 11,570 AFY of storage water rights from the Duchesne River (with two fills per season). If the natural flows of the Duchesne River are insufficient to fill Midview Reservoir, the Ute Indian Tribe has additional water rights to 11,600 AF of storage in Starvation Reservoir, owned by Reclamation, on the Strawberry River that can be used to supplement the storage in Midview Reservoir. This exchange does not result in increased diversions or divert from outside the Reservation and, therefore, is considered part of the Ute Indian Tribe's total reserved water rights diversion.

#### *5.1.5.5 Reservoirs*

Towave Reservoir in the south of the Ute Indian Tribe Reservation.
*Source: Ute Indian Tribe*

In total, the Ute Indian Tribe owns, or is a beneficiary of, seven reservoirs on the Reservation (Table 5.1-E). Though these reservoirs provide benefits to the Ute Indian Tribe, due to their locations they are largely insufficient to supply the majority of the Tribe's water demands (largely agricultural) that are described above. Bottle Hollow Reservoir, on the Uinta River, has a maximum capacity of 11,800 AF. Towave and Weaver Reservoirs, located in the Hill Creek Basin, have a combined maximum storage of 550 AF. Cedarview Reservoir, in the Cottonwood Creek drainage of the Uinta River Basin, has a maximum capacity of about 2,500 AF. The Ute Indian Tribe holds a Utah State water right for irrigation water from Cedarview Reservoir, so its operation is not considered a Tribal reserved water right use. Burton Reservoir, off-stream of Deep Creek (a tributary to the Uinta River), has an estimated capacity of 34 AF and is used for irrigation under a Utah State water right.

Under the Midview Exchange Agreement, Midview Reservoir was transferred to BIA and is to be held in trust for the benefit of the Ute Indian Tribe as part of the UIIP. The 5,800 AF reservoir is used for irrigation and recreation, and the Ute Indian Tribe has a right to fill the reservoir twice per year. The Ute Indian Tribe also has some direct flow water rights in the Duchesne River as part of the Midview Exchange Agreement. If the natural flow of the river is insufficient to fill Midview Reservoir twice in a season, up to 11,600 AF of storage water may be substituted from Starvation Reservoir, located on the Strawberry River upstream of the confluence of the Strawberry and Duchesne Rivers near Duchesne, Utah. Starvation Reservoir is owned by Reclamation and is used for other irrigation, recreation, municipal and industrial water requirements, and flood control uses.

**TABLE 5.1-E**
Ute Indian Tribe Reservoirs

| Reservoir | Reservoir Capacity (AF) |
|---|---|
| Midview | 5,800[1] |
| Bottle Hollow | 11,800 |
| Towave | 350 |
| Weaver | 200 |
| Cedarview | 2,500 |
| Burton | 34 |
| **Total** | **20,684** |

[1] Under the Midview Exchange Agreement, Starvation Reservoir storage may be used to ensure that Midview Reservoir can be filled twice per season.

Private irrigation companies have built numerous storage reservoirs along the Uinta and Lake Fork Rivers and other waterways of the Reservation. Many of these reservoirs are enlargements of natural high mountain lakes, but some larger reservoirs (for example, Moon Lake Reservoir, Big Sand Wash Reservoir, and Upper Stillwater Reservoir) have been built by Reclamation and benefit non-tribal water rights users. Total high mountain storage within the Lake Fork and Uinta River Basins is more than 21,000 AF. Total non-tribal storage on or near the Reservation, excluding Flaming Gorge Dam, is about 1.6 million acre-feet.

### *5.1.5.6 Water Use Efficiency and Conservation*

The condition of the UIIP's canals and structures is extremely poor due to deferred maintenance over a long period of time, resulting in substantial water losses due to seepage in canals and laterals. Furthermore, the poor condition of distribution structures presents difficulties in the management and distribution of water to users in the UIIP. The UIIP's Operation and Maintenance Company, a private, non-profit corporation chartered under the laws of the Ute Indian Tribe with a Board of Directors who are landowners and water users under the UIIP, prioritizes necessary system repairs based on user feedback, but the overall deteriorating condition of the Project has resulted in a backlog of maintenance that will require comprehensive rehabilitation to resolve. The Ute Indian Tribe has undertaken several studies to demonstrate the poor condition of UIIP infrastructure, prioritize areas for betterment, and quantify potential water savings to Tribal water deliveries from UIIP improvements.

A lateral and structure of the UIIP Uintah Canal in poor condition.
*Source: Ute Indian Tribe*

River diversion structures by the UIIP are operated primarily via remote technology, allowing river commissioners to easily adjust canal diversions. Irrigators throughout the Basin are gradually transitioning to sprinkler systems, increasing irrigation efficiency by minimizing runoff and deep percolation. Additionally, open channel canals in the Basin are periodically being replaced with pipeline, often with funding support from federal programs. Most recently, Reclamation funded the replacement of 5.2 miles of the non-tribal Ouray Park open irrigation canal with pipeline to reduce seepage and system evaporation. The Ute Indian Tribe has begun seeking funding for similar projects within the UIIP.

Sprinkler irrigation on Tribal lands in the UIIP.
*Source: Ute Indian Tribe*

#### *5.1.5.7 Summary of Current Water Use*

Figure 5.1-B depicts, and Table 5.1-F summarizes, the Ute Indian Tribe's current water use of 212,564 AFY by diversion and 128,788 AFY by depletion, out of the Tribe's total diversion water rights, including unresolved claims, of 549,685 AFY. The Ute Indian Tribe's total average agricultural water diversion from 2009-2013 was 211,042 AFY and is organized below by river basin. Irrigation diversion records do not always separate out tribal and other water use. Therefore, tribal water irrigation diversions and depletions were estimated based on diversion records from the Duchesne, Lake Fork, Yellowstone, Uinta, and Whiterocks Rivers, where the majority of tribal irrigation water use presently occurs. The Ute Indian Tribe's total average livestock water diversion is 650 AFY. Total estimated irrigated agricultural and livestock water use by diversion is 211,692 AFY. Tribal DCMI diversions, approximately 872 AFY, are diverted by the Tribal Water System. Although the Tribal Water System diverts from the Whiterocks River and Uriah Heap Springs, the DCMI diversions were assigned to the Whiterocks River as these springs are hydrologically connected to the river. Table 5.1-F organizes the Ute Indian Tribe's current average annual water use by Basin, with the exception of livestock water use, which could not be disaggregated by river system. Figure 5.1-B depicts the Ute Indian Tribe's current water use of 212,564 AFY by diversion and 128,788 AFY by depletion.

**FIGURE 5.1-B**
Ute Indian Tribe's Current Average Annual Water Use (in Utah)

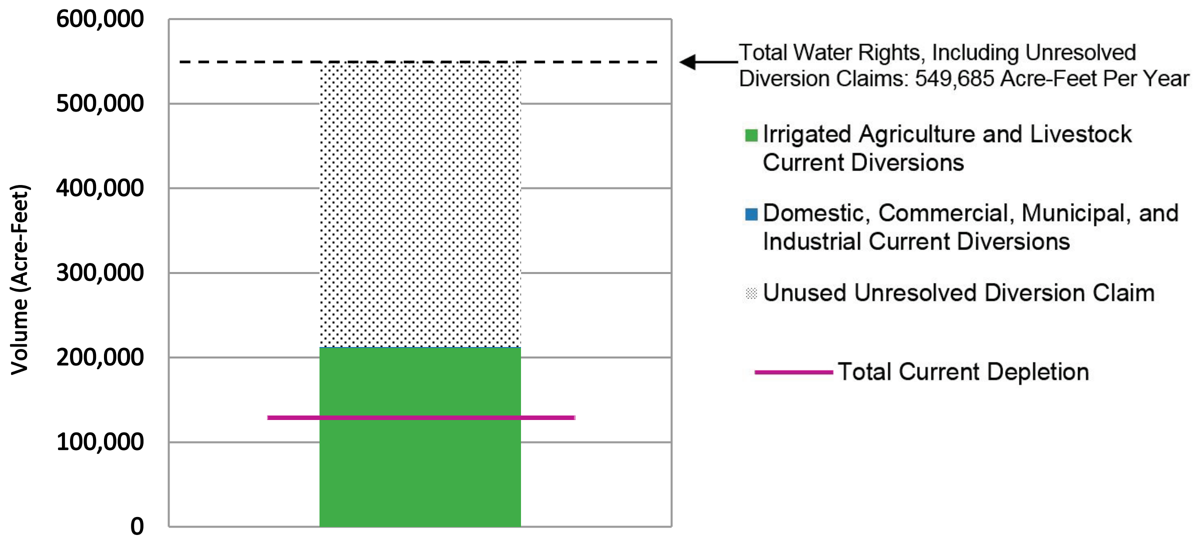



**TABLE 5.1-F**
Ute Indian Tribe Current Average Annual Water Use by Basin (in Utah)[1,2]

| Source | Water Use Category | Current Diversion (AFY) | Estimated Current Depletion (AFY) |
|---|---|---|---|
| Duchesne | AG | 75,568 | 37,784 |
| Lake Fork | AG | 41,686 | 27,791 |
| Yellowstone | AG | 1,345 | 672 |
| Uinta | AG | 54,489 | 37,234 |
| Whiterocks | AG | 37,954 | 23,785 |
| | DCMI | 872 | 872 |
| Green River System | All Uses | - | - |
| Subtotals | AG | 211,692 | 127,916 |
| | DCMI | 872 | 872 |
| **Total** | | **212,564** | **128,788** |

AG – Irrigated Agriculture and Livestock
DCMI – Domestic, Commercial, Municipal, and Industrial
1 Because stock watering use was not available by Source, only the subtotals for both AG current diversion and current depletion include the estimated 650 AFY of livestock water use. Non-consumptive cultural water uses are not included in the Table.
2 The Ute Indian Tribe holds senior reserved water rights in the Green River System. These water rights are presently being used to irrigate small-scale irrigation projects. Attempts to quantify these irrigated acres have been unsuccessful due to a lack of water use records, so diversion and depletion AFY were not included.

### 5.1.6 Tribal Water Use Challenges

Presently, the chief challenge to the use and development of the Ute Indian Tribe's water is the unresolved state of the Tribe's Indian water rights claims, including finalization of the Ute Indian Water Compact with the State of Utah and the Federal government. Though federal court decrees in 1923 (adjudicating a portion of the Ute Indian Tribe's reserved water rights) and additional formal agreements between the parties over the past decades have firmly established the Ute Indian Tribe's senior reserved water rights in the Uinta Basin, today the Tribe remains unable to fully utilize, administer, develop, and enforce its water resources as a sovereign nation. By resolving the Ute Indian Tribe's full Indian water rights claims, either through litigation or a Ute Indian Water Compact with United States Congressional approval that recognizes the Ute Indian Tribe's regulatory authority over its Tribal reserved water rights and provides for the best administrative water management practices based on the recognized and established quantifications, the Tribe believes that it can assert its governmental authority to develop its full Indian reserved water rights. This will bring certainty with regard to water rights to all water users within the exterior boundary of the Reservation and enforcement authority for the Ute Indian Tribe. The Ute Indian Tribe has initiated the development of a Tribal Water Resources Ordinance that will govern water planning, record keeping, managing, permitting, regulating, and enforcing the Tribe's water rights.

Cedarview Reservoir with a low water level near Neola, Utah.
*Source: Ute Indian Tribe*

Though the Ute Indian Tribe holds senior reserved water rights to the natural flows of several rivers in the Uinta Basin, seasonal flow variations frequently do not correspond with crop water demands. Often the Ute Indian Tribe's and allottee's crops are left dry while non-UIIP irrigators utilize storage facilities for supplemental water. It is estimated that tribal lands receive an insufficient water supply (based on Reclamation standards) in seven out of ten years. Many of the storage facilities on the Reservation were developed as part of federal projects, like the Colorado River Storage Project Act establishing the CUP, but others were established by private water user organizations, such as the Moon Lake Water Users Association. The development of water facilities to satisfy only the needs of non-tribal irrigators in the Uinta Basin throughout the twentieth century, with the later effort to develop the Tribal reserved water rights and use, creates uncertainty for junior water rights holders of State-based water rights who divert water despite the Ute Indian Tribe's undeveloped, but higher priority, reserved water rights.

By conducting its own resources studies and improvement plans, the Ute Indian Tribe plans to develop water projects that can improve water deliveries to Tribal and allottee lands and improve the Reservation livelihood for its Tribal members without substantial conflict with existing State water uses. Furthermore, the Ute Indian Tribe believes that sufficient environmental flows in many of the Reservations waterways, particularly the Lake Fork and Uinta Rivers, are sorely lacking. Under the existing system of competing water rights, it is nearly impossible to allow these flows to bypass diversions. With improved water management abilities and supplemental storage facilities, the Ute Indian Tribe is interested in establishing environmental flows that will protect the health and viability of the Reservations' streams, and provide supplemental irrigation water to the UIIP to reduce water shortages.

Under the proposed Revised Ute Indian Compact of 1990, the Indian water rights claims for 27,080 acres of the Ute Indian Tribe's practicably irrigable acreage from what is known as Group 5 lands were moved to the Green River Basin. These unresolved claims total 113,378 AFY of diversion, which are presently identified only as "paper water rights" that cannot be reasonably put to use by the Ute Indian Tribe on these lands. The promised Ute Indian Unit, that was to be a part of the CUP, was never constructed to bring Green River water to the Lake Fork and Uinta River Basins, and the Green River flows through a portion of the Reservation in the deep Desolation Canyon. The Ute Indian Tribe is actively exploring ways to put these water rights claims to use as "wet water rights," and securing conditions that will allow this to take place.

Although the Ute Tribal Water System presently serves the majority of Tribal members living on the Reservation, there are Tribal members on the western portion of the Reservation who lack access to the Tribal Water System and are supplied with DCMI water by other public community water systems or domestic water wells. The Ute Indian Tribe is interested in extending its Tribal Water System, but securing funding for such infrastructure will present additional challenges. The public water sources may also face water rights, supply, and quality challenges common to public water systems.

The West Fork of the Uinta River.
*Source: Ute Indian Tribe*

Finally, given the above challenges, the Ute Indian Tribe requires funding and increased regulatory flexibility to put its full Indian reserved water rights to use so that it may establish the permanent homeland promised with the establishment of its Reservation and recognized in the *Winters* doctrine and decrease the poverty of its Tribal members through economic development of its water that results in improved standards of living for its members.

### 5.1.7 Projected Future Water Development

The Ute Indian Tribe's future water development was assessed by first examining the location, quantity and type of current water use and, then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development. The Ute Indian Tribe's total reserved water rights, based on the 1965 Deferral Agreement, is 549,685 AFY by diversion. The current water use is 212,564 AFY.

The scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreased flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

The Ute Indian Tribe contemplated its future water development through 2060 by reviewing its current water use estimates and reflecting upon how these might change under the four scenarios. During this process, the Ute Indian Tribe considered such elements as the scenario conditions described in the storylines, current or future planned projects, anticipated changes in water use by category, and the extent and condition of existing water infrastructure and the need, as well as the cost, for new infrastructure to support water development. The Ute Indian Tribe contemplated future development in the four water use categories: Irrigated Agricultural and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges Water Use (TRAN).

From this examination, the Ute Indian Tribe extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared a quantified water development schedule. The Ute Indian Tribe used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each development schedule is presented in the following sections.

#### *5.1.7.1 Future Water Development Schedules*

The assumptions for each schedule are described below and the schedules presented graphically in Figure 5.1-C and numerically in Table 5.1-G.

*Current Water Development Trends (Scenario A)*

If current trends in on-reservation water development continue and governance, funding, and resolution of tribal claims remain the same, the Ute Indian Tribe's water diversions will increase 159 percent to a full reserved water rights entitlement of 549,685 AFY by 2040. AG, including livestock, water use diversions will increase from 211,692 AFY by approximately 73 percent to 365,414 AFY, including development on the Green River, White River, and the Bitter, Sweet Water, Hill, and Willow creeks. DCMI water use would increase 1,192 percent on the

Reservation to a total diversion of 11,264 AFY. The Scenario A water development schedule assumes that reserved water rights, totaling 173,007 AFY are used for TRAN by 2040. Water used for ENV purposes is not included in the development schedule as it is non-consumptively used to aid instream flows.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, Ute Indian Tribe water diversions will increase to the full use of its water right by 2055. The Ute Indian Tribe assumed that AG, DCMI, and Green River entitlements used for TRAN will be fully developed by 2055. This represents a fifteen-year delay in comparison to the modeled results under Scenario A. Water used for ENV purposes is not included in the development schedule as it is non-consumptively used to aid instream flows.

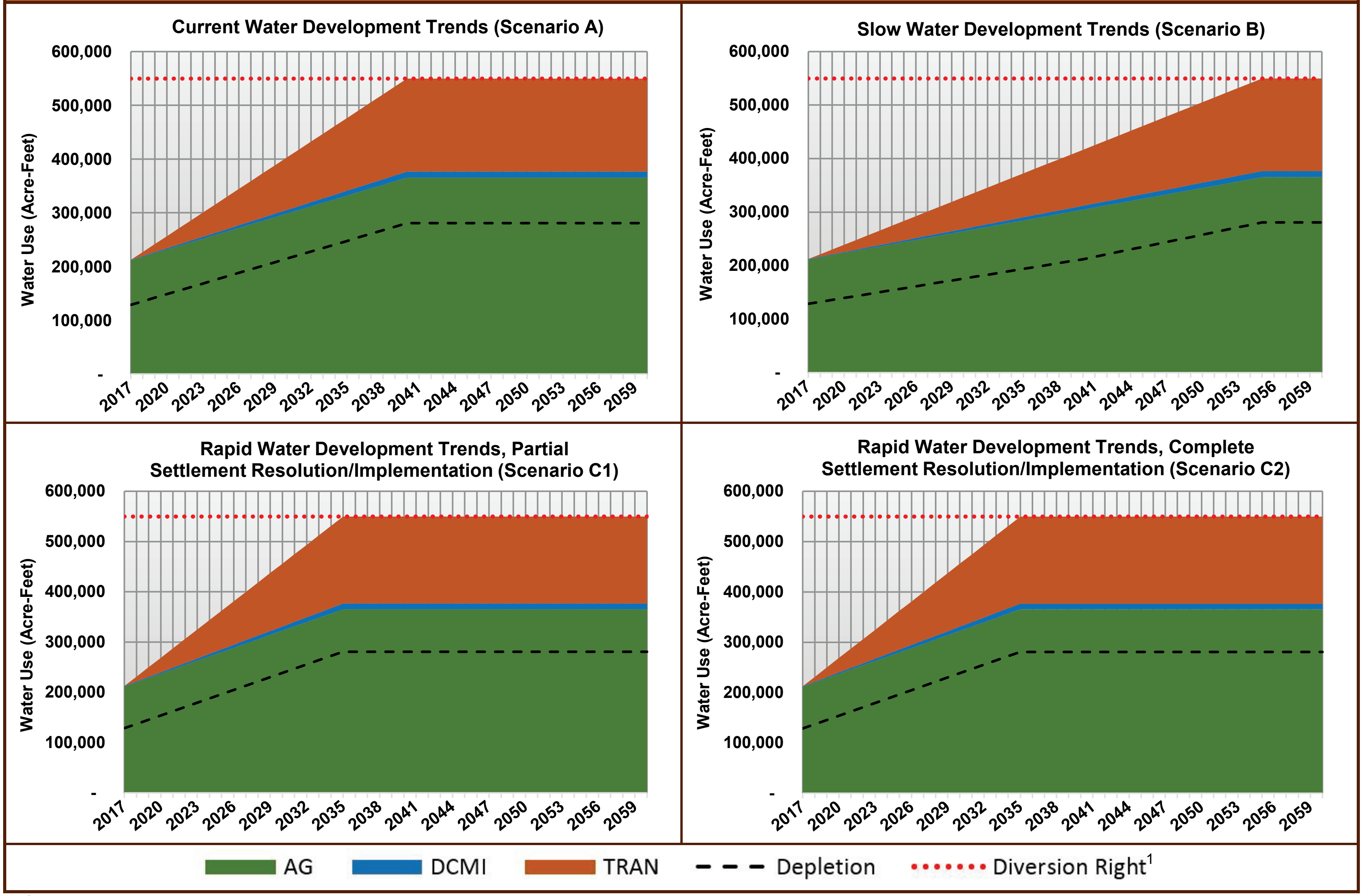
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. The Ute Indian Tribe assumed that the Ute Indian Tribal water diversions will increase to the full use of its water rights entitlement of 549,685 AFY by 2035 with the same water uses (AG, DCMI, and TRAN) as described in Scenario A.

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. The Ute Indian Tribe's water use and development rate for Scenario C2 is the same as Scenario C1 and follows the same assumptions.

**FIGURE 5.1-C**
Ute Indian Tribe Projected Future Water Development (in Utah) (Scenarios A, B, C1, and C2)




[1] Ute Indian Tribe's total reserved water rights by diversion, including unresolved claims, is 549,685 AFY.

### *5.1.7.2 Summary of Projected Future Water Development*

The Ute Indian Tribe's current water use and projected future water development under the Tribal Water Study's water development scenarios, and modeled for analysis purposes, is presented in Table 5.1-G.

**TABLE 5.1-G**
Summary of Ute Indian Tribe Current Water Use and Projected Future Water Development (in Utah)[1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion |
| **Current Use** | *AG* | 211,692 | 127,916 | 211,692 | 127,916 | 211,692 | 127,916 | 211,692 | 127,916 |
| | *DCMI* | 872 | 872 | 872 | 872 | 872 | 872 | 872 | 872 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **212,564** | **128,788** | **212,564** | **128,788** | **212,564** | **128,788** | **212,564** | **128,788** |
| **Use at 2040** | *AG* | 365,414 | 182,376 | 304,735 | 152,166 | 365,414 | 182,376 | 365,414 | 182,376 |
| | *DCMI* | 11,264 | 10,669 | 7,161 | 6,783 | 11,264 | 10,669 | 11,264 | 10,669 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 173,007 | 87,731 | 104,715 | 53,101 | 173,007 | 87,731 | 173,007 | 87,731 |
| | **Total** | **549,685** | **280,776** | **416,611** | **212,050** | **549,685** | **280,776** | **549,685** | **280,776** |
| **Use at 2060** | *AG* | 365,414 | 182,376 | 365,414 | 182,376 | 365,414 | 182,376 | 365,414 | 182,376 |
| | *DCMI* | 11,264 | 10,669 | 11,264 | 10,669 | 11,264 | 10,669 | 11,264 | 10,669 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 173,007 | 87,731 | 173,007 | 87,731 | 173,007 | 87,731 | 173,007 | 87,731 |
| | **Total** | **549,685** | **280,776** | **549,685** | **280,776** | **549,685** | **280,776** | **549,685** | **280,776** |

[1] Ute Indian Tribe's total reserved water rights by diversion, including unresolved claims, is 549,685 AFY.

# 5.2 Southern Ute Indian Tribe

## 5.2.1 Introduction

The original Southern Ute Indian Reservation (Reservation) was carved out of the historical Ute homelands in 1868. The present Reservation boundary, encompassing approximately 1,067 square miles, is located in the southwest portion of Colorado and shares a border with the Ute Mountain Ute Reservation to the west, the State of New Mexico to the south, and the Jicarilla Apache Nation Reservation to the southeast. The Reservation boundary is roughly 75 miles long and 15 miles wide, in which approximately 499 square miles are Tribal land, 472 square miles are private fee simple, and the remaining 96 square miles are federal lands (SUIT, 2012).

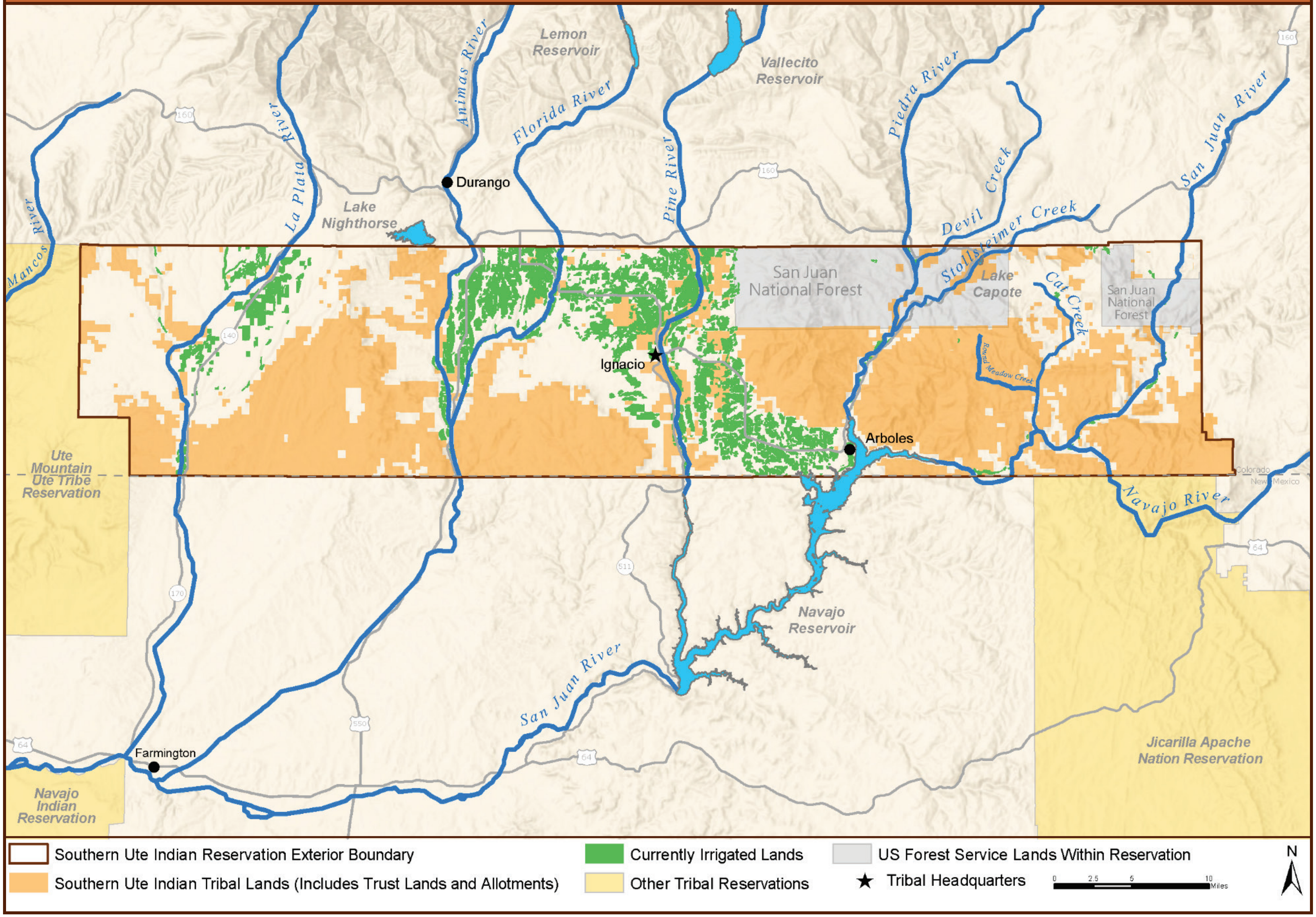
Southern Ute Tribal Museum
*Photo courtesy of Southern Ute Indian Tribe*

The Southern Ute Indian Tribe's (SUIT or Tribe) current enrollment is a little over 1,500 members. Approximately 1,000 Tribal members live within the exterior boundaries of the Reservation, on both Tribal and private land, with the majority living along the Pine River corridor. Due to the checkerboard nature of land ownership within the Reservation boundaries, Tribal water use and other water use are closely intertwined, especially in regard to water delivery and return flows (SUIT, 2015).

Ignacio, Colorado, with a population of about 700, is the largest town on the Reservation, and site of the BIA Southern Ute Agency. Durango, Colorado with a population of about 17,500, is about five miles north of the Reservation and Farmington, New Mexico, with a population of about 45,000, lies about 29 miles south of the Reservation boundary.

Figure 5.2-A presents a general location map with Reservation boundaries, communities, and other important features.

**FIGURE 5.2-A**
Southern Ute Indian Tribe Reservation Map






*See the Disclaimer and Introduction to Chapter 5.0.*

### 5.2.2 Physical Setting

The agricultural landscape of the Pine River Valley with the San Juan and HD Mountains in the background.
*Photo courtesy of Southern Ute Indian Tribe*

The topography of the SUIT Reservation is generally rugged, with several river valleys and a few major ridges dividing it into distinct regions. The western and central portions both consist of rolling mesas broken up by small canyons and arroyos. Due to the lack of water availability for both domestic and agricultural uses, the western third of the Reservation is locally referred to as the "Dry Side." The majority of the irrigated lands, along with the highest population numbers, are found in the central region. Eastward, the ridges and peaks dominate the landscape as they become larger and more timber covered. Elevations range from about 6,000 feet along the La Plata River near the southwest corner of the Reservation and along the San Juan River near Arboles, Colorado, to over 9,200 feet on Archuleta Mesa in the southeast corner of the Reservation.

From an ecological standpoint, the Reservation occupies a transition zone between the desert regions of the Four Corners and the subalpine zones of the San Juan Mountains. Eastern portions of the Reservation contain Ponderosa pine, mixed conifer and aspen stands; however, most of the Reservation consists of sagebrush savanna, pinyon-juniper woodland, and cleared agricultural land.

Pinyon-juniper woodlands and sagebrush dominate much of the uncleared portions of the lower elevation landscape on the Southern Ute Indian Reservation.
*Photo courtesy of Southern Ute Indian Tribe*

#### *5.2.2.1 Watersheds*

The SUIT Reservation lies within the San Juan River drainage system. The San Juan River drains the eastern one-third of the Reservation, flowing to the southwest. In the western two-thirds of the Reservation, drainage is mostly to the south via the Piedra, Los Pinos (locally referred to as the Pine River), Florida, Animas, and La Plata Rivers, all tributaries to the San Juan River. Navajo Reservoir, formed by Navajo Dam in New Mexico, forms a significant body of water on the San Juan River that extends into the southeastern part of the Reservation. Navajo Dam and Reservoir were authorized in 1956 as a part of the Colorado River Storage Project, and were completed in 1963. Although the Tribe does not have any rights to water in Navajo Reservoir, the Reservoir's role in managing flow levels for the San Juan River Basin Recovery Implementation Program (SJRBRIP) means that it is crucial to ensuring that the Tribe can utilize its reserved water rights given that all rivers on the Reservation are tributary to the San Juan. See Table 5.2-B for more information regarding water reliability in each river basin.

The Animas River south of Durango.
*Photo courtesy of Southern Ute Indian Tribe*

#### *5.2.2.2 Hydrogeology*

The complex sedimentary geology underlying the SUIT Reservation means that groundwater exists in both alluvial and bedrock aquifers. The alluvial formations consist of both terrace and river deposits and tend to have the highest yields with the best water quality. Their size and thickness vary in the different basins, but they are usually shallow and recharge quickly. The bedrock formations are primarily sandstone with confining layers of shale between them. With the exception of the Animas Formation, bedrock aquifers generally have lower yields and their output is more likely to have water quality issues, limiting its potability.

#### *5.2.2.3 Climate*

Annual precipitation on the SUIT Reservation ranges from 8 to 20 inches. Precipitation occurs primarily in the winter and the late summer when a strong monsoonal cycle typically develops. Due to topography and the nature of monsoonal thunderstorms, precipitation patterns often are localized and precipitation events can be brief but dramatic. Temperature extremes can range from highs near 100 °F to lows of around -20 °F but year-round averages are in the 40°s to 60°s with abundant sunshine.

### 5.2.3 Historical Use and Cultural Importance of Water

Prior to government interference, the Ute people were hunters and gatherers, moving in small bands in the summer months while hunting and collecting food to preserve for the winter (Jefferson et al., 1972). Groups would camp along the rivers to take advantage of the game drawn to the water, the fish in the river, and to utilize the abundant cottonwoods and willows for shelter and shade. According to a Tribal Elder, water has always been a provider. However, the government's focus on trying to make Utes into farmers brought a new aspect to their relationship with water (Quintana, 2004). Water was still to be a provider, but it now would be manipulated and controlled.

Cottonwood galleries and willow stands line much of the Pine River as it crosses the Southern Ute Indian Reservation.
*Photo courtesy of Southern Ute Indian Tribe*

The signing of the 1868 Treaty (Treaty with the Ute Indians, 15 Stat. 619) created a reservation that encompassed roughly the western third of present day Colorado, including the vast watersheds of the Western Slope. But the discovery of gold and silver in the San Juan Mountains and the accompanying influx of miners led to the forcible relinquishment of the

San Juan area and its mountainous headwaters under the Brunot Agreement of 1873 (Agreement of Sept. 13, 1873, ratified by Act of April 29, 1874, ch. 136.). Subsequent agreements and events in the 1870s and 1880s further reduced the Ute lands in Colorado, resulting in the relocation of the Northern Ute Bands to Utah and the Southern Ute Bands to a narrow strip along the New Mexico border in the southwestern portion of Colorado.[1] The implementation of the allotment policy under the Hunter Act of 1895 (28 Stat. 677, signed February 11, 1895, ch. 113) ultimately led to the Ute Strip being divided into two reservations, with the eastern allotted portion becoming the current Southern Ute Reservation and the western un-allotted portion becoming the current Ute Mountain Ute Reservation (Jefferson et al., 1972).

Beginning with the Brunot Agreement, the government sought to discourage the hunting economy of the Southern Utes by transitioning them to farming (Schurz, 1877). Because of this policy, water, and access to it, have played a large role in shaping and defining the settlement and development patterns on the Southern Ute Reservation. As early as 1880, as the concept of allotment was being debated, Indian Agent Henry Page pointed out in his annual report that, "land on the Southern Ute Reservation could not be cultivated without the use of irrigation ditches." (Quintana, 2004) The first irrigation ditches to serve Southern Ute lands were built around 1885 and by 1888 almost 600 acres were reported to be in cultivation along the Pine River.

With the enactment of allotment on the SUIT Reservation, the construction of irrigation ditches took on a new priority. The majority of allotments were taken along the Pine River, but even with tracts laid out in long, narrow strips to maximize access to the riparian corridor, many Tribal members ended up with little access to irrigation water. In late 1896, the Indian Service (the predecessor to the BIA) began work on the Spring Creek Ditch to serve the majority of allotments east of the Pine River. Around the same time, the Animas Ditch was constructed to serve allotments along the Animas River.

A tribal diversion on the Pine River circa 1927. This same diversion structure is still in use, despite its antiquated condition.
*Source: Irrigation Reports, 1907-1946. Phoenix Area Office. Branch of Irrigation. Records of the Bureau of Indian Affairs (RG 75). National Archives at Riverside, Perris, CA.*

In 1899, lands not already allotted on the SUIT Reservation were opened to homesteading and settlers quickly moved in to claim land and water (Quintana, 2004). Settlers and developers, under Colorado water law statute, enlarged some of the existing government ditches and claimed rights in them. The water situation was rapidly becoming complicated and contentious. Local Indian Agents pressed officials in Washington, D.C. to act quickly to secure the necessary water rights for all Tribal allotments, but as Easterners, the officials did not appreciate the value of water in the West and the need for urgent action.

[1] More information available at: www.southernute-nsn.gov/history

By 1914, Tribal and other water claims on the Pine River, many of which were speculative, totaled more than ten times the natural flow rate of the river (BIA Irrigation Report, H. F. Robinson, 1914). Under the *Winters Doctrine*,[2] the Tribe had first water rights on the Pine River, based upon the 1868 Reservation establishment date, but the amount of water the Tribe was entitled to was not yet determined. This was ultimately decided on the Pine River in the 1930 case *United States v. Morrison Consolidated Ditch Co*.[3] But the question of reserved rights on other rivers across the Reservation remained and would not be fully answered for another 56 years.

The need for reservoirs, both to control seasonal flooding and to ensure a steady supply of irrigation water throughout the growing season, was recognized early in the settlement of the SUIT Reservation, but authorization of funding would not come for several decades. Vallecito Dam was the first to be authorized in 1937, and completed in 1941. Lemon Reservoir, on the Florida River, was also contemplated at this time, but World War II and other political priorities delayed its construction authorization until 1960.

The question of the Tribe's reserved water rights were finally settled in 1986 with the Colorado Ute Indian Water Rights Final Settlement Agreement ("1986 Settlement Agreement"). A significant portion of the settlement, both for the Southern Ute and Ute Mountain Ute Tribes (referred to collectively as the 'Colorado Utes'), was the final authorization of the Animas-La Plata Project (A-LP). Initially authorized in 1968, the final scaled-down version of the project was not completed until 2013.

The following was developed by current SUIT Members as a description of water's cultural significance:

> *Since before it was the state of Colorado the Utes have always been here, and we have always stayed where the water was. We depend on our water sources for our very existence and we gave thanks to the Creator that we have water for our use. In the early days we traveled to the heated springs at Pagosa Springs. This was the healing place for us. This was a very good place to go and bathe in or drink the mineral water. At one time, the Navajos and the Utes fought over the use of the hot springs, which happened around 1867. The Utes won the fight. At our homes we took care of the water and did not waste it. We used water in our everyday needs. We stored water in jugs lined with pitch to store and use later. In the early years, the rivers and streams were clean fresh water and we took water from them. We did not have to worry about what was in the water.*
>
> *Water has also been a part of the traditional ways. This would be the Bear Dance, Sundance, Native American Church, and Sweat ceremonies. Each of these use sacred water in the ceremony.*
>
> *The Southern Ute Bear Dance takes place in the spring, when we gather to celebrate the awaking of the bear. Bear dance songs are sung and we welcome the bear from its winter sleep.*

[2] *Winters v. United States,* 207 U.S. 564 (1908).

[3] *United States v. Morrison Consolidated Ditch Co.*, No. 7736 (D. Colo. Oct. 25, 1930).

*Sundance takes place in the summer for four days. Each sundancer dances and prays for four days without food or water. Sacred water is brought in for the dancers on the last day.*

*The sweat ceremony is one traditional way of praying for many native people. Sacred water is used to put on heated rocks. Buckets of water are brought inside the ceremony and prayers are spoken to the Creator for the use of water. Prayer is spoken that the water that flows upon Mother Earth will remain clean and to feed all living beings, from the smallest to the largest. Water is put on the rocks and the healing steam comes forth to all people inside the lodge. Water is taken by all persons after offering the water to Mother Earth.*

*The Native American Church also uses water as an important part of their ceremony.*

*Clearly, water is an integral part of the Tribe's life and plays a great part in its cultural ways.*

Utes crossing the Pine River (1899).
*Source: Denver Public Library, Western History Collection, H.S. Poley, photographer, P-51*

### 5.2.4 Southern Ute Indian Tribe Water Supply

Since the Colorado Utes' reserved water rights under the *Winters Doctrine* were senior to all other rights in the San Juan and Dolores Basins in Colorado, the resolution of these reserved water rights claims was critical to all water users in both basins in Colorado. The 1986 Settlement Agreement, signed on December 10, 1986, quantified the SUIT's water rights on several rivers and projects, including both direct diversion and storage rights with priorities ranging from 1868 to 1976[4] (Table 5.2-A). Congress implemented portions of the 1986 Agreement when it enacted the Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No. 100-585, 102 Stat. 2973 (1988 Settlement Act). That legislation was amended by the Colorado Ute Settlement Act Amendments of 2000, enacted as Title III of Pub. L. 106-554, 114 Stat. 2763, 2763A-258 to 266 (codified as a note to 22 U.S.C. § 2452) (Dec. 21, 2000) (2000 Amendments) (with minor amendments in Pub. L. 110-161, Section 130 (Dec. 26, 2007)).

[4] Additional state adjudicated rights held by the Tribe have priorities later than 1976.

#### *5.2.4.1 Colorado Consent Decrees*

SUIT's settlement-based reserved water rights are decreed by river basin or watershed, and include direct diversion and depletion-based surface water rights, Reservation-based storage rights, tributary groundwater rights, and allocations in three federal reservoir projects. The 1986 Settlement Agreement, as implemented by the 1988 Settlement Act and as amended by the 2000 Amendments and the Colorado State Court consent decrees, contains important provisions that address, among other things, the nature of the Tribe's reserved water rights, administration of the Tribe's water rights, and changes of water rights.

*General Diversion and Depletion Rights*

The 1986 Settlement Agreement also quantified existing and future use water rights, including direct diversion surface water rights and storage rights, as well as a water right to support development for oil and gas and road work on the Reservation. The 2000 Amendments altered the A-LP facilities to be built to settle the Tribal claims on the Animas and La Plata Rivers. The 2000 Amendments also altered the amount of water allocated to the Tribe with respect to A-LP.

The Ute municipal diversion on the Pine River.
*Photo courtesy of Southern Ute Indian Tribe*

Pursuant to the various Consent Decrees, the Tribe's direct diversion water rights, depletion rights and Reservation-based storage rights include, but are not limited to:

(1) On the Pine River, the Tribe retained its reserved water right with an 1868 priority date for 181.7 cubic feet per second (cfs), as set forth in the 1930 federal decree and 1934 state decree, and was allocated its proportionate share of a 1/6th interest in Vallecito Reservoir.

(2) On the Florida River, the Tribe was allocated 563 acre-feet per year (AFY) of Florida Project water and 1,090 AFY of non-project reserved water rights.

(3) On Stollsteimer Creek, the Tribe received a reserved water right with an 1868 priority date for storage of 1,850 AFY in Pargin Reservoir (commonly referred to as Lake Capote), a reserved water right with a 1986 priority date for one refill in Lake Capote in the amount of 1,850 acre-feet (AF), and two reserved water rights for a total of 5.5 cfs from Stollsteimer Creek.

(4) On the Piedra River, the Tribe received a reserved water right with an 1868 priority date for direct flow diversions of 1,595 AFY.

(5) On Devil Creek, the Tribe received a reserved water right with an 1868 priority date subordinated to all rights with an adjudication date prior to 1976 for direct flow diversions of 183 AFY.

(6) On the San Juan River, the Tribe received a reserved water right with an 1868 priority date for direct flow diversions of 1,530 AFY.

(7) On Round Meadow Creek, the Tribe received a reserved water right with an 1868 priority date for direct flow diversions of 975 AFY.

(8) On Cat Creek, the Tribe received a reserved water right with an 1868 priority date for direct flow diversions of 1,372 AFY.

(9) On the Animas River, the Tribe received a water right for present and future municipal and industrial uses with an average annual depletion not to exceed 16,525 AFY.

(10) Reservation-wide, in all drainages, the Tribe received a reserved water right for oil and gas associated diversions in the amount of 117.5 AFY and a water right for road construction and maintenance purposes in the amount of 12.05 AFY. Both rights have a March 2, 1868 priority date.

*On-Reservation Groundwater Rights*

SUIT received tributary groundwater rights for domestic and livestock wells with a March 2, 1868, priority date in the amount of 2,000 AFY.

**TABLE 5.2-A**
Southern Ute Indian Tribe Reserved and Adjudicated Water Rights
*(Annual diversion rights are approximate and may not account for specific timing and volumetric limitations associated with some rights)*

| River Basin | Type | Annual Diversion Right (AFY) | Depletion Right (AFY) | Net Acres (approx.) | Priority Dates |
|---|---|---|---|---|---|
| Animas River | River Direct Diversion | 2,334 | - | 551 | 1868 |
| | Ponds, Springs, Wells, etc. | 34 | - | Domestic, Livestock, Wildlife, etc. | 1868 |
| | Animas-La Plata Project | 44,662 | 16,525 | DCMI Only | 1868/1938[1] |
| Florida River | River Direct Diversion | 1,090 | - | 545 | 1868 subordinated to 1976 |
| | Ponds, Springs, Wells, etc. | 13 | - | Domestic, Livestock, Wildlife, etc. | 1868 |
| | Florida Project | 2,563 | - | 1,054 | various |
| La Plata River | River Direct Diversion | 657 | - | 155 | 1868 |
| | Ponds, Springs, Wells, etc. | 142 | - | Domestic, Livestock, Wildlife, etc. | 1868 |
| Piedra River | River Direct Diversion | 1,595 | - | 535 | 1868 |
| | Stollsteimer Creek Direct Diversion | 1,800 | - | 600 | 1912 subordinated to 1986; 1928 |
| | Devil Creek Direct Diversion | 183 | - | 61 | 1868 subordinated to 1986 |
| | Ponds, Springs, Wells, etc. | 22 | - | Domestic, Livestock, Wildlife, etc. | 1868 |
| | Lake Capote (supplemental storage) | 1,850 | - | Used to supplement direct diversion irrigation when water is unavailable or out of priority | 1868 |
| | | 1,850 (refill) | - | | 1986 |

**TABLE 5.2-A**
Southern Ute Indian Tribe Reserved and Adjudicated Water Rights
*(Annual diversion rights are approximate and may not account for specific timing and volumetric limitations associated with some rights)*

| River Basin | Type | Annual Diversion Right (AFY) | Depletion Right (AFY) | Net Acres (approx.) | Priority Dates |
|---|---|---|---|---|---|
| Pine River | River Direct Diversion | 65,852 | - | 15,973[2] | 1868 |
| | Ponds, Springs, Wells, etc. | 246 | - | Domestic, Livestock, Wildlife, etc. | 1868 |
| | Ute Municipal Direct Diversion | 1,571 | - | DCMI Only | 1868 subordinated to 1976 |
| | Vallecito Reservoir (supplemental storage) | 21,613 | - | Used to supplement direct diversion irrigation and Ute Municipal right when water is unavailable or out of priority | various |
| San Juan River | River Direct Diversion | 1,530 | - | 510 | 1868 |
| | Cat Creek Direct Diversion | 1,372 | - | 482 | 1868 |
| | Round Meadow Direct Diversion | 975 | - | 325 | 1868 |
| | Ponds, Springs, Wells, etc. | 149 | - | Domestic, Livestock, Wildlife, etc. | 1868 |
| Mancos River | Stock Ponds Only | 1 | - | Livestock, Wildlife | 1868 |
| Navajo River | Springs, Ponds | 19 | - | Livestock, Wildlife | 1868 |
| Reservation-Wide All Basins | Miscellaneous (future wells, road maintenance, oil and gas) | 2,130 | 2,130 | DCMI, Livestock | 1868 |
| **Total Diversion Right** *(does not include supplemental storage volumes)* | | **128,939** | | | |

[1] Like most of the rights included in the Colorado Ute Indian Water Settlement Act of 1988, Southern Ute's A-LP right has an 1868 priority date based upon the establishment of the reservation, but it also shares in the A-LP adjudication date of 1966, and an appropriation date of 1938.

[2] Pine River Irrigated Acreage includes all Tribal Tract A, Tract B, and Tract C lands as listed in the Vallectio Reservoir 1940 MOU between BIA, Reclamation, and SUIT.

The reliability of SUIT's surface water supplies varies greatly depending on the river basin and the year. Table 5.2-B describes the general reliability of the surface water supplies.

**TABLE 5.2-B**
Surface Water Reliability

| River | Reliability | Description |
|---|---|---|
| Animas River | Good | Large watershed; reliable flows; Tribe has storage rights under A-LP and some direct diversion rights; shortages currently uncommon. |
| Florida River | Fair | Small watershed; large number of users; Lemon Reservoir, the only storage in this drainage, often fails to fill, resulting in a diminished supply to all irrigators; shortages are not uncommon. |
| La Plata River | Poor | Small watershed; over-allocated; Tribe has limited rights; shortages are very common. Water availability is further restricted because of the La Plata River Compact with New Mexico. |
| Piedra River | Excellent | Small number of Tribal water users; reliable flows; Tribe has direct diversion and some storage rights; shortages very uncommon. |
| Pine River | Excellent | Tribal direct diversion rights are the most senior on the river; primary source of water for the majority of Tribal irrigators; good reservoir storage; shortages very uncommon. |
| San Juan River | Good | Large watershed; reliable flows; small number of Tribal users; Tribe has some direct diversion rights and undeveloped storage rights; shortages uncommon. |

### *5.2.4.2 Federal Project Water Allocations*

SUIT's settlement-based water rights, as described above, include allocations from the following federal reservoir projects:

*Animas-La Plata Project*

The A-LP Project's Ridges Basin Dam and Reservoir, Lake Nighthorse, near Durango, Colorado.
*Photo courtesy of Southern Ute Indian Tribe*

The A-LP Project was a key component of the 1988 Settlement Act. The primary objective of the A-LP at that time was to supply irrigation, municipal and industrial water to the Ute Mountain Ute and Southern Ute Tribes. However, due to concerns over the potential adverse effect of the Project on two endangered fish, the 1988 Settlement Act provisions were amended in 2000 and provided for the completion and implementation of a downsized Project and elimination of the irrigation component. Approval to begin construction was granted in October 2001, initial site work began in April 2002, and the work was completed in 2013. The A-LP Project off-channel reservoir, Lake Nighthorse, which filled in 2011, stores water diverted from the Animas River. SUIT's allocation in the A-LP Project is 38,108.5 AF of storage with a depletion right of 16,525 AFY for municipal and industrial use. Due to a lack of infrastructure, the Tribe is limited in how it can currently utilize its A-LP storage allocation, but efforts are being made to address this issue.



*See the Disclaimer and Introduction to Chapter 5.0.*

*Florida Project*

The Florida Project, operated by the Florida Water Conservation District, delivers storage water from Lemon Reservoir to 1,054 irrigable acres of SUIT lands in the Florida drainage. Lemon Dam and Reservoir, located on the Florida River, was completed in 1963 by Reclamation as a key part of the Florida Project. The Reservoir has a capacity of 40,146 AF to provide irrigation water and flood control and, of the full capacity, 2,563 AF is allocated for Tribal parcels. The Reservoir is operated based on shared shortage and often fails to fill, resulting in a diminished supply to all irrigators.

Rehabilitation of a Tribal canal in the Pine River valley using a dragline – circa 1964.
*Photo courtesy of Southern Ute Indian Tribe*

*Pine River Indian Irrigation Project*

This BIA-operated project serves both Tribal and other irrigators across 16,966 acres of irrigable land. Most of the irrigated lands receive direct diversions through approximately 175 miles of project ditches and laterals. Vallecito Dam and Reservoir was completed in 1940 by Reclamation primarily to provide storage water for irrigation purposes along with some other uses. One sixth of the 129,700 AF Reservoir capacity belongs to SUIT; the other 5/6ths belong to the Pine River Irrigation District, which operates the Reservoir.

### 5.2.5 Current Water Use and Operations

The majority of SUIT's current water use is for agricultural irrigation, although a small percentage (approximately three percent) is used for domestic, commercial, municipal and industrial (DCMI) purposes.

#### *5.2.5.1 Irrigated Agriculture and Livestock Water Use Category*

Most agricultural production on the SUIT Reservation is focused on hay production and maintaining irrigated pasture for livestock. Historically, grain and tree fruit crops were grown in the area, but this has diminished as regional food production patterns have changed.

A short growing season (120-150 days) and temperature extremes have precluded the production of many other crops in the area. Some residents keep small vegetable gardens and backyard orchards, but this use is relatively small in the scope of this study.

A network of telemetry linked gages provide real-time ditch flow measurement on portions of the Pine River Indian Irrigation Project.
*Photo courtesy of Southern Ute Indian Tribe*

The majority of the Tribe's irrigated lands is held by individual Tribal members as allotments or assignments ranging in size from 20 to 200 acres, making them suitable only for producing supplemental income from agriculture. Even among other irrigators in the area, single-income, full-time farm operations are the exception.

The Tribe does not currently have any commercial farm operations, but it does maintain a small buffalo herd of around 30 head for Tribal member consumption and cultural uses.

Hay production is the focus of most irrigators on the Southern Ute Indian Reservation.
*Photo courtesy of Southern Ute Indian Tribe*

Of the Tribe's 22,000 acres of potentially irrigable land, only 7,500 acres or so are currently in production and actively managed. Much of this disparity is due either to a lack of water delivery infrastructure or the poor condition of existing infrastructure. The Pine River Indian Irrigation Project (PRIIP), which serves the majority of Tribal irrigators, suffers from a large maintenance backlog, a lack of funding, and staffing shortages.

Whether it is the Florida Project, the PRIIP, or smaller private ditches, all water delivery to Tribal lands is by means of unlined canals and ditches. Many of the diversions and other ditch structures are between 50 and 90 years old and flood irrigation is still the primary form of irrigation among Tribal water users. With grant and technical assistance from Reclamation, the Tribe has installed a network of remote gage stations to monitor diversions on portions of the PRIIP; this has been recently expanded to include two automated ditch headings. The Florida Water Conservancy District has also installed a few automated headgates and started lining a portion of its primary canals, but the majority of the irrigation systems, both on and off the Reservation, are still manually operated.

In addition to irrigated lands, approximately 70,000 acres of grazing lands are currently available by permit to Tribal members raising livestock. These range units are managed by the Tribe's Range Division and are scattered across the Reservation. Water sources on the range units consist of a mix of wells, livestock ponds, springs, and catchments and are utilized by wildlife as well as livestock. These sources are generally reliable, but drought conditions over the past decade have affected the availability of both water and forage. Diversion totals for Tribal irrigation for the period from 2009 through 2013 are presented in Table 5.2-C.

**TABLE 5.2-C**
SUIT Irrigation Diversions (2009 – 2013)[1]

| Irrigation Diversions | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| Surface Water | 31,450 | 31,500 | 31,600 | 31,500 | 31,500 |
| Groundwater | minor | minor | minor | minor | minor |
| Storage | 2,865 | 2,725 | 2,670 | 2,875 | 2,800 |
| **Total** | **34,315** | **34,225** | **34,270** | **34,375** | **34,300** |

[1] Annual volumes depict major diversions and are not comprehensive.

### *5.2.5.2 Domestic, Commercial, Municipal, and Industrial Water Use Category*

<u>Domestic Use</u>

Approximately 600-800 AFY of water is delivered through the Southern Ute municipal water system to serve Tribal homes, offices, and facilities, as well as other households, retail businesses, and light industrial operations around Ignacio. Tribal households not served by the municipal system rely upon wells or water hauling to obtain their domestic water. Much of the water used for large-scale outdoor landscaping around Ignacio (parks, athletic fields, etc.) comes from area irrigation ditches or is pumped from the Pine River under a state adjudicated right.

Domestic water sales to the Town of Ignacio system account for roughly 15 percent of the current Ute municipal water treatment plant output. The estimated average water use per day and year is described in Table 5.2-D. Table 5.2-E presents additional information on daily water use. The DCMI water use for the period from 2009 through 2013 is presented in Table 5.2-F. Use in 2010 and 2011 is high because of pipeline leaks.


The treatment plant for the Ute municipal system that serves the Southern Ute Indian Tribe campus, the Town of Ignacio, and close to 350 residences via 19 miles of pipeline.
*Photo courtesy of Southern Ute Indian Tribe*

**TABLE 5.2-D**
Domestic, Commercial, Municipal, and Industrial Use under the Ute Municipal Diversion for 2013

| Water Use | Volume (average gallons per day) | Volume (AFY) |
|---|---|---|
| Water Sold to Town of Ignacio system | 71,430 | 80 |
| Tribal Household Use - On Pipeline | 37,485 | 42 |
| Tribal Household Use - Contract Haul | 6,873 | 8 |
| Tribal Casino Use | 84,917 | 95 |
| Tribal Sun Ute Recreation Center Use | 8,180 | 9 |
| Other Household Use - On Pipeline | 15,575 | 17 |
| Other Uses (Includes, commercial water dock sales, Tribal campus use, fire hydrants, etc.) | 225,827 | 253 |
| **Total Water Treatment Plant Output** | **450,287** | **504**[1] |

[1] Treatment Plant annual output amounts may differ from annual diversion amounts due to settling pond evaporation and seepage, raw water used for back flushing operations, etc.

**TABLE 5.2-E**
Daily Water Use per Customer Type on Ute Municipal System

| Customer Type | Number of Accounts | Average Use per Account (gallons per day) | Total Average Use per day (gallons) |
|---|---|---|---|
| Tribal Households on Pipeline | 255 | 147 | 37,485 |
| Tribal Households on Contract Haul | 56 | 122 | 6,873 |
| Other Households on Pipeline | 89 | 175 | 15,575 |
| Accounts in Ignacio System (includes household and commercial accounts) | 413 | 173 | 71,430 |

**TABLE 5.2-F**
Domestic, Commercial, Municipal, and Industrial Surface Diversions (2009 – 2013)[1]

| DCMI Surface Diversions | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| Ute Municipal System | 978 | 1,009 | 1,012 | 870 | 632 |

[1] Annual volumes depict major diversions and are not comprehensive.

*Commercial and Industrial Use*

Despite extensive oil and gas development on the SUIT Reservation, current commercial and industrial uses of Tribal water are somewhat limited. Based on anecdotal observations, a large portion of the water purchases at the commercial water dock on the Ute Municipal system are by oil and gas contractors hauling water for construction and maintenance operations, but these uses are not tracked. In Colorado Water Division 7, water is broadly available, legally and physically, for oil and gas development activities so operators have not had to rely on decreed sources, with the exception of coalbed methane wells that intercept tributary groundwater in water critical areas. In these cases, operators are required to augment any potential depletions to prevent injury to senior users. The Tribe has agreements in place to provide 30 AFY of exchange water for these augmentation purposes. Other recent industrial uses have included a gravel pit and concrete batch plant operated as a Tribal enterprise. These operations have relied upon state-adjudicated well rights for their water supplies.

SUIT's Consent Decrees include 117.5 AFY of reserved water rights for uses associated with oil and gas development and 12.05 AFY for uses associated with road construction and maintenance. These uses have not historically been quantified or recorded.

### 5.2.5.3 Environmental, Cultural, and Recreational Water Use Category[5]

SUIT places a high value on water quality because of its importance to aquatic life, wildlife, and human life. The Tribe has monitored water quality on the Reservation for over 20 years with support from the U.S. Environmental Protection Agency (EPA) under the Clean Water Act Section 106 Program. The Tribe has recently applied for Regulatory Authority from the EPA to implement its own Tribal Water Quality Standards on the Reservation.

[5] These uses are non-consumptive.

Pine River north of Ignacio. In many ways the rivers are the heart of the Southern Ute Indian Reservation.
*Photo courtesy of Southern Ute Indian Tribe*

Historically, water quality concerns on the reservation focused on the Animas River and the potential heavy metal contamination from the Silverton mining district, located about 45 miles upstream of the SUIT Reservation border. However, sampling has shown that while the metals are found in significant quantities in the Silverton area, they do not appear to be of significant concern downstream on the portion of the Animas that crosses the Reservation.

Today, the primary water quality concerns on the Reservation center on elevated nutrient concentrations in several of the rivers. Discharges from waste water treatment plants, leaky septic systems, and runoff from agricultural production all lead to increased concentrations of nitrogen and phosphorus. These nutrient levels can cause high variations in water chemistry which can be stressful to aquatic life and manifest itself in reproductive and behavioral problems.

Other parameters of concern on the Reservation are concentrations of E. coli, a bacterial pollutant from livestock. Heavy livestock grazing in river bottoms has reduced riparian vegetation that impacts stream stability, water temperature, and sediment load to the river. Low flow conditions from decreased snowpack runoff and demands from irrigation can also yield higher temperatures and decreased habitat for aquatic life. In response, the Tribe has started excluding riparian zones from agricultural assignments. Local cost-share programs are also available to assist with riparian exclusion fencing projects.

SUIT is a participant in the SJRBRIP, the reasonable and prudent alternative which ultimately allowed construction of A-LP to move forward. Concerns over the potential impacts on endangered fish species led to the downsizing of the A-LP in 2000 as well as the incorporation of an environmental bypass flow requirement. The SJRBRIP has two goals: (1) to conserve populations of Colorado pikeminnow and razorback sucker in the San Juan Basin, consistent with the recovery goals established under the Endangered Species Act; and (2) to proceed with water development in the Basin in compliance with federal and state laws, interstate compacts, court decrees, and federal trust responsibilities to the SUIT, UMUT, and the Jicarilla Apache and Navajo Nations.

Among other things, the SJRBRIP established flow recommendations to protect the endangered fish populations in the San Juan River which also directly benefit the health of riparian plant communities. Riparian areas and many of their plant species are culturally significant to the Tribe. The use of Tribal reserved water rights for maintaining environmental flows on the Pine River is currently pending. Decreed flows may potentially range from five to 360 cfs.

Of SUIT's water resources, only Lake Capote is operated specifically for recreational purposes, including fishing, boating and aesthetic/camping purposes. Vallecito Reservoir, Lemon Reservoir, and Lake Nighthorse are all operated for storage purposes, with fishing, boating, and camping as additional benefits. Lake Nighthorse recently opened to recreation.


Lake Capote with Chimney Rock National Monument in the background.
*Photo courtesy of Southern Ute Indian Tribe*

All Tribal water rights in area rivers contribute to recreation opportunities. Tribal fishing permits, available to the general public, allow fishing access to SUIT lands on the Animas, Pine, Piedra, and San Juan Rivers. Rafting, both commercial and private, takes place on the Animas, Piedra, and San Juan Rivers.

#### *5.2.5.4 Reservoirs*

As described earlier, SUIT has storage allocations in several federal reservoirs: Vallecito Reservoir on the Pine River, Lemon Reservoir on the Florida River, and Lake Nighthorse off-channel from the Animas River. In addition, the Tribe owns Pargin Reservoir, better known as Lake Capote, located on Stollsteimer Creek, a tributary of the Piedra River. Lake Capote is currently operated for recreational and fishery purposes as it serves a small camping facility operated by the Tribe, but it is also decreed for irrigation, domestic, stock, and augmentation use. Lake Capote is decreed for 1,850 AF of storage rights plus one refill, but the facility currently has capacity for only 654 AF.


Lemon Reservoir on the Florida River provides irrigation water to Tribal and other irrigators on the central portion of the Southern Ute Reservation.
*Photo courtesy of Southern Ute Indian Tribe*

The reservoir capacities are listed in Table 5.2-G.

**TABLE 5.2-G**
Southern Ute Indian Tribe System Reservoirs

| Reservoir Name | Reservoir Capacity (AF) | Southern Ute Indian Tribe Portion (AF) |
|---|---|---|
| Vallecito Reservoir | 129,700 | 21,617 AFY Allocation primarily for irrigation purposes |
| Lake Nighthorse | 123,500 | 38,108.5 AF of storage capacity for municipal and industrial uses |
| Lemon Reservoir | 40,146 | 2,563 AF capacity for irrigation and flood control |
| Lake Capote | 654[1] | 1,850 AF decreed storage + 1,850 AFY refill right |
| **Total** | **294,000** | **65,988.5** |

[1] Lake Capote's current capacity is less than the full decreed amount.

### 5.2.5.5 Water Use Efficiency and Conservation

SUIT's Agriculture Division is currently undertaking an agricultural lands rehabilitation project. The goal of the project is to restore the condition and productivity of Tribal irrigated lands by installing new center pivot and side-roll sprinkler systems on tracts of land that are currently unmanaged or neglected. It is hoped that these installations can exhibit the value of modern efficient irrigation methods, help demonstrate different crop types and their relative characteristics, and provide a high-quality, low cost hay source for Tribal members while helping reduce the amount of noxious weeds and erosion on Reservation lands.

Cost-share opportunities to improve irrigation efficiency and reduce nonpoint source pollution from return flows are also available to individual Tribal irrigators through both the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) and EPA section 319 grants. The EPA grants are administered through the Tribe's Environmental Programs Division and the NRCS has a representative based in Ignacio. Over the past decade, the Tribe has worked with 38 area irrigators, 27 of which are Tribal, through its section 319 program.

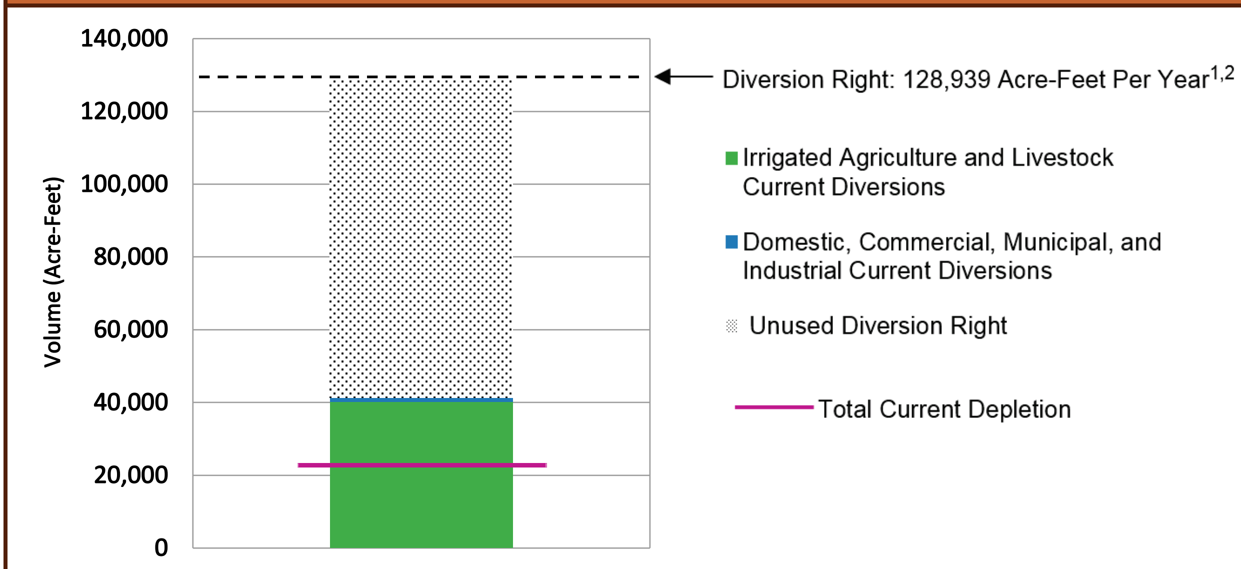
In addition, the Tribe is in the process of developing several water management guidance documents. The Tribe recently completed Phase I of its Water Resources Inventory Planning Document. In addition, a draft conservation/efficiency plan for its Florida Project lands has been completed, and a similar plan for its Pine River irrigated lands is contemplated.

Gated pipe provided by cost-share programs help improve irrigation efficiency on the Southern Ute Indian Reservation as well as helping to reduce erosion and sediment load in area rivers.
*Photo courtesy of Southern Ute Indian Tribe*

### *5.2.5.6 Summary of Current Water Use*

Current annual water use for SUIT's reserved water rights is presented below in Figure 5.2-B and Table 5.2-H. Irrigation diversion records do not always separate out Tribal and other use. Therefore Tribal irrigation diversions were calculated based upon current irrigated acreage, water supply characteristics such as priority of rights, defined duty of water, volumetric limitations, etc.), and crop type. Due to a lack of measurement on many smaller water sources, reasonable standardized assumptions were used to determine their diversion amounts. Where records were available, the period of 2009 through 2013 was used to help guide development of the assumptions. Depletion amounts were then derived from the diversion numbers using standard engineering efficiency estimates accepted by the State of Colorado and assigned based on water use category and structure type.

**FIGURE 5.2-B**
Southern Ute Indian Tribe Current Tribal Water Use (2009 – 2013) and Reserved Water Rights in Colorado




[1] Source: Total diversion right calculated based on water right amounts and volumetric limitations specified in the State of Colorado and the Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No. 100-585, 102 Stat. 2973 (1988), further amended in 2000 and 2007. Consent Decrees entered December 19, 1991, under case W-1603-76A-K; the Consent Decrees for the Animas and La Plata River were amended in 2006.

[2] Includes Southern Ute Indian Tribes's Animas La-Plata depletion right of 16,525 AFY converted into a diversion right by applying a 37 percent efficiency for a diversion right of 44,662 AFY.

**TABLE 5.2-H**
Southern Ute Indian Tribe Current Annual Water Use by Basin in Colorado (2009 – 2013)[1]

| Source | Water Use Category | Diversion (AFY) | Estimated Current Depletion (AFY) |
|---|---|---|---|
| Animas River | AG | 2,363.70 | 1,313.30 |
| | DCMI | 4.69 | 1.74 |
| San Juan River | AG | 519.14 | 435.39 |
| | DCMI | 4.69 | 1.41 |
| Pine River | AG | 34,431.22 | 18,979.19 |
| | DCMI | 1,152.21 | 345.75 |
| Piedra River | AG | 13.65 | 13.65 |
| | DCMI | 8.05 | 2.42 |
| Florida River | AG | 2,007.37 | 1,107.37 |
| | DCMI | 5.36 | 1.61 |
| La Plata River | AG | 796.68 | 501.19 |
| | DCMI | 2.01 | 0.74 |
| Mancos River | AG | 0.81 | 0.81 |
| Navajo River | AG | 19.14 | 19.14 |
| Misc. (future wells, road maintenance, oil and gas) | DCMI | - | - |
| Subtotals | AG | 40,151.71 | 22,370.04 |
| | DCMI | 1,177.01 | 353.66 |
| **Total** | | **41,328.72** | **22,723.70** |

[1] The period 2009 through 2013 was used to guide the development of current annual water use, but additional information was provided for the purposes of the Tribal Water Study.

AG – Irrigated Agriculture and Livestock
DCMI – Domestic, Commercial, Municipal, and Industrial

## 5.2.6 Tribal Water Use Challenges

### *5.2.6.1 Supply Challenges*

When considering the challenges SUIT faces in using their water, the logical starting point is water supply. The Tribe is fortunate in that its Reservation and corresponding reserved water rights span several San Juan River tributary basins. Being located higher up in the watershed generally means that both water supply and water quality are good. The drawback is that the supply is more reliant on natural streamflow levels fed directly by snowpack and rainfall, and therefore is more likely to be impacted by localized drought patterns. Although the construction of reservoirs in the area has aided in providing a more reliable annual water supply, some of the smaller watersheds, like the Florida and La Plata Rivers, are still prone to shortages. At present, little to no infrastructure exists to move water between any of the basins. Prolonged regional drought and shifting climate patterns pose a much greater supply challenge because of their impacts across all watersheds in the region. There has historically been, and will likely be in the future, supply and demand challenges due to large-scale regional drought. Historic drought conditions have impacted the water supply, even within the reservoir structures. Lack of adequate precipitation to fill the reservoirs coupled with high temperatures can lead to water shortages, especially in the later summer months.

High elevation snowpack, like that from the San Juan Mountains, plays a significant role in the reliability of water supplies on the Southern Ute Reservation. In the foreground is Dry Creek, a tributary of the Pine River.
*Photo courtesy of Southern Ute Indian Tribe*

### *5.2.6.2 Infrastructure Challenges*

Probably the greatest challenge SUIT faces in trying to access and utilize its reserved water rights relates to the costs of maintaining existing and developing new water delivery infrastructure for both agricultural and municipal purposes. Agriculture accounts for the vast majority of current Tribal water use. Irrigation use is highly visible and therefore irrigation infrastructure issues are more easily highlighted. Domestic water use may constitute a smaller overall percentage of Tribal water but the importance of being able to easily access safe and clean domestic water cannot be overstated due to its direct impacts on human health and quality of life. For these reasons, the majority of recent Tribal water infrastructure investments have been focused on domestic systems.

Irrigation technology and infrastructure on the Southern Ute Reservation has changed little in the past 60 years.
*Photo courtesy of Southern Ute Indian Tribe*

### *5.2.6.3 Agriculture*

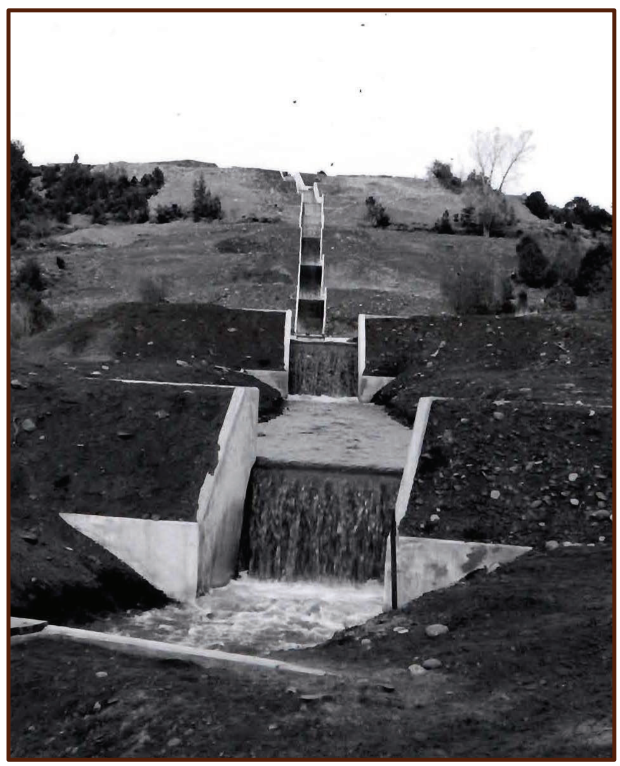
SUIT farm lands are served by two federal irrigation projects and numerous small, stand-alone ditches. In some instances diversification can be beneficial, but in this case the lack of a large integrated irrigation system leads to numerous inefficiencies and a duplication of efforts. It means that Tribal managers and irrigators have to deal with several entities, varying water delivery policies and schedules, multiple billing systems, and differing levels of system reliability. The lack of remote monitoring and system automation increases the amount of time and labor required to administer water delivery, contributes to the likelihood of conflict between water users, and leads to less efficient utilization of the water itself.

Significantly deteriorated infrastructure hampers irrigation water delivery to portions of the Southern Ute Reservation.
*Photo courtesy of Southern Ute Indian Tribe*

The broken terrain of the Southern Ute Reservation requires extensive engineering to convey irrigation water. A series of large drop structures on the Dr. Morrison Canal as it appeared in 1927 (above), and its modern configuration upon completion in 1959 (right).

*Source: Irrigation Reports, 1907-1946. Phoenix Area Office. Branch of Irrigation. Records of the Bureau of Indian Affairs (RG 75). National Archives at Riverside, Perris, CA.*

Most of the irrigation systems within the boundaries of the SUIT Reservation were constructed over 50 years ago, with some of them considerably older. The majority of Tribal irrigators are served by the BIA's PRIIP. Much of the PRIIP's system infrastructure is over 100 years old and has not seen major project-wide rehabilitation since the 1960s. Roughly one-third of the project's 16,966 designated acres lack any means of water delivery. On those portions with existing delivery systems, the actual delivery of water is often hampered by the poor condition of those systems. Ineffective diversion structures, broken headgates, leaking flumes, eroded drop structures, damaged measurement devices, failed culverts, and vegetation-choked ditches mean that many Tribal irrigators receive only a fraction, if any, of the irrigation water they are entitled to receive and for which they pay non-refundable annual operation and maintenance fees.



Currently, maintenance of the PRIIP infrastructure is performed primarily by the BIA Irrigation Division. With more than 175 miles of irrigation canals and laterals, the BIA struggles to maintain a large enough budget and staff to properly address all the infrastructure issues on the PRIIP.



*See the Disclaimer and Introduction to Chapter 5.0.*

Maintenance on other Tribal ditches is handled by the SUIT's Water Resources Division or by the water users themselves. Management, operation, and maintenance expenses increase on an annual basis; however, federal and Tribal budgets are not able to increase at the same rate. This makes it increasingly difficult to maintain, much less improve or expand, the irrigation delivery infrastructure.

The overall topography of the Reservation is extremely variable, making conveyance and application of irrigation water difficult. Canal alignments are often long and sinuous in order to negotiate the broken terrain and maintain grade. It is not uncommon to have canals perched high on steep hillsides and alluvial benches. Area soils can be highly erosive and unstable which makes those canals on steep hillsides vulnerable to seepage, slumps, and complete bank failures.

Irrigable parcels are generally small and irregular in shape. An individual 160-acre allotment may be bisected by several arroyos and small drainages, making the installation of center pivots, side rolls, or even gated pipe challenging. Gently or irregularly sloping pastures can be difficult to properly spread water across, making even flood irrigation practices challenging. A lack of lined or piped canals does not allow for easy sprinkler or gated-pipe configurations and leads to increased seepage and transmission loss. These topographical challenges, combined with the financial costs associated with sprinkler systems, means most Tribal irrigators continue to rely on flood irrigation.

The topography of the Southern Ute Reservation presents numerous challenges for agricultural producers, including erosive soils, sinuous canal alignments, rolling terrain, and rocky outcrops.
*Photo courtesy of Southern Ute Indian Tribe*

The physical and financial challenges associated with the Tribe's irrigation infrastructure also present a related set of socio-economic challenges. The increasing costs and unreliability of irrigation water delivery make agricultural operations an economically daunting prospect for many Tribal members. The economics of agriculture in the area have always been challenging due a shorter growing season and a lack of good transportation options for moving products to market. Additionally, the Tribe struggles with the same issue that plagues agricultural communities nationwide: a lack of interest by the younger generations and the inability of older generations to sustain the level of effort required to be financially successful. So the challenge ultimately becomes how to provide reliable, efficient delivery of irrigation water without undermining the economic feasibility of Tribal agricultural operations or further discouraging the recruitment of younger Tribal producers.

#### *5.2.6.4 Domestic*

There is a definite need in the area for the development of rural water systems to serve both Tribal and other populations. Poor groundwater quality and declining well production rates force many residents to rely on water hauling.

However, the checkerboard nature of landownership on the Reservation, combined with the rural, dispersed settlement pattern of the area's population, makes the development of domestic water systems complicated and expensive. Although the comingled populations do offer some opportunities for Tribal municipal systems to market water to nearby non-tribal residents or for isolated Tribal populations to access domestic water by means of a non-tribal system, these projects require significant cooperation among various land owners and jurisdictions to obtain rights of way, develop inter-governmental agreements, etc. Some local entities are hesitant to partner with the Tribe on projects due to differing regulations, sovereign immunity considerations, and questions regarding taxing authority.

Rural domestic water systems can require miles of pipeline to serve only a small number of residences, increasing the per user costs for both construction and maintenance.
*Photo courtesy of Southern Ute Indian Tribe*

Even without these logistical hurdles, the difficulty of obtaining funding to develop new municipal infrastructure is a huge challenge. Reductions in federal allocations, shrinking local budgets, declining tax revenues due to the drop in oil and gas prices, and, the ever-rising costs of construction materials only continue to add to that challenge.

#### *5.2.6.5 Legal and Administrative Hurdles and Costs*

As previously mentioned, SUIT's reserved water rights have been quantified and are decreed by river basin or watershed. However, settling the Tribe's water rights is just the first step in the process. Implementation of the Tribe's water rights is an on-going process including, among other things, protection of those rights from infringement, encroachment and injury. Moreover, while there is a demand for water in multiple sectors outside of the Reservation boundaries, the challenges facing the Tribe in accessing those demands includes certain legal limitations.

### 5.2.7 Projected Future Water Development

SUIT's future water development was assessed by first examining the location, quantity, and type of current water use and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development. Narrative descriptions of these scenarios (storylines) were created and provided a rational basis for considering a wide range of future tribal water development.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreased flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

SUIT contemplated its future water development through 2060 by reviewing its current water use estimates and reflecting upon how they might change under each of the four scenarios. During this process, the Tribe considered such elements as the scenario conditions described in the storylines, current or future planned projects, water availability in each of the river basins that cross the Reservation, anticipated changes in water use by category, the extent and condition of existing water infrastructure, and the need, as well as the cost, for new infrastructure to support water development. The Tribe contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges (TRAN).

The actual quantification was performed by systematically considering, in light of current conditions and trends, each of the Tribe's reserved water rights, including:

- The decreed uses,
- The demand for those uses,
- The reliability of the water supply, and
- The infrastructure required to develop or expand the use of that water right.

From this examination, SUIT extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared a quantified water development schedule. Subsequently, SUIT used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each scenario development schedule is presented in the following section.

#### *5.2.7.1 Future Water Development Schedules*

The assumptions for each schedule are described below and the quantified schedules are presented graphically in Figure 5.2-C and numerically in Table 5.2-I.

*Current Water Development Trends (Scenario A)*

If current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same, by 2060 the total water diversions on the SUIT Reservation could increase by approximately 60 percent, mainly due to increased AG water use along the San Juan, Pine, Piedra, and Florida Rivers. DCMI water use could more than double by 2060, mostly due to use along the Pine River. ENV water use could increase to as much as 5,500 AFY along the Pine River. 700 AFY could be diverted for TRAN from the Animas River by 2060.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in the governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, SUIT prepared a water development schedule that projects total water diversions could decrease approximately 15 percent by 2060. Declining levels of funding and a lack of tribal economic development are expected to result in the continued decline of aging irrigation infrastructure and corresponding reductions in AG Water Use. DCMI use would likely stabilize because of slower growth in both Tribal and other demand.

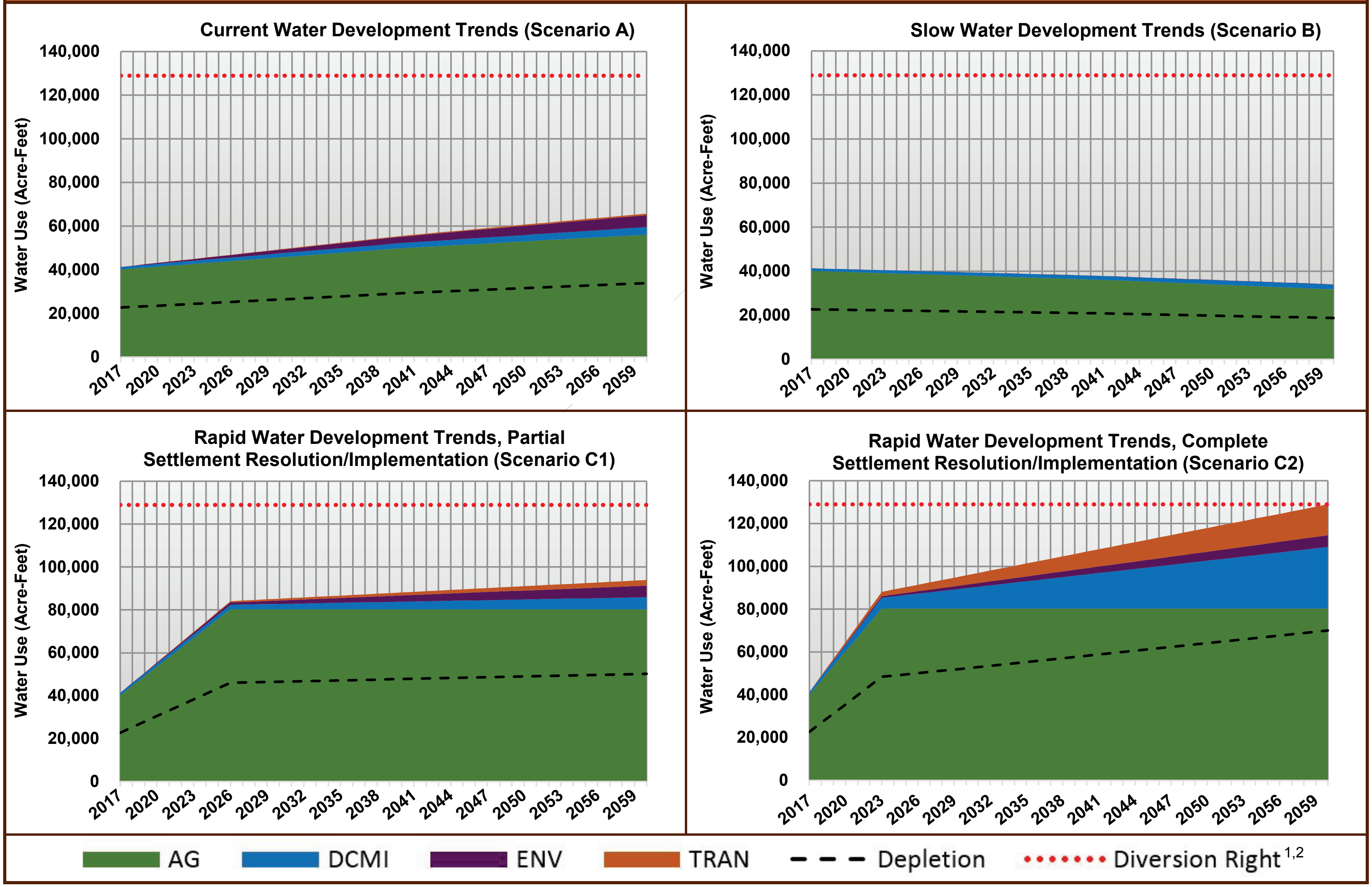
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of tribal water claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to expanded tribal economic development. By 2060, total SUIT water diversions would increase approximately 2.25 times. This is mostly due to a doubling in agricultural water diversions by 2026 to 80,283 AFY because of irrigation infrastructure expansion and improvements. This level of AG water use continued through 2060. DCMI water use could increase five times by 2060 and ENV water use could increase to as much as 5,430 AFY on the Pine River. 2,620 AFY could be diverted for TRAN from the Animas River by 2060.

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases economic and water development opportunities. Under this scenario, SUIT assumed full use of its right by 2060. AG water use was maximized at 80,283 AFY in 2023, so all development after that time is in the DCMI, ENV, and TRAN water use categories. DCMI diversions increase almost 25 times by 2060. Most of the remaining use is due to TRAN, which increase to 14,410 AFY by 2060.

**FIGURE 5.2-C**
Southern Ute Indian Tribe Projected Future Water Development in Colorado (Scenarios A, B, C1, and C2)




[1] Southern Ute Indian Tribe's total Colorado reserved diversion water right is estimated to be 128,939 AFY.

[2] Includes Southern Ute Indian Tribe's Animas La-Plata depletion right of 16,525 AFY converted into a diversion right by applying a 37 percent efficiency for a diversion right of 44,662 AFY.

### *5.2.7.2 Summary of Projected Future Water Development*

SUIT's current water use and projected future water development under the Tribal Water Study's water development scenarios, and modeled for analysis purposes, is presented in Table 5.2-I.

**TABLE 5.2-I**
Summary of Southern Ute Indian Tribe Current Water Use and Projected Future Water Development in Colorado[1,2]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion |
| Current Use | *AG* | 40,152 | 22,370 | 40,152 | 22,370 | 40,152 | 22,370 | 40,152 | 22,370 |
| | *DCMI* | 1,177 | 354 | 1,177 | 354 | 1,177 | 354 | 1,177 | 354 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **41,329** | **22,724** | **41,329** | **22,724** | **41,329** | **22,724** | **41,329** | **22,724** |
| Use at 2040 | *AG* | 49,911 | 28,066 | 36,272 | 20,397 | 80,283 | 45,146 | 80,283 | 45,146 |
| | *DCMI* | 2,356 | 790 | 1,712 | 543 | 3,560 | 1,194 | 15,923 | 5,342 |
| | *ENV* | 2,942 | 59 | 89 | 2 | 2,904 | 58 | 2,942 | 59 |
| | *TRAN* | 374 | 374 | 0 | 0 | 1,401 | 1,401 | 7,708 | 7,708 |
| | **Total** | **55,583** | **29,289** | **38,073** | **20,942** | **88,148** | **47,799** | **106,856** | **58,255** |
| Use at 2060 | *AG* | 56,127 | 31,856 | 31,811 | 18,055 | 80,283 | 45,566 | 80,283 | 45,566 |
| | *DCMI* | 3,452 | 1,196 | 2,177 | 724 | 5,632 | 1,952 | 28,746 | 9,963 |
| | *ENV* | 5,500 | 110 | 116 | 2 | 5,430 | 109 | 5,500 | 110 |
| | *TRAN* | 700 | 700 | 0 | 0 | 2,620 | 2,620 | 14,410 | 14,410 |
| | **Total** | **65,779** | **33,862** | **34,104** | **18,781** | **93,965** | **50,247** | **128,939** | **70,049** |

[1] Southern Ute Indian Tribe's total Colorado reserved diversion water right is estimated to be 128,939 AFY.

[2] Includes Southern Ute Indian Tribe's Animas La-Plata depletion right of 16,525 AFY converted into a diversion right by applying a 37 percent efficiency for a diversion right of 44,662 AFY.

## 5.3 Ute Mountain Ute Tribe

### 5.3.1 Introduction

The Ute Mountain Ute Tribe's (UMUT or Tribe) Reservation (Reservation) of approximately 900 square miles (600,000 acres) lies in southwest Colorado, southeast Utah and northwest New Mexico. Towaoc, Colorado is the main tribal population center and the location of the tribal headquarters. The Tribe's Reservation in Utah consists of several trust land parcels, known as White Mesa, totaling approximately 20 square miles (15,000 acres). Additional tribal and individual tribal member-owned trust allotment lands are located along Allen Canyon, Utah. The Tribe also owns lands outside the Colorado and New Mexico Reservation and Utah Reservation, referred to as Tribal Ranches or Tribal fee lands, in both Colorado and Utah.

The Tribe's current enrollment is approximately 2,100 members. The current population on the Colorado portion of the Reservation is approximately 1,700 residents, most of whom are enrolled members of the Tribe (U.S. Census Bureau, 2011). Approximately 350 tribal members reside on the Utah Reservation in the community of White Mesa.

Figure 5.3-A presents a general location map with Reservation boundaries, communities, and other important features.

### 5.3.2 Physical Setting

The portion of the Reservation in Colorado and New Mexico is located on the Colorado Plateau and is characterized by open arid lands with increasingly deep canyons and mesas to the east and south. The elevation of this portion of the Reservation ranges from 5,000 feet near the San Juan River in the Four Corners region to almost 10,000 feet at the top of Sleeping Ute Mountain, located in the northwest portion of the Reservation.

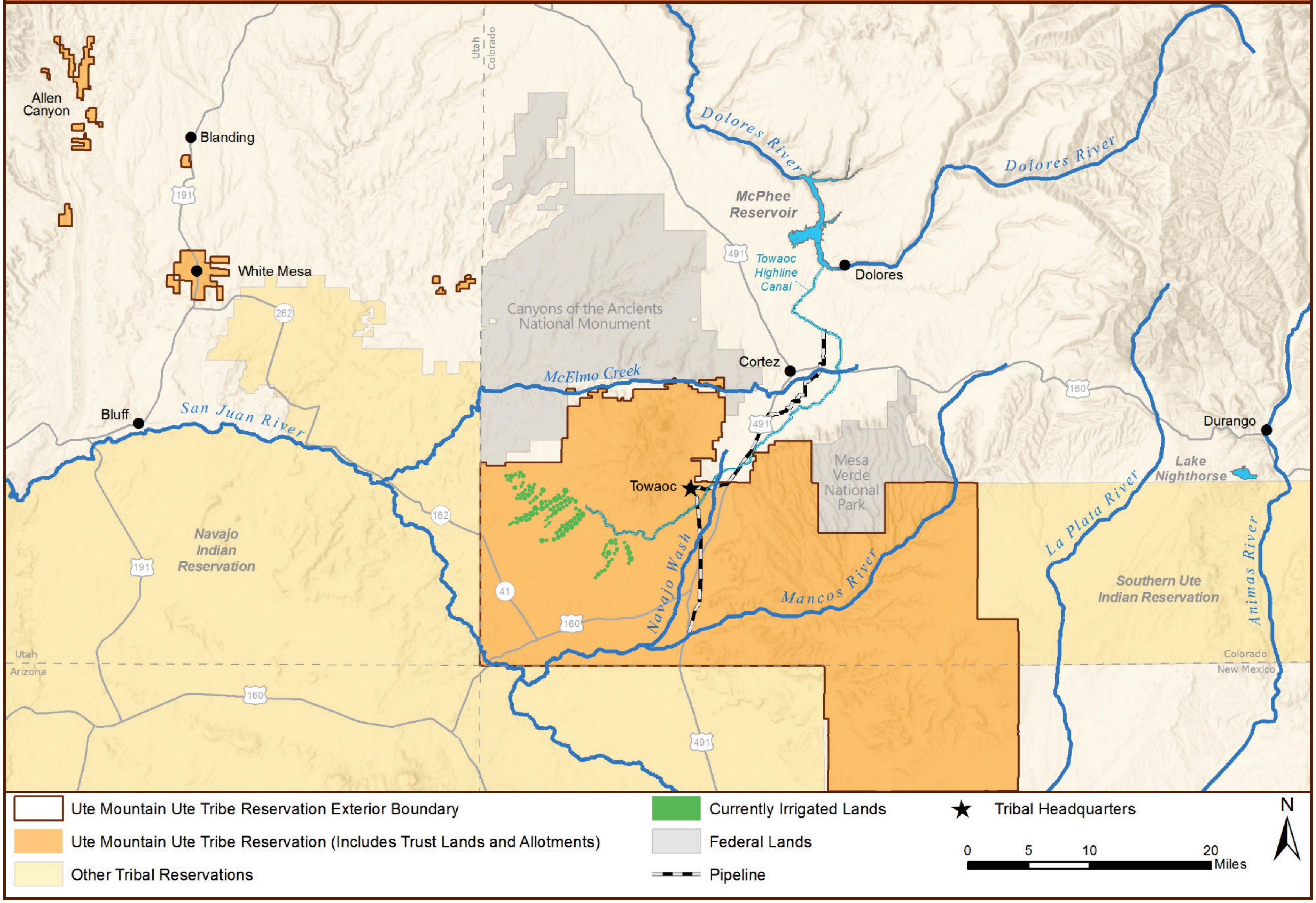
Sleeping Ute Mountain and Chimney Rock
*Source: Ute Mountain Ute Tribe*

The Utah portion of the Reservation lies at an elevation of approximately 5,300 feet and consists of arid flat lands interspersed with arroyos and canyons that are tributaries to the San Juan River.

#### *5.3.2.1 Watersheds*

The Colorado portion of the Reservation is located in the Upper San Juan Basin and includes portions of the Mancos River, La Plata River, McElmo Creek, and Navajo Wash sub-basins. The UMUT stores water in the Animas La Plata (A-LP) Project, which is supplied from the Animas River, also part of the Upper San Juan Basin. The Tribe's Dolores Project allocation provides water to the Tribe from the Dolores River Basin, part of the Upper Colorado River watershed.

**FIGURE 5.3-A**
Ute Mountain Ute Tribe Reservation Map






*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.3.2.2 Hydrogeology*

San Juan River near the Four Corners
*Source: Ute Mountain Ute Tribe*

The Dakota Aquifer associated with the Dakota Sandstone Formation is the primary regional aquifer for the Reservation. The Dakota Sandstone, exposed on the surface along the western boundary of the Reservation and in the area surrounding the Ute Mountain intrusion, is approximately 100-200 feet thick. Both of the adjacent units, the Morrison Formation and the Mancos Shale, are relatively non-permeable layers that provide an upper and lower seal for the Dakota Aquifer and create confined aquifer conditions when present. The Dakota Aquifer is recharged by precipitation occurring at the outcrop on Sleeping Ute Mountain, which receives approximately 20-25 inches of precipitation annually. From this mountainous recharge area of approximately 7,000 feet in elevation, the groundwater flows slowly through the confined Dakota Aquifer, generally south-southwest, to the San Juan River where small seeps drain any residual water from the formation.

#### *5.3.2.3 Climate*

In Colorado, the Reservation's annual precipitation ranges from 25 inches per year at the highest elevation (top of Sleeping Ute Mountain) to approximately 8 inches per year at the lowest point on the Reservation near the Four Corners. Similarly, evaporation is lowest at less than 55 inches per year at Sleeping Ute Mountain and highest at a rate of over 60 inches per year near the Four Corners.

In Utah, based on the town of Blanding's climate station data, the Reservation receives approximately 13 inches of precipitation per year and temperatures average between 37 °F and 64 °F on an annual basis.

### 5.3.3 Historical Use and Cultural Importance of Water

The UMUT, comprised of the Weenuche band of Utes, historically occupied the La Plata and San Miguel mountain regions along the various northern tributaries of the San Juan River. The Weenuche were a hunter-gatherer society that moved with the seasons. In the spring and summer months, the Weenuche would follow wild game and seek additional water sources in the mountains. In the fall, they would travel from the higher mountain elevations to the warmer regions of southwest Colorado, northwestern New Mexico, and southeastern Utah for the duration of winter.

Through various treaties with the federal government in the late nineteenth century, the Tribe yielded much of its ancestral Colorado homeland. Federal Indian policy at the time sought to assimilate Indian tribes into yeoman farmers by breaking their communal landholdings into individual assigned allotment tracts, typically consisting of 160-acre parcels. The Tribe initially rejected the allotment policy and the accompanying agricultural lifestyle. Instead the Tribe opted to settle on arid communal lands in the far southwestern corner of Colorado, where water was scarce and the lands not as conducive to farming.

West of the Colorado portion of the Reservation, a separate group of the Tribe settled in Montezuma Creek, Allen Canyon, and other drainages of the Abajo Mountains in southeastern Utah. These smaller bands intermarried with Paiute Indians and some eventually took up farming on individual and tribal allotments. Like their Colorado counterpart, without adequate irrigation, these Utah lands were not well-suited for cultivation. Today, most of those tribal members have settled in the community of White Mesa, Utah.

With the challenges posed by scarce water resources and non-fertile lands, many of the tribal members in each state largely took up ranching and stock raising of sheep, cattle and horses. Seasonal movements of the Tribe were then dictated by the need to find suitable grazing land in the high mesas and water, usually in canyons and nearby springs, washes or wells. The UMUT and individual tribal members still continue to raise livestock, including bison, within the rugged terrain of their Reservation and their off-Reservation Ranches.

Water also plays a central role in the cultural practices of the Tribe and its relationship to the natural world. Water brings life, sustenance, and is a tool of blessing and prayer for the Tribe. Each year in the spring the Tribe hosts the Bear Dance in Towaoc, and in the White Mesa community during the summer. The Bear Dance is a social gathering and a personal endurance milestone of individuals of the Tribe, including their friends and relatives from the Southern Ute Indian Tribe and the Ute Indian Tribe. Over the course of several days, a significant amount of water is used to wet the grounds for the ceremonial dance and to refresh the people in attendance.

Water also has an important role in the Tribe's Sun Dance ceremony and Sweat Lodge Ceremony. Participants of the Sun Dance fast for several days. At the conclusion of the ceremony, water from mountain springs is used to rejuvenate and purify the participants. Similarly, the Sweat Ceremony is centered around water as the primary natural element that provides renewal, restoring balance and spiritual sustenance to the participants. Because water is held in reverence and is critical to these traditional ceremonies, water quality is also highly important to the cultural practices of the Tribe. Therefore, it is necessary for the water to be of pristine quality in order for healing and sustenance to occur and to provide the participants with the necessary mindset in practicing their traditions.

### 5.3.4 Ute Mountain Ute Tribe Water Supply

The UMUT has litigated and settled its surface water and tributary groundwater rights for Reservation lands located in the State of Colorado. See Colorado Ute Indian Water Rights Settlement Agreement (Dec. 10, 1986) (Colorado Settlement Agreement); Colorado Ute Indian Water Settlement Act, Pub. L. No. 100-585, 102 Stat. 2973 (Nov. 3, 1988), subsequently amended, Colorado Ute Settlement Act Amendments of 2000, Pub. L. No. 106-554, 114 Stat 2763 (Dec. 21, 2000) (2000 Amendments) (with minor amendments in P.L. 110-161 [Dec. 26, 2007]).

The Tribe's settlement-based water rights in Colorado are decreed by river basin or watershed, and include direct diversion surface water rights, Reservation-based storage rights, tributary groundwater rights, and allocations in two federal reservoir projects. The Colorado Settlement Agreement, as implemented by the federal legislation and by Colorado State Court consent decrees, contains important provisions that address, among other things, the nature of the Tribe's reserved water rights, administration of the Tribe's water rights, and changes of water rights.

The Tribe is currently litigating its federal Indian reserved water rights associated with the portion of their Reservation located in the State of New Mexico. The Tribe has not yet litigated or settled its federal reserved water rights for the portion of the Reservation in the State of Utah. The following description of the Tribe's quantified settlement water rights is limited to its Colorado settlement-based water rights and does not include unresolved claims in Utah and New Mexico.

#### *5.3.4.1 Federal Project Water Allocations*

The UMUT's settlement-based water rights include allocations from both the Dolores Project and from the A-LP Project (Table 5.3-A).

*Dolores Project*

The Dolores Project, which reached final completion in September 1998, is located in the Dolores and San Juan River Basins in southwestern Colorado and uses the Dolores River to provide water for multiple uses in southwest Colorado. The water is stored in McPhee Reservoir on the Dolores River and is delivered trans-basin to lands in the San Juan Basin. The Tribe's allocation in the Dolores Project totals 25,100 acre-feet per year (AFY) and includes 23,300 AFY of agricultural irrigation water, 1,000 AFY of municipal and industrial water, and 800 AFY of fish and wildlife development water.


McPhee Reservoir
*Source: Ute Mountain Ute Tribe*

The UMUT's demand for irrigation water for its Farm and Ranch Enterprise (FRE) can exceed its settlement-based water supply (depending on the given crop plan each year). The Tribe currently leases additional available water from other Dolores Project users, including the Dolores Water Conservancy District (DWCD) and the Montezuma Valley Irrigation Company (MVIC). Total lease amounts range between 4,000 to 6,000 AFY in non-shortage years when the Tribe receives its full Dolores Project supply, and are significantly higher in years when the Tribe shares shortages in the Dolores Project. These leases are short-term and are not available in all years. The Tribe is working to find a more reliable, long-term additional supply from the Dolores Project to allow the Tribe flexibility in determining future annual crop plans for the FRE.

Water shortage allocations for the Dolores Project are governed by the Colorado Settlement Agreement as well as associated agreements and laws. Generally, the Dolores Project prioritizes meeting municipal and industrial uses first, then shortages are shared among irrigation users and the fish and wildlife pool. The Dolores Project fish and wildlife pool (a designated amount of water available in storage for release downstream) has been modified since the original approval of the Dolores Project and is managed by the Biology Committee in coordination with Reclamation under the Operating Agreement that was enacted in 2000. The reserved water rights for the Dolores Project are subject to curtailment by non-project senior water rights and subject to agreements between MVIC and the DWCD.

Animas River
*Source: Ute Mountain Ute Tribe*

### *Animas-La Plata Project*

The A-LP Project, located in La Plata and Montezuma Counties in southwestern Colorado and San Juan County in northwestern New Mexico, was authorized by the Colorado River Basin Project Act of September 30, 1968 (Public Law 84-485). The 2000 Amendments provide for implementation and completion of the project. Construction approval was granted in October 2001 and initial site work began in April 2002.

Filled in 2011, the A-LP Project reservoir, named Lake Nighthorse, is an off-channel reservoir that stores water diverted from the Animas River. The UMUT's allocation in the A-LP Project is 16,525 AFY of average depletions of municipal and industrial water. At this time the Tribe cannot deliver its water supply from the A-LP Project to the Reservation, as a significant water delivery infrastructure must be constructed to access its allocation. While the A-LP Project has a total allocation of average annual depletion of 57,100 AFY, policies concerning shortage sharing are in the process of being developed.

**TABLE 5.3-A**
Federal Project Water Allocations in the Colorado Consent Decrees

| Project | Colorado Case Number | Priority Date | Volume (AFY) | Notes |
|---|---|---|---|---|
| Dolores Project | W-1603-76H | This water shall have an 1868 priority date, shall for all time be subordinated to all water rights decreed and senior to the Dolores Project, and shall share for all time on a pro rata basis the priority of the Dolores Project, which has an adjudication date of March 22, 1963, and an appropriation date of September 10, 1940. | 25,100 of diversions | Diversion of 23,300 AF for Irrigation, 1,000 AFY for Municipal, 800 AFY for fish/wildlife. |
| Animas-La Plata Project | W-1603-76F | This water shall have an March 2, 1868 priority date, shall be subordinated to all water rights decreed and senior to the A-LP Project, and shall share on a pro rata basis the priority of the A-LP Project, which has an adjudication date of March 21, 1966 and an appropriation date of September 2, 1938. | 16,525 of depletions[1] | Value shown is average annual depletions which can be used for M&I uses only. Diversion amount basis may vary. |

[1] For the purposes of the Tribal Water Study, the Ute Mountain Ute Tribe's Animas La-Plata depletion right of 16,525 AFY was converted into a diversion right by applying a 37 percent efficiency for a total of 44,662 AFY.

### *5.3.4.2 Surface Water, Storage, and Groundwater Rights*

The UMUT's on-Reservation direct diversion surface water rights and storage rights include rights to the Mancos River, Navajo Wash and the San Juan River, as well as a water right to support development for oil and gas and road work on the Colorado portion of the Reservation. The Mancos River (including Navajo Wash) is the most significant on-Reservation surface water resource. Upstream of the Reservation boundary, other water development significantly depleted flows prior to the Colorado Settlement Agreement. Settlement allocations in the Colorado Settlement Agreement for the Mancos River and Navajo Wash are largely subordinated to rights adjudicated prior to 1985.

The Tribe's settlement-based water rights included water rights for future on-Reservation uses in Colorado as follows: two AFY for oil and gas development, and one AFY for road construction and maintenance (Table 5.3-B).

The Tribe's tributary groundwater rights for domestic and livestock wells include an allocation that can be developed in McElmo Basin and an overall limit for development across the Colorado portion of the Reservation for a total of 259 gallons per minute (gpm) for domestic and livestock wells (Table 5.3-C). The Tribe also has a water right for future domestic and tributary groundwater for a total of 1,850 AFY per year (Table 5.3-D). The Colorado Settlement Agreement contains specific provisions governing how the Tribe and the State of Colorado issue well permits for the development of the Tribe's settlement-based allocation of tributary groundwater for domestic or livestock purposes. In 2013, the Tribe and the State developed the first set of new permits under this joint permitting program (Table 5.3-C).

Mancos River
*Source: Ute Mountain Ute Tribe*

**TABLE 5.3-B**
Direct Flow and Storage Reserved Water Rights of the Ute Mountain Ute Tribe

| Stream | Colorado Case Number | Priority Date | Rate (cfs) | Volume (AFY) | Decreed Uses |
|---|---|---|---|---|---|
| Mancos River | W-1603-76G | A reserved water right with a March 2, 1868 priority date, subordinated to all rights with an adjudication date prior to 1985 | | 21,000 AFY | For irrigation of 7,200 acres within the Reservation |
| Navajo Wash | W-1603-76G | A reserved water right from the Navajo Wash drainage with a March 2, 1868 priority date, subordinated to all rights with an adjudication date prior to 1985 | 15 cfs | 4,800 AFY | For irrigation of 1,200 acres of tribal lands within Navajo Wash. See also Case No. 81CW126 stipulation |
| San Juan River | W-1603-76B | A reserved water right with a July 25, 1868 priority date | 10 cfs | 1,600 AFY | For irrigation of 640 acres of Tribal lands within the San Juan mainstem drainage |
| McElmo Creek | W-1603-76 I | A reserved water right with a February 8, 1904 priority date | 1.04 cfs | 752.93 AFY | For irrigation of 26 acres of land by the Wilson Ditch |
| Additional Diversions - All Drainages within Reservation | W-1603-76 B, G, I, J | A reserved water right with a March 2, 1868 priority date | | 2 AFY | Oil and Gas Development, maximum of 6,000 barrels per site |
| Additional Diversions - All Drainages within Reservation | W-1603-76 B, G, I, J | A reserved water right with a March 2, 1868 priority date | | 1 AFY | Road Construction and Maintenance |

cfs – cubic feet per second

**TABLE 5.3-C**
Groundwater Basins and the Colorado Consent Decrees

| Basin | Colorado Case Number | Priority Date | Domestic Wells[1] | | | Livestock Wells[2] | | |
|---|---|---|---|---|---|---|---|---|
| | | | Number | gpm | AFY | Number | gpm | AFY |
| San Juan | W-1603-76B | March 2, 1868 or May 10, 1911 | 0 | 0.00 | 0.00 | 20 | 85.50 | 137.91 |
| Mancos | W-1603-76G | March 2, 1868 or May 10, 1911 | 1 | 5.00 | 8.05 | 19 | 138.00 | 222.60 |
| Dolores | W-1603-76H | No Existing Use Structures | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| McElmo | W-1603-76I | March 2, 1868 or May 10, 1911 | 2 | 10.00 | 16.10 | 2 | 10.00 | 16.13 |
| La Plata | W-1603-76J | March 2, 1868 | 0 | 0.00 | 0.00 | 2 | 10.00 | 16.13 |
| **Total** | | | **3** | **15** | **24.15** | **43** | **243.5** | **392.77** |

[1] There is no AFY amount given in the Colorado Consent Decrees for Domestic Wells. These values were calculated by multiplying the value for gpm by 525,600 minutes in one year and then dividing that value by 325,851 gallons in one AFY.

[2] There is no AFY amount given in the Colorado Consent Decrees for Livestock Wells. These values were calculated by multiplying the value for gpm by 525,600 minutes in one year and then dividing that value by 325,851 gallons in one AFY.

**TABLE 5.3-D**
Future Domestic and Tributary Groundwater Uses

| Basin | AFY |
|---|---|
| McElmo | 350 |
| All other Basins within Ute Mountain Ute Reservation | 1500 |
| **Total** | 1,850 |

#### 5.3.4.3 Colorado Off-Reservation Water Rights

In addition to the UMUT's Colorado-based settlement rights, the Tribe holds additional water rights associated with off-Reservation Tribally-owned Ranches located in Colorado and Utah. Management and protection of the tribal ranch water supplies are critical to Tribal enterprise and Tribal member cattle operations and horse herds (which rotate grazing between the Ranches and the Reservation), tribal hay production, and environmental and wildlife purposes. This off-Reservation water supply in turn affects other related management plans, such as the implementation of the Tribe's new species management plan for the Gunnison Sage Grouse on the Pinecrest Ranch near Gunnison, Colorado.

Additionally, the Tribe recently acquired rights to storage space in the new Long Hollow Reservoir Project in Colorado. This storage space may facilitate the protection, movement, development, and use of existing Tribal water supplies both on and off the Reservation.

#### 5.3.4.4 Unresolved Indian Water Rights Claims in New Mexico and Utah

In New Mexico, the UMUT is currently participating in the San Juan River general stream adjudication to quantify its reserved water rights on the portion of the Tribe's Reservation located within the State of New Mexico. To support this process, the Tribe is currently preparing information for the quantification of its reserved water rights.

In Utah, the Tribe has unresolved claims associated with its trust lands and water right permits in Utah; however, the State of Utah does not have a process underway for quantifying the Tribe's federal Indian reserved water rights.

The portion of the Reservation in Utah is served by a groundwater supply that is treated and distributed to users on the Reservation. Future work to address water quality concerns and system reliability and redundancy are in the planning phases.

### 5.3.5 Current Water Use and Operations

The Reservation lands are semi-arid with significant water supply needs for irrigation, energy, economic development and domestic purposes.

#### 5.3.5.1 Irrigated Agriculture and Livestock Water Use Category

The UMUT's FRE is a tribally-run agriculture and cattle operation on the Reservation in Colorado. The Tribe also has approximately 375 acres of other irrigated lands on the Reservation in Colorado (associated with its Demonstration Farm and its Mancos Creek Farm) that are not included in the diversion records (Table 5.3-E).

Farm and Ranch Headquarters below Sleeping Ute Mountain
*Source: Ute Mountain Ute Tribe*

*Farm and Ranch Enterprise*

The Tribe's agricultural supply on the Colorado portion of the Reservation for its FRE is from the Dolores Project, via the Towaoc-Highline Canal. The Tribe's allocation from the Dolores Project for agricultural use is not adequate for the FRE current demands, as discussed previously. The Farm and Ranch lands range from approximately 7,500 to 7,800 irrigable acres which grow a range of crops. Currently, crops include alfalfa, several varieties of corn, pasture grass, winter wheat, and triticale.

**TABLE 5.3-E**
Annual Agricultural Water Diversion from the Towaoc Highline Canal for the Farm and Ranch Enterprise (2009 – 2013) [1,2,3,4]

| | Surface Water Diversions | | | | |
|---|---|---|---|---|---|
| | **2009** | **2010** | **2011** | **2012** | **2013** |
| Dolores Project Allocation (AF) | 28,467 | 28,520 | 27,623 | 28,213 | 9,119 |
| Total Irrigated Area (acres) | 7,520 | 7,366 | 7,500 | 7,534 | 2,892 |
| AF per Acre | 3.8 | 3.9 | 3.7 | 3.7 | 3.2 |

Source: DWCD

[1] Includes leased water that is delivered to Farm and Ranch Enterprise (FRE), which is not part of the Tribe's diversion allocation of 23,300 AF. The Tribe has water demands greater than its allocation which it currently partially meets using leased water, as available.

[2] Data is measured at the Energy Dissipation Structure on the Towaoc-Highline Canal which is close to the point of delivery on to the Reservation and approximately 11.5 miles above the point of use by FRE. The data, which comes from DWCD and is used in Dolores Project accounting and cost allocations, includes a five percent increase to the amount measured at the Energy Dissipation Structure to account for losses, according to the DWCD. Therefore, the water actually received by FRE at the Energy Dissipation Structure is approximately five percent less than the values shown here.

[3] Data shown in Water Years (begin in November).

[4] Water is delivered to the Demonstration Farm via the Rocky Ford Lateral by MVIC and is not included in this table. FRE staff report that there are typically no shortages of supply.

The Farm and Ranch lands receive water from the Dolores Project via the Towaoc-Highline Canal. The canal is approximately 41 miles long and lined with various materials including geotextile fabrics. The water delivery system has adequate elevation head to allow for gravity-fed center pivot and sprinkler irrigation on all the Farm and Ranch fields.

Pivot irrigation on Farm and Ranch lands
*Source: Ute Mountain Ute Tribe*

The yield of the Dolores Project varies by year and therefore requires adaptability on the part of the FRE. The current crop distribution includes approximately 3,625 acres of alfalfa, 600 acres of pasture grass, 200 acres of grass alfalfa mix, 2,900 acres of various types of corn, and 320 acres of winter wheat or triticale.

Towaoc Highline Canal
*Source: Ute Mountain Ute Tribe*

The total consumptive use requirement for FRE for the 2009 through 2014 period ranges from 8,307 AFY to 17,671 AFY. It is important to note that the lower consumptive use is due to FRE fallowing fields due to lack of water supply and should not be taken as an indication of the planned consumptive use for FRE at full production.

The UMUT's FRE pays its pro-rata amount of the operations and maintenance costs of the Dolores Project and shared facilities based on the amount of water received from the project, pursuant to the DWCD and Tribe's Repayment Contracts with Reclamation. These costs vary by year and are calculated annually by the DWCD. Based on the Charge Notices for 2006-2009, the Tribe pays a rate of between $1.93 and $2.81 per acre-foot (AF) to the Dolores Project. The Tribe's FRE also pays a pro-rata amount of costs for the Towaoc-Highline Canal pursuant to the Repayment Contract between DWCD, MVIC, the Tribe, and Reclamation (Contract No. 9-07-40-R0730). The annual rate is determined by the Towaoc-Highline Canal Committee and in 2008 and 2009 the amount was $15.91 per AF.

*Demonstration Farm*

The Demonstration Farm currently grows 100 acres of alfalfa and 25 acres of pasture grass. The consumptive use requirement for the Demonstration Farm is approximately 355 AFY, based on the values for alfalfa and pasture grass. The water supply for the Demonstration Farm is from MVIC, which is also a participant in the Dolores Project and owns water rights in the Dolores River senior to the Dolores Project. The Tribe owns 200 MVIC shares, which is equal to 2.5 cfs, according to the Consent Decree. This water is delivered via the MVIC infrastructure to the Tribe's point of diversion for the Demonstration Farm.

*Mancos Creek Farm*

The Mancos Creek Farm is undergoing improvements to bring it back into production using reserved water rights from the Mancos River; therefore, no current water use data is available. The Tribe is exploring development of additional water resources including permitting of several monitoring wells and use of wells for livestock water supply in the Mancos River Canyon area.

Mancos Creek Farm Ditch
*Source: Ute Mountain Ute Tribe*

*Livestock*

Resource Water Drinker
*Source: Ute Mountain Ute Tribe*

The cattle enterprise, named the Bow and Arrow herd, has 500 to 600 cows. The cattle graze the Farm and Ranch lands in the non-irrigation season and are managed on the Tribe's range units on the Colorado portion of the Reservation and on Tribal Ranches or off-Reservation leased rangelands during the irrigation season. The current non-irrigation season water demand for 600 head of cattle is approximately five AF, based on a rate of 15 gallons of water per cow per day.

Individual tribal members also raise livestock on range units on the portion of the Reservation in Colorado that are managed by the Tribe's Department of Natural Resources (DNR). The water supply available on the range units is inadequate to meet all livestock and wildlife demand. The DNR has deepened most of the livestock wells to approximately 400 feet. However, DNR does not currently have the capacity to maintain and repair the infrastructure as needed to procure adequate groundwater across range units particularly during recent drought conditions. There are approximately 1,000 cow-calf pairs, 50 bulls, and three buffalo on range units each year that are actively managed. These stock have an annual water demand of approximately 9 AFY. In addition, there are approximately 300 feral cattle, 200 feral horses, and hundreds of elk that use approximately 11 AFY, including livestock watering supplies on the Reservation in Colorado. The water supply for livestock grazed on the Reservation is primarily from stock reservoirs.

#### *5.3.5.2 Domestic, Commercial, Municipal, and Industrial Water Use Category*

The population on the portion of the UMUT Reservation in Colorado is approximately 1,666 people in 529 households based on Indian Health Service data and U.S. Census data. The water supply for this municipal use is from the Dolores Project, and it is delivered from McPhee Reservoir via the Dolores Tunnel to the Cortez Water Treatment Plant. After treatment, Cortez delivers water throughn a 21-mile pipeline to the tribal community of Towaoc.

The calculated current water residential use is approximately 275 gallons per capita per day (Indian Health Service, 2013). The municipal water supply also serves the Tribe's government offices, and provides water to the Ute Mountain Casino, Hotel and Resort and the Weeminuche Construction Authority offices. These government and commercial uses are metered separately and were not included in the calculation of per capita residential use. Also, irrigation of ball fields and a cemetery are not currently metered and may affect the estimated residential demands. The rate of water use per capita may change in the future as system efficiencies improve and the level of income and development on the Reservation increases.

Based on limited historical data from Cortez during the period of 2010 through 2013, the peak municipal and industrial system demands occur during the summer, which corresponds with high residential and park irrigation demands (Table 5.3-F). Peak month water use in July ranged from 74.5 AF to 91.1 AF, though the single highest monthly demand was 101.2 AF in June of 2011.

On average, the lowest month of usage is November, which ranges from 28.0 AF to 44.1 AF, and the single lowest monthly demand was 25.8 AF in January of 2012. Note that the historical data may not be accurate due to poor meter calibration. Additionally, the repair of major leaks reduced the total water consumption in 2010. Only commercial and industrial uses which are supplied by the Tribe's water supply system are included in this summary. There are water uses for road maintenance and gravel production that come from surface water sources when they are legally and physically available. Industrial uses for oil and gas development on the Reservation are not included as most of the water supply currently comes from off-Reservation sources.

**TABLE 5.3-F**
Municipal and Industrial Water Use on Ute Mountain Ute Reservation in Colorado

| Month | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| January | 48.4 | 38.9 | 89.4 | 25.8 | 38.7 |
| February | 43.4 | 31.7 | 73.5 | 27.1 | 38.2 |
| March | 55.9 | 35.3 | 74.9 | 30.5 | 35.7 |
| April | 52.1 | 37.4 | 76.9 | 41.3 | 36.8 |
| May | 82.6 | 51.5 | 90.7 | 68.0 | 57.2 |
| June | 86.3 | 74.7 | 110.6 | 84.9 | 79.4 |
| July | 116.4 | 81.4 | 99.7 | 88.5 | 84.7 |
| August | 112.2 | 66.6 | 88.5 | 89.2 | 65.9 |
| September | 85.9 | 75.9 | 66.2 | 74.0 | 47.5 |
| October | 60.1 | 60.1 | 56.1 | 46.1 | 36.0 |
| November | 38.4 | 44.1 | 31.4 | 32.2 | 28.0 |
| December | 46.3 | 68.0 | 34.9 | 35.4 | 28.5 |
| **Total DWCD Annual Data** | **828** | **665.6** | **892.9** | **643** | **576.6** |

Source: DWCD does not provide monthly time step data. Wright Water Engineers calculated the monthly values based on the percent delivered each month from the Cortez Meter Data and applied to the total DWCD annual data.

The UMUT's municipal water supply system delivers water to residents, government buildings, and commercial users via a pipeline that has a 12-inch diameter section 6.3 miles long and a 14-inch diameter section 14.4 miles long. At Towaoc, the system also includes three storage tanks and several valves and other necessary infrastructure. Commercial, industrial, and government users of the system pay for water usage based on meter data. The Tribe's Public Works Department oversees operations and management of the system on the Reservation as well as the conveyance line from the City of Cortez.

The Public Works Department charges a water rate, based on the metered water use, to commercial, industrial, and governmental entities that are supplied by the Tribe's municipal system. Tribal members living on the Reservation in Colorado do not pay for their residential water service individually; costs are paid from the Tribe's general fund. The Tribe pays its pro-rata portion of the operation and maintenance fees for use of municipal and industrial water from the Dolores Project, pursuant to the Repayment Contract between the DWCD and Reclamation (Contract No. 7-07-40-W0470). This cost varies annually and is managed by the DWCD. In 2006, the rate was $1.93 per acre-foot (AF) based on the notice provided by the DWCD.

Based on the sanitary survey conducted by the Indian Health Service in White Mesa, Utah, the average daily water use on the White Mesa water supply system was 0.038 AF in 2014. The system relies on two wells, one with a maximum pumping rate of 80 gpm and the other with a maximum pumping rate of 98 gpm. However, water quality concerns and the need for improved water quality treatment may affect the yield and reliability of the system. To address some of those concerns, the UMUT is presently constructing the White Mesa Water Infrastructure Improvement Project, which is slated to be complete in January of 2019.

#### *5.3.5.3 Environmental, Cultural, and Recreational Water Use Category*

The UMUT values maintaining river system health and riparian species as well as wildlife on the Reservation. The Tribe uses some riparian species, such as willow and cottonwood, for traditional purposes. In 2011, the Tribe adopted Water Quality Standards for Surface Waters of the Reservation. These standards aim to protect the quality of waters for designated uses including fish, aquatic life, recreation, and tribal cultural uses. The Tribe's Environmental Programs Department oversees the water quality regulations as well as efforts to protect riparian habitats and wetlands. Currently, the Tribe is managing water on the Reservation to irrigate wetlands in the Mancos River basin. Due to the complications of measuring "diversions" to a wetland, the Tribe has not recorded or reported the consumptive use and non-consumptive uses of the wetland irrigation. In the future, the Tribe may document the wetland irrigation use as part of its reserved water rights.

Currently, the Tribe does not have reserved water rights or water demands for protecting use by fish, wildlife, or for cultural values. The Consent Decree allocates 800 AFY from the Dolores Project for tribal wildlife use. This water is accounted for under the FRE diversions as it provides a supply for lands that are used by wildlife for forage particularly during the winter.

Mancos River at Weber Canyon
*Source: Ute Mountain Ute Tribe*



*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.3.5.4 Reservoirs*

In addition to the Dolores Project (McPhee Reservoir) and the A-LP Project (Lake Nighthorse), the UMUT has off-Reservation water rights for reservoirs associated with its Tribal Ranches, for use as stock ponds and recreation (Table 5.3-G). Current reservoir use calculations, based on the number of grazed cattle per range unit, show a total demand of 63 AFY from reservoirs. The Tribe's DNR manages the reservoirs which have ongoing maintenance and repair needs. Most reservoirs are filled from wells, while some are filled from surface water, as available.

Ismay Reservoir has a capacity of approximately 120 AF and is currently used as operational storage for irrigation of the Demonstration Farm. At the same time, the reservoir is used for recreational activities (primarily fishing) by tribal members and provides aesthetic values to the Tribe's nearby casino.

Lake Nighthorse
*Source: Ute Mountain Ute Tribe*

**TABLE 5.3-G**
Water System Reservoirs in Colorado

| Reservoir | Location | Capacity (AF) Total | Capacity (AF) Active | UMUT Portion of Reservoir (AF) |
|---|---|---|---|---|
| McPhee Reservoir | Off-Reservation | 381,195 | 229,182 | 25,100 Allocation; no specific storage allocation |
| Lake Nighthorse | Off-Reservation | 123,541 | 90,000 | 38,108.5 of storage capacity |
| Ismay Reservoir | On-Reservation | 120 | 120 | 120 capacity |
| Consent Decree Reservoirs | On-Reservation | 508 | 508 | 508 |
| **Totals** | | **505,364** | **319,810** | **63,836.5** |

Sources: Bureau of Reclamation website for the Dolores Project, Tribal Settlement Agreement, Consent Decrees and Repayment Contracts, Aerial Imagery, diversion records from Tribe for Colorado Division of Water Resources

Canal siphon at the foot of Sleeping Ute Mountain
*Source: Ute Mountain Ute Tribe*

#### *5.3.5.5 Water Use Efficiency and Conservation*

The UMUT's municipal system on the Reservation in Colorado is managed by the Public Works Department which repairs leaks as they are identified. In 2014, the Public Works Department facilitated a leak detection survey on the oldest portion of system's pipelines.

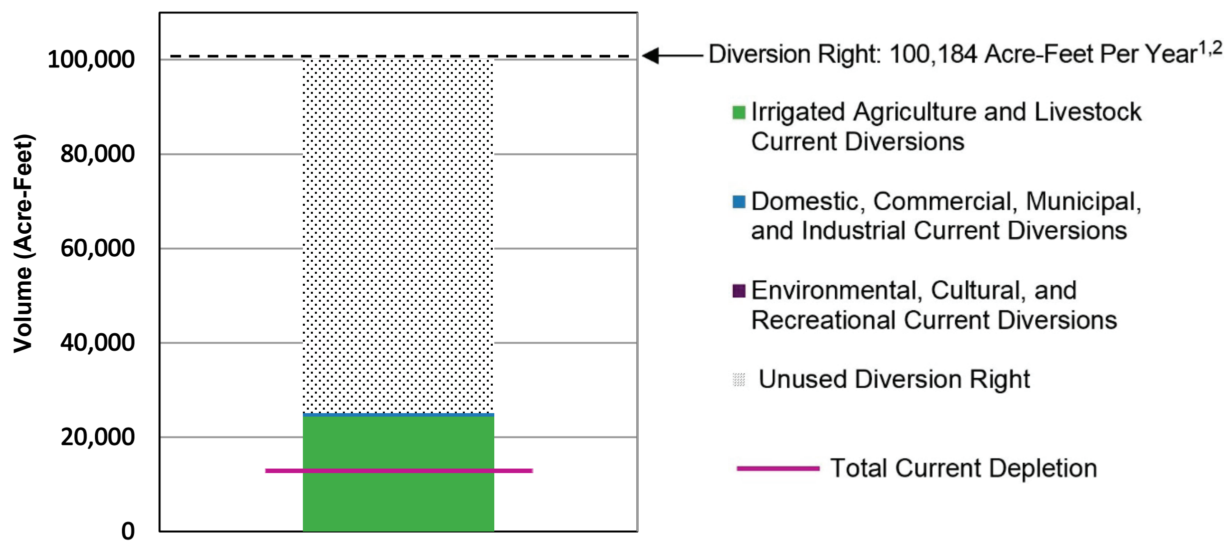
The FRE employs highly efficient irrigation infrastructure to the extent feasible. This includes center pivots that are gravity fed through pipelines from the Towaoc-Highline Canal. The FRE uses two mobile soil moisture monitors that are linked to the irrigation supply management system. Each center pivot is tied into the main system and operates based on data from soil moisture, weather, and water supply. Farm and Ranch staff closely monitor water use and manage the irrigated area and crops to maximize production within the limited water supply. Where feasible in other irrigated areas and on Tribal Ranches, the Tribe uses gated pipe, side-rolls or other efficient means of irrigation.

Nozzle upgrades on Farm and Ranch center pivots
*Source: Ute Mountain Ute Tribe*

#### *5.3.5.6 Summary of Current Water Use*

Current average annual water use for the UMUT reserved water rights is presented below in Figure 5.3-B and Table 5.3-H. Irrigation diversion records do not always separate out Tribal and other water use. Therefore, tribal irrigation diversions were calculated based upon current irrigated acreage, water supply characteristics (i.e. priority of rights, defined duty of water, volumetric limitations, etc.), and crop type. Due to a lack of measurement on many smaller water sources, reasonable standardized assumptions were used to determine their diversion amounts. Where records were available, the period of 2009 through 2013 was used to help guide development of the assumptions. Depletion amounts were then derived from the diversion numbers using standard engineering efficiency estimates accepted by the State of Colorado and assigned based on water use category and structure type.

**FIGURE 5.3-B**
Ute Mountain Ute Tribe Current Average Annual Water Use (2009 – 2013) and Reserved Water Rights in Colorado




[1] Sources: 1986 Colorado Ute Settlement Agreement; Ute Mountain Ute Reservation Existing Water Use Inventory Sheet per Consent Decree Exhibit; Consent Decrees entered December 19, 1991, under case W-1603-76J.

[2] Includes Ute Mountain Ute Tribes's Animas La-Plata reserved average annual depletion water right of 16,525 AFY converted into a diversion right by applying a 37 percent efficiency for a total of 44,662 AFY.

**TABLE 5.3-H**
Ute Mountain Ute Tribe Current Average Annual Water Use by Basin in Colorado (2009 – 2013)

| Source | Water Use Category | Diversion (AFY) | Estimated Current Depletion (AFY) |
|---|---|---|---|
| Dolores | AG | 24,388[1] | 12,194 |
| | DCMI | 721 | 648 |
| Animas La-Plata | All Uses | 0 | 0 |
| Mancos River | All Uses | 0 | 0 |
| Navajo Wash | AG | 1 | 1 |
| San Juan River | DCMI | 60 | 54 |
| McElmo Creek | All Uses | 0 | 0 |
| Additional Diversions | DCMI | 1 | 1 |
| Groundwater Basins | AG | 6 | 3 |
| | DCMI | 2 | 2 |
| | ENV | 2 | 1 |
| Future Domestic and Tributary Groundwater | All Uses | 0 | 0 |
| Subtotal | AG | 24,395 | 12,198 |
| | DCMI | 784 | 706 |
| | ENV | 2 | 1 |
| **Total** | | **25,181** | **12,905** |

AG – Irrigated Agriculture and Livestock
DCMI – Domestic, Commercial, Municipal, and Industrial
ENV – Environmental, Cultural, and Recreational

[1] Includes additional leased water that is delivered to the Farm and Ranch Enterprise (FRE), which is not part of the Tribe's diversion allocation of 23,300 AF. The Tribe has water demands greater than its allocation which it partially meets using leased water, as available.

### 5.3.6 Tribal Water Use Challenges

The UMUT is confronted with a number of challenges in developing their water resources on Reservation lands that span three states and on noncontiguous off-Reservation ranch lands. Coordination of water management and administration among the Tribe, multiple states, and multiple agencies to address the Tribe’s water needs is further complicated by downriver administration problems in the Colorado and New Mexico watersheds.

A lack of funding also presents a major hurdle that affects all areas concerning planning, development, management, and maintenance of tribal groundwater and surface water supplies. As noted above, considerable funding is needed to plan and construct water delivery infrastructure from the A-LP Project to the Reservation. At the same time, additional funding is needed for the operation, maintenance, repair, and replacement of aging infrastructure at the Dolores Project and other water delivery and treatment facilities. A consistent source of funding is also needed to maintain and protect the Tribe's allocated water resources in regional adjudications that may impact the Tribe's water rights. With sufficient funding and coordination, such legal issues could potentially be reduced when coupled with increased tribal capacity for water management and administration, comprehensive Basin-wide planning, and coordination among the various stakeholders.

Water quality is a growing concern to the Tribe due to off-Reservation environmental threats to groundwater and surface water. Historical and present-day mining near Reservation borders are the basis for the Tribe's concerns related to contamination of tribal water resources. As a result, future planning and development of tribal water resources and infrastructure must factor in potential off-Reservation environmental contamination. Detailed protocols are also necessary to address immediate and long term recourse. Again, adequate planning and coordination between governing entities is essential to addressing the various water quality issues.

Finally, planning and protocol development is also needed to address the looming threat of drought and subsequent shortages across the Basin. Drought is expected to trigger critical shortages to range resources and Dolores Project supplies, thus hindering the Tribe's FRE and other uses. Careful administration and shortage sharing among the various water users is therefore essential, in accordance with the Colorado Settlement Agreement.

### 5.3.7 Projected Future Water Development

The UMUT's future water development was assessed by first examining the location, quantity and type of current water use, and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development. Narrative descriptions of these scenarios (storylines) were created and provided a rational basis for considering a wide range of future tribal water development.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreased flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

The UMUT contemplated its future water development through 2060 by reviewing its current water use estimates and reflecting upon how they might change under each of the four scenarios. During this process, the Tribe considered such elements as the scenario conditions described in the storylines, current or future planned projects, water availability in each of the river basins that cross the Reservation, anticipated changes in water use by category, the extent and condition of existing water infrastructure and the need, as well as the cost, for new infrastructure to support water development. The Tribe contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges (TRAN).

From this examination, the UMUT extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared a quantified water development schedule. Subsequently, the UMUT used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each scenario development schedule is presented in the following section.

#### *5.3.7.1 Future Water Development Schedules*

The assumptions for each schedule are described below and the quantified schedules are presented graphically in Figure 5.3-C and numerically in Table 5.3-I.

*Current Water Development Trends (Scenario A)*

If current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same, by 2060 the total water diversions on the UMUT Reservation will increase by approximately 11 percent due to increased agricultural water use along the Mancos River, Navajo Wash, San Juan River, and McElmo Creek and increased DCMI water use. DCMI used for the A-LP Project is assumed to increase to about 30 percent of the right by 2060 (300 water taps) along with small DCMI water use increases in other basins and from groundwater. The schedule assumes full development (800 AFY) of the Dolores right by 2060 for ENV purposes and a small use on the Mancos River for restoration purposes. No TRAN water use is assumed through 2060.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, UMUT prepared a water development schedule that assumed no changes in current water use.

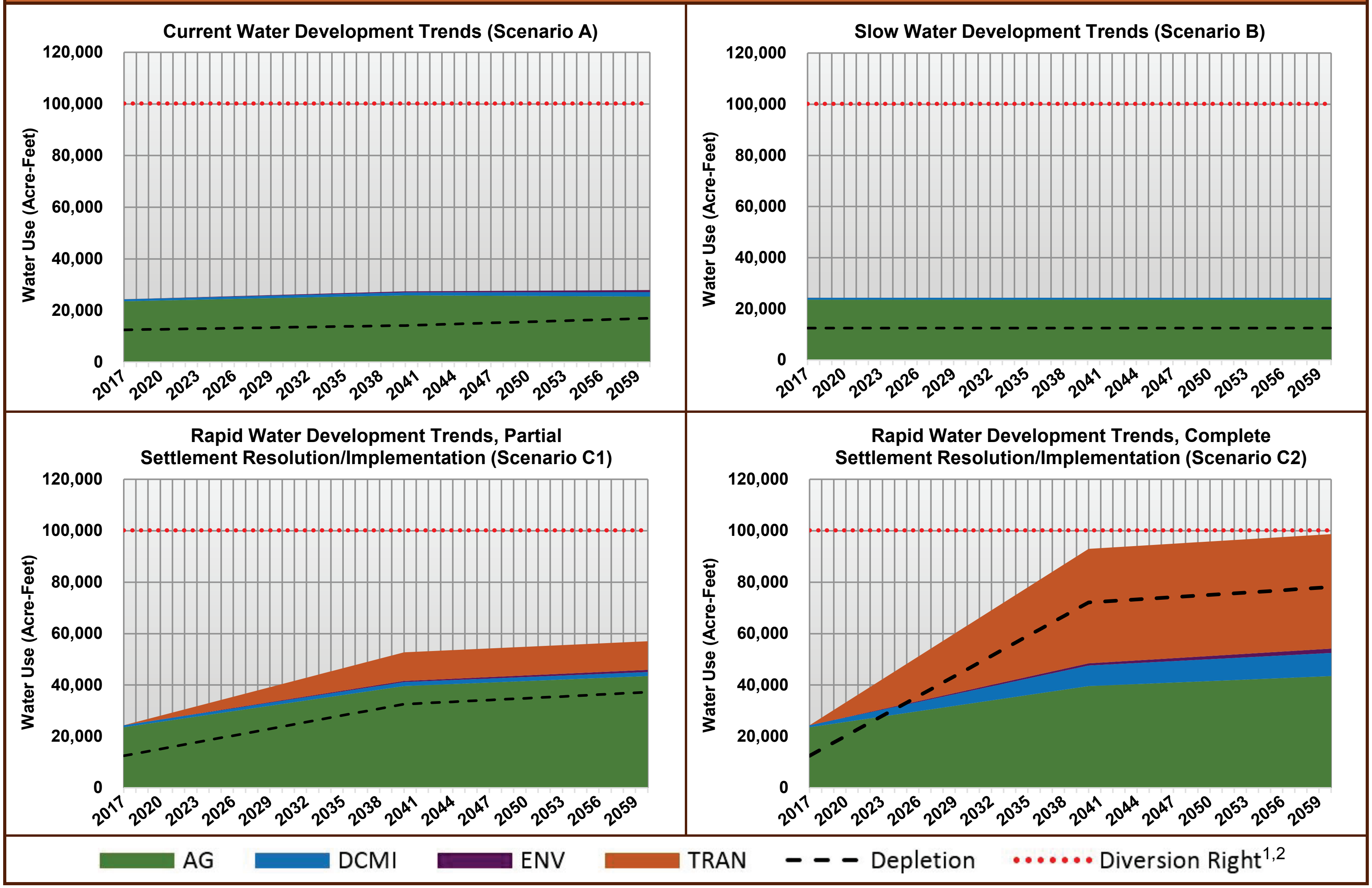
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. By 2060, total UMUT water diversions double to 50,009 AFY mainly due to increased AG water use along the Mancos River, Navajo Wash, San Juan River, and McElmo Creek and additional water needs for the Farm and Ranch Enterprise. DCMI water used for the A-LP Project is assumed to increase to about 30 percent of the right by 2040 (300 water taps) along with increased water needs for energy development. The water development schedule assumes a five percent increase in ENV water use for environmental purposes. In addition, it is assumed that 25 percent of the unused A-LP Project water (nearly 5,000 AFY) is leased to surrounding communities.

#### *Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. Under this scenario, UMUT reaches full development of its water right by 2060. AG water use is assumed to be the same as Scenario C1, but DCMI is increased for energy production, ENV water use doubles, and all unused A-LP Project water (16,115.29 AFY) is leased to surrounding communities.

**FIGURE 5.3-C**
Ute Mountain Ute Tribe Projected Future Water Development in Colorado (Scenarios A, B, C1, and C2)




[1] Ute Mountain Ute Tribe's reserved diversion water right in Colorado is 100,184 AFY.

[2] Includes Ute Mountain Ute Tribe's Animas La-Plata average annual depletion right of 16,525 AFY converted into a diversion right by applying a 37 percent efficiency for a total of 44,662 AFY.

### *5.3.7.2 Summary of Projected Future Water Development*

The UMUT's current water use and projected future water development under the Tribal Water Study's water development scenarios, and modeled for analysis purposes, is presented in Table 5.3-I.

**TABLE 5.3-I**
Summary of Ute Mountain Ute Tribe Current Water Use and Projected Future Water Development in Colorado[1,2]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion |
| **Current Use** | *AG* | 23,580[3] | 11,790 | 23,580[3] | 11,790 | 23,580[3] | 11,790[3] | 23,580[3] | 11,790 |
| | *DCMI* | 784 | 706 | 784 | 706 | 784 | 706 | 784 | 706 |
| | *ENV* | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **24,366** | **12,497** | **24,366** | **12,497** | **24,366** | **12,497** | **24,366** | **12,497** |
| **Use at 2040** | *AG* | 25,879 | 12,940 | 23,580 | 11,790 | 39,601 | 19,801 | 39,601 | 19,801 |
| | *DCMI* | 1,143 | 1,056 | 784 | 706 | 1,574 | 1,456 | 8,000 | 7,400 |
| | *ENV* | 404 | 202 | 2 | 1 | 424 | 212 | 848 | 424 |
| | *TRAN* | 0 | 0 | 0 | 0 | 11,132 | 11,132 | 44,528 | 44,528 |
| | **Total** | **27,426** | **14,198** | **24,366** | **12,497** | **52,731** | **32,601** | **92,977** | **72,153** |
| **Use at 2060** | *AG* | 25,405 | 14,984 | 23,580 | 11,790 | 43,493 | 24,201 | 43,493 | 24,201 |
| | *DCMI* | 1,709 | 1,613 | 784 | 706 | 1,574 | 1,495 | 8,900 | 8,455 |
| | *ENV* | 804 | 402 | 2 | 1 | 844 | 422 | 1,688 | 844 |
| | *TRAN* | 0 | 0 | 0 | 0 | 11,132 | 11,132 | 44,528 | 44,528 |
| | **Total** | **27,918** | **16,999** | **24,366** | **12,497** | **57,043** | **37,250** | **98,709** | **78,123** |

1 Ute Mountain Ute Tribe's reserved diversion water right in Colorado is 100,184 AFY.
2 Includes Ute Mountain Ute Tribe's Animas La-Plata average annual depletion right of 16,525 AFY converted into a diversion right by applying a 37 percent efficiency for a total of 44,662 AFY.
3 For modeling purposes, current AG use is capped at the Ute Mountain Ute Tribe's Dolores agricultural diversion allocation of 23,300 AFY; therefore, the current use in this table is not the same as the current use listed in Table 5.3-H.

## 5.4 Jicarilla Apache Nation

### 5.4.1 Introduction

The Jicarilla Apache Nation Indian Reservation (Jicarilla Reservation or Reservation) spans more than 879,917 acres in north central New Mexico. The Reservation is located in the upper reaches of the San Juan River Basin and the Rio Chama in north central New Mexico and straddles the Continental Divide. The Reservation's northern boundary borders the Colorado line. The western boundary of the reservation is about 15 miles east of Navajo Reservoir.

Dulce, NM is the Reservation's sole community and is home to the Jicarilla Apache Nation's (Jicarilla or Nation) tribal headquarters. In 2010, the Nation had a population of 3,254.

Figure 5.4-A presents a general location map with Reservation boundaries, communities, and other important features.

### 5.4.2 Physical Setting

The geography on the Jicarilla Reservation ranges from high desert at the south boundary, at about 6,500 feet in elevation, to mountainous areas reaching over 11,400 feet in elevation in the north. The landscape varies from rugged pine-covered mesas and pinion-juniper woodlands to lowland sagebrush flats. Coniferous forest dominates the higher elevations in mountainous areas.

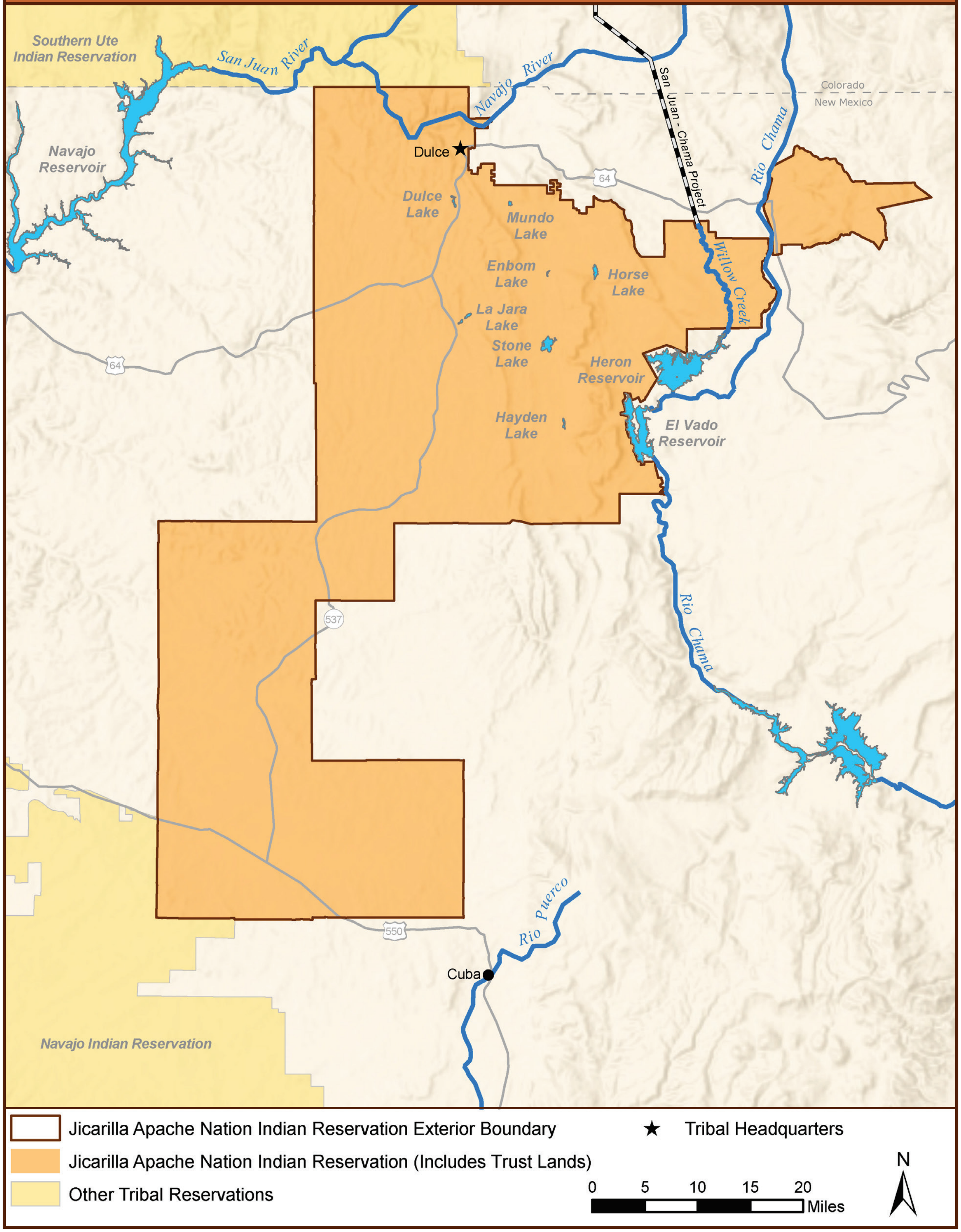
#### *5.4.2.1 Watersheds*

The Jicarilla Reservation is located in the Upper San Juan Basin. The following water bodies lie within the Reservation boundaries: Willow Creek, Rio Chama, Dulce Lake, Mundo Lake, Horse Lake, La Jara Lake, Enbom Lake, Hayden Lake, and Stone Lake. The Navajo River, which is a tributary to the San Juan River, is a perennial stream on the Reservation.

#### *5.4.2.2 Climate*

In winter, the average temperature is 24.9 °F, and the average daily minimum temperature is 7.9 °F. In summer, the average temperature is 62.6 °F, and the average daily maximum temperature is 82.0 °F. The average annual total precipitation at Dulce, NM is 17.89 inches. Of this, about 7.0 inches, or 39 percent, usually falls in June through September. Thunderstorms occur on about 41 days each year, and most occur in July and August. The average annual snowfall is 56.5 inches at Dulce. On average, 58 days per year have at least one inch of snow on the ground.

**FIGURE 5.4-A**
Jicarilla Apache Nation Indian Reservation Map






*See the Disclaimer and Introduction to Chapter 5.0.*

### 5.4.3 Historical Use and Cultural Importance of Water

In 1887 when the original 416,000-acre Jicarilla Reservation of Northern New Mexico was created by the executive order of February 11, 1887, water was a major consideration. At the time the Reservation was created, the General Allotment Act of 1887 (or the Dawes Act as it was popularly known) was enacted, which sought to divide reservation lands into allotments for individual Indians and families, and to encourage farming on lands allotted to individual Indians. The Jicarilla were able to revert their individual allotments back to tribal ownership, thus avoiding the fractionation of tribal lands and their appurtenant water rights.

Due to the high elevation of the Reservation, along with the heavily timbered slopes and the short crop-growing season, homestead-style farming on the original lands of the Jicarilla Apache was unsuccessful. Thus, these lands were largely devoted to commercial timber operations. By 1906, the Reservation had nearly doubled in size by the addition of what is now the southern end of the Reservation. This additional land provided year-round grazing of livestock as well as subsistence farming. In the 20th century, the Nation gained tourism and recreation benefits from its Reservation lands and waters. From the mid-20th century to the present, oil and gas development is the principal economic activity on the Reservation, resulting in the use of significant quantities of water as well as the prospect of significant degradation of water quality on the Reservation.

Realizing that rapid growth throughout the American Southwest was resulting in massive diversions of the region’s rivers, including the sacred rivers encompassing their homeland, in the 1960s the Jicarilla began a concerted effort to define in modern terms the extent of their indisputable rights to permanent sources of water to make their homelands permanently habitable and productive. These efforts have led to significant settlements and court decrees setting forth the Nation’s rights to waters from both the San Juan River and Rio Chama systems, as well as rights to participate in major federal water projects authorized and funded by the United States Congress.

The Nation’s ancient culture provides that the Nation’s water uses will determine Jicarilla’s cultural future as a distinct people. Nearly 70 years of intense economic activity on the Reservation have led the Nation to bring modern technology, scientific research, and economic analysis into deliberations concerning the future of the Nation’s water.

Water, in all its forms from clouds that bring the rain, to the snow that provides the blanket of winter and icy spring flows, to its life-giving presence in rivers, lakes, and streams, is sacred to the Jicarilla people and has been a fundamental tenet of the Nation’s religion since time immemorial. In Jicarilla creation stories, “Born of Water” is a major deity who made the world a safe place for human habitation and brought the four sacred rivers – the Arkansas, Rio Grande, Canadian, and Pecos Rivers – to the Jicarilla people. This territory encompasses sacred mountains as well, including Mount Blanca in southern Colorado that feeds water from snowmelt into the Rio Grande River. These river basins roughly define the territorial boundaries of the aboriginal Jicarilla homelands, encompassing much of present-day northeastern New Mexico, southeastern Colorado, and the panhandles of Oklahoma and Texas.

To the Jicarilla, their sacred homelands, with all their animal, plant, and water resources, were given to them by Great Spirit and are to be protected and honored through religious ceremonies and rituals. Even today traditional Jicarilla families travel to bathe their infants in and seek the blessing of the waters of these sacred rivers of the Jicarilla people. The Jicarilla homelands are considered sacred, shaping Jicarilla religion, culture, lifestyles, and their very identities as a distinct people. Elders still predict spring flows and summer availability of water from the timing rather than the density of snowfall, closely reflecting what scientists today refer to as its moisture content. The landscape and climate of their lands have always dictated the traditional culture of the Jicarilla. Water, to the Jicarilla, has never been just a commodity or a necessity of life, but a sacred element that requires respect, reverential treatment, and efficient use, and is used symbolically in all religious ceremonies and rituals.

The persistence of Jicarilla culture in a real sense is connected to the land, its natural resources, and its environment. The land and its waters not only hold the key to the past of the Jicarilla people but define their present. The reverence for and appreciation of the scarcity of water continue to dictate the Jicarilla's individual and cultural relationship to their homeland. The features of the landscape, especially its water resources, are instrumental and integral to the Nation's modern economic development and the preservation of this ancient culture in the 21st century.

### 5.4.4 Jicarilla Apache Nation Water Supply

In October 1992, Congress enacted the Jicarilla Apache Tribe Water Rights Settlement, P. L. No. 102-441, 106 Stat. 2237 (1992) (Settlement Act). The Settlement Act represents a full and final settlement of the future use water right claims of the Nation to the waters of the Colorado River. As part of the Settlement Act, Congress approved a contract between the Nation and the Secretary of the Interior dated December 8, 1992 ("Federal Contract") to provide for the diversion by the Nation of 33,500 acre-feet per year (AFY), with a corresponding depletion right of 25,500 AFY, from the Navajo Reservoir water supply at or above the reservoir, and to provide for the delivery to the Nation of 6,500 AFY at Heron Reservoir through the San Juan-Chama Project. Through the Federal Contract, the Nation agreed to subordinate its reserved water rights in exchange for the right to use wet water delivered by the United States at the locations and in the amounts described above. The United States has title to the delivered water by virtue of state law, and the state law priority date for that water is 1955.

In addition to the reserved water rights for future use mentioned above, in 1999, the Eleventh Judicial Court of New Mexico in the San Juan River Adjudication entered a Partial Final Decree adjudicating Jicarilla's water rights in the San Juan River Basin in New Mexico. Under the Partial Final Decree, the Nation has a reserved right for historic and existing uses not to exceed an annual diversion of 5,682.92 AFY or the quantity necessary to supply a depletion of 2,194.58 acre-feet (AF), whichever is less, and a net evaporation of 2,187.16 AF. These are federal reserved rights with a priority date of 1880 (Table 5.4-A).

With respect to the water made available from the Navajo Reservoir or the San Juan-Chama Project under the terms of the Federal Contract, during periods when the Secretary finds that the actual water supply is more or less than the estimated firm yield to the project, Jicarilla shares in the available water supply in the ratio that its contract amount bears to the firm yield. In times of shortage, the Nation shares in the available water supply in the manner set forth in Section 11(a) of the Act of June 13, 1962, 76 Stat. 96, 99-100.

Jicarilla also has rights to the use of water in the Rio Puerco Stream system, but these rights have not yet been formally adjudicated or legally addressed.

**TABLE 5.4-A**
Water Rights (1923 Federally Decreed Rights and Other Reserved Water Rights)

| Basin/River | Diversion Location | Diversion Right (AFY) | Depletion Right (AFY) | Net Acres | Priority Dates |
|---|---|---|---|---|---|
| San Juan | Navajo Reservoir or Navajo River within Jicarilla Reservation | 33,500 | 25,500 | | 1955 |
| San Juan | Heron Reservoir via San Juan-Chama | 6,500 | 6,500 | | 1955 |
| San Juan | Historical and Existing Uses | 5,682.92 | 2,194.98 | 438 | Sept. 21, 1880 |
| **Total** | | 45,682.92 | 34,194.98 | | |

## 5.4.5 Current Water Use and Operations

There is essentially no irrigated agriculture on the Jicarilla Reservation, and current domestic, commercial, municipal, and industrial water use is minimal. The majority of the Nation's water is subleased to other water users outside the Reservation boundaries. The Settlement Act expressly permits the Nation to sublease water off-Reservation to generate revenue. Jicarilla subleases water to users both in and outside of the Colorado River Basin.

### *5.4.5.1 Domestic, Commercial, Municipal, and Industrial Water Use Category*

Records of actual water use are limited to the diversions and depletions for domestic, commercial, municipal and industrial use within the community of Dulce (Table 5.4-B). The Navajo River runs north of Dulce and provides the community with its domestic water supply.

**TABLE 5.4-B**
Domestic, Commercial, Municipal, and Industrial Water Use (2010 – 2014)

| Location | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 |
| Dulce Water Treatment Plant | 575.56 | 547.47 | 597.82 | 610.78 | 592.16 |
| Dulce Wastewater Treatment Plant | 378.60 | 334.70 | 340.55 | 356.15 | 368.60 |
| **Total** | 954.16 | 882.17 | 938.37 | 966.93 | 960.76 |

Source: Jicarilla Apache Nation Utility Authority

### *5.4.5.2 Environmental, Cultural, and Recreational Water Use Category*

There are seven fishing lakes on the Jicarilla Reservation: Hayden, La Jara, Stone, Mundo, Enbom, Dulce and Horse lakes. Each lake ranges in size from 35 to 500 acres, when full. Additionally, approximately 12 miles of the Navajo River on the Reservation provide fishing opportunities. The Jicarilla Game and Fish Department has been working on habitat restoration in the Navajo River to protect three rare native fish species – the Rio Grande cutthroat trout, roundtail chub, and the razorback sucker.

### *5.4.5.3 Transfers, Leases, and Exchanges Water Use Category*

Leasing of Jicarilla's settlement water is provided for in the 1992 Settlement Act and the Federal Contract with the United States. The Nation leases its settlement water to a number of different entities for off-Reservation use subject to the approval of the Secretary of the Interior. Since settling its water rights in 1992, the Nation has entered into more than a dozen leases with off-Reservation entities. The first and largest of the leases was a 21-year lease for 16,500 AFY to the Public Service Company of New Mexico (PNM). PNM used the water for the utility's coal-fired San Juan Generating Station. The smallest lease was for municipal supply to the Elks Lodge in Farmington, New Mexico for 15 AFY. Most of the Nation's off-Reservation water leasing goes toward industrial uses related to power generation and coal mining. The Nation executed two contracts for municipal supply to cities – one in 2004 to supply the City of Santa Fe, New Mexico with 3,000 AFY, and one in 2011 to supply the City of Gallup, New Mexico with 7,500 AFY in the future as a component of the Navajo Gallup Water Supply Project. The Nation has also leased water to Reclamation, which used 5,300 AF in 2013 as in-stream flow in the Rio Grande to protect the endangered silvery minnow. Table 5.4-C presents leases from 2009 through 2013.

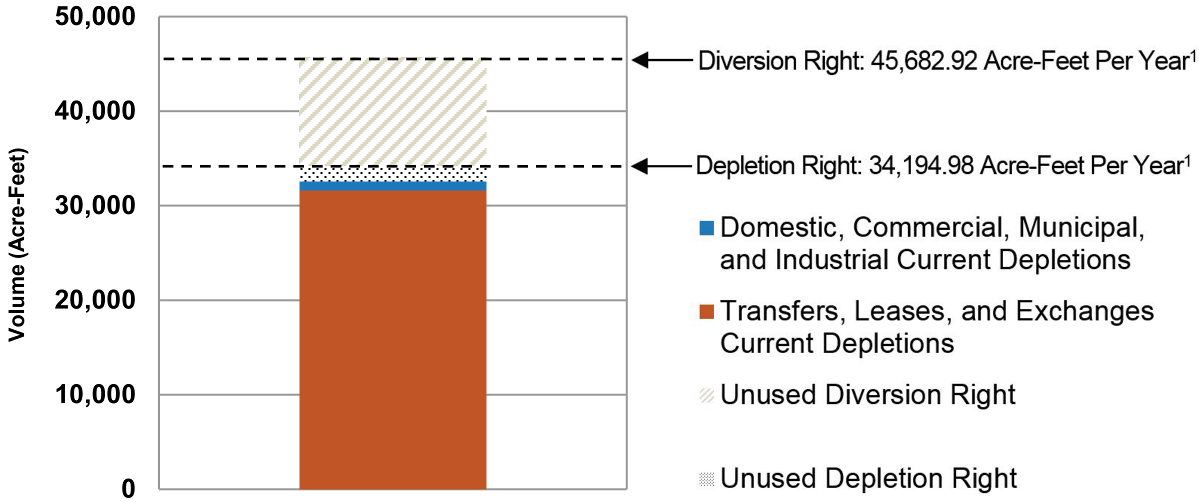
**TABLE 5.4-C**
Jicarilla Settlement Water Leases (2009 – 2013)

| Recipient | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| Bureau of Reclamation | 3,000 | 3,500 | 3,000 | 5,400 | 5,300 |
| Rio Chama Acequia Association | 500 | 0 | 500 | 1,000 | 600 |
| City of Santa Fe | 3,000 | 3000 | 3,000 | 0 | 0 |
| Club at Las Campanas, Inc. | 0 | 0 | 0 | 0 | 600 |
| Elks Lodge | 15 | 15 | 15 | 15 | 15 |
| Giant Refinery | 340 | 340 | 340 | 340 | 340 |
| San Juan Basin Water Haulers | 100 | 100 | 100 | 100 | 100 |
| PNM/BHP Billiton | 16,200 | 16,200 | 16,200 | 16,200 | 16,200 |
| Arizona Public Service/BHP Billiton | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 |
| **Total** | **31,655** | **31,655** | **31,655** | **31,555** | **31,655** |

### *5.4.5.4 Summary of Current Water Use*

Jicarilla's average annual water use for the period from 2009 through 2013 is presented in Figure 5.4-B and Table 5.4-D.

**FIGURE 5.4-B**
Jicarilla Apache Nation Current Average Annual Water Use in New Mexico




[1] Source: 1992 Jicarilla Apache Tribe Water Rights Settlement, Pub. L. No. 102-441, 106 Stat. 2237; Partial Final Judgment and Decree of the Water Rights of the Jicarilla Apache Tribe, State of New Mexico ex rel. State Engineer v. United States, No. CIV 75-184 (N.M. Dist. Ct. 11th Jud. Dist. Feb. 22, 1999).
[2] DCMI use represents the average Water Treatment Plant output for the period from 2010 through 2014. TRAN use represents the average amount of leased water for the period from 2009 through 2013.

**TABLE 5.4-D**
Jicarilla Apache Nation Current Average Annual Water Use by Basin in New Mexico

| Source | Water Use Category[1] | Diversion (AFY) | Estimated Current Depletion (AFY) |
|---|---|---|---|
| San Juan | DCMI | 940 | 940 |
| | TRAN | 31,635 | 31,635 |
| **Total** | | **32,575** | **32,575** |

DCMI – Domestic, Commercial, Municipal, and Industrial
TRAN – Transfers, Leases, and Exchanges
[1] DCMI use represents the average Water Treatment Plant output for the period from 2010 through 2014. TRAN use represents the average amount of leased water for the period from 2009 through 2013.

### 5.4.6 Tribal Water Use Challenges

Access to water is fundamental to the right of the Nation to use and enjoy its lands, to maintain the integrity of its territories, and to provide for the needs of its people. In 1992, the Nation obtained a full and final settlement of its future use water right claims to the waters of the Colorado River. Jicarilla's water rights provide access to water for the Nation to conduct cultural practices, provide drinking water to the community of Dulce, and support economic development. In short, Jicarilla's water rights enable the Nation to maintain self-sufficiency.

While Jicarilla has obtained a full and final settlement of its water right claims on the Colorado River, it still faces challenges in the areas of obtaining funding for on-Reservation water infrastructure development and rehabilitation; legal, administrative, and political barriers affecting the ability to fully realize the benefits of its right to sublease water off-Reservation for its economic benefit; declining water quality; and the effects of climate change on water supplies.

Jicarilla lacks the economic resources to build and maintain infrastructure for delivery of water. Development of the Nation's water rights and the capability to use water on the Reservation largely depends on the construction of major new water infrastructure to allow the Tribal community to access water Jicarilla already holds the rights to. Constructing new water infrastructure requires significant financial resources and long-term investments from both the Nation and the federal government. One of the primary challenges is the availability of federal funds to implement ongoing and future water development projects.

The economic survival of the Nation largely depends on having water for domestic use. For the most part, the Jicarilla people are not able to live or work on the Reservation outside the town of Dulce, New Mexico due to, among other things, a lack of sufficient water systems in other locations on the Reservation. The population has limited economic resources that make large capital investments necessary to develop additional water systems difficult to achieve. Further, the widely dispersed on-Reservation population results in large distances between water sources and water users.

The existing water system for the town of Dulce consists of a piecemeal municipal water delivery and wastewater collection system. This system has deteriorated over the years due to lack of capital improvements and maintenance by BIA, which previously owned and operated the system. Because of this deterioration, the wastewater system and system lagoons operate at over 100 percent capacity during the summer months and over 500 percent capacity during the winter months.

The Jicarilla Apache Reservation Rural Water System Project was designed to replace existing water and wastewater facilities in and around the town of Dulce, and provide services to the newly developed area of Mundo Ranch. However, the failure of necessary federal funding for the project has resulted in a very slow-moving project that has not kept up with the Nation's increasing need for repair and maintenance of the existing water system.

The lack of reliable potable water and sufficient infrastructure impedes economic development and has detrimental effects on the quality of life, including public health, and economic self-sufficiency of Jicarilla. The Nation needs a reliable, high-quality water supply in areas outside of Dulce to continue diversifying the economy for on-Reservation employment and to live in the Nation's traditionally dispersed manner across Reservation lands.

Another water use that Jicarilla relies on for economic survival is subleasing its settled water rights to other water users outside Reservation boundaries. Such subleases can provide income that can help build the Nation's economic self-sufficiency while allowing non-Indians access to needed water. Given the high economic value of water in some off-Reservation areas, subleasing has become an important means to raise funds for water development projects, to achieve the highest and best use of Jicarilla's water rights, and to provide for the needs of the Nation and its people.

However, legal issues associated with jurisdiction and control over Jicarilla's water marketing efforts present a challenge to the Nation's efforts to expand its water marketing program and to fully realize the value of its settled water rights. The Nation's water marketing program has been highly successful and has generated a substantial amount of income for the Nation each year. For decades, the Nation has been diligent in seeking out active water users and subleasing its settlement water to these users at rates near the top of the New Mexico water market. However, in recent years, the Nation's water marketing revenue has slowly declined due to low water demand, low market prices, and the expiration and non-renewal of some of the Nation's more profitable long-term leases. Existing policies and regulations have been relied upon to attempt to limit the Nation's off-Reservation use of its water. This may result in the Nation having large amounts of unused water, losing substantial revenue, and ultimately not realizing the true economic value of its water rights in future years.

Declining water quality also threatens to limit Jicarilla's future uses and value of water. Indian reservations face some of the greatest water pollution threats of any areas in the United States and the Jicarilla Reservation is no exception. Sources of impairment to water quality on the Reservation include: oil and gas activities, septic systems, landfills, grazing, timber and logging activities, commercial development, electric generating systems, ranching, and recreation. Indeed, a burgeoning issue in natural gas production is the practice of hydraulic fracturing and the concerns this raises for both environmental and water resource contamination and of overlapping and potentially burdensome federal, tribal and state regulations.

To add to these concerns, there is also the issue of how water supplies are changing due to climate change. Prolonged drought conditions in the Southwest have seriously affected the fishing lakes on the Jicarilla Reservation, which has resulted in decreased opportunities for fishermen. Water levels of lakes in the region have drastically decreased over the last few decades, with some lakes completely dried up. Of the seven fishing lakes on the Reservation, two of these lakes, Hayden Lake and La Jara Lake, are currently dry. Reduced rainfall will also negatively impact native plants, some of which are culturally important to the Nation.

Finally, another challenge for the Nation is that the basic law governing allocation of Western water has not changed substantially in over 100 years, and is steeped in dated concepts fashioned to address situations no longer relevant. Indeed, Jicarilla's water settlement was negotiated over twenty years ago and does not reflect current changes in water supply, demand and values. Water itself, the regional demand on it, and views of its value is changing at a rate that outpaces the ability of the law to adapt. The Nation finds itself in a constant struggle with Western water policymakers and practitioners to introduce flexibility into the law to address changes in basin-wide issues of supply, demand and values.

### 5.4.7 Projected Future Water Development

Jicarilla's future water development was assessed by first examining the location, quantity and type of current water use and then, by applying the Tribal Water Study's scenario planning process envisioning a range of future water development.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.

- **Slow Water Development Trends (Scenario B):** Decreases flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

Jicarilla contemplated its water development through 2060 by reviewing its current water use estimates and reflecting upon how these might change under the four scenarios. During this process, the Nation considered such elements as the scenario conditions described in the storylines, current or future planned projects, anticipated changes in water use by category and the extent and condition of existing water infrastructure and the need, as well as the cost, for new infrastructure to support water development. Although the majority of the Nation's water is currently leased to other water users, the Nation contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges Water Use (TRAN).

From this examination, Jicarilla extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared a quantified water development schedule. Subsequently, Jicarilla used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each development schedule is presented in the following sections.

#### *5.4.7.1 Future Water Development Schedules*

The assumptions used to prepare each water development schedule are described below. The schedules presented graphically in Figure 5.4-C and numerically in Table 5.4-E.

*Current Water Development Trends (Scenario A)*

If current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same, Jicarilla assumed that full use of its water diversion right (45,682.92 AFY) will occur by 2040. Domestic use was assumed to increase by five percent in the northern part of the Reservation through 2060 for on-Reservation housing (about 50 houses by 2060). An additional 1,200 AFY was assumed for housing, commercial and industrial development in the southern part of the Reservation by 2040. After 2040, any water right not used for DCMI purposes was assumed to be leased to other water users. There is currently no AG or ENV water use on the Jicarilla Reservation, and this trend was assumed through 2060.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, Jicarilla assumed a 45 percent decrease in TRAN water use due to changes in local water use and availability and a loss of prior subleasees, such as resulting from a shutdown of the Public Service Company of New Mexico's coal power plant. DCMI remained constant with current use through 2060. No AG or ENV use was assumed.

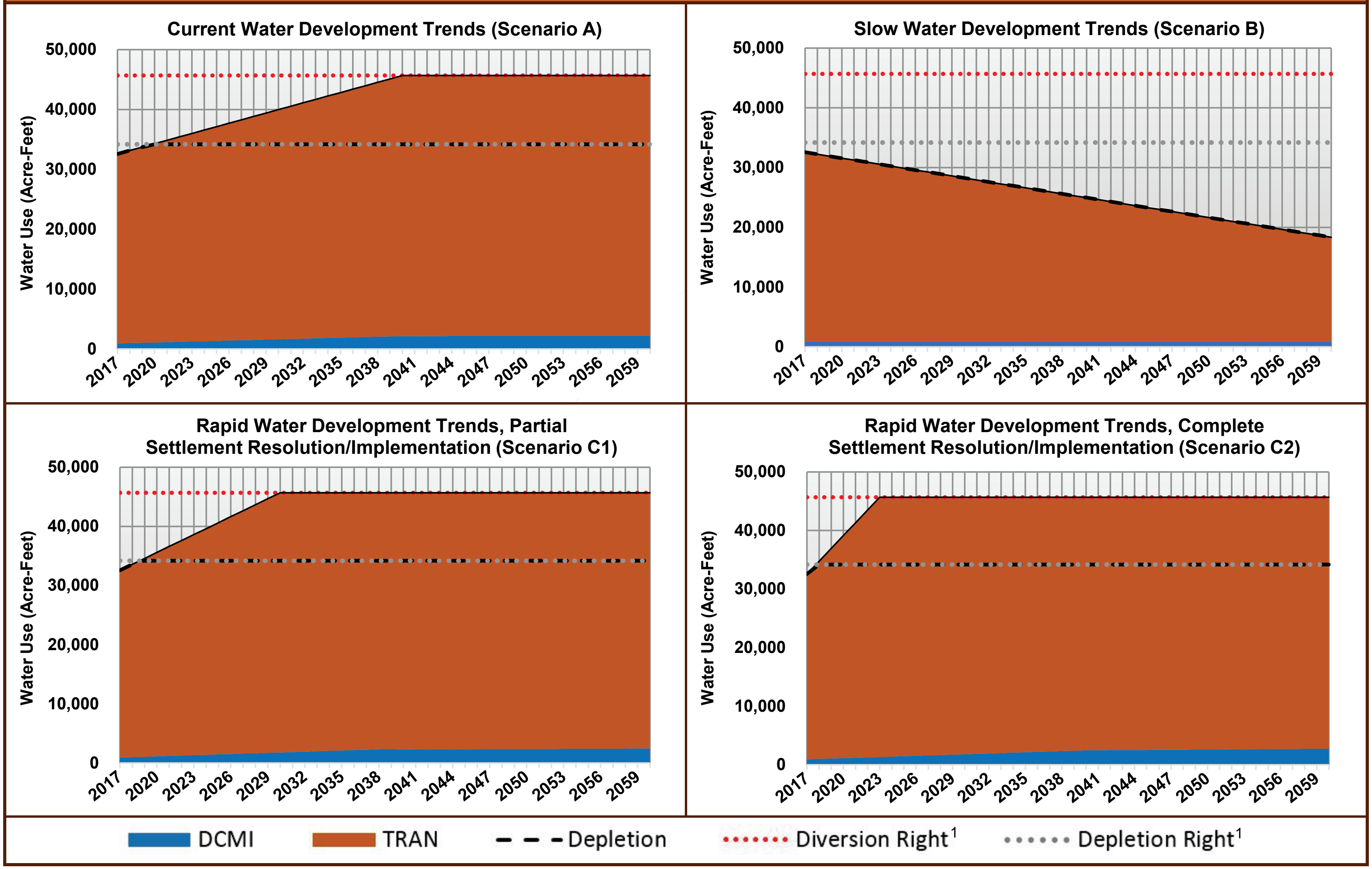
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. Jicarilla assumed full development of its water diversion right (45,682.92 AFY) by 2030 due to the ability to lease to interstate markets. Domestic use was assumed to increase by 33 percent through 2040 for on-Reservation housing (about 300 houses) and remain constant through 2060. An additional 1,200 AFY was assumed for housing, commercial and industrial development in the southern part of the Jicarilla Reservation by 2040. After 2030, any water right not used for DCMI purposes was assumed to be leased to other water users. No AG or ENV use was assumed.

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. Under this scenario, Jicarilla assumed full development of its water diversion right (45,682.92 AFY) by 2023 due to the ability to lease to interstate markets. Domestic use was assumed to increase by 66 percent through 2060 for on-Reservation housing (about 600 houses). An additional 1,200 AFY was assumed for housing, commercial and industrial development in the southern part of the Reservation by 2040. After 2023, any water right not used for DCMI purposes was assumed to be leased to other water users. No AG or ENV use was assumed.

**FIGURE 5.4-C**
Jicarilla Apache Nation Projected Future Water Development in New Mexico (Scenarios A, B, C1, and C2)




[1] Jicarilla Apache Nation's diversion water right in New Mexico is 45,682.92 AFY and depletion right is 34,194.98 AFY.

### *5.4.7.2 Summary of Projected Future Water Development*

Jicarilla's current water use and projected future water development under the Tribal Water Study's water development scenarios, and modeled for analysis purposes, is presented in Table 5.4-E.

**TABLE 5.4-E**
Summary of Jicarilla Apache Nation Current Water Use and Projected Future Water Development in New Mexico[1,2]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion |
| Current Use | *AG* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCMI* | 940 | 940 | 940 | 940 | 940 | 940 | 940 | 940 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 31,635 | 31,635 | 31,635 | 31,635 | 31,635 | 31,635 | 31,635 | 31,635 |
| | **Total** | **32,575** | **32,575** | **32,575** | **32,575** | **32,575** | **32,575** | **32,575** | **32,575** |
| Use at 2040 | *AG* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCMI* | 2,165 | 2,165 | 940 | 940 | 2,306 | 2,306 | 2,480 | 2,480 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 43,518 | 32,030 | 24,021 | 24,021 | 43,377 | 31,889 | 43,203 | 31,715 |
| | **Total** | **45,682.92** | **34.194.98** | **24,961** | **24,961** | **45,682.92** | **34.194.98** | **45,682.92** | **34.194.98** |
| Use at 2060 | *AG* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *DCMI* | 2,187 | 2,187 | 940 | 940 | 2,450 | 2,450 | 2,760 | 2,760 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 43,496 | 32,008 | 17,399 | 17,399 | 43,233 | 31,745 | 42,923 | 31,435 |
| | **Total** | **45,682.92** | **34.194.98** | **18,339** | **18,339** | **45,682.92** | **34.194.98** | **45,682.92** | **34.194.98** |

[1] Jicarilla Apache Nation's diversion water right in New Mexico is 45,682.92 AFY and depletion right is 34,194.98 AFY.
[2] Total in the table may not be the sum of components due to rounding.

## 5.5 Navajo Nation

### 5.5.1 Introduction


The Navajo Indian Reservation (Reservation) was established in 1868, and has been expanded through a series of executive orders, public land orders, and acts of Congress to become the largest Indian reservation in the United States covering more than 27,000 square miles (roughly the same size as West Virginia) in the Four Corners Region in Arizona, New Mexico and Utah. The tribe's official name is the Navajo Nation (Nation). The Hopi Tribe's Reservation lies within the boundaries of the Navajo Reservation. The land holdings in the Navajo Nation are varied, especially in New Mexico, as summarized in Table 5.5-A.

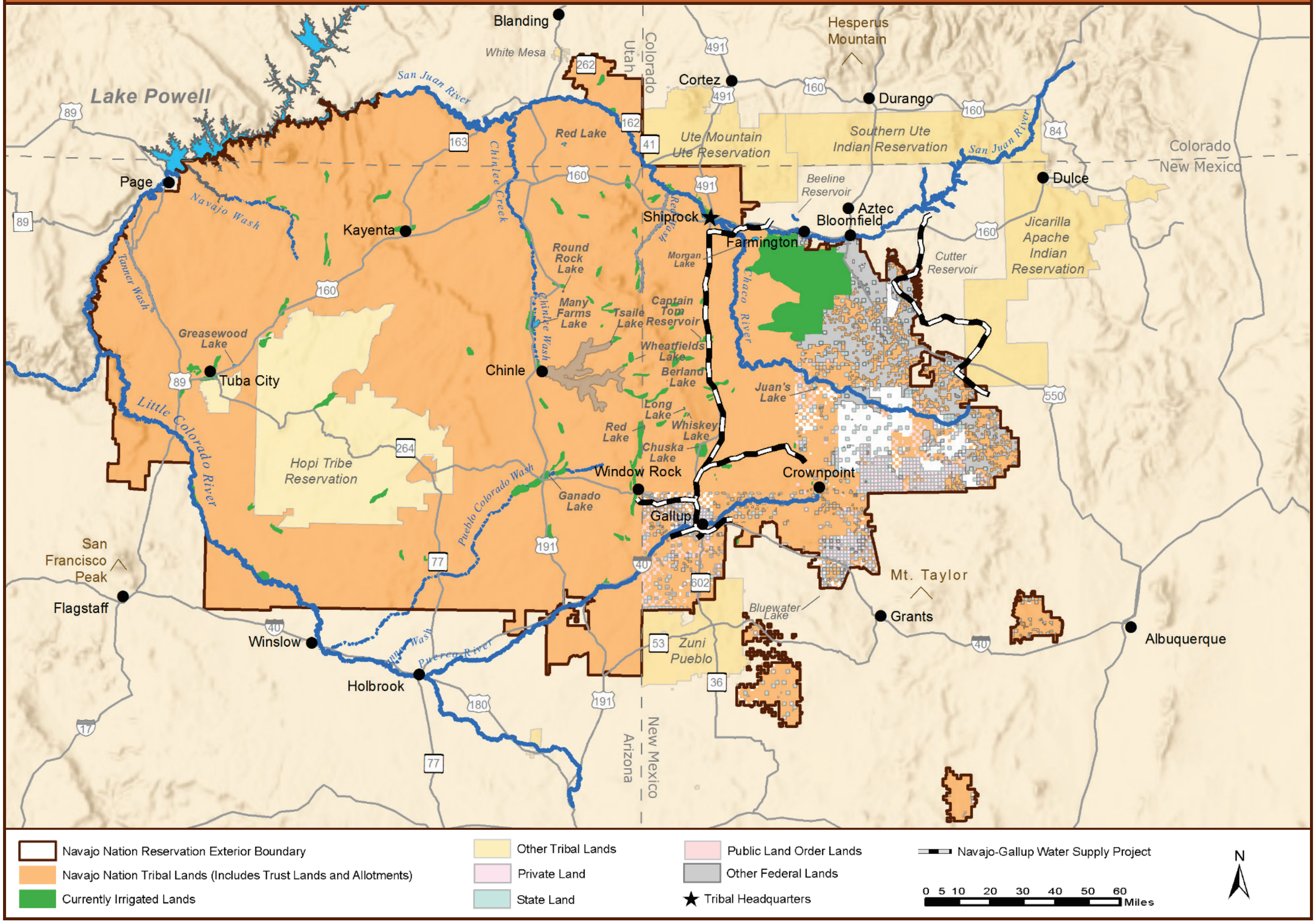
Figure 5.5-A presents a general location map with Reservation boundaries, communities, and other important features.

**TABLE 5.5-A**
Acreage Summary of Navajo Nation Lands as of 1998 (Navajo Division of Economic Development, 2010)

| Types of Lands | Arizona | New Mexico | Utah | Total |
|---|---|---|---|---|
| Navajo Nation Trust | 10,158,784.82 | 2,795,418.96 | 1,223,933.96 | 14,178,137.74 |
| Navajo Nation Fee | 585,169.98 | 357,000.00 | 424.90 | 942,594.88 |
| Individual Indian Allotment | 81,963.81 | 671,043.50 | 9,741.80 | 762,749.11 |
| State Lands Lease | 256,905.79 | 126,760.10 | | 383,665.89 |
| BLM Leases | | 150,002.23 | | 150,002.23 |
| U.S. Forest Service Permit | 174,000.00 | | | 174,000.00 |
| Government E.O. PLO & School Tract | | 91,838.99 | 5.99 | 91,844.98 |
| New Lands | 345,032.00 | | | 345,032.00 |
| **Total** | 11,601,856.40 | 4,192,063.78 | 1,234,106.65 | 17,028,026.83 |

The Navajo Nation is divided into 110 chapters. Each chapter has a local governing body. There are a variety of land status within some chapters, especially in the eastern and southeastern chapters in New Mexico. Each chapter has a main community where most activity occurs. There are several larger communities such as Shiprock, NM; Window Rock, AZ; Chinle, AZ; Kayenta, AZ; Tuba City, AZ; and Crownpoint, NM that are key areas of economic activity.

**FIGURE 5.5-A**
Navajo Nation Reservation Map

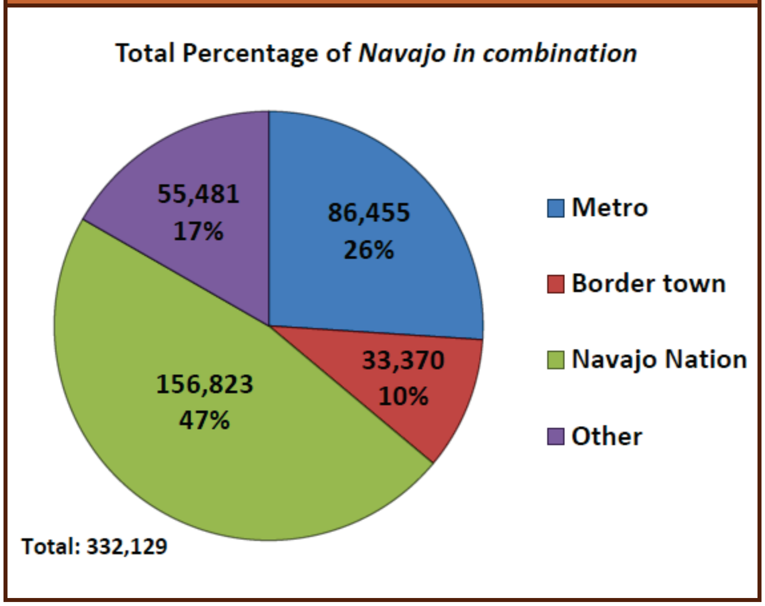





See the Disclaimer and Introduction to Chapter 5.0.

In 2013, the Navajo Division of Heath analyzed the 2010 Census data for the Navajo population and identified three categories: 1) Navajo alone; 2) Navajo in combination; and 3) All races. Navajo alone are Navajos claiming only to be of Navajo ancestry and no other race. Navajo in combination are Navajos who claim to be of Navajo ancestry in combination with other races. In 2010, there were a total of 332,129 individuals claiming to have Navajo ancestry (Navajo in combination). According to the 2010 Census, there were 156,823 Navajos (in combination) living on the Navajo Nation (Figure 5.5-B) and the total population (all races) on the Navajo Nation was 173,667. The twelve border towns included Aztec, Bloomfield, Farmington, Grants, and Gallup, New Mexico; Flagstaff, Holbrook, Page, and Winslow, Arizona; Cortez and Durango, Colorado; and Blanding, Utah. From 2000 to 2010, there was an overall increase in the Navajo population from 298,197 to 332,129 (11.3 percent) but a decline in the Navajo population living on the Navajo Nation from 167,539 to 156,823 (-6.3 percent) (Navajo Department of Health [NDOH], 2013).

**FIGURE 5.5-B**
Navajo population by location (NDOH, 2013)




The Navajo Nation operates under an Executive, Legislative and Judicial Branch. The Executive Branch operates under the direction of an elected president and vice-president. Within the Executive Branch, the Navajo Nation Division of Natural Resources and the Navajo Nation Environmental Protection Agency (NNEPA), manage the Navajo Nation's water resources.

The Navajo Nation Council was established in 1938. In 2010, the Council was reduced from 88 members to 24 members. The Legislative Branch has five standing committees, including: 1) Resources & Development, 2) Budget & Finance, 3) Law & Order, 4) Health, Education & Human Services, and 5) the Naa'bik'iyati' Committee. These committees provide oversight for the Executive Branch programs. The Resources & Development Committee works in cooperation with the Executive Branch President and other committees of the Navajo Nation Council on proposed legislation or actions affecting natural resources. The Resources & Development Committee provides legislative oversight authority for the Division of Natural Resources.

The Navajo Department of Water Resources (NDWR) is the primary department within the Navajo Nation Division of Natural Resources that is responsible for the protection, management and development of the water resources of the Navajo Nation. Through its branches, the NDWR is responsible for the long-term stewardship of the Nation's water resources. The NDWR is well positioned to coordinate the review of proposed water projects to ensure an assured water supply with appropriate entities.

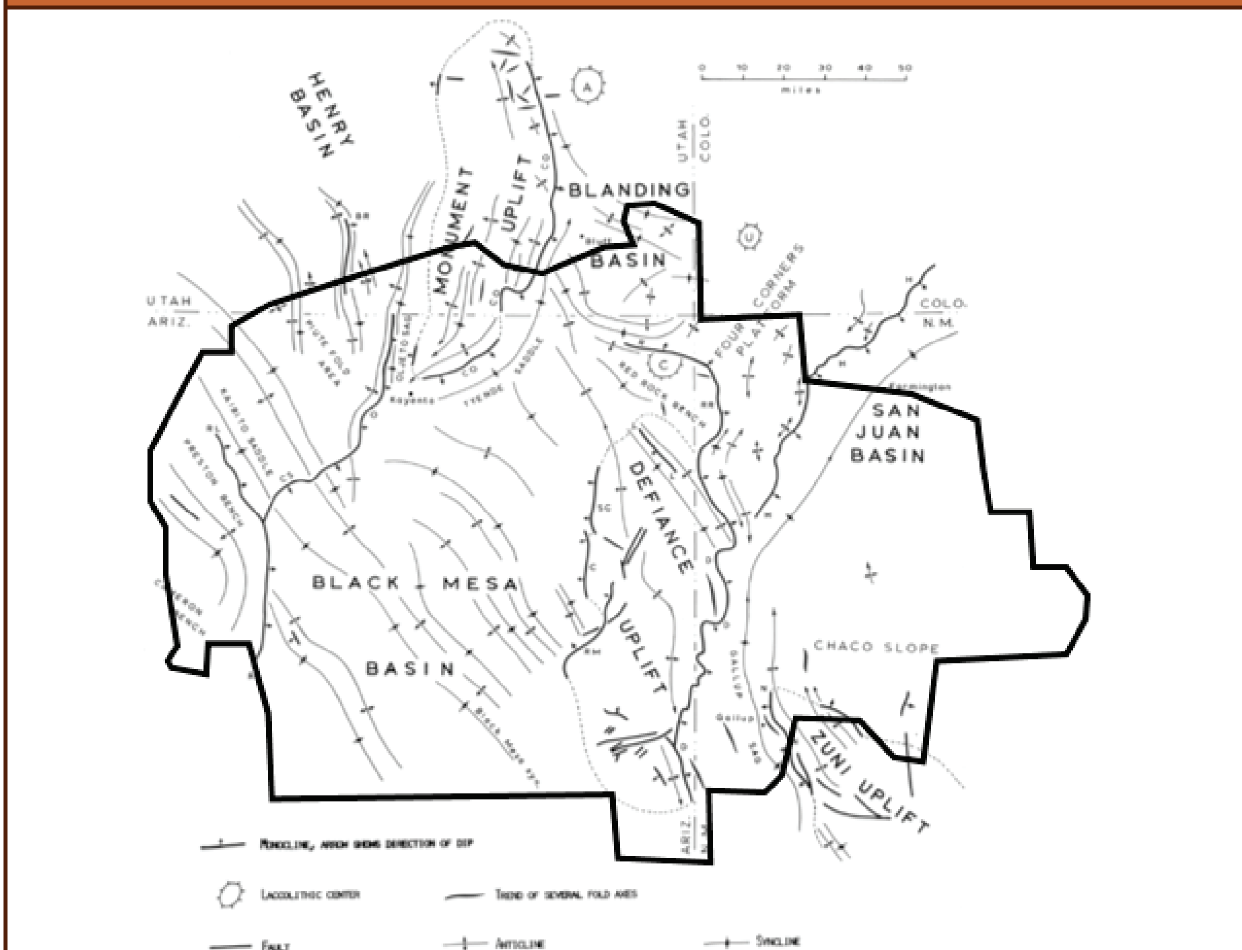
## 5.5.2 Physical Setting

The Navajo ancestral lands are characterized as being within and near the four sacred Mountains of Blanca Peak in Colorado (eastern mountain), Mt. Taylor in New Mexico (southern mountain), San Francisco Peaks in Arizona (western mountain) and Hesperus Peak in Colorado (northern mountain) as illustrated in the Navajo Nation flag and Figure 5.5-A.

Almost all the Navajo Nation is located within the high desert of the Colorado Plateau physiographic province. The complex topography of Navajo Nation is characterized by arid deserts at elevations as low as 5,500 feet and elevations as high as 10,500 feet. The three most prominent landforms are the Chuska Mountains with elevations greater than 9,000 feet along the Arizona-New Mexico border, the Defiance Uplift with elevations greater than 7,000 feet to the southwest of the Chuska Mountains, and Black Mesa in the west-central portion of the Navajo Nation. Black Mesa covers about 2,000 square miles and is characterized by 2,000-foot-high cliffs on its northern and northeastern sides, but slopes gradually down to the south and southwest.

The three most extensive basins on and adjacent to Navajo Nation lands are the San Juan Basin to the east of the Defiance Uplift and Chuska Mountains, the Black Mesa Basin to the west of the Defiance Uplift, and the Blanding Basin to the north, mainly in southeastern Utah (Figure 5.5-C).

**FIGURE 5.5-C**
Major structural features on and around the Navajo Nation (Woodward, 1973)



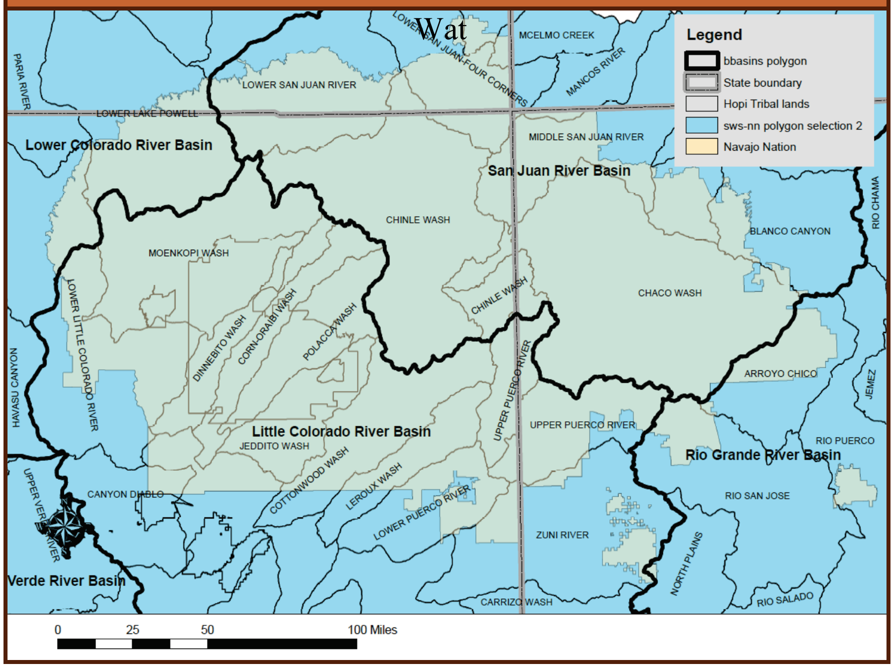



*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.5.2.1 Watersheds*

The majority of the Navajo Nation is located within the Upper and Lower Colorado River Basins. A portion of the western boundary borders the Colorado River mainstem and most of the northern boundary borders or encompasses the San Juan River (Figure 5.5-A). The Navajo Nation also has lands within the Rio Grande Basin. Navajo Nation lands within the San Juan Basin of New Mexico, Utah and Arizona are tributary to the Upper Colorado River Basin and lands within the Little Colorado River Basin of New Mexico and Arizona are tributary to the Lower Colorado River Basin. The remaining Navajo Nation lands to the southeast in New Mexico are within watersheds tributary to the Rio Grande. There are multiple watersheds within the basins (Figure 5.5-D).

**FIGURE 5.5-D**
Watersheds on and near the Navajo Nation lands




#### *5.5.2.2 Hydrogeology*

The Navajo Nation currently accesses approximately 20 groundwater aquifers ranging in various depth and capacities. Some of these aquifers are hydrologically connected and can be grouped into systems. Access to groundwater can be valuable during times of drought since most deep and larger aquifers are not affected by drought to the same extent as surface water and alluvial supplies.

A majority of the Navajo Nation's current water demands are met by groundwater. These aquifers can be characterized as either confined or unconfined. The two major groundwater basins on the Navajo Nation are the San Juan Basin in New Mexico and the Black Mesa Basin in Arizona (Figure 5.5-C). There are additional smaller basins such as the Blanding Basin, which is primarily in Utah, that provide additional smaller quantities of water.

The more extensive and more utilized aquifers for domestic and municipal purposes are described below. These aquifers include, from shallow to deep, several alluvial aquifer systems: the Mesaverde Group aquifer, the Dakota (D) aquifer that includes the Morrison (M) aquifer, the Navajo (N) aquifer, and the Coconino (C) aquifer.

<u>*Alluvial Aquifers*</u>

Quaternary alluvium is found in arroyos, washes, and stream channels and is a source of limited water for domestic, stock and municipal uses.

**FIGURE 5.5-E**
Mesaverde aquifer system on the Colorado Plateau (USGS, 1996) with Navajo Nation exterior boundary for reference

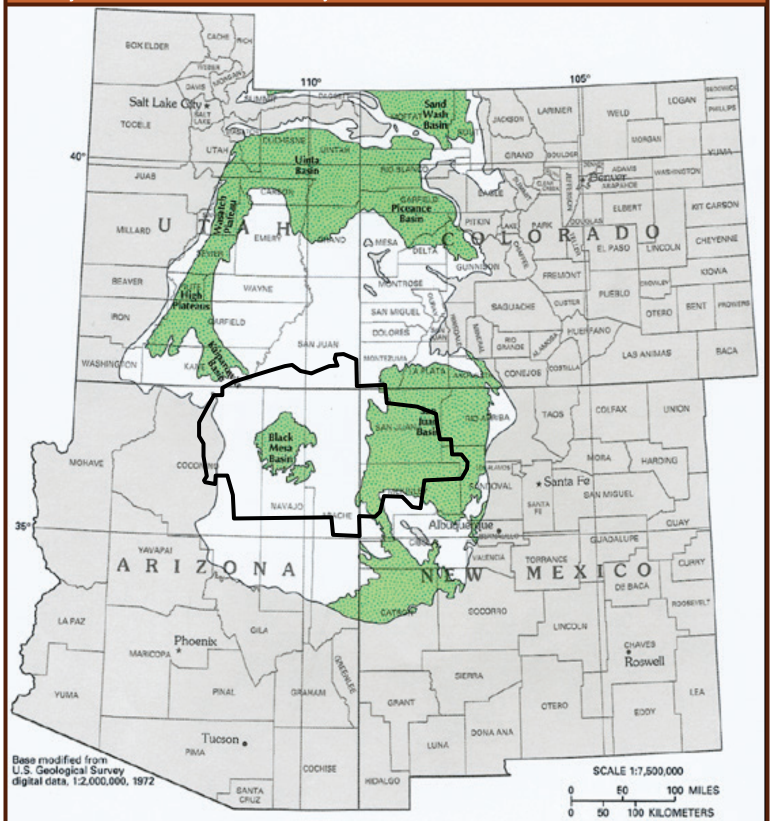



*Figure 116.* The Mesaverde aquifer is present in several parts of the area underlain by the Colorado Plateaus aquifers. The aquifer is most extensive in basins but also underlies plateaus in central Utah.

## *Mesaverde Group Aquifer*

The Mesaverde Group formations provide water mostly for small domestic or stock uses mostly in the San Juan Basin of New Mexico and Black Mesa region of Arizona. Around the Black Mesa region in Arizona the Mesaverde Group includes the Yale Point, Wepo and Toreva sandstones and yields from these formations are low. Figure 5.5-E depicts the Mesaverde aquifer areas.

## *Dakota (D) Aquifer*

The D aquifer is a multiple aquifer system composed of the Dakota Sandstone, Westwater Canyon Member of the Morrison Formation, and the Cow Springs Member of the Entrada Sandstone (Lopes and Hoffman, 1997). The D aquifer has been described by Cooley and others (1969) as consisting of several thin isolated semi-connected sandstone water-bearing units that are separated by thick sequences of mudstone and siltstone. The rocks of the D aquifer are about 700 feet thick in the southeastern part of the Black Mesa and thicken to about 1,300 feet thick near the center of the Mesa before thinning to less than 100 feet to the northwest (Lopes & Hoffman, 1997). The D aquifer overlies the N aquifer throughout much of the Black Mesa area.

In the southern areas of the Navajo Nation in New Mexico, the Dakota Sandstone is generally less than 100 feet thick and consists of cross-bedded sandstone, carbonaceous siltstones, shales, and coal (New Mexico Interstate Stream Commission [NMISC], 2017). The Dakota Sandstone produces generally fair water quality with well yields of approximately 50 gallons per minute (gpm) (Dam, 1995). The Westwater Canyon Member of the Morrison Formation in New Mexico consists of fluvial sandstones and can yield up to 50 gpm. Water quality is variable due to uranium mineralization in some areas northeast of Gallup, NM. These formations are deeper and more saline in the deeper portions of the San Juan Basin.

Figure 5.5-F includes the D aquifer (Dakota) and N aquifer (Glen Canyon) systems.

*Navajo (N) Aquifer*

The N aquifer exists solely within the Navajo and Hopi Reservations and is one of the most extensively studied aquifers in the region. The N aquifer is comprised of both an unconfined and a confined region. The N aquifer is confined where it is overlain by the Carmel Formation. A majority of the confined region underlies Black Mesa. The N aquifer extends into Utah east of Comb Ridge and thins to the east and is not present in New Mexico (Figure 5.5-G).

**FIGURE 5.5-F**
Dakota-Glen Canyon aquifer system on the Colorado Plateau (USGS, 1996) with Navajo Nation exterior boundary for reference

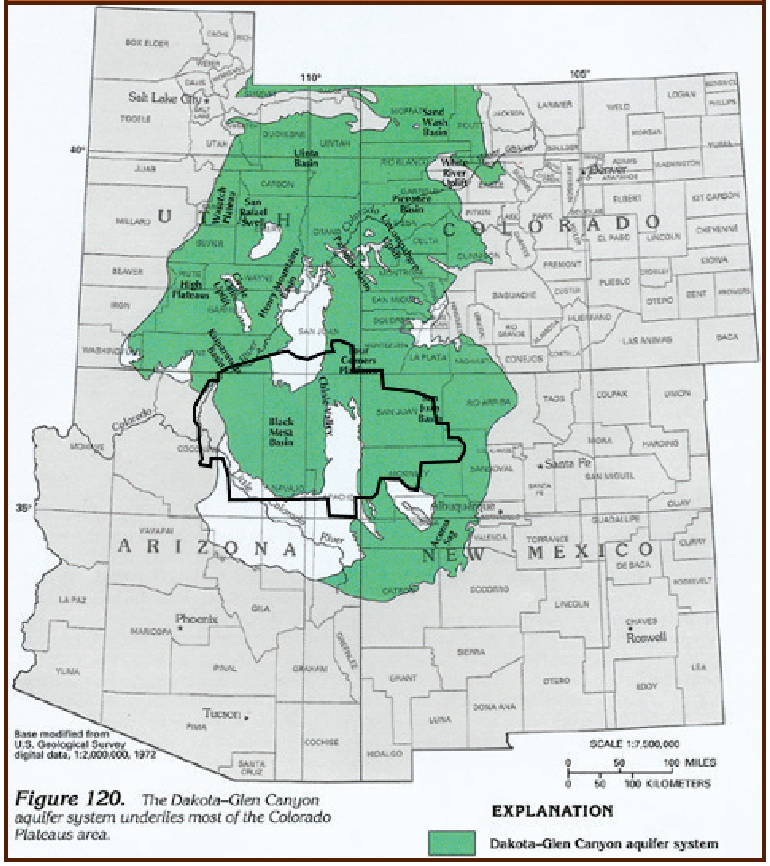
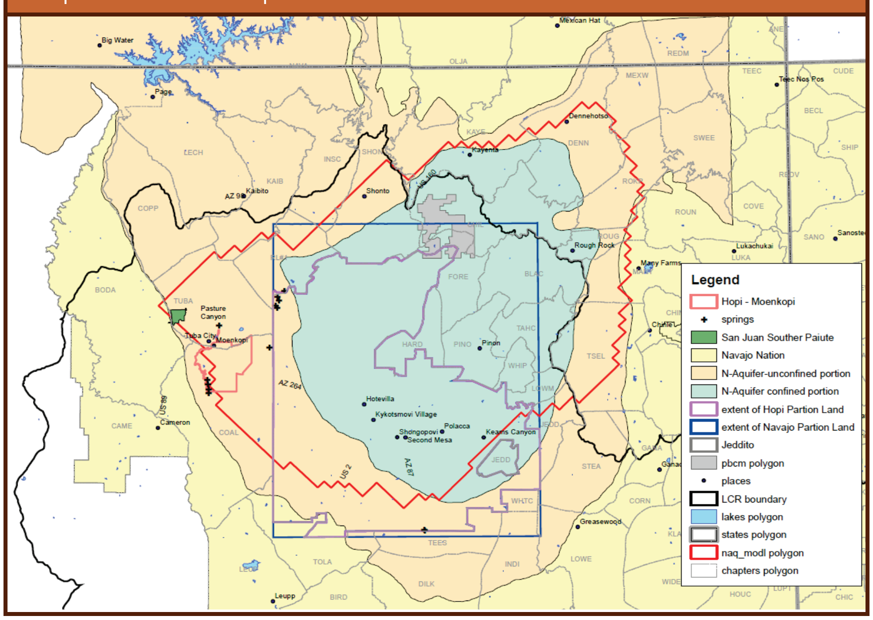


*Figure 120.* The Dakota–Glen Canyon aquifer system underlies most of the Colorado Plateaus area.

The N aquifer consists of three formations that function as a single aquifer: the Navajo Sandstone, the Kayenta Formation, and the Lukachukai Member of the Wingate Sandstone (U.S. Geological Survey [USGS], 2005). It is characterized by deep saturated thickness, relatively high water quality, but limited recharge due to its confined nature (HDR Engineering Inc., 2003).

**FIGURE 5.5-G**
N Aquifer Information Map




A desire to monitor the N aquifer water supply as a shared resource for primary drinking water for the Navajo and Hopi Tribes in the area of Black Mesa led to the establishment of a monitoring program of the water resources in 1971 by the USGS, the Arizona Department of Water Resources (ADWR), and the two tribes. In 1983 the BIA joined the cooperative monitoring effort. Since 1983, the Navajo Tribal Utility Authority (NTUA), Peabody Western Coal

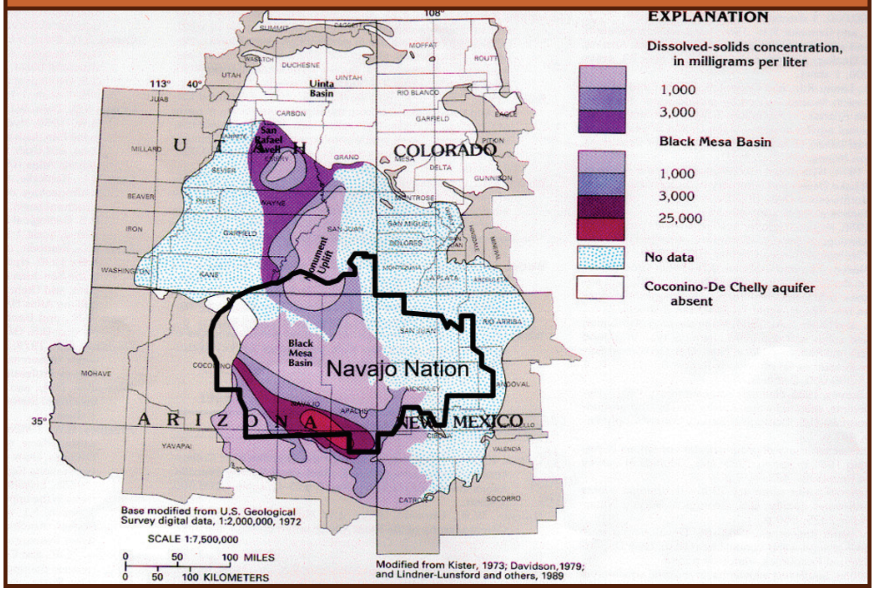
Company, the Hopi Tribe, BIA Navajo Region, and the Hopi Agency of the BIA have assisted in the collection of hydrologic data. The USGS publishes an annual monitoring report and established a website[1] to provide information on the Black Mesa Monitoring Program.

Pursuant to the Surface Mining, Control and Reclamation Act of 1977, a Cumulative Hydrologic Impact Assessment (CHIA) was performed in 1989 and updated in 2016 by the Office of Surface Mining Reclamation and Enforcement. Hydrologic concerns identified as part of the CHIA are related to the industrial pumping of the N aquifer.

Several groundwater models were developed to characterize the N aquifer. The models attempted to incorporate available information concerning aquifer hydraulic parameters, depths of geologic formations, recharge areas, and discharge areas to make the model project realistic groundwater responses to historic and future groundwater withdrawals.

### *Coconino (C) Aquifer*

**FIGURE 5.5-H**
Extent and Total Dissolved Solids Concentration of C Aquifer




The C aquifer is a much larger aquifer than the N aquifer and extends into Utah and New Mexico with variable water quality (Figure 5.5-H). The main stratigraphic unit of the C aquifer is the Coconino Sandstone or its equivalent, the De Chelly Sandstone. The C aquifer generally dips toward the center of the Black Mesa Basin from its outcrops. In the center of the Black Mesa Basin, the aquifer is buried beneath more than 4,900 feet of overlying sediments. The C aquifer can yield up to 500 gpm in the southwest portion of the Navajo Nation and up to 100 gpm from the De Chelly Sandstone in the Ganado/Chinle region.

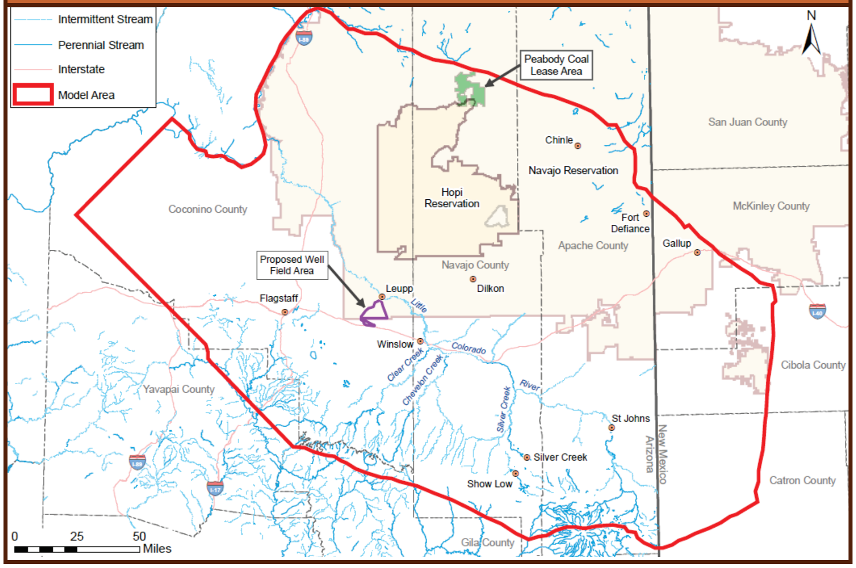
On the eastern edge of Arizona, the De Chelly Sandstone is uplifted by the north-northwest trending Defiance Anticline. Monoclines on either side of this ridge dip to the west and east under younger rocks in the Black Mesa (Arizona) and San Juan (New Mexico) Basins, respectively.

In the southern region of the Navajo Nation in New Mexico, the San Andres Limestone and Glorieta Sandstone are the equivalent to the C aquifer formations. The combined San Andres and Glorieta aquifer system produces good amounts of water in some areas on and near the Zuni Reservation and communities adjacent to Interstate 40 east of Gallup, NM. Wells have variable yields, potentially producing 50 to 200 gpm, and water quality is generally good.

[1] Available at: https://www.usgs.gov/centers/az-water/science/black-mesa-monitoring-program

In 2005, the Navajo Nation actively participated in a study to assess a proposed well field from the C aquifer south of Leupp, Arizona and to evaluate potential impacts to existing wells in the vicinity of the proposed project well field. A groundwater model was developed by S.S. Papadopulos & Associates, Inc. to evaluate the impact of the proposed pumping (Figure 5.5-I). The model structure was based upon the geologic, hydrologic, and topographic constraints in the basin. The model used historical pumping and water use data, estimates of aquifer properties, and historical water level and stream flow data.

**FIGURE 5.5-I**
C Aquifer Groundwater Model Boundary (SSP&A, 2005)




### *5.5.2.3 Climate*

The climate of the Navajo Nation is arid to semi-arid, as most areas receive less than 10 inches of precipitation annually. The Navajo Nation is subject to extreme seasonal temperatures, with rather cold winters and hot summers. The annual average temperature across the Navajo Nation ranges from about 40 °F to about 55 °F, with differences driven by elevation and latitude.

## 5.5.3 Historical Use and Cultural Importance of Water

The Navajo Nation's historical use of water is extensive. The largest uses of water are for irrigation, industrial, municipal and domestic purposes. Lesser amounts are used for livestock and other purposes.

## 5.5.4 Navajo Nation Water Supply

Navajo Nation lands are within the Upper Colorado River Basin, Lower Colorado River Basin, and the Rio Grande Basin. The Navajo Nation has extensive water rights which are largely unquantified except in the San Juan River Basin of New Mexico. The Navajo Nation claims historic, appropriative and reserved rights to the use of all the water necessary for the Navajo Nation to be the permanent homeland for the Navajo people. Both the United States and Arizona Supreme Courts have recognized that water is necessary for tribes to secure permanent homelands. See *Winters v. United States*, 207 U.S. 564, 567 (1908) and *In re the General Adjudication of All Rights to Use Water in the Gila River System and Source*, 35 P. 3d 68, 76 (2001). These rights are not lost through non-use and cannot be abandoned.

#### *5.5.4.1 Diversion and Depletion Rights*

*San Juan River Basin, Utah*

The Navajo Nation has negotiated a proposed water rights settlement agreement for the San Juan River Basin of Utah and is in the process of obtaining congressional ratification.

*Lower Colorado River Basin, Arizona*

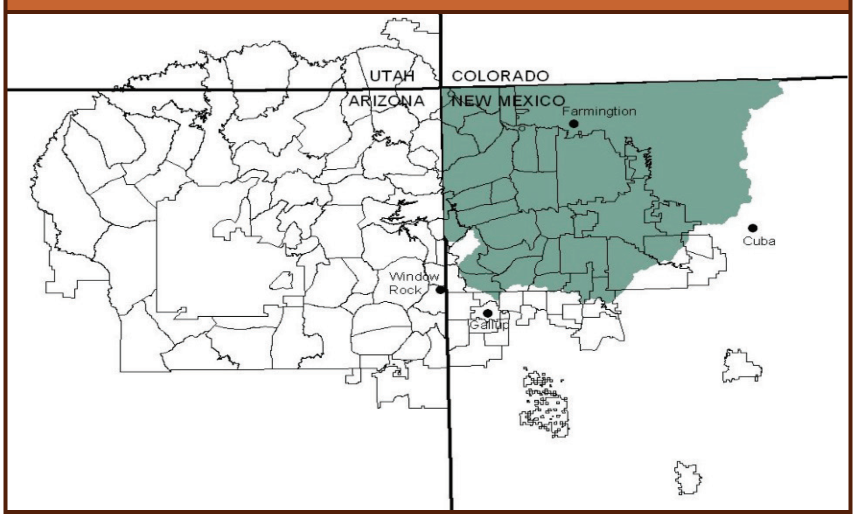
The Navajo Nation negotiated proposed settlement agreements to the Little Colorado River Basin of Arizona in 2010 and 2012 but those agreements were never realized. The 2010 agreement also included a proposed Lower Basin mainstem Colorado River allocation that was not realized. Currently, the adjudication of water rights for the Little Colorado River Basin in Arizona is proceeding, and the court has set a schedule to quantify the Hopi Tribe and Navajo Nation claims in the next several years.

*Upper Colorado River Basin, Arizona*

There is no active water rights adjudication for waters in the Upper Colorado River Basin of Arizona. The Navajo Nation continues to make use of waters within this basin.

*San Juan River Basin, New Mexico*

**FIGURE 5.5-J**
San Juan River Basin in New Mexico




On March 30, 2009, Congress enacted Public Law 111-11, the Northwestern New Mexico Rural Water Projects Act (Act), which authorized the United States of America, acting through the Secretary of the Interior, to execute an agreement among the Navajo Nation, the State of New Mexico, and the United States, settling the Navajo Nation's reserved water rights to the San Juan River Basin in New Mexico (Figure 5.5-J). The settlement agreement was executed by the parties on December 17, 2010 and approved by the adjudication court in 2013. There are several deadlines that must be met in order for the settlement to be considered final. While all deadlines are specifically identified in the Act, as a general matter, all deadlines must be met by December 31, 2024 for the settlement to be considered effective.

Through the settlement, the Navajo Nation is entitled to divert more than 633,000 acre-feet per year (AFY) and deplete more than 327,000 AFY of water (Table 5.5-B). The settlement provides for reductions of certain Navajo Nation diversions if needed to accommodate New Mexico's obligations under the Colorado River Compact. Part of the Navajo Nation's Upper Basin San Juan River rights in the State of New Mexico will be met with water from Nighthorse Reservoir in Colorado, a facility of the Animas-La Plata (A-LP) Project. The amount involved is a diversion of 4,680 AFY and a depletion of 2,340 AFY.

**TABLE 5.5-B**
Navajo Nation Water Rights for San Juan Basin in New Mexico

| Summary of the Water Rights of the Navajo Nation San Juan River in New Mexico Settlement | | |
|---|---|---|
| **Component** | **Diversion (AFY)** | **Depletion (AFY)** |
| Navajo Indian Irrigation Project (110,630 acres) | 508,000[1] | 270,000 |
| Hogback Irrigation Project (8,830 acres) | 48,550 | 21,280 |
| Fruitland Irrigation Project (3,335 acres) | 18,180 | 7,970 |
| Animas-La Plata Project | 4,680 | 2,340 |
| Navajo-Gallup Water Supply Project | 22,650 | 20,780 |
| Misc. Municipal Uses | 2,600 | 1,300 |
| Tributary Groundwater | 2,000 | 2,000 |
| Tributary Surface Water (Small Historic & Existing Uses) | 26,871 | 11,309 |
| **Total** | **633,531** | **336,979[2]** |

[1] Navajo Indian Irrigation Project (NIIP) average diversion limited to 353,000 AFY.
[2] Net San Juan River depletion 327,489 AFY.

The reserved water rights of the Nation are more fully described in the Partial Final Judgment and Decree of the Water Rights of the Navajo Nation and Supplemental Partial Final Judgment and Decree of the Water Rights of the Navajo Nation, entered in *New Mexico v. United States*, CV-75-184 (11th Judicial District Court, San Juan County, NM).

*Rio San Jose Basin, New Mexico*

The Navajo Nation has some lands within the Rio San Jose Basin of New Mexico. The Rio San Jose adjudication case is State of New Mexico ex rel. State Engineer v. Kerr-McGee Corporation, et al., Case No, CG-83-190-CV and CB-83-220-CV (Consolidated) (13th Judicial District Court, Cibola County, NM). The current proceeding is Subproceeding 1: The Adjudication of the Pueblos of Acoma and Laguna's Past and Present Water Uses (NMISC, 2017).

#### 5.5.4.2 Federal Project Water Allocations

The Navajo Nation has three federal water projects: A-LP Water Project, NIIP, and the Navajo-Gallup Water Supply Project.

*Animas-La Plata Project*

The A-LP Project was authorized through Public Law 106-554 – Colorado Ute Settlement Act Amendments of 2000 (Act). The Act was signed on October 25, 2000, and amended in 2000, 2006, and 2008. The Act authorized the construction of Lake Nighthorse near Durango, CO and a water line to augment the existing water distribution system on the Navajo Nation between Farmington and Shiprock, NM with up to 4,680 AFY. The Navajo Nation's water allocation for A-LP is included in the water rights settlement for the San Juan Basin in New Mexico.

The Farmington to Shiprock Pipeline is 90 percent complete. Completion of the pipeline has been delayed due to a failure of a slope which broke the pipeline in Upper Fruitland Chapter; however, completion is expected in 2018 or 2019. The administration of recreation at Lake Nighthorse is currently in discussions.

*Navajo Indian Irrigation Project*

NIIP was authorized in June 1962 through Public Law 87-483. The project is located in the northeast part of the Reservation in northwest New Mexico and, when completed, is to serve 110,630 acres. The water allocation for NIIP is included in the water rights settlement for the San Juan Basin in New Mexico.

Project construction began in 1964 and construction funding is transferred from the BIA to Reclamation. The BIA is responsible for project oversight and environmental compliance. The BIA is responsible for the irrigation delivery system and the Navajo Nation is responsible for on-farm activities and operation and maintenance (O&M) on NIIP.

NIIP has not realized its full economic potential, and it is only 70 percent complete. The Navajo Nation has made several specific suggestions to realize NIIP's potential, including: 1) increase the annual construction funds to complete both the distribution systems and on-farm components in a shorter period of time, 2) vertically integrate to increase economic returns and employment, and 3) adequately fund the O&M. The Navajo Nation, BIA, and Reclamation have assembled a project team to address the long-range plans for NIIP.

*Navajo-Gallup Water Supply Project*

The Navajo-Gallup Water Supply Project (NGWSP or Project) was authorized for construction in 2009 as part of the Omnibus Public Land Management Act of 2009, Title X Part III (Public Law 111-11). Project beneficiaries include the Navajo Nation, Jicarilla Apache Nation, and City of Gallup. The purpose is to construct water transmission pipelines capable of conveying treated San Juan River water to Navajo Nation communities in northwestern New Mexico and northeastern Arizona; the southwestern portion of the Jicarilla Apache Nation; and the City of Gallup for domestic, commercial, municipal and light industrial purposes (Figure 5.5-A).

The Project is comprised of a Cutter Lateral and a San Juan Lateral. The Cutter Lateral will divert water from Cutter Reservoir, which is supplied from Navajo Reservoir, and will serve eastern Navajo communities and the Jicarilla Apache Nation. The San Juan Lateral will divert water from the San Juan River and extend south, roughly following US Highway 491 through Gallup with laterals to Crownpoint, NM and Window Rock, AZ (Table 5.5-C). Each lateral will have a water treatment plant, numerous pumping plants, and storage tanks. The Project is being designed to serve a 2040 population of approximately 250,000. The Project has been divided into 27 Reaches for construction. In order to meet the legislated deadline for completion, simultaneous construction is occurring at sections (Reaches) throughout the Project area by various project participants including Reclamation, Navajo Nation, City of Gallup, and Navajo Area Indian Health Service (IHS). Reclamation is the lead construction agency and has developed Financial Assistance Agreements with project participants to assist in construction.

The water allocation for NGWSP is included in the water rights settlement for the San Juan Basin in New Mexico.

The Project will tie into existing and future public water systems. The 6,411 AFY designated for Navajo communities in Arizona would come from a block of Arizona's Colorado River allocation. The water is available for uses in New Mexico, but the water for Arizona communities (6,411 AFY) is contingent upon a Navajo Nation agreement with Arizona for water rights in Arizona as mandated by Public Law 111-11.

**TABLE 5.5-C**
Navajo-Gallup Water Supply Project Allocations

| Project Lateral | Capacity (AFY) |
|---|---|
| ***Cutter Lateral*** | |
| - Navajo Nation | 3,445 |
| - Jicarilla Apache Nation | 1,200 |
| ***San Juan Lateral*** | |
| - Navajo Nation | |
| - New Mexico | 19,208 |
| - Arizona | 6,411 |
| - City of Gallup | 7,500 |
| **Total** | 37,764 |

### *5.5.4.3 Surface Water Supplies*

The Navajo Nation has access to on-Reservation surface water. The amount of surface water available for use depends on location, drainage area, precipitation and quality. Surface water sources for the main Reservation include the mainstem of the Colorado River, the Little Colorado River, the San Juan River, and ephemeral streams and washes. The major surface water supplies are described below.

*Colorado River*

The Navajo Nation water rights claims in the mainstem of the Colorado River remain unquantified. For the Navajo Nation, access to mainstem water is limited by legal, physiographic, and environmental factors.

*Little Colorado River*

ADWR (1994) estimates the median annual flow of the Little Colorado River at the Reservation border is 162,900 AFY. The erratic flow regime and high sediment load of the Little Colorado River create challenges to water development.

San Juan River

According to reports from the San Juan River Recovery Implementation Program (Holden, 1999) the median annual flows of the San Juan River at Bluff, Utah is 1,620,000 AFY. A limiting factor for water development in this Basin is the protection of the endangered Colorado pike minnow and the razorback sucker.

*Tributary Washes*

There is a lack of flow data for the tributary washes and streams to precisely quantify flows. However, the washes are generally ephemeral with erratic flow regimes and they may not be reliable water supplies for municipal purposes. Water is frequently stored in large shallow reservoirs, which are subject to high infiltration and evaporation losses. Consequently, the firm yield from these washes is far less than the average annual flow. At higher elevations, the perennial streams provide the recharge to the aquifers.



*See the Disclaimer and Introduction to Chapter 5.0.*

*Other River Systems*

The Navajo Nation has important land holdings in the Rio Grande, Rio Puerco, Rio San Jose, Zuni River, Bill Williams, and Verde River watersheds.

#### 5.5.4.4 Groundwater Supplies

Groundwater is the most heavily utilized and dependable municipal water source for the Navajo Nation. It is found in the major water-bearing formations described below, as well as other minor aquifers. Although groundwater storage greatly exceeds the annual demand, only a small fraction of the groundwater in storage can be readily developed. It is also important that domestic groundwater withdrawals in the future remain within sustainable limits to ensure an adequate supply of water for future generations of Navajo people.

*Coconino (C) Aquifer*

The C aquifer underlies most of the Reservation in the Little Colorado River Basin. It is recharged from outcrops on the Defiance Plateau, the Mogollon Rim, and the San Francisco Mountains. The communities of Cameron, Leupp, Ganado and Chinle, among others, depend on the C aquifer for much of their municipal water supply. It is also a major source of industrial water for neighboring communities in the Little Colorado River Basin.

*Navajo (N) Aquifer*

The N aquifer has less storage than the C aquifer, but overall it has better water quality. The communities of Kaibeto, Kayenta, Pinon, Tuba City, and the Peabody Coal Mine, among others, depend on the N aquifer.

*Dakota (D) Aquifer*

The D aquifer is on the eastern portion of the Reservation and is considered to have poor water quality. However, the communities of Tsayatoh, Sanostee, Smith Lake, and Casamera Lake, among others, rely on it as their primary source of water.

The San Juan Structural Unit includes several formations that are primarily located within the State of New Mexico. The major water-bearing formations that provide water to Navajo public water systems are the Morrison and Mesa Verde. The communities of Crownpoint, Tohatchi, and Sanostee depend on the Morrison Aquifer. Several communities in the Eastern Agency including Coyote Canyon and Two Grey Hills rely on the Mesa Verde Aquifer. The Glorietta Aquifer and the Gallup Sandstone provide water to many of the neighboring communities in New Mexico including the City of Gallup.

*Alluvial Aquifers*

Alluvial aquifers underlie many of the washes on the Navajo Nation, but their total available volume has not been evaluated. The communities of Fort Defiance and Saint Michaels receive 70 percent of their water supply from the Black Creek alluvial aquifer, which recharges rapidly. Dilkon, Cameron, and Lower Greasewood also rely on alluvial systems. Typically, these aquifers have very limited storage capacity and development potential, and are more prone to droughts. Furthermore, water quality problems such as high dissolved solids limit use.



*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.5.4.5 Water Supply Planning Efforts and Potential Future Projects*

On July 17, 2000, the Navajo Nation and Reclamation signed a memorandum of understanding to support the Navajo Nation's efforts to develop its water resources. This strategy is articulated in *Water Resource Development Strategy for the Navajo Nation, NDWR 2001* (Strategy Document). The Strategy Document describes the tremendous overall need for water development on the Navajo Nation, and lays out a strategy for meeting the need. The Development Strategy includes:

- Developing large regional water supply projects.
- Developing and rehabilitating local domestic and agricultural water projects.
- Assistance for water haulers.
- Preparing Reservation-wide chapter water plans based on municipal sub-areas to assess needs and prioritizing projects.
- Completing NIIP.
- Continuing to address deficiencies in water storage facilities.
- Improving drought response and mitigation.
- Improving flood plain management.
- Continuing with watershed restoration projects.
- Establishing technical advisory committees for major water projects or initiatives; these committees will coordinate technical and fiscal resources of the Navajo Nation and Federal agencies.

*Regional Water Supply Projects*

The cornerstone of the Strategy Document is several large, regional water supply projects that will provide safe, new, and reliable water supplies for municipal use and will stimulate sustainable economic development on the Reservation. These regional projects will maximize the number of water users that will have reasonable access to the mainline delivery systems. Most of these projects have made significant progress since July 2000. The proposed regional water supply projects will convey municipal water to many chapters on the Reservation. The proposed regional projects are estimated to cost billions of dollars to construct. They include, but are not limited to:

- Navajo Gallup Water Supply Project/Gallup Regional System
- North Central Arizona Water Supply Project/Western Navajo Pipeline
- Tuba City Regional Water Plan
- Southwest Navajo Rural Water Supply Appraisal Study
- Leupp-Dilkon Regional Water Supply Development Project
- Kayenta Regional Water Supply Development Project

*Local Water Supply Projects*

Even with the large regional projects, without additional local infrastructure, conveyance and treatment capacity will be inadequate to deliver potable water from the regional systems to many of the water users. If the regional projects and the associated local distribution systems are fully constructed, approximately 40 percent of the chapters will rely on local water sources and facilities. Many of these areas have systems that require rehabilitation, and many areas require new systems.  In 2016 the Indian Health Service identified almost 500 projects with a total cost of approximately $600 million on the Sanitation Deficiency System list.

A partial list compiled by the NDWR of strategically significant municipal projects includes:

- Page-LeChee Water Supply Project
- To'hajiilee Water Planning and Construction
- Manymules Water Supply Project
- Navajo Mountain Water Supply Project
- Coyote Canyon Regional Water Plan
- White Rock Planning Project

The rehabilitation and development of local irrigation and livestock water systems is also an important component of the Strategy Document.  Reclamation has supported the completion of numerous projects.

#### *Assistance for Water Haulers*

For areas where distribution systems are currently infeasible, community wells and watering points need to be upgraded or constructed to improve access for water haulers, perhaps utilizing a water-hauling truck service.  The IHS and State of New Mexico have been funding this work.  According to IHS statistics, since 2000 the percentage of homes hauling water has declined by almost 10 percent.  In 2010 the NDWR initiated a $2 million pilot water hauling program funded by EPA in Leupp chapter.

#### *Chapter and Regional Water Plans to Assess Needs and Prioritize Projects*

To effectively meet these deficiencies, the Navajo Nation is systematically identifying the full scope and need on the Reservation.  With assistance from state and federal agencies, the Navajo Nation is preparing Chapter and Regional Water Plans across the Reservation.  The plans develop alternatives based on a short-term, mid-term, and long-term basis.

#### *Address Deficiencies in Storage Facilities*

The U.S. Department of the Interior (DOI) Dam Safety Program's nationwide technical priority rating includes 15 high hazard dams on the Navajo Nation.  Dam safety work has been completed on Canyon Diablo, Round Rock, Ganado, Wheatfield, and Many Farms Dams.  Five others, Captain Tom, Tsaile, Charlie Day, Red Lake, and Asaayi, are ranked in the top ten by the DOI.  In 2006 the NDWR Safety of Dams Branch estimated that approximately $47 million of improvements are needed over the next ten years to address operational deficiencies in the remaining unsafe dams.  These improvements include conducting deficiency verification analyses, developing standard operating procedures, preparing emergency action plans, establishing early warning systems, and addressing structural problems.

#### *Drought Response and Mitigation*

Since the signing of the MOU in July 2000, the Navajo Nation has been subject to extremely dry years.  Reclamation and the BIA funded the Navajo Nation's 2003 Drought Contingency Plan which follows the National Drought Mitigation Center guidelines.  This plan was adopted by the Navajo Emergency Management Commission.  Reclamation funded drought mitigation projects at Navajo Mountain, Alamo, Toadlena, Window Rock, Bird Springs, and Bodaway-Gap and many other places. Reclamation funded new projects at Lupton and Lower Greasewood, and also played a key role in recent shortage sharing agreements for the San Juan River Basin in New Mexico. Additional studies and mitigation of climate change impacts are needed.

*Flood Plain Management*

Throughout most of the U.S., 100-year flood plans have already been delineated. With these delineations, entities can participate in Federal Emergency Management Agency flood insurance programs. Addressing flood hazards is required for essentially all federally funded construction programs. Typically, on the Navajo Nation, adequate delineations are not available. Consequently, the Navajo Nation worked with the U.S. Army Corps of Engineers (USACE) to produce, in a phased approach, floodplain delineations throughout the Navajo Nation.

*Watershed Restoration*

Almost all the watersheds on the Navajo Nation are degraded due to land use practices that occurred without sufficient attention to their impact on the watershed. Overgrazing has had a major impact on the watersheds, resulting in more intense runoff events. When these events occur on degraded watersheds, they produce additional sediment loads in the reservoirs. These events incise channels which de-waters the alluvial groundwater, destroying riparian areas and reducing the carrying capacity of the land. With a restored watershed, floods can be attenuated and recharge can be increased. Wetland values can also be enhanced. With proper grazing management the fodder production can be increased.

NDWR has participated in several watershed restoration projects and continues to partner with the EPA in implementing Section 319 projects, the BLM in watershed restoration activities in the Rio Puerco Watershed, and the USACE in watershed assessments.

### 5.5.5 Current Water Use and Operations

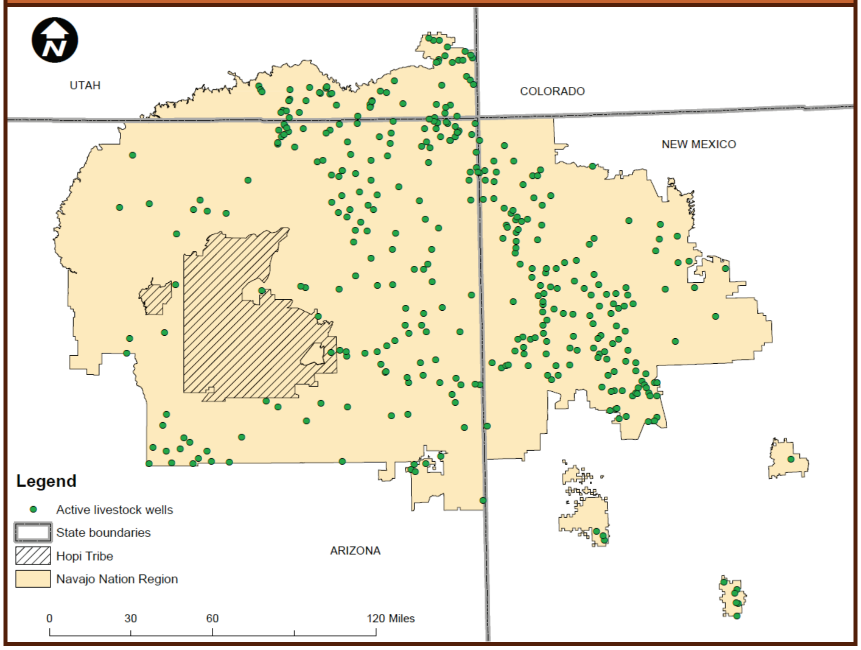
The majority of the Navajo Nation's current water use is for agricultural irrigation, although approximately 11 percent is used for domestic, commercial, municipal, and industrial purposes.

#### *5.5.5.1 Irrigated Agriculture and Livestock Water Use Category*

The Navajo Nation Department of Agriculture estimates that livestock on the Navajo Nation require approximately one to two million gallons per day or 1,000 to 2,000 AFY of water. The water for livestock comes primarily from surface water impoundments and livestock wells (Figure 5.5-K). NDWR maintains approximately 900 livestock wells throughout the Navajo Nation. In 1993 the NDWR estimated that the total water supply for livestock from the windmill-powered wells was 865 AFY. NDWR estimates there are approximately 7,500 stock ponds on the Navajo Reservation.

In 1986 the Soil Conservation Service (SCS) conducted an inventory of irrigation projects across the Navajo Nation. The SCS investigated 83 irrigation projects to determine existing conditions, consolidate resource data, and prioritize projects for possible rehabilitation (SCS, 1986) (Figure 5.5-L). According to BIA records, by 1950 these small projects irrigated 46,219 acres of land. In 1960, pursuant to Public Law 86-636, Navajo Tribe Transfer of Irrigation Project Works,

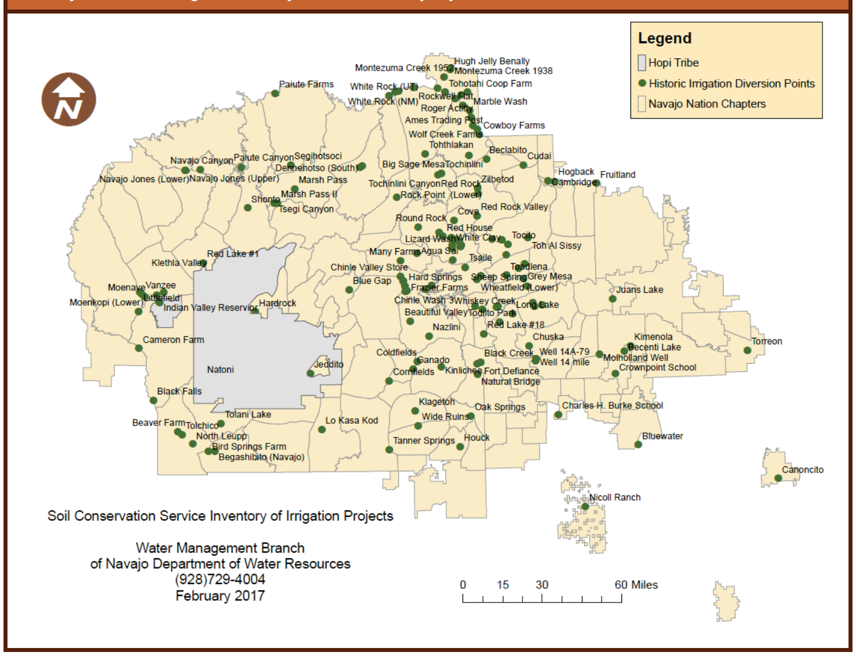
**FIGURE 5.5-K**
Active livestock wells during the 1990s and 2000s




Congress transferred O&M responsibilities for the Navajo irrigation systems from the BIA to the Navajo Nation (NDWR, 2003).

During the 1980s, these small irrigation projects were capable of irrigating approximately 55,000 acres of land (SCS, 1986). Since that time, due to inadequate management and inadequate funding for operation, maintenance and replacement, many of these systems have deteriorated and are in need of funding. The survey did not include a survey of the NIIP.

**FIGURE 5.5L**
Navajo Nation Irrigation Projects Inventory by USDA SCS in 1986




The Fruitland and Hogback Irrigation Projects are receiving funds through the Navajo Nation in the New Mexico San Juan Basin Water Rights Settlement which was authorized for funding through Public Law 111-11. These projects will continue to utilize water on an annual basis. The NDWR, San Juan River Farm Board and San Juan River Dineh Water Users Association coordinate the O&M activities through a tri-party agreement.

While a majority of historic irrigation projects are not actively monitored there are existing efforts to improve several of these irrigation systems. In 2016, the Navajo Nation allocated funds to improve the Many Farms, Tsaile-Wheatfields, and Hogback Irrigation Systems over a 5-year period. In addition, the proposed Navajo Utah Water Rights Settlement Agreement proposes to provide funds for an agriculture management and conservation program.

The Navajo Nation continues to advocate for the completion of the NIIP. Approximately 70,000 acres of the planned 110,000 acres is developed. Public Law 111-11 clarified additional uses of NIIP water that will assist Navajo Agricultural Products Industry (NAPI) in developing additional projects. In 2016, NIIP diverted approximately 237,000 AFY of water.

The Fruitland Irrigation Project, Hogback Irrigation Project, and NIIP have participated in a San Juan Basin shortage sharing agreement entitled *Recommendations for San Juan River Operations and Administration* to limit the diversion of water since 2003 in coordination with other major water users in the San Juan Basin. The agreement is renewed periodically, and the most recent expires in 2019. Table 5-5-D shows the six years of diversions for the participating entities.

**TABLE 5.5-D**
Annual Diversion Limits for Navajo Nation in the *Recommendations for San Juan River Operations and Administration*

| Project | Year (AFY) | | | | | | Rate (cfs) | Period |
|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | | |
| Navajo Indian Irrigation Project | 209,546 | 214,730 | 230,000 | 232,000 | 235,000 | 237,000 | -- | 3/15 – 11/15 |
| Fruitland Irrigation Project | -- | -- | -- | -- | -- | -- | 100 | 4/01 – 10/31 |
| Hogback Irrigation Project | -- | -- | -- | -- | -- | -- | 170 | 4/01 – 10/31 |

cfs – cubic feet per second

#### *5.5.5.2 Domestic, Commercial, Municipal, and Industrial Water Use Category*

*Domestic and Municipal*

The total municipal water consumption on the Reservation is approximately 12,000 AFY. According to NNEPA, in 2017 there were 182 public water supply systems on the Navajo Reservation. Between 1998 and 2006 the number of connections increased from 28,789 to 40,766 (NDWR, 2001). The vast majority of these systems rely on groundwater.

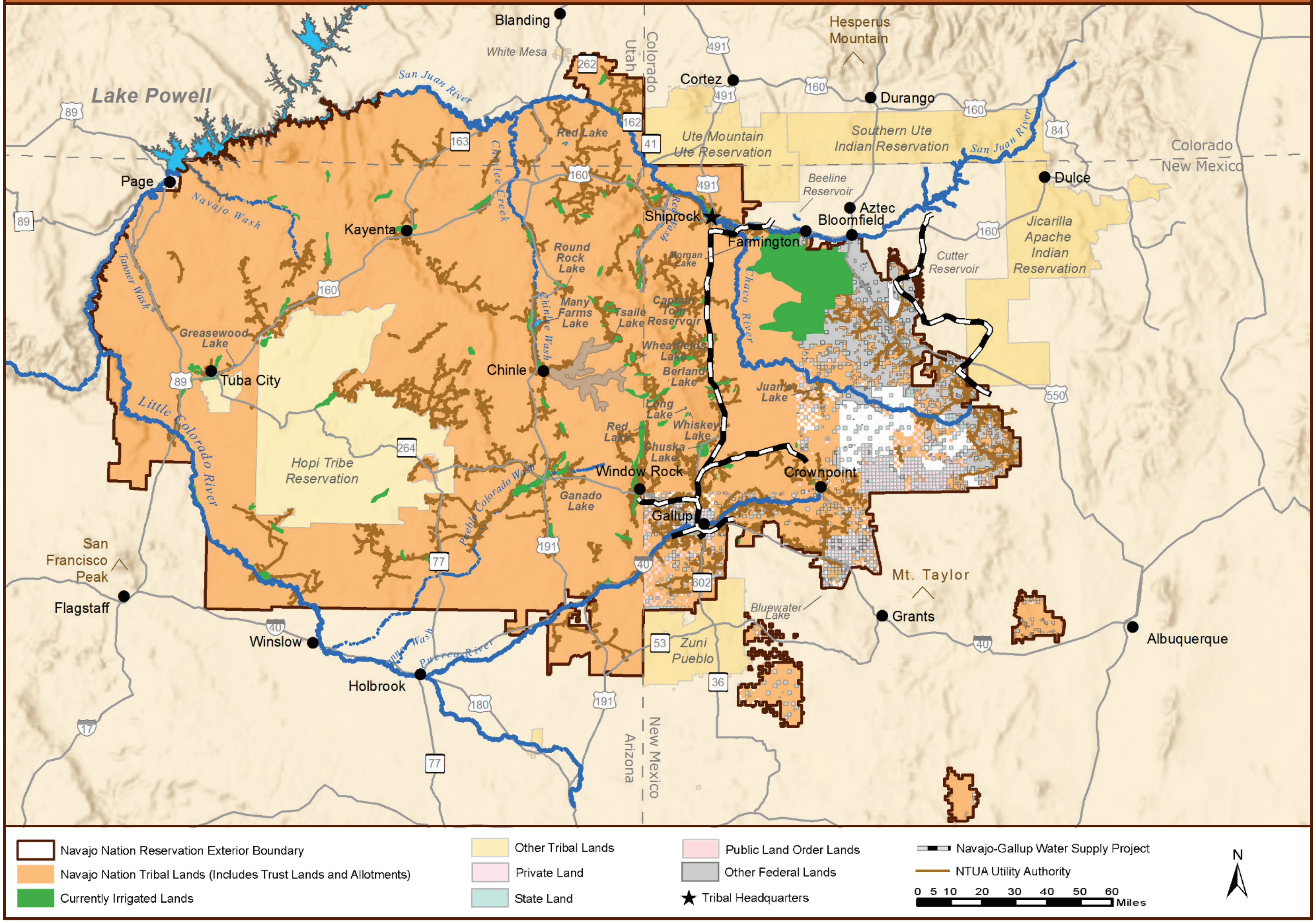
Navajo Tribal Utility Authority (NTUA) is the largest supplier of domestic and municipal water on the Navajo Nation and currently operates approximately 90 public water systems, delivering approximately 12,000 AFY of residential water serving approximately 65 percent of the on-Reservation population (Table 5.5-E and Figure 5.5-M). In 2010 NTUA reported 35,000 connections serving approximately 130,000 people, most of whom are on the Reservation.

**TABLE 5.5-E**
Public Water Systems

| Number of Water Systems by Owners | # of Systems |
|---|---|
| Navajo Tribal Utility Authority (NTUA) | 94 |
| Tribal, government (Navajo Nation Water Resources, Navajo Parks & Recreation, etc.) | 9 |
| Tribal, chapters | 4 |
| Tribal, utilities (Ramah Navajo Utility Authority) | 4 |
| Businesses (Black Mesa Shopping Center, Tségi Anasazi Inn, Burnham Junction Mustang) | 8 |
| Companies (Peabody Western Coal Company, El Paso Natural Gas, TWP) | 5 |
| Federal, government (National Park Service) | 2 |
| Institutions, health (Ganado Sage Memorial Hospital, MV Mission Hospital, etc.) | 2 |
| Missions & Churches (Navajo Gospel Mission, White Post Mission) | 2 |
| Schools, BIA | 33 |
| Schools, Grant | 7 |
| Schools, Private (St. Michaels Indian School and Immanuel Mission) | 2 |
| Schools, Public (Ganado Public School, Tohatchi Public Schools, Tsé Yí Gai H.S., etc.) | 9 |
| **Grand Total of PWS's** | **182** |

Source: NNEPA Public Water Supervision Program website (2017)

**FIGURE 5.5-M**
NTUA Water Systems






See the Disclaimer and Introduction to Chapter 5.0.

The Navajo Nation departments operate a few water systems that are largely subsidized by Tribal funds and community block grants. These systems are typically smaller than the NTUA systems, are typically not metered, and generally have worse economies of scale. Consequently, they generate inadequate revenue for proper administration and maintenance. The NDWR has made it a priority to upgrade these systems to NTUA standards and convey the O&M to NTUA.

In addition to these systems, the BIA operates approximately 40 water systems. Almost all were intended for BIA schools and school-related housing. The remaining smaller systems are operated by other chapters, schools, missions, trading posts, and private commercial operators.

The NDWR worked with NTUA to acquire historic water delivery to public water systems operated and maintained by NTUA and a complete data set was developed for the years 1996 through 2005. Efforts to obtain additional data post-2005 have been difficult and limited to specific project areas (Table 5.5-F).

Per capita water use on the Reservation for NTUA public water systems is approximately 80 gallons per capita per day. The average per capita use for 80 neighboring communities in the Western United States is 190 gallons per day (NDWR, 2001). It is estimated that the current annual municipal water production on the Navajo Reservation by NTUA is approximately 12,000 AFY.

Several public water systems utilize, either partially or fully, alluvial groundwater and are susceptible to drought (Table 5.5-G). Jeddito and Cameron previously used alluvial source wells but are now intertied long distances to other groundwater sources.

**TABLE 5.5-F**
NTUA Water Delivery to Public Water Systems (1996 – 2005)

| Year | AF |
|---|---|
| 1996 | 9,211 |
| 1997 | 7,617 |
| 1998 | 9,935 |
| 1999 | 9,570 |
| 2000 | 10,080 |
| 2001 | 12,934 |
| 2002 | 10,906 |
| 2003 | 11,822 |
| 2004 | 12,277 |
| 2005 | 11,851 |

Source: NTUA

**TABLE 5.5-G**
Water Systems with Alluvial Sources

| Public Water System and Operator | Source |
|---|---|
| Alamo, NM - CHAPTER | Alluvial |
| Church Rock, NM - NTUA | Alluvial and sandstone in Chinle Formation |
| Lake Valley, NM - NTUA | Alluvial |
| Dilkon, AZ - BIA | Alluvial |
| Dilkon, AZ - NTUA | Alluvial |
| Fort Defiance/Window Rock, AZ - NTUA | Alluvial and Gallup Sandstone |
| Chinle, AZ - NTUA | Alluvial and DeChelly Sandstone |
| Rough Rock, AZ - NTUA | Alluvial |
| Wheatfields, AZ - NTUA | Alluvial |
| Lower Greasewood/Whitecone/etc., AZ - NTUA | Alluvial |
| Rock Point, AZ - NTUA | Alluvial |
| Oljato, AZ/UT - NTUA | Alluvial |
| Two Grey Hills, NM - NTUA | Alluvial |
| Houck, AZ - NTUA | Alluvial |



*See the Disclaimer and Introduction to Chapter 5.0.*

*Commercial and Industrial Use*

Peabody Western Coal Company (PWCC) is the principal industrial water user permitted through the Navajo Nation. PWCC began operating a coal strip mine in the northern part of the study area in 1968. From 1968 through 2005, PWCC used N aquifer water to slurry coal along a 273-mile pipeline from Black Mesa to a power plant in Laughlin, Nevada. The quantity of water from the PWCC N aquifer well field increased from about 100 acre-feet (AF) in 1968 to about 4,480 AF in 2005. In 2006, PWCC reduced industrial pumping to about 1,200 AFY due to the closure of the power plant at Laughlin, Nevada which resulted in a shutdown of the slurry line.

Another major industrial water user on the Navajo Nation is the Navajo Generating Station (NGS). NGS has a contract with Bureau of Reclamation to divert water from Lake Powell and consume up to 34,100 AFY for the generation of thermal power. The Arizona Legislature authorized NGS to divert water from Lake Powell and to consume up to 34,100 AFY for the operation of a thermal generating plant. Ariz. Rev. Stat. § 45-166. The most recent permitted water right for NGS is 28,709 AFY (Certificate Nos. 4050.0001 and 4050.0003). In 2017, the owners of NGS and the Navajo Nation executed an agreement to retire NGS at the end of 2019.

**TABLE 5.5-H**
Navajo Nation Lakes and Reservoirs

| Name | Storage Capacity (AF) |
|---|---|
| Asaayi[1] | 682 |
| Antelope Lake | 75 |
| Aspen Lake | 68 |
| Beeline Reservoir | 1,000 |
| Berland Lake | 7 |
| Blue Canyon[1] | 1,905 |
| Captain Tom[1] | 1,170 |
| Charlie Day | 4 |
| Chuska Reservoir | 3,345 |
| Cutter Reservoir[1] | 1,793 |
| Ganado Lake[1] | 3,750 |
| Greasewood Lake | 1,980 |
| Juan’s Lake | 2,650 |
| Long Lake | 3,255 |
| Many Farms[1] | 14,500 |
| Morgan Lake | 16,750 |
| Red Lake[1] | 10,650 |
| Red Lake | 4,480 |
| Round Rock[1] | 1,070 |
| To’Hajiilee Lake[1] | 1,344 |
| Todacheene[1] | 80 |
| Trout Lake | 120 |
| Tsaile Lake[1] | 5,100 |
| Wheatfields[1] | 4,500 |
| Whiskey Lake[1] | 7,458 |
| Window Rock[1] | 210 |
| **Total** | **87,946** |

[1] NDWR Safety of Dams Plan of Operation.

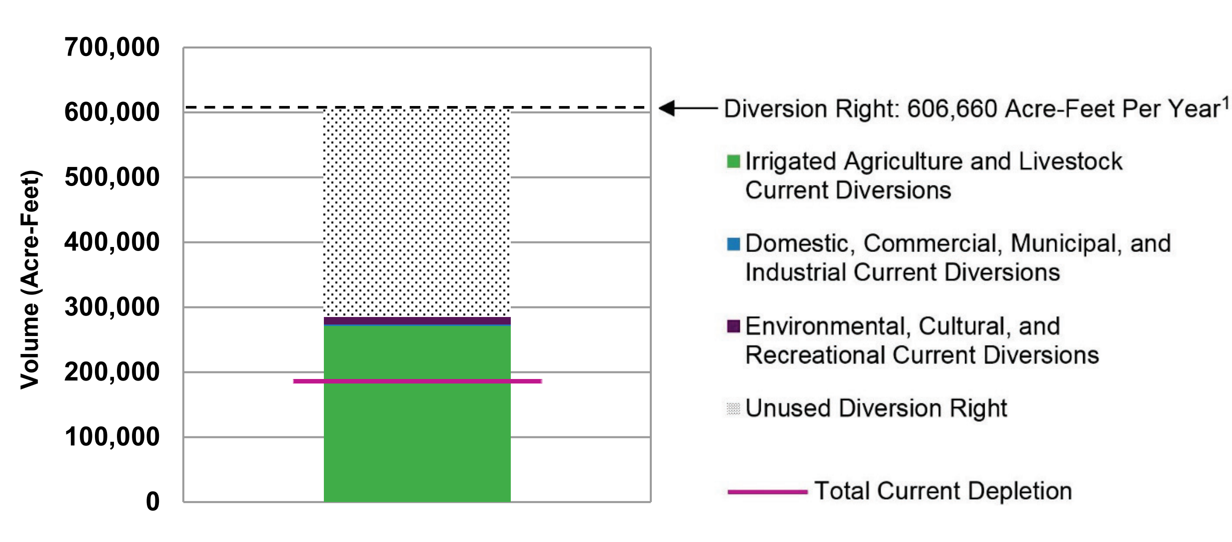
### *5.5.5.3 Environmental, Cultural, and Recreational Water Use Category*

The reservoirs on the Navajo Nation provide storage for irrigation water, livestock, wildlife and recreation. There are more than 20 significant storage facilities (Table 5.5-H). A reservoir was considered significant if it has a surface area greater than 200 acres, is included in the NDWR Safety of Dams Plan of Operation, or is stocked by the Navajo Department of Fish & Wildlife. The lakes and reservoirs have a combined storage capacity greater than 80,000 AF.

### *5.5.5.4 Summary of Current Water Use*

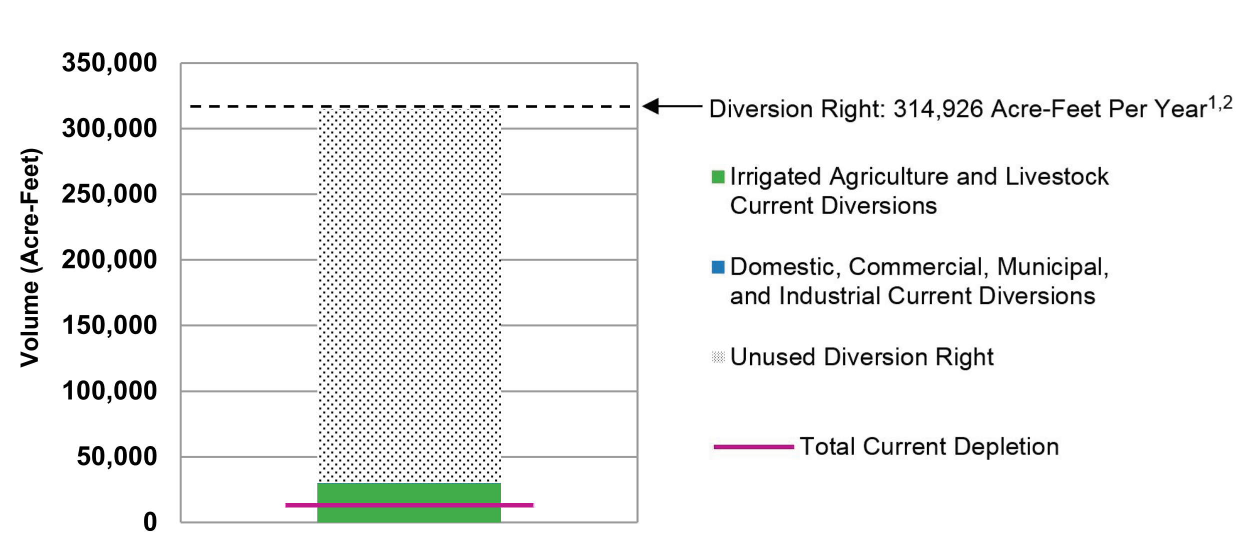
The Navajo Nation’s recent average annual water use for the states of New Mexico, Utah, and Arizona are presented in Figure 5.5-N through 5.5-P and Table 5.5-I. Due to a lack of measurement on many smaller water sources, reasonable standardized assumptions were used to determine their diversion amounts. Depletion amounts were then derived from the diversion numbers using standard engineering efficiency estimates and assigned based on water use category and structure type.

**FIGURE 5.5-N**
Navajo Nation Current Average Annual Water Use in New Mexico




[1] Navajo Nation reserved diversion water right in New Mexico is 606,660 AFY and depletion right is 325,670 AFY; does not include tributary surface water depletions of 26,871 AFY.

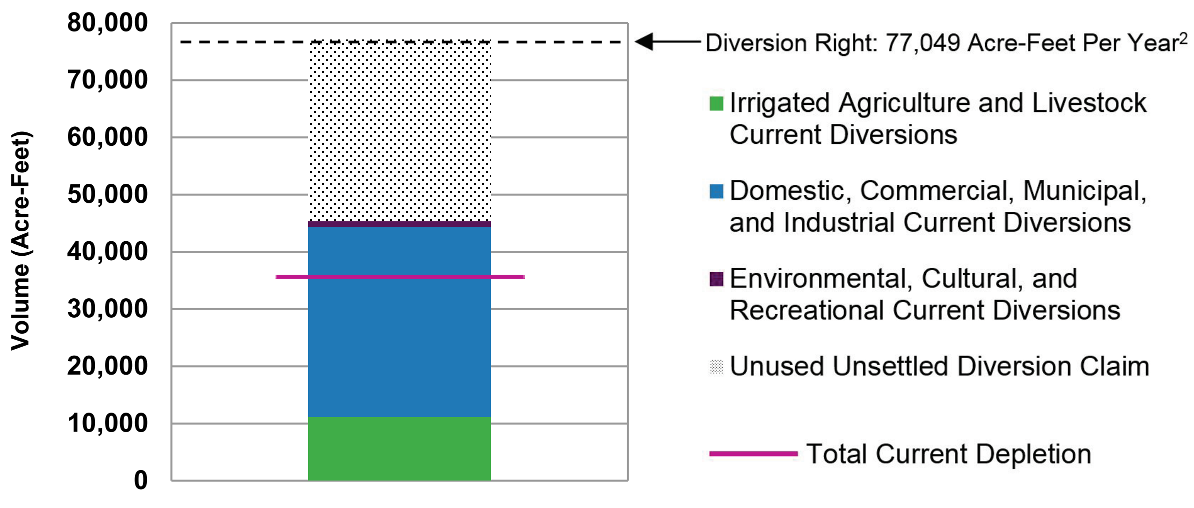
**FIGURE 5.5-O**
Navajo Nation Current Average Annual Water Use in Utah




[1] Navajo's proposed settlement for claims of 314,926 AFY in Utah is based on an annual diversion of 435 cubic feet per second from the San Juan River subject to a maximum depletion of 81,500 AFY. The diversion limit does not apply to diversions from groundwater or from Lake Powell, so long as total Navajo depletions in Utah do not exceed 81,500 AFY.

[2] Navajo's proposed settlement in Utah has not yet been ratified by Congress.

**FIGURE 5.5-P**
Navajo Nation Current Average Annual Water Use in Arizona (Upper Basin)[1]




[1] No Arizona Lower Basin water use is included.
[2] Navajo's Upper Basin unresolved depletion claim in Arizona of 47,000 AFY was converted to an unresolved diversion claim for Tribal Water Study modeling purposes by applying a 61 percent efficiency for a diversion right of 77,049 AFY.

**TABLE 5.5-I**
Navajo Nation Current Average Annual Water Use by State (2009 – 2013)

| State | Water Use Category | Diversion (AFY) | Estimated Current Depletion (AFY) |
|---|---|---|---|
| New Mexico | AG | 271,369 | 183,948 |
| | *DCMI* | 2,103 | 1,052 |
| | *ENV* | 12,090 | 1,209 |
| | ***State Subtotal*** | ***285,562*** | ***186,209*** |
| Utah | *AG* | 29,918 | 12,765 |
| | *DCMI* | 450 | 405 |
| | ***State Subtotal*** | ***30,368*** | ***13,170*** |
| Arizona (Upper Basin) | *AG* | 11,163 | 4,800 |
| | *DCMI* | 33,222 | 29,900 |
| | *ENV* | 1,000 | 1,000 |
| | ***State Subtotal*** | **45,385** | **35,700** |
| **Total** | | **361,315** | **235,079** |

AG – Irrigated Agriculture and Livestock
DCMI – Domestic, Commercial, Municipal, and Industrial
ENV – Environmental, Cultural, and Recreational

### 5.5.6 Tribal Water Use Challenges

#### *5.5.6.1 Supply Challenges*

Surface water development is hindered by a variety of practical and legal constraints. Access to mainstem Colorado River water is limited by legal, physiographic, and environmental factors. The erratic flow regime and high sediment load of the Little Colorado River and other watersheds create challenges to water development. The washes are generally ephemeral with erratic flow regimes and they may not be reliable water supplies for municipal purposes. Water is frequently stored in large shallow reservoirs, which are subject to high infiltration and evaporation losses. Consequently, the firm yield from these washes is far less than the average annual flow.

Groundwater development depends on location, aquifer characteristics, and water quality. Many portions of the Navajo Nation need imported water due to the lack of local adequate groundwater supplies.

#### *5.5.6.2 Infrastructure Challenges*

The Navajo Nation has been waging an uphill battle for many years to maintain and modernize its water resource infrastructure. However, given existing agency resources, budgets, and authorizations, many of the water infrastructure deficiencies on the Reservation will continue to go unattended and the problems may become more acute. The NDWR identified a need to better define and clarify the water resource problems confronting the Navajo Nation and to develop a plan for addressing those problems. The effort resulted in the Strategy Document. This document was first produced in July 2000. It has been updated with data available in the 2010 Census, more recent information from the Division of Economic Development, and separate investigations of the Navajo water projects.

The Navajo Nation has made significant investments in recent years to obtain better insight into the water infrastructure development needs on the Navajo Nation. In 2012 and 2016, the Navajo Nation funded several regional plans that includes identifying the short-term, mid-term and long-term public water system infrastructure needs. Several of these reports are finalized, some are almost finalized, and some have just begun. These capital improvement plans incorporate an increasing population over a 40- to 50-year planning horizon combined with increasing economic development.

#### *5.5.6.3 Agriculture*

One of the purposes of the 1986 Soil Conservation Service inventory of irrigation projects was to identify and prioritize the infrastructure needs of the small Navajo Nation irrigation projects. Since that time, there has been little to no funding to address many of the deficiencies and many of the small irrigation projects continue to face many challenges.

#### *5.5.6.4 Domestic*

The NDWR estimates that approximately 30 percent of the households on the Reservation are without direct access to public water systems and haul water long distances to provide water for their families. Families, which haul water for domestic purposes, spend the equivalent of $43,000 per AF of water compared with $600 per AF for typical suburban water users in the region. This Navajo water hauling cost is $133 per thousand gallons. This water is among the most expensive in the U.S. for a sector of the population that is among the poorest (NDWR, 2001).

These water haulers often rely on non-potable water sources such as stock tanks for drinking water. Those that do have running water depend on public water supply systems that are deteriorating and are struggling to generate adequate revenues for maintenance. Some of these water systems have exceeded the maximum sustainable withdrawal capacity of their source aquifers, have poor water quality, and are susceptible to drought.

The lack of a reliable and affordable potable water supply stifles economic growth throughout the Reservation. According to the 2010 Census, more than half of the Navajo population live off the Navajo Reservation. Assuming the economic and social conditions can be improved, and that emigration can be reduced, by the year 2050 the on-Reservation population of the Navajo Nation is projected to be over 300,000. If the disparities in water use between the Navajo people and the rest of the United States are reduced, the total annual municipal water demand on the Reservation will exceed 50,000 AFY. This demand requires more than four times the current water system capacity. Overcoming the legacy of economic neglect and the readily apparent deficits in infrastructure will require an aggressive water development program.

The Navajo Nation is committed to improving the standard of living on the Reservation. The fundamental first step in improving the socioeconomic conditions is stimulating economic developments which will, in turn, reduce demands on federal programs. Recognizing that water is integral to human health and safety and economic development, the Navajo Nation has made one of its highest priorities to be developing reliable water supplies.

If the Navajo people are to achieve a standard of living comparable with neighboring communities, the Nation must reassess future water demand on the Reservation and explore options for providing adequate water to its people. Several conditions compound this problem. First, the Navajo population has very limited economic resources, making capital investments problematic and repayment capacities of the Navajo communities very low. Second, the Navajo population is widely dispersed across the Reservation, resulting in large distances between water sources and water users, and extremely high unit O&M costs. Third, the Navajo Nation has not established a depreciation fund that can adequately repair and replace the existing water systems, many of which are at or near the end of their design life. Finally, environmental and endangered species concerns combined with scarce water make new water development, already a costly proposition, even more difficult.

These conditions result in expensive water and a constant struggle to generate adequate revenue to build and maintain water systems. Not only is the Navajo Nation unable to meet growing demands, it is struggling to operate and maintain the existing systems. This leaves the Navajo Nation caught up in a cycle of trying to catch up. The proposed regional systems have economies of scale, and will provide the core water infrastructure for more densely sited housing in the future. Due to limited funding, for systems that do have the priority and receive funding, the IHS typically designs for a domestic demand of 200 to 250 gallons per household per day, or only 50 gallons per capita per day. This rate is less than half of the other municipal per capita use in Arizona. The IHS adds 50 percent to its design capacity for future growth.

Under its current authority, the IHS cannot typically provide for the water supply needs of commercial or industrial users. These commercial users, which are critical to a robust and sustainable economy, are forced to carry the technical and financial burden of developing their own water supplies. This burden, combined with the other obstacles, makes the creation of business opportunities on the Reservation exceptionally difficult. The Navajo Nation is working to remove as many administrative obstacles as possible. However, the difficulty of securing water can only be addressed by creating an adequate water infrastructure.

The NTUA water systems face critical economic problems. The NTUA infrastructure has many miles of pipeline systems, but has few connections per mile. For some of these water systems, the operating cost exceeds the system revenue. Costlier NTUA systems are subsidized by larger, more cost efficient systems. Furthermore, NTUA does not have the financial resources to maintain an adequate depreciation fund. Consequently, funding may not be readily available when the $300 million of existing NTUA infrastructure needs to be replaced.

As challenging as the current circumstances are, without dramatically improved water resources development efforts, the future may be more challenging.

### 5.5.7 Projected Future Water Development

The Navajo Nation's future water development was assessed by first examining the location, quantity and type of current water use and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreases flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

The Navajo Nation contemplated its future water development through 2060 by reviewing its current water use estimates and reflecting upon how these might change under the four scenarios. During this process, the Nation considered such elements as the scenario conditions described in the storylines, current or future planned projects, anticipated changes in water use by category, and the extent and condition of existing water infrastructure and the need, as well as the cost, for new infrastructure to support water development. The Navajo Nation contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges (TRAN).

From this examination, the Nation extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared quantified water development schedules for its reserved water rights and unresolved claims in New Mexico, Utah, and the Upper Basin in Arizona. No water use or future development was modeled for the Lower Basin in Arizona. Subsequently, the Nation used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each development schedule is presented in the following sections.

#### *5.5.7.1 Future Water Development Schedules*

The assumptions used to prepare each water development schedule are described below. The schedules are presented graphically for New Mexico in Figure 5.5-Q and numerically in Table 5.5-J, for Utah in Figure 5.5-R and Table 5.5-K, and Arizona (Upper Basin) in Figure 5.5-S and Table 5.5-L.

### New Mexico

*Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. Currently, almost all of the Nation’s New Mexico water use is for irrigation (271,369 AFY). Under Scenario A, the Nation assumed that irrigation depletion would increase from 183,948 AFY to 297,438 AFY because the NIIP Project depletions would almost double by 2040 due to increased acreage under irrigation and increasing efficiency to 73 percent. By 2060, the Fruitland and Hogback Irrigation Projects would increase to their full diversion rights, helping to bring AG diversions to 433,698 AFY. DCMI water diversions would increase substantially from the current use of 2,103 AFY to 57,139 AFY in 2060 because of granary processing facilities such as Navajo Agricultural Products Industry’s (NAPI) Flour Mill (NIIP Project), the development of the Navajo-Gallup Water Supply Project to full depletion right, the development of the A-LP to the Nation’s full diversion right, the full development of San Juan tributary groundwater, and the full development of the reserved New Mexico San Juan River diversion right. ENV water use diversions would remain constant through 2060 at 12,090 AFY. There would be no TRAN water use under Scenario A.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, it was assumed that by 2060 all the irrigation projects would increase at a rate that is only 25 percent of the Scenario A rate. NIIP Project DCMI diversions would double by 2060, but other DCMI diversions would increase at a rate that is 75 percent of the Scenario A rate. Total DCMI diversions by 2060 would be 42,703 AFY. ENV water use diversions would remain constant through 2060 at 12,090 AFY. There would be no TRAN water use under Scenario B.

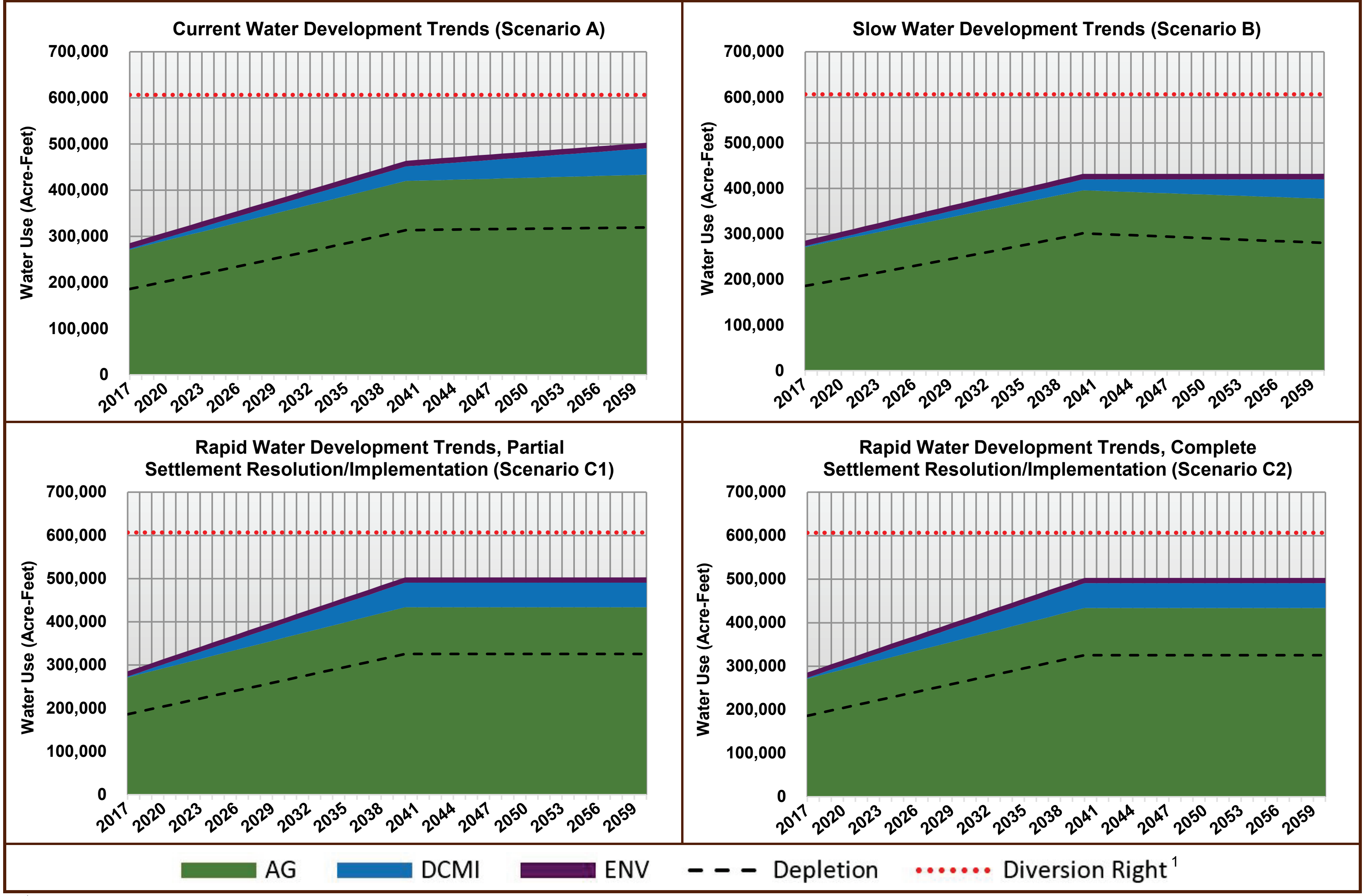
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. Under Scenario C1, the Nation assumed that irrigation diversions would increase from 271,369 AFY to 433,890 AFY by 2040 because the NIIP Project depletions would nearly triple due to increased acreage under irrigation and increasing efficiency to 73 percent. The Fruitland and Hogback Irrigation Projects would increase to their full diversion rights by 2040. DCMI water use diversions would increase substantially from current use of 2,103 AFY to 56,859 AFY in 2040. NIIP Project DCMI use would triple by 2060, and other DCMI diversions would reach their full water right at 2040. ENV water use diversions would remain constant through 2060 at 12,090 AFY. There would be no TRAN water use under Scenario C1.

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. The Nation assumed the development schedule would be the same as Scenario C1.

**FIGURE 5.5-Q**
Navajo Nation Projected Future Water Development in New Mexico (Scenarios A, B, C1, and C2)




[1] Navajo Nation reserved diversion water right in New Mexico is 606,660 AFY and depletion right is 325,670 AFY; does not include tributary surface water depletions of 26,871 AFY.

## Utah

### *Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. Under Scenario A in Utah, the Nation assumed that AG diversions would triple by 2060 from 29,918 AFY to 89,754 AFY. DCMI water use diversions would increase from the current use of 450 AFY to 2,000 AFY by 2060. There would be no ENV or TRAN water use under Scenario A.

### *Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario in Utah, it was assumed that all the irrigation project diversions would increase at a rate that is 25 percent of the Scenario A development rate. DCMI water use diversions would increase slowly from the current use of 450 AFY to 563 AFY in 2060. There would be no ENV or TRAN water use.

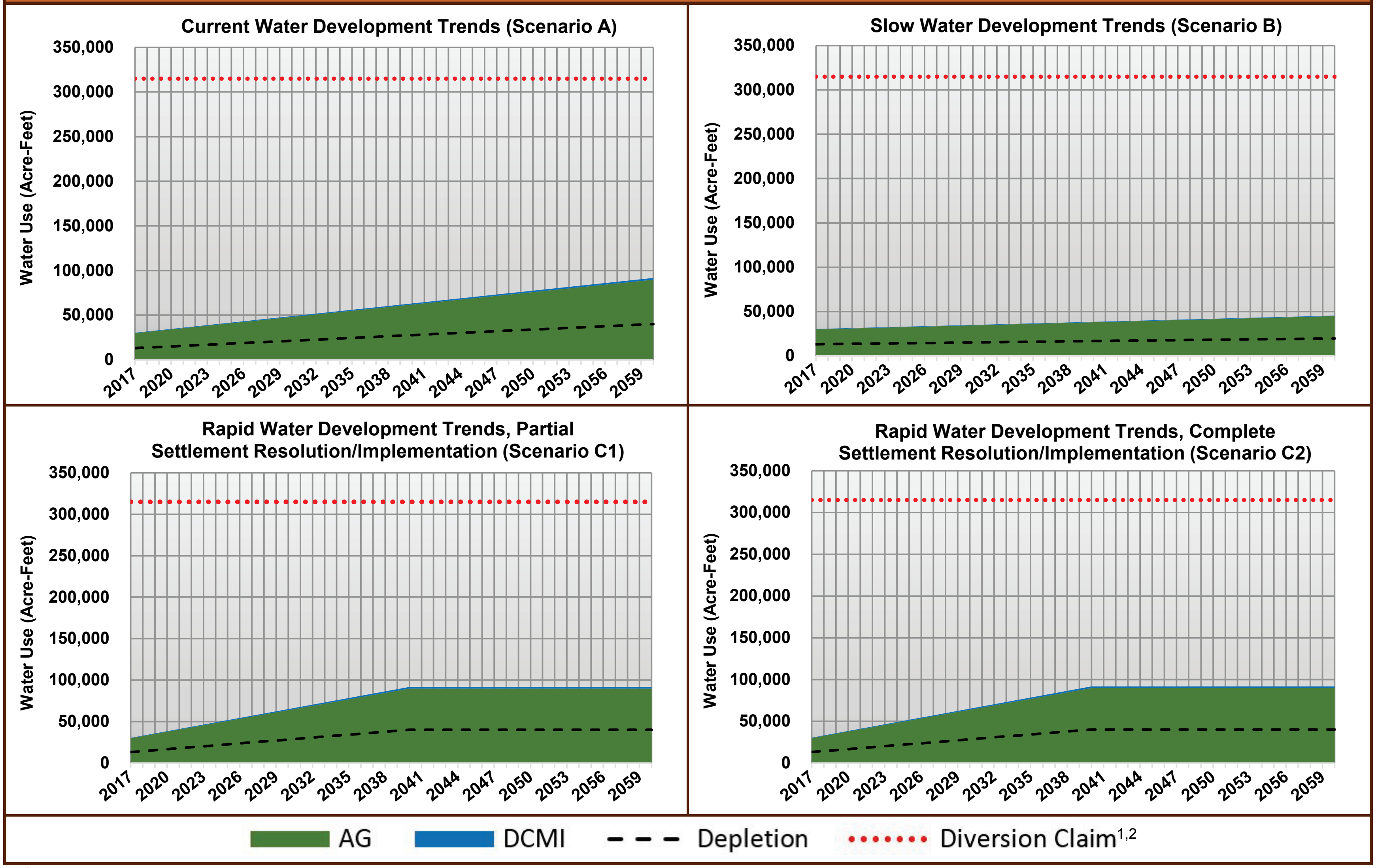
### *Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. Under Scenario C1, the Nation assumed that irrigation diversions would triple from 29,918 AFY to 89,754 AFY by 2040. By 2040, DCMI water use diversions would increase from the current use of 450 AFY to 2,000 AFY. There would be no ENV or TRAN water use.

### *Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. The Nation assumed the development schedule would be the same as Scenario C1.

**FIGURE 5.5-R**
Navajo Nation Projected Future Water Development in Utah (Scenarios A, B, C1, and C2)




[1] Navajo's proposed settlement for claims of 314,926 AFY in Utah is based on an annual diversion of 435 cubic feet per second from the San Juan River subject to a maximum depletion of 81,500 AFY. The diversion limit does not apply to diversions from groundwater or from Lake Powell, so long as total Navajo depletions in Utah do not exceed 81,500 AFY.

[2] Navajo's proposed settlement in Utah has not yet been ratified by Congress.

## Arizona (Upper Basin)

### *Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. Under Scenario A in the Upper Basin portion of Arizona, the Nation assumed that AG diversions would increase from 11,163 AFY to 16,744 AFY by 2060. DCMI water use would decrease substantially because of the closing of the Navajo Generating Station (NGS). At the time the modeling was performed for the Tribal Water Study, it was assumed that one power generating unit would close in 2019, reducing NGS diversions from 25,800 AFY to 17,200 AFY. It was assumed the remaining two units would close in 2044, reducing NGS diversions from 17,200 AFY to 0 AFY. It now appears that the NGS will close in 2019, reducing DCMI use in the Upper Basin of Arizona even more quickly. ENV water use diversions would remain constant through 2060 at 1,000 AFY. There would be no TRAN water use under Scenario A.

### *Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario in the Upper Basin of Arizona, the Nation assumed that AG water diversions would increase at a rate that is 25 percent of the Scenario A rate. The NGS assumptions would affect DCMI use as in Scenario A, and other DCMI uses would decrease slightly through 2060 as compared to Scenario A. ENV and TRAN use would be the same as in Scenario A.

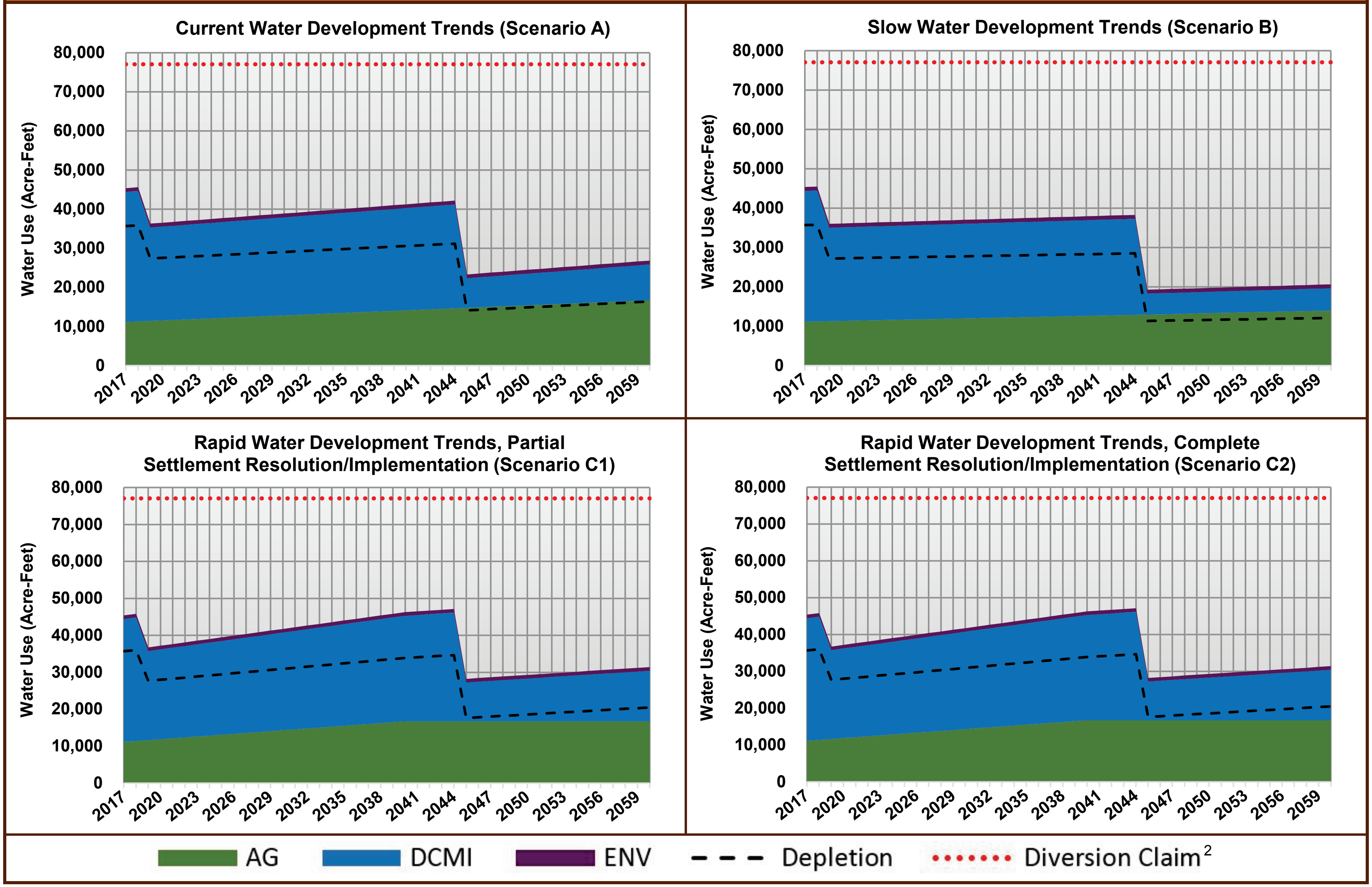
### *Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. Under Scenario C1, the Nation assumed that irrigation diversions would increase from 11,163 AFY to 16,744 AFY by 2040. The NGS assumptions would affect DCMI use as in Scenario A, and other DCMI uses would increase slightly through 2060 as compared to Scenario A. ENV and TRAN use would be the same as in Scenario A.

### *Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. The Nation assumed the development schedule would be the same as Scenario C1.

**FIGURE 5.5-S**
Navajo Nation Projected Future Water Development in Arizona (Upper Basin) (Scenarios A, B, C1, and C2)[1]




[1] No Arizona Lower Basin water use is included.

[2] Navajo's Upper Basin unresolved depletion claim of 47,000 AFY in Arizona was converted to an unresolved diversion claim for Tribal Water Study modeling purposes by applying a 61 percent efficiency for a diversion right of 77,049 AFY.



See the Disclaimer and Introduction to Chapter 5.0.

### *5.5.7.2 Summary of Projected Future Water Development*

Navajo's current water use and projected future water development under the Tribal Water Study's water development scenarios, and modeled for analysis purposes, is presented in Tables 5.5-J, 5.5-K, and 5.5-L.

**TABLE 5.5-J**
Summary of Navajo Nation Current Water Use and Projected Future Water Development in New Mexico[1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion |
| **Current Use** | *AG* | 271,369 | 183,948 | 271,369 | 183,948 | 271,369 | 183,948 | 271,369 | 183,948 |
| | *DCMI* | 2,103 | 1,052 | 2,103 | 1,052 | 2,103 | 1,052 | 2,103 | 1,052 |
| | *ENV* | 12,090 | 1,209 | 12,090 | 1,209 | 12,090 | 1,209 | 12,090 | 1,209 |
| | *TRAN* | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| | **Total** | **285,562** | **186,209** | **285,562** | **186,209** | **285,562** | **186,209** | **285,562** | **186,209** |
| **Use at 2040** | *AG* | 420,151 | 297,438 | 395,852 | 289,227 | 433,890 | 297,277 | 433,890 | 297,277 |
| | *DCMI* | 31,539 | 15,028 | 24,126 | 11,325 | 56,859 | 26,984 | 56,859 | 26,984 |
| | *ENV* | 12,090 | 1,209 | 12,090 | 1,209 | 12,090 | 1,209 | 12,090 | 1,209 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **463,780** | **313,675** | **432,068** | **301,761** | **502,839** | **325,470** | **502,839** | **325,470** |
| **Use at 2060** | *AG* | 433,698 | 291,058 | 377,520 | 259,446 | 433,698 | 297,136 | 433,698 | 297,136 |
| | *DCMI* | 57,139 | 27,125 | 42,704 | 19,972 | 57,139 | 27,125 | 57,139 | 27,125 |
| | *ENV* | 12,090 | 1,209 | 12,090 | 1,209 | 12,090 | 1,209 | 12,090 | 1,209 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **502,927** | **319,392** | **432,314** | **280,627** | **502,927** | **325,470** | **502,927** | **325,470** |

[1] Navajo Nation reserved diversion water right in New Mexico is 606,660 AFY and depletion right is 325,670 AFY; does not include tributary surface water depletions of 26,871 AFY.


*See the Disclaimer and Introduction to Chapter 5.0.*

**TABLE 5.5-K**
Summary of Navajo Nation Current Water Use and Projected Future Water Development in Utah[1,2]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion |
| Current Use | *AG* | 29,918 | 12,765 | 29,918 | 12,765 | 29,918 | 12,765 | 29,918 | 12,765 |
| | *DCMI* | 450 | 405 | 450 | 405 | 450 | 405 | 450 | 405 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **30,368** | **13,170** | **30,368** | **13,170** | **30,368** | **13,170** | **30,368** | **13,170** |
| Use at 2040 | *AG* | 61,923 | 26,627 | 37,919 | 16,305 | 89,754 | 38,295 | 89,754 | 38,295 |
| | *DCMI* | 1,279 | 1,151 | 510 | 459 | 2,000 | 1,800 | 2,000 | 1,800 |
| | *ENV* | 0 | 0 | 0 | 0. | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **63,202** | **27,778** | **38,429** | **16,764** | **91,754** | **40,095** | **91,754** | **40,095** |
| Use at 2060 | *AG* | 89,754 | 38,295 | 44,877 | 19,148 | 89,754 | 38,295 | 89,754 | 38,295 |
| | *DCMI* | 2,000 | 1,800 | 563 | 506 | 2,000 | 1,800 | 2,000 | 1,800 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **91,754** | **40,095** | **45,440** | **19,654** | **91,754** | **40,095** | **91,754** | **40,095** |

[1] Navajo's proposed settlement for claims of 314,926 AFY in Utah is based on an annual diversion of 435 cubic feet per second until 81,500 AFY of water is depleted.

[2] Navajo's proposed settlement in Utah of 81,500 AFY has not yet been ratified by Congress.

**TABLE 5.5-L**
Summary of Navajo Nation Current Water Use and Projected Future Water Development in Arizona (Upper Basin)[1,2]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion | Diversion | Depletion |
| **Current Use** | *AG* | 11,163 | 4,800 | 11,163 | 4,800 | 11,163 | 4,800 | 11,163 | 4,800 |
| | *DCMI* | 33,222 | 29,900 | 33,222 | 29,900 | 33,222 | 29,900 | 33,222 | 29,900 |
| | *ENV* | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **45,385** | **35,700** | **45,385** | **35,700** | **45,385** | **35,700** | **45,385** | **35,700** |
| **Use at 2040** | *AG* | 14,148 | 6,084 | 12,655 | 5,442 | 16,744 | 7,200 | 16,744 | 7,200 |
| | *DCMI* | 26,103 | 23,493 | 24,276 | 21,848 | 28,540 | 25,686 | 28,540 | 25,686 |
| | *ENV* | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **41,251** | **30,577** | **37,931** | **28,290** | **46,284** | **33,886** | **46,284** | **33,886** |
| **Use at 2060** | *AG* | 16,744 | 7,200 | 13,953 | 6,000 | 16,744 | 7,200 | 16,744 | 7,200 |
| | *DCMI* | 9,111 | 8,200 | 5,694 | 5,125 | 13,667 | 12,300 | 13,667 | 12,300 |
| | *ENV* | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **26,855** | **16,400** | **20,647** | **12,125** | **31,411** | **20,500** | **31,411** | **20,500** |

[1] No Arizona Lower Basin water use is included.

[2] Navajo's Upper Basin unresolved depletion claim of 47,000 AFY in Arizona was converted to an unresolved diversion claim for Tribal Water Study modeling purposes by applying a 61 percent efficiency for a diversion right of 77,049 AFY.

# 5.6 Fort Mojave Indian Tribe

## 5.6.1 Introduction

The 32,000-acre Fort Mojave Indian Reservation (Reservation) lies at the juncture of Arizona, California, and Nevada with land in all three states. The Fort Mojave Indian Tribe's (FMIT or Tribe) Tribal Headquarters is in Needles, California.

The 2012 Census lists the population of the Reservation as 1,657, most of whom live in four more or less equal-sized communities. The original Fort Mojave Indian Reservation was formed by Executive Order in 1890 from the former Camp Mojave military reservation and the non-contiguous and Camp Mojave Hay and Wood Reserve. These were connected in 1901 and in 1911, 33 even-numbered sections in the Mohave Valley were added.

Figure 5.6-A presents a general location map with boundaries, communities, and major facilities.

## 5.6.2 Physical Setting

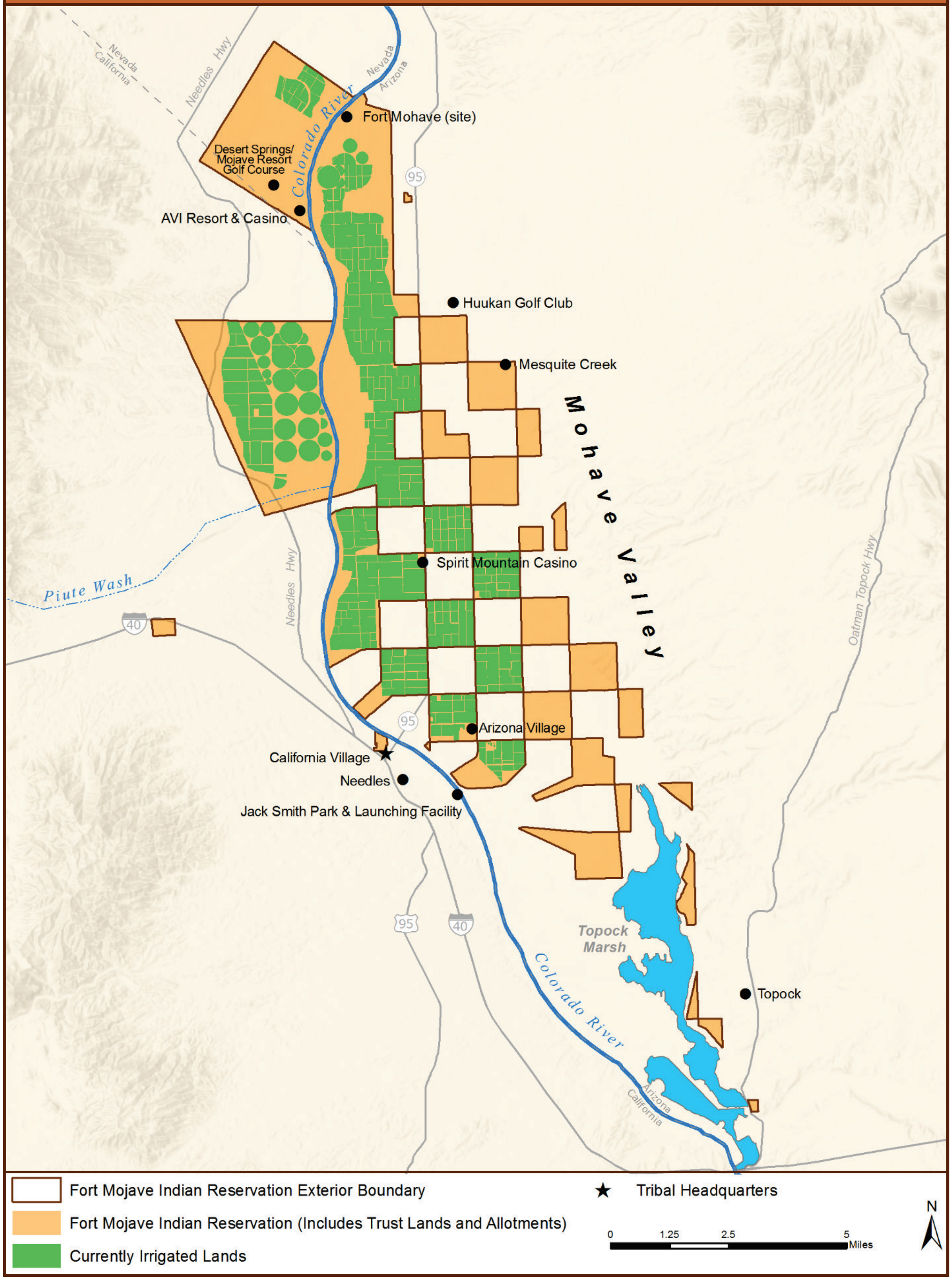
The Reservation lies in the first floodplain valley on the Lower Colorado River. The dominant feature of the area is the Colorado River and most of the Reservation is in the historic floodplain. The Valley is bounded on the east by the Black Mountains of Arizona, on the west by the Dead Mountains of California, on the north by the City of Bullhead City, Arizona, and on the south by the Havasu National Wildlife Refuge. The elevation ranges from 455 to 925 feet above sea level.

Desert Springs Golf Course located on the Fort Mojave Indian Reservation.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

### *5.6.2.1 Watersheds*

The watershed is the west slope of the 5,000 foot Black Mountains, the east slope of the 4,000 foot Dead Mountains and the watershed of Piute Wash which drains 1,000 square miles of desert and mountainous terrain. The inflow to the Reservation from the local mountains is rare and comes from the occasional heavy rains associated with the summer monsoon season. The watershed of Piute Wash contains mountains with an elevation of up to 6,500 feet. It too, only flows during heavy storms but can exceed 10,000 cubic feet per second and has caused severe flooding.

**FIGURE 5.6-A**
Fort Mojave Indian Reservation Map






*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.6.2.2 Hydrogeology*

Looking northwest toward Nevada across the Colorado River from the Arizona sector of the Fort Mojave Indian Reservation.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

The Reservation is located on part of the floodplain of the Colorado River in an area of undifferentiated alluvial sediments and sedimentary rocks of Quaternary Age that includes floodplain deposits derived from the surrounding mountains. Groundwater is generally shallow ranging from ten to twenty feet. Groundwater in the Mohave Valley is considered to be Colorado River water for accounting purposes; however, it is partially derived from the surrounding mountains.

#### *5.6.2.3 Climate*

The Reservation lies in the transition zone between the Mojave and Sonoran deserts. The climate is similar to the other low desert valleys of the Southwest (Köppin Climate Classification BWh). Summers are very hot and winters are generally mild. The average mid-winter temperatures are 67 °F and 38 °F although the coldest nights can be 20 °F or less, and periods of 80 °F weather are not uncommon. Average mid-summer temperatures are 106 °F and 71 °F although the warmest days can approach or exceed 120 °F. The average annual rainfall is 4.39 inches, most of which occurs in winter, but severe local storms do occur in the late summer monsoon period. The wettest month is February with an average of 1.11 inches; the driest is May with an average of 0.02 inches. Snowfall is very rare. The Reservation normally experiences periods of high winds in the spring and fall. Weather records on the Reservation go back to 1992 and can be accessed through the University of Arizona's Arizona Meteorological Network System.

### 5.6.3 Historical Use and Cultural Importance of Water

Looking southwest at the Colorado River separating the Fort Mojave Indian Reservation's Nevada and Arizona holdings; pictured is the Tribe's Avi Hotel complex and the Veterans' Memorial Bridge (connecting Fort Mohave, AZ to Laughlin, NV).
*Source: Russell Ray of the Fort Mojave Indian Tribe*

The FMIT made good use of the desert resources, but it was the Colorado River and its associated riparian zone that provided the food and shelter for what is thought to have been up to 30,000 people. The Colorado River originally was a wide and braided life-giving river. The River had many more times the bank line than exists now. The River would flood every spring with the snowmelt from the Rocky Mountains and slowly recede through the summer and fall. This allowed several plantings of crops such as corn, beans, squash, and melons.

In the recent past, cultural use of the River has been non-consumptive. The Tribe is planning to use a share of its decreed water right to restore backwaters and some shoreline to a semblance of their pre-dam condition.

Mojave Golf Resort adjacent to the Avi Hotel and Desert Springs golf community on the Fort Mojave Indian Reservation in southern Nevada.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

Veterans' Memorial Bridge connecting Fort Mohave, AZ to Laughlin, NV; Fort Mohave Indian Tribe's Avi Hotel lies at the upper-right.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

### 5.6.4 Fort Mojave Indian Tribe Water Supply

Pursuant to the Supreme Court Consolidated Decree of 2006, federal reserved water rights for Colorado River water were quantified for the Fort Mojave Indian Reservation in Arizona with priority dates of September 18, 1890, and February 2, 1911; and in California and Nevada with a priority date of September 18, 1890. The amounts, including added lands, priority dates, and states where the water rights are perfected are presented in Table 5.6-A.

**TABLE 5.6-A**
Fort Mojave Indian Tribe Colorado River Diversion Right

| Reservation | State | Diversion Water Right (AFY)[1] | Net Acres | Priority Within State | Priority Date |
|---|---|---|---|---|---|
| Fort Mojave Indian Reservation | Arizona | 27,969 | 4,327 | 1 | Sept. 18, 1890 |
| | | 75,566 | 11,691 | 1 | Feb. 2, 1911 |
| | California | 16,720 | 2,587 | 1 | Sept. 18, 1890 |
| | Nevada | 12,534 | 1,939 | 1 | Sept. 18, 1890 |
| **Totals** | | **132,789** | **20,544** | | |

[1] Source: Consolidated Decree of March 27, 2006. The quantity of water in each instance is measured by (i) diversions or (ii) consumptive use required for irrigation of the respective acreage and for satisfaction of related uses, whichever of (i) or (ii) is less.
AFY – Acre-feet per year

### 5.6.5 Current Water Use and Operations

Currently water is used for agriculture, turf irrigation, domestic needs, and cooling water for a generating plant. Over 90 percent of the FMIT's total diversion goes to irrigated agriculture. Agricultural water is pumped directly from the mainstream using ten pumping stations that range from 100 to 500 horsepower. The pumps deliver water to concrete lined, gravity canals that bring water to the fields. There are no irrigation projects on the Reservation and these systems are owned, operated, and maintained by individual farms. Domestic water is pumped from wells.

#### *5.6.5.1 Irrigated Agriculture and Livestock Water Use Category*

Approximately half of the Reservation is devoted to intensively farmed, irrigated agriculture and it is the largest consumer of water on the Reservation. The crops produced vary from year to year depending on market conditions, but upland cotton and alfalfa hay are the dominant crops. Olives, sudan, okra seed, wheat, barley, milo, grain hay, and other hays are also produced.

Alfalfa fields managed by AKA Farms at the northern Arizona sector of the Fort Mojave Indian Reservation, looking south.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

Irrigation Canal (north-south) at the SW corner of the Fort Mojave Indian Reservation in Mohave Valley.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

Olive Trees (80,000) planted at AKA Farms' south-central California section within a center pivot system, the first of its kind in the world.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

Table 5.6-B presents the amount of water diverted for agricultural purposes to farms in Arizona, California, and Nevada from 2009 through 2013. Table 5.6-C describes the practices used to apply irrigation water.

**TABLE 5.6-B**
Fort Mojave Indian Tribe Irrigated Agriculture and Livestock Water Diversions (2009 – 2013)

| Diversions by State | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| Nevada | 3,204 | 2,582 | 2,969 | 2,365 | 2,816 |
| Arizona | 64,03 | 59,218 | 68,116 | 64,700 | 60,966 |
| California | 18,099 | 11,720 | 14,762 | 15,782 | 15,259 |
| **Totals** | **85,346** | **73,520** | **85,847** | **82,847** | **79,041** |

**TABLE 5.6-C**
Average Agricultural Crop Data (2009 – 2013)

| Crop | Average Acreage | Average Water Delivery (AFY) | Percent Flood (Acres) | Percent Sprinkler (Acres) | Percent Drip (Acres) |
|---|---|---|---|---|---|
| Field | 11,805 | 78,768 | 85 | 12 | 3 |

### *5.6.5.2 Domestic, Commercial, Municipal, and Industrial Water Use Category*

The electric generating plant pumps its water directly from the Colorado River. As with the farms, the water allocation is embodied in the lease. Irrigation water for the two Tribally owned golf courses is pumped from onsite wells, again, individually operated. Domestic water for residences and Reservation businesses is pumped from wells and delivered by the Tribally owned Fort Mojave Tribal Utilities Authority which also provides sewer on (and off) the Reservation.

One of several commercial centers on Fort Mojave Indian Reservation land in Fort Mohave, AZ – near the northernmost reach of the Reservation.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

Fort Mojave Tribal Utilities Authority Municipal Wastewater Treatment Facility holding pond at the south-central Reservation; the facility serves residential, industrial, and commercial entities throughout the region of Mohave Valley and Fort Mohave.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

The Southpoint natural gas-fired electric generating plant at the extreme SE corner of the Fort Mojave Indian Reservation.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

**TABLE 5.6-D**
Fort Mojave Indian Tribe Domestic, Commercial, Municipal, and Industrial Water Diversions (2009 – 2013)

| Diversions by State | Year (AF) | | | | |
|---|---|---|---|---|---|
| | **2009** | **2010** | **2011** | **2012** | **2013** |
| Arizona | 2,734 | 2,278 | 1,682 | 1,994 | 2,877 |
| California | 39 | 53 | 64 | 57 | 42 |
| Nevada | 1,652 | 1,649 | 1,769 | 2,305 | 2,296 |
| **Totals** | **4,425** | **3,980** | **3,515** | **4,356** | **5,215** |

#### 5.6.5.3 Environmental, Cultural, and Recreational Water Use Category

Presently, environmental use is confined to starter irrigation for revegetation projects on wildland fire burns. Cultural and recreational uses involve non-consumptive uses of the mainstream Colorado River such as boating, fishing, hunting and swimming.

#### 5.6.5.4 Reservoirs

There are no storage reservoirs on the Reservation. There is a small holding reservoir at the generating station and sprinkler irrigation regulating reservoirs on three of the farms.

Newly-installed holding reservoir for Colorado River water storage at the east margin of AKA's California farm.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

#### 5.6.5.5 Water Use Efficiency and Conservation

Modern farm development on the Reservation began in the mid-1970s. The common practice then was to develop fields with quarter mile irrigation runs, with 0.3 to 0.4 foot per 1000 falls. There are a few of these left and irrigation efficiency is approximately 60 percent. More recently developed and converted fields have sixth-mile runs and no slope. The original 16-inch ports every 100 feet are being replaced with large flow turnouts for surge irrigation. Irrigation efficiency in these fields is about 80 percent.

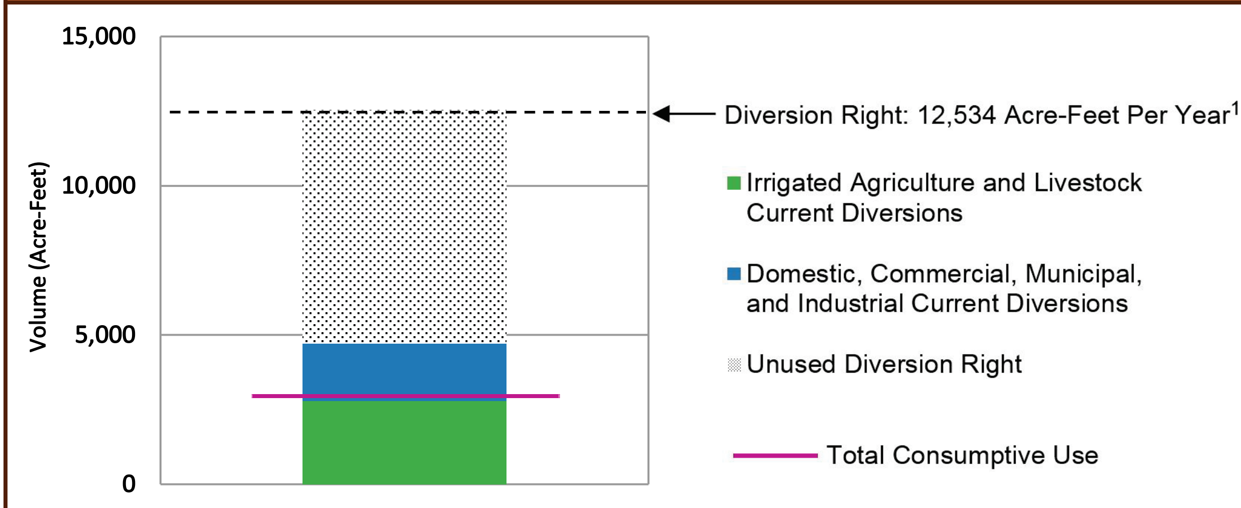
New center pivot system installed at the southeast corner of AKA's SE California farm.
*Source: Russell Ray of the Fort Mojave Indian Tribe*

FMIT is converting its flood irrigated land to low head center pivot sprinkler systems. So far, 18 percent of the land has been converted. These systems are 90 percent plus efficient. Increasing irrigation efficiency does not really conserve water. The crops consumptive use is what it is, the rest returns to the river system and is available for downstream use.

### *5.6.5.6 Summary of Current Water Use*

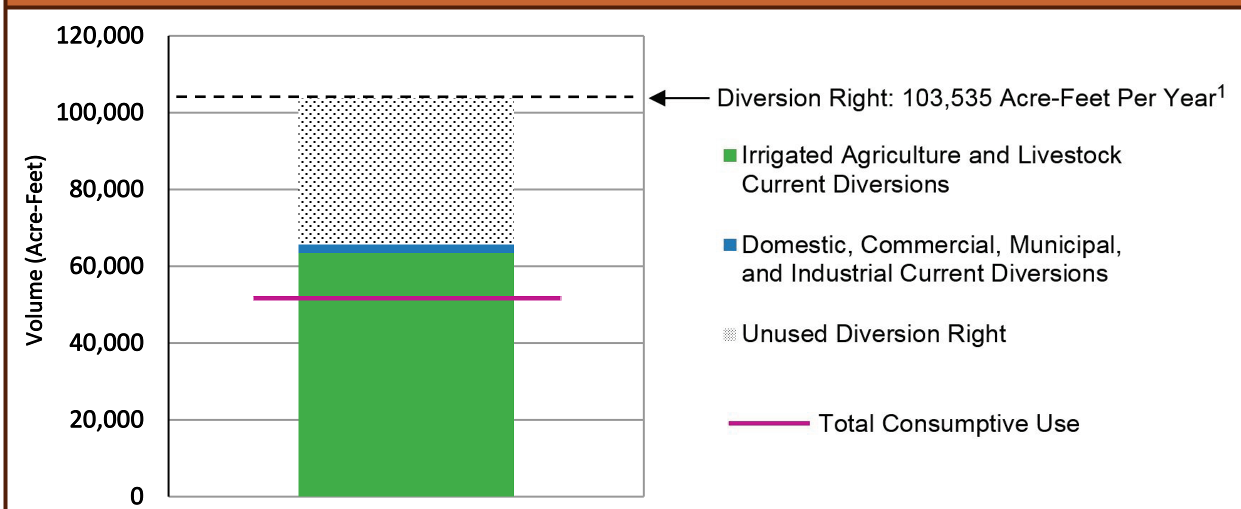
The FMIT's average annual water use for the period 2009 through 2013 in Nevada, Arizona, and California is presented in Figures 5.6-B, 5.6-C, and 5.6-D, respectively, and in Table 5.6-E. The average annual water use for this period is consistent with Reclamation's Colorado River Accounting and Water Use Reports: Arizona, California, and Nevada (Water Accounting Report) (Reclamation, 2017) and was supplemented with water use information provided by the Tribe for the purpose of the Tribal Water Study. Consumptive use was estimated using either efficiency factors in the Water Accounting Report or standard engineering efficiencies.

**FIGURE 5.6-B**
Fort Mojave Indian Tribe Current Average Annual Water Use in Nevada (2009 – 2013)



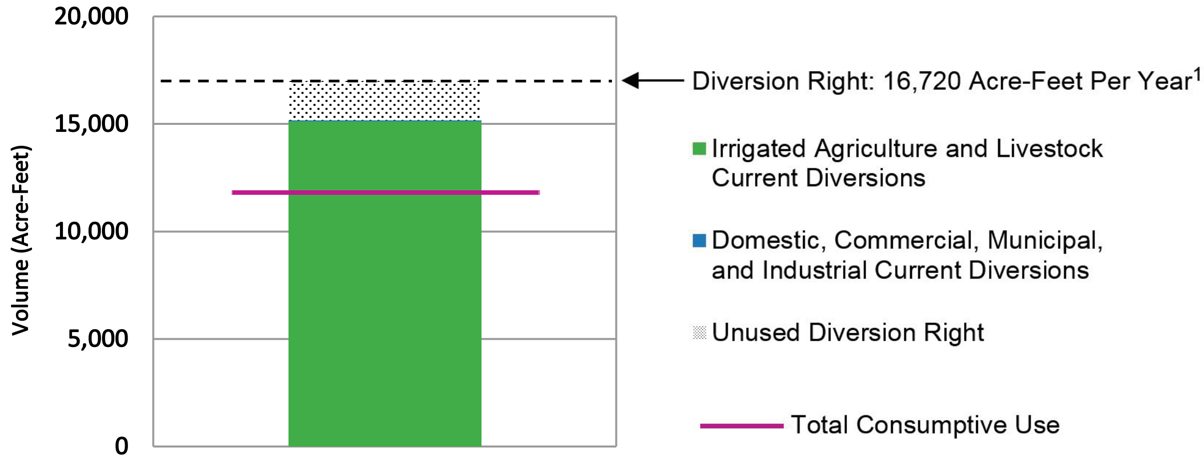

[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 12,534 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 1,939 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

**FIGURE 5.6-C**
Fort Mojave Indian Tribe Current Average Annual Water Use in Arizona (2009 – 2013)




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 103,535 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 16,018 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

**FIGURE 5.6-D**
Fort Mojave Indian Tribe Current Average Annual Water Use in California (2009 – 2013)




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 16,720 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 2,587 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

**TABLE 5.6-E**
Fort Mojave Indian Tribe Current Average Annual Water Use by State (2009 – 2013)

| State | Water Use Category | Diversion (AFY) | Estimated Current Consumptive Use (AFY) |
|---|---|---|---|
| Nevada | AG | 2,787 | 2,174 |
| | DCMI | 1,934 | 774 |
| | ***Subtotal by State*** | ***4,721*** | ***2,948*** |
| Arizona | AG | 63,409 | 49,515 |
| | DCMI | 2,313 | 2,166 |
| | ***Subtotal by State*** | ***65,722*** | ***51,681*** |
| California | AG | 15,124 | 11,797 |
| | DCMI | 51 | 20 |
| | ***Subtotal by State*** | ***15,175*** | ***11,817*** |
| **Total** | | **85,618** | **66,446** |

AG – Irrigated Agriculture and Livestock
DCMI – Domestic, Commercial, Municipal, and Industrial

### 5.6.6 Tribal Water Use Challenges

There are no legal or institutional challenges. The FMIT has the undisputed right to divert 132,789 acre-feet (AF) annually for beneficial purposes and has the ability to do that without any outside involvement. There are no government irrigation projects. The remaining potential farmland is further from the Colorado River. It can be accessed with gravity canals, but that requires siphons under checkerboard intersections with multiple buried utilities. There is experience accomplishing this, but it is somewhat of an engineering challenge.

Fort Mojave Indian Tribe's Willow Pump on the Arizona side of the Colorado River bringing water to AKA Farms' SW Arizona section)
*Source: Russell Ray of the Fort Mojave Indian Tribe*

### 5.6.7 Projected Future Water Development

FMIT's future water development was assessed by first examining the location, quantity and type of current water use and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.

- **Slow Water Development Trends (Scenario B):** Decreases flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

FMIT contemplated its future water development through 2060 by reviewing its current water use estimates and reflecting upon how these might change under the four scenarios. During this process, the Tribes considered such elements as the scenario conditions described in the storylines, current or future planned projects, anticipated changes in water use by category, and the extent and condition of existing water infrastructure and the need, as well as the cost, for new infrastructure to support water development. FMIT contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges (TRAN).

From this examination, FMIT extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared quantified water development schedules for its reserved water rights in Nevada, Arizona and California. Subsequently, FMIT used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each development schedule is presented in the following sections. Although the FMIT participated in the scenario planning process, the Tribe considers that it is in the Rapid Growth Scenario and expects to be using nearly its full reserved water right by 2020. Agricultural irrigation will continue to be the largest user and some freeboard is needed to allow for variations in the weather but the FMIT's goal is to be using about 95 percent of its right by 2020.

#### *5.6.7.1 Future Water Development Schedules*

The assumptions used to prepare each water development schedule are described below. The schedules are presented graphically for Nevada in Figure 5.6-E and numerically in Table 5.6-F, for Arizona in Figure 5.6-F and Table 5.6-G, and California in Figure 5.6-G and Table 5.6-H.

## Nevada

*Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. In Nevada, the FMIT expects to divert its full reserved water right of 12,534 AFY by 2025, mainly through an increase in AG water use. Agricultural efficiency would increase to 90 percent by 2060, increasing consumptive use. DCMI diversions would gradually increase to approximately 6,960 AFY by 2040 and remain constant through 2060. Any water right remaining after water is diverted for DCMI use would be used for AG. All ENV water use is non-consumptive and there would no TRAN water use under Scenario A.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. The FMIT assumes that the Scenario B schedule would be the same as Scenario A as the Tribe cannot imagine a slower growth rate than Current Water Development Trends. The Tribe is not dependent on federal funding for future water development and Tribal income is sufficient to maintain the current trajectory.

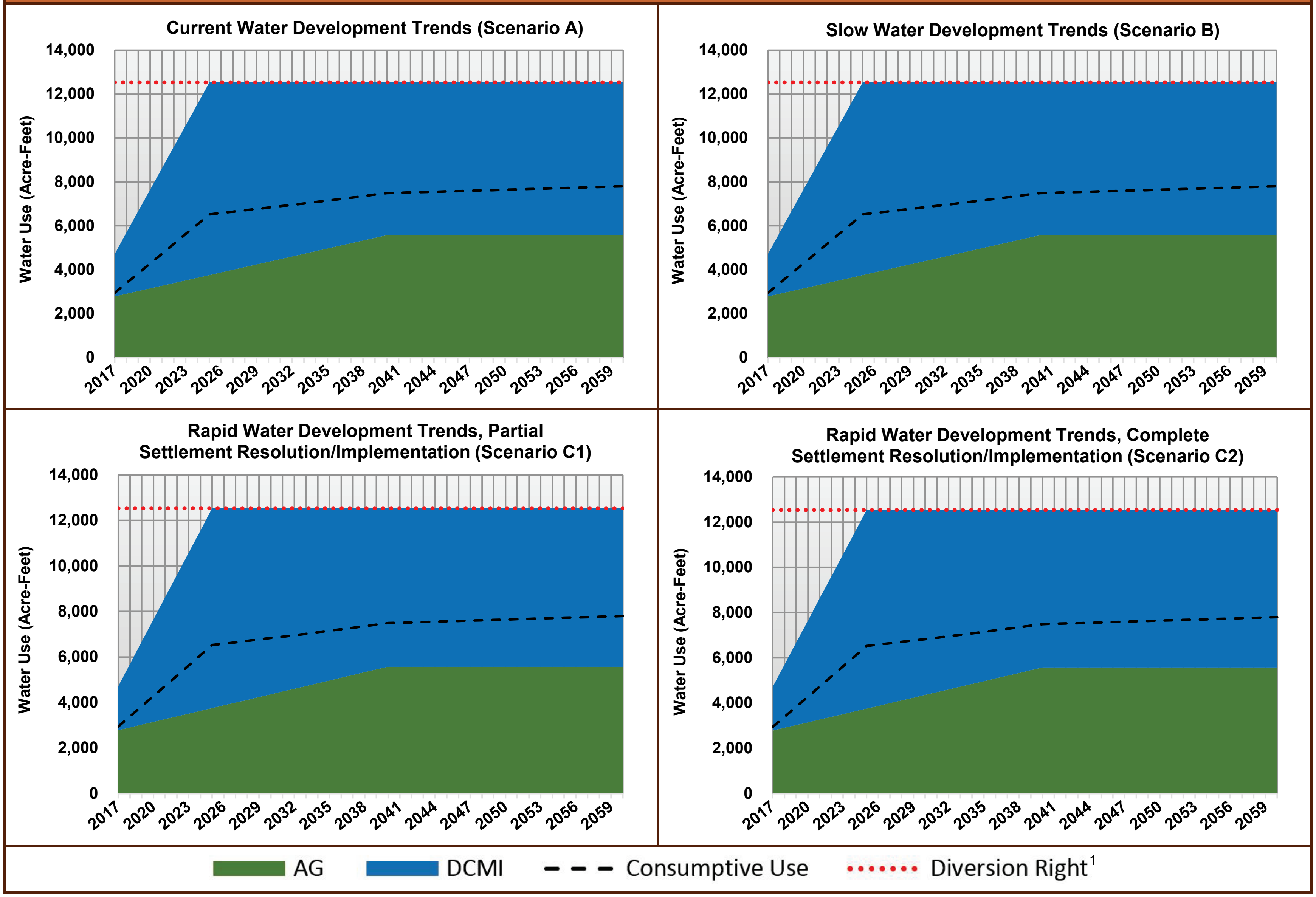
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. The schedule for this scenario is the same as Current Water Development Trends, Scenario A.

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. The schedule for this scenario is the same as Current Water Development Trends, Scenario A.

**FIGURE 5.6-E**
Fort Mojave Indian Tribe Projected Future Water Development in Nevada (Scenarios A, B, C1, and C2)




[1] Fort Mojave Indian Tribe's reserved diversion water right in Nevada is 12,534 AFY.

## Arizona

*Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. In Arizona, the FMIT expects to divert its full reserved water right of 103,535 AFY by 2025, mainly through an increase in DCMI water use. Agricultural diversions would remain constant with current use (63,481 AFY) although efficiency would increase to 73 percent by 2040 and 90 percent by 2060, increasing consumptive use. Any diversions not used for AG would be used to increase DCMI diversions to reach the Tribe's full water right by 2020. All ENV water use is non-consumptive and there would no TRAN water use under Scenario A.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. The FMIT assumes that the Scenario B schedule would be the same as Scenario A as the Tribe cannot imagine a slower growth rate than Current Water Development Trends. The Tribe is not dependent on federal funding for future water development and Tribal income is sufficient to maintain current trajectory.

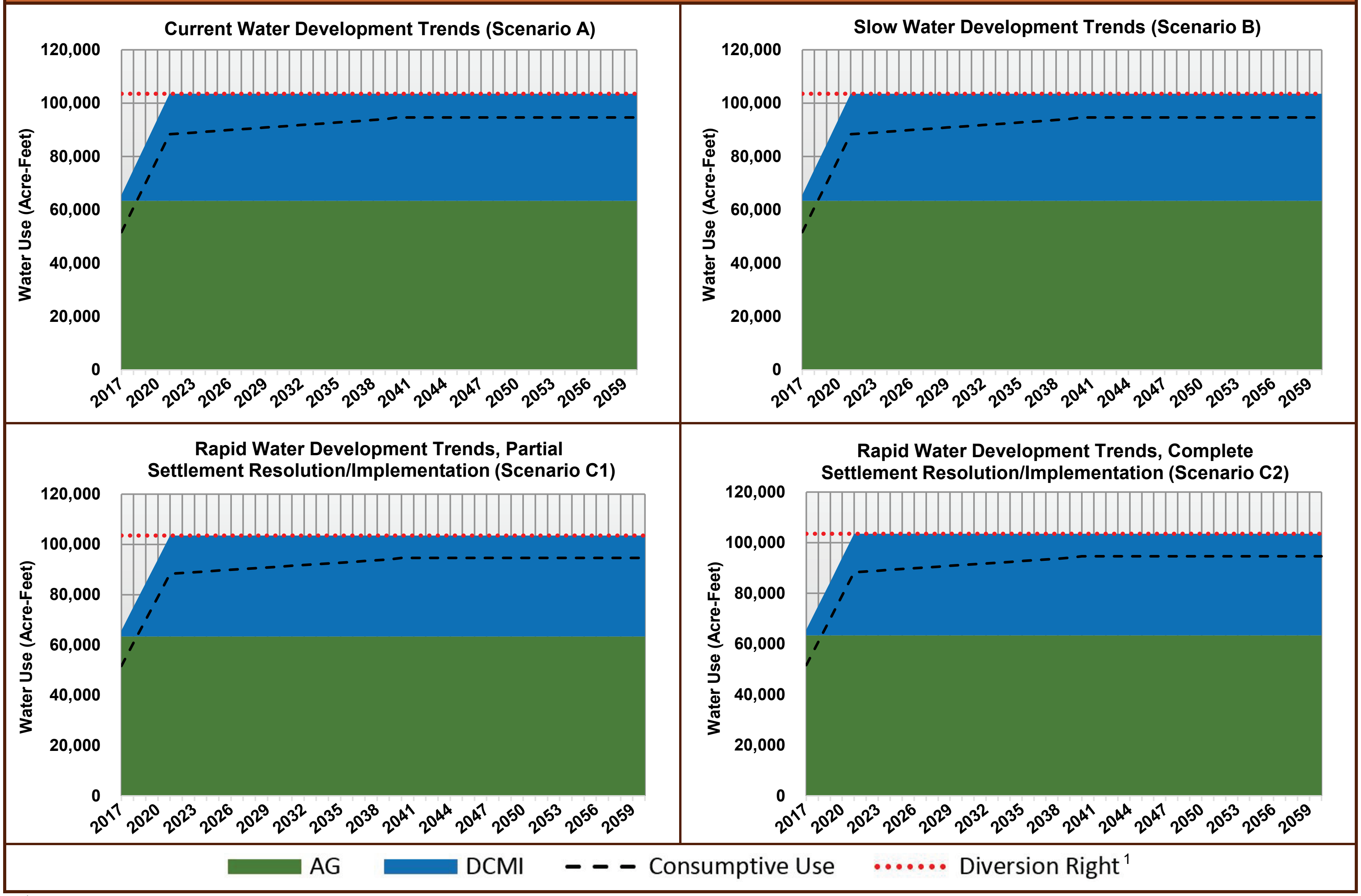
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. The schedule for this scenario is the same as Current Water Development Trends, Scenario A, except that AG and DCMI efficiencies would increase, increasing consumptive use. AG efficiency would increase by 10 percent in 2020 and 90 percent by 2060. DCMI efficiency would increase to 90 percent by 2060 due to an increase in energy production.

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. The schedule for this scenario is the same as Scenario C1.

**FIGURE 5.6-F**
Fort Mojave Indian Tribe Projected Future Water Development in Arizona (Scenarios A, B, C1, and C2)




[1] Fort Mojave Indian Tribe's reserved diversion water right in Arizona is 103,535 AFY.

## California

### *Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. In California, the FMIT currently diverts 15,124 AFY for AG purposes, almost its full right of 16,720 AFY. The Tribe assumed a slight increase in AG diversions by 2018 to reach full right. Agricultural efficiency would increase to 90 percent by 2060, increasing consumptive use. DCMI diversions would remain the same at 51 AFY. All ENV water use is non-consumptive and there would no TRAN water use under Scenario A.

### *Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. The FMIT assumes that the Scenario B schedule would be the same as Scenario A as the Tribe cannot imagine a slower growth rate than current trends. The Tribe is not dependent on federal funding for future water development and Tribal income is sufficient to maintain current trajectory.

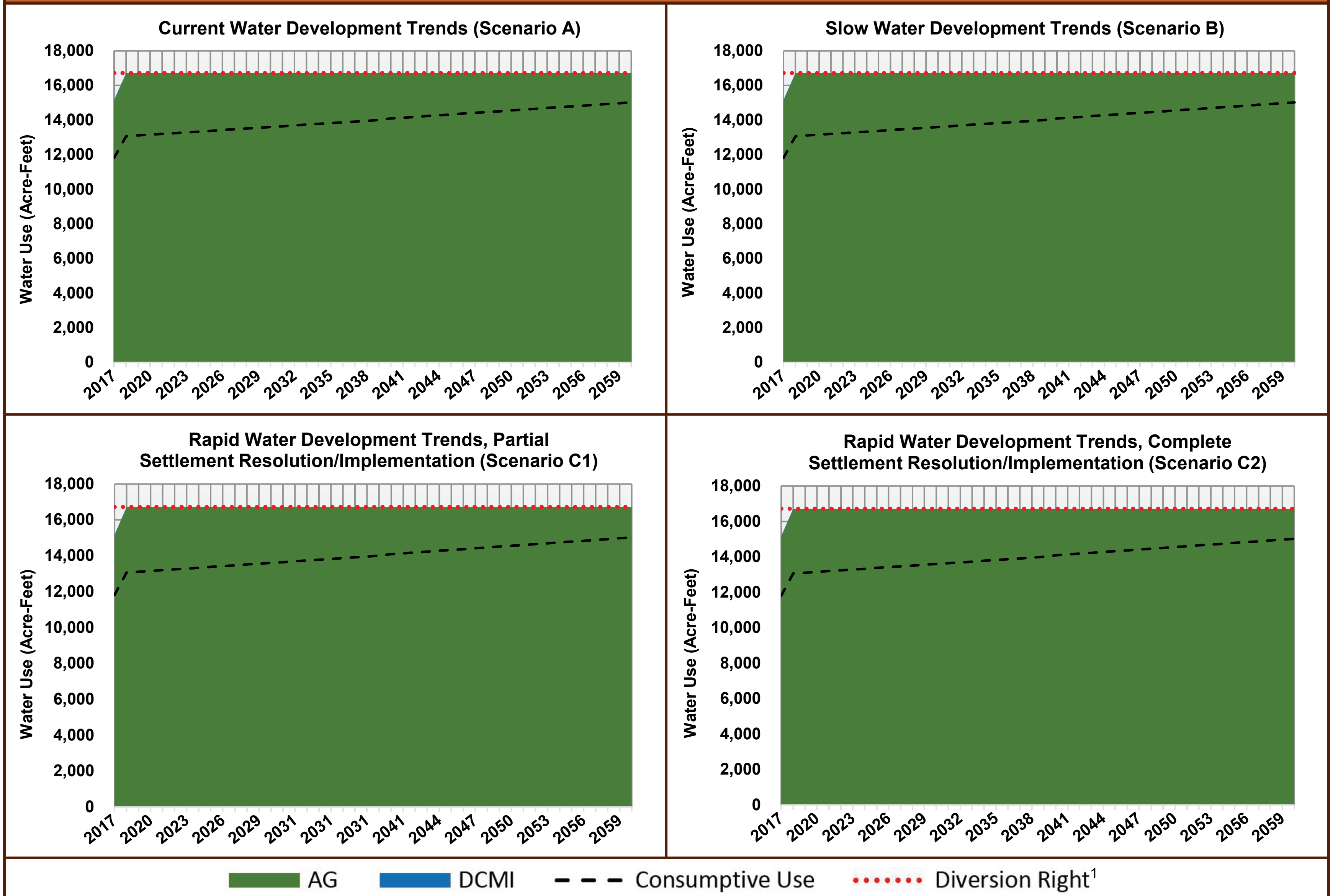
### *Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. The schedule for this scenario is the same as Current Water Development Trends, Scenario A.

### *Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. The schedule for this scenario is the same as Current Water Development Trends, Scenario A.

**FIGURE 5.6-G**
Fort Mojave Indian Tribe Projected Future Water Development in California (Scenarios A, B, C1, and C2)




[1] Fort Mojave Indian Tribe's reserved diversion water right in California is 16,720 AFY.

### *5.6.7.2 Summary of Projected Future Water Development*

FMIT's current water use and projected future water development under the Tribal Water Study's water development scenarios, and modeled for analysis purposes, is presented in Table 5.6-F, 5.6-G, and 5.6-H.

**TABLE 5.6-F**
Summary of Fort Mojave Indian Tribe Current Water Use and Projected Future Water Development in Nevada[1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| Current Use | *AG* | 2,787 | 2,174 | 2,787 | 2,174 | 2,787 | 2,174 | 2,787 | 2,174 |
| | *DCMI* | 1,934 | 774 | 1,934 | 774 | 1,934 | 774 | 1,934 | 774 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **4,721** | **2,948** | **4,721** | **2,948** | **4,721** | **2,948** | **4,721** | **2,948** |
| Use at 2040 | *AG* | 5,574 | 4,706 | 5,574 | 4,706 | 5,574 | 4,706 | 5,574 | 4,706 |
| | *DCMI* | 6,960 | 2,784 | 6,960 | 2,784 | 6,960 | 2,784 | 6,960 | 2,784 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **12,534** | **7,490** | **12,534** | **7,490** | **12,534** | **7,490** | **12,534** | **7,490** |
| Use at 2060 | *AG* | 5,574 | 5,017 | 5,574 | 5,017 | 5,574 | 5,017 | 5,574 | 5,017 |
| | *DCMI* | 6,960 | 2,784 | 6,960 | 2,784 | 6,960 | 2,784 | 6,960 | 2,784 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **12,534** | **7,801** | **12,534** | **7,801** | **12,534** | **7,801** | **12,534** | **7,801** |

[1] Fort Mojave Indian Tribe's reserved diversion water right in Nevada is 12,534 AFY.

**TABLE 5.6-G**
Summary of Fort Mojave Indian Tribe Current Water Use and Projected Future Water Development in Arizona[1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| Current Use | *AG* | 63,409 | 49,515 | 63,409 | 49,515 | 63,409 | 49,515 | 63,409 | 49,515 |
| | *DCMI* | 2,313 | 2,166 | 2,313 | 2,166 | 2,313 | 2,166 | 2,313 | 2,166 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **65,722** | **51,681** | **65,722** | **51,681** | **65,722** | **51,681** | **65,722** | **51,681** |
| Use at 2040 | *AG* | 63,409 | 57,068 | 63,409 | 57,068 | 63,409 | 57,068 | 63,409 | 57,068 |
| | *DCMI* | 40,126 | 37,576 | 40,126 | 37,576 | 40,126 | 37,576 | 40,126 | 37,576 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **103,535** | **94,644** | **103,535** | **94,644** | **103,535** | **94,644** | **103,535** | **94,644** |
| Use at 2060 | *AG* | 63,409 | 57,068 | 63,409 | 57,068 | 63,409 | 57,068 | 63,409 | 57,068 |
| | *DCMI* | 40,126 | 37,576 | 40,126 | 37,576 | 40,126 | 37,576 | 40,126 | 37,576 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **103,535** | **94,644** | **103,535** | **94,644** | **103,535** | **94,644** | **103,535** | **94,644** |

[1] Fort Mojave Indian Tribe's reserved diversion water right in Arizona is 103,535 AFY.



*See the Disclaimer and Introduction to Chapter 5.0.*

**TABLE 5.6-H**
Summary of Fort Mojave Indian Tribe Current Water Use and Projected Future Water Development in California [1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| **Current Use** | *AG* | 15,124 | 11,797 | 15,124 | 11,797 | 15,124 | 11,797 | 15,124 | 11,797 |
| | *DCMI* | 51 | 20 | 51 | 20 | 51 | 20 | 51 | 20 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **15,175** | **11,817** | **15,175** | **11,817** | **15,175** | **11,817** | **15,175** | **11,817** |
| **Use at 2040** | *AG* | 16,669 | 14,072 | 16,669 | 14,072 | 16,669 | 14,072 | 16,669 | 14,072 |
| | *DCMI* | 51 | 20 | 51 | 20 | 51 | 20 | 51 | 20 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **16,720** | **14,092** | **16,720** | **14,092** | **16,720** | **14,092** | **16,720** | **14,092** |
| **Use at 2060** | *AG* | 16,669 | 15,002 | 16,669 | 15,002 | 16,669 | 15,002 | 16,669 | 15,002 |
| | *DCMI* | 51 | 20 | 51 | 20 | 51 | 20 | 51 | 20 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **16,720** | **15,022** | **16,720** | **15,022** | **16,720** | **15,022** | **16,720** | **15,022** |

[1] Fort Mojave Indian Tribe's reserved diversion water right in California is 16,720 AFY.

## 5.7 Chemehuevi Indian Tribe

### 5.7.1 Introduction

Established in 1907, the Chemehuevi Indian Reservation (Reservation) is located approximately 40 miles south of Needles, California on the California shore of Lake Havasu, across the reservoir from Lake Havasu City, Arizona. The Reservation is comprised of approximately 32,000 acres of trust land that includes thirty miles of Colorado River frontage.

The Reservation is divided into two segments, one directly north of Havasu Landing and one directly to the south. An improved road cuts through the northern segment from Havasu Landing with unsurfaced roads branching off of it. The northern section also has a private, unimproved air strip. The southern section has much rougher terrain and only one surfaced road entering into the southeast corner serving the Roads End Trading Post.

The Chemehuevi Indian Tribe (Tribe) has an enrollment of 1,145 members, with approximately 250 living on the Reservation. Approximately 350 tribal members live near the Reservation area and access and use Tribal water resources.

Figure 5.8-A presents a general location map with Reservation boundaries, communities, and other important features.

### 5.7.2 Physical Setting

The topography in the northern half of the Reservation is distinctly different from that of the southern portion. The north is primarily an outwash area from hills to the west with an average slope of three percent or less leading towards Lake Havasu. Elevation for this area averages around 870 feet at its high point, down to about 500 feet.

The southern half of the reservation is more rugged and comprised largely of the Whipple Mountains. Rocky outcrops, canyons, and deep washes are typical; however, the shoreline areas are relatively flat. Elevation for this area averages 1050 feet down to 500 feet.

#### *5.7.2.1 Watersheds*

The Colorado River forms the eastern border of the Reservation. Flows in this reach of the river are regulated by Davis and Parker Dams.

The Reservation gets an annual average of approximately 4 in of precipitation on the approximately 32,000 acres of Tribal lands. Some of this precipitation comes from monsoonal storms that generate stormwater runoff, which flows towards the Colorado River.

#### *5.7.2.2 Hydrogeology*

The Reservation is located on part of the floodplain of the Colorado River in an area of undifferentiated alluvial sediments and sedimentary rocks of Quaternary age that include floodplain deposits and fanglomeratic deposits derived from the surrounding mountains. Colorado River water is supplied to the Reservation by numerous domestic and irrigation wells.

**FIGURE 5.7-A**
Chemehuevi Indian Tribe Reservation Map




*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.7.2.3 Climate*

The reservation is in the Sonoran Desert. Wintertime highs are generally in the upper 60s to lower 70s (°F). Lows during the winter are between 40 °F and 50 °F. Highs in June, July, August, and September remain in the 100 °F to 110 °F range, and days over 115 °F or even +120 °F are not rare.

The average annual precipitation is approximately four inches, with winter rains forming about 50 percent of the annual total precipitation. Winter rains are generally gentle, prolonged and occur over a wide area. Sporadic, intense summer rains occur from July – September.

### 5.7.3 Chemehuevi Indian Tribe Water Supply

The Tribe holds present perfected federal Indian reserved water rights from the Colorado River mainstream pursuant to the decree in *Arizona v. California* ,547 U.S. 150 (2006) (commonly referred to as the 2006 Consolidated Decree). The amounts, including added lands, priority dates, and states where the water rights are perfected are presented in Table 5.7-A.

**TABLE 5.7-A**
Chemehuevi Indian Tribe Colorado River Decreed Diversion Right

| Reservation | State | Diversion Water Right (AFY)[1] | Net Acres | Priority Within State | Priority Date |
|---|---|---|---|---|---|
| Chemehuevi Reservation | California | 11,340 | 1,900 | PPR | Feb. 2, 1907 |
| **Totals** | | **11,340** | **1,900** | | |

[1] Source: Consolidated Decree of March 27, 2006. The quantity of water in each instance is measured by (i) diversions or (ii) consumptive use required for irrigation of the respective acreage and for satisfaction of related uses, whichever of (i) or (ii) is less.

AFY – Acre-feet per year

### 5.7.4 Current Water Use and Operations

Most of the water use on the Reservation is municipal and industrial. Because of poor quality soils, little farming occurs on the Reservation. However, the Lake Havasu area experiences extremely high levels of visitors during the spring and summer and many holidays.

#### *5.7.4.1 Irrigated Agriculture and Livestock Water Use Category*

Agricultural water use on the Reservation has focused on providing native plants for cultural purposes and localized fruit and vegetable production for the community. Efforts have been drastically impacted by the lack of funding and the unreliability of an existing surface water pumping station. The Tribal farm has been making a tremendous effort to make its current 80-acre parcel productive. Efforts to amend the soil has caused an increase in water use and additional irrigation needs. Irrigation water is conveyed mostly by approximately 15 miles of pipelines pumping directly from the Colorado River and a few miles of ditches and unlined canals to direct and store flood water.

Table 5.7-B describes well production for the period from 2010 to 2014. Table 5.7-C describes the acreage irrigated and the water application system.

**TABLE 5.7-B**
Chemehuevi Irrigated Agriculture and Livestock Water Diversions (2010 – 2014)

| Diversions | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 |
| Surface Water Delivered | 25 | 21.2 | 21.2 | 39.84 | 63.2 |

AF – Acre-feet

**TABLE 5.7-C**
Chemehuevi Current Agricultural Water Use Application

| Crop | Total Acreage | Acreage Irrigated by Application | |
|---|---|---|---|
| | | Flood | Sprinkler |
| Field Crop | 40 | 30 | 10 |
| Fruit and Tree Nuts | 10 | 10 | 0 |
| Vegetables | 10 | 10 | 0 |
| Other | 20 | 20 | 0 |

### *5.7.4.2 Domestic, Commercial, Municipal, and Industrial Water Use Category*

Colorado River water is diverted for domestic and municipal use from wells located on the Reservation in the River's floodplain. The East and West Wells pumping stations feed the public water supply system for the Chemehuevi Indian community, the Havasu Landing Resort & Casino entities, and Vista De Lago, a gated community located off Tribal lands but a user of water transferred from the Tribe. Section 36, a community surrounded by the Reservation, currently pumps surface water from the Colorado River, but is interested in obtaining water from the Tribe due to its better quality.

Table 5.7-D describes well production for the period from 2010 to 2014. Table 5.7-E describes municipal and industrial use for the same time frame.

**TABLE 5.7-D**
Colorado River Water Obtained Via Wells (2010 – 2014)

| Diversions | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 |
| Domestic Wells | 116 | 118 | 119 | 185 | 117 |
| Airport Well (no meter) | 5 | 5 | 5 | 0 | 0 |
| Havasu Ventures Domestic Wells | 10 | 10 | 10 | 10 | 10 |
| **Totals** | 131 | 133 | 134 | 195 | 127 |

**TABLE 5.7-E**
Chemehuevi Domestic, Commercial, Municipal, and Industrial Water Diversions (2010 – 2014)

| Diversions | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 |
| Residential - Tribal | 32 | 29 | 31 | 31 | 32 |
| Residential - Resort | 36 | 41 | 43 | 43 | 40 |
| Commercial, Industrial, and Institutional - Tribal | 8 | 3 | 6 | 7 | 8 |
| Commercial, Industrial, and Institutional - Resort | 40 | 44 | 39 | 46 | 38 |
| Outdoor Landscaping (e.g. parks, golf courses) | 1 | 1 | 1 | 1 | 17 |
| Residential - Tribal | 117 | 118 | 120 | 128 | 135 |
| **Totals** | 32 | 29 | 31 | 31 | 32 |

### 5.7.4.3 Environmental, Cultural, and Recreational Water Use Category

Annually, the Tribal Environmental Department completes projects to expand native vegetation habitats in riparian zones. Areas infested with non-native salt cedar (tamarisk) are being re-vegetated with native cottonwood, willow and mesquite. This restoration effort used five acre feet per year (AFY) between 2010 and 2014.

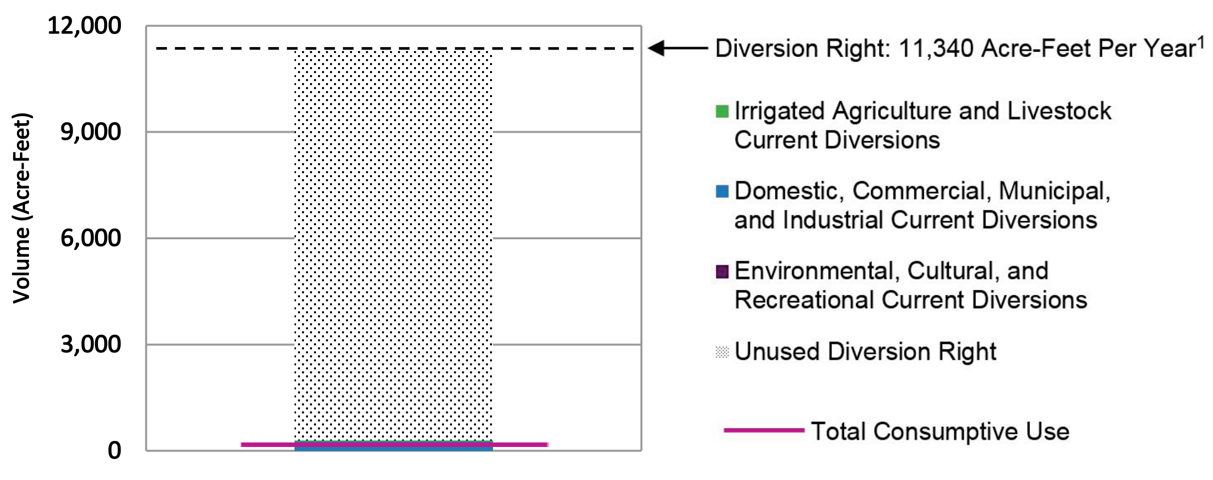
### 5.7.4.4 Water Use Efficiency and Conservation

All companies and contractors are required to ensure water efficient practices are implemented during the development of projects on Reservation lands.

### 5.7.4.5 Summary of Current Water Use

The Tribe's average annual water use for the period 2010 through 2014 in California is presented in Figure 5.7-B and Table 5.7-F. The average annual water use for this period is consistent with Reclamation's Colorado River Accounting and Water Use Reports: Arizona, California, and Nevada (Water Accounting Report) (Reclamation, 2017) and was supplemented with water use information provided by the Tribe for the purpose of the Tribal Water Study. Consumptive use was estimated using either efficiency factors in the Water Accounting Report or standard engineering efficiencies.

**FIGURE 5.7-B**
Chemehuevi Indian Tribe Current Average Annual Water Use in California (2010 – 2014)




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 11,340 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 1,900 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

**TABLE 5.7-F**
Chemehuevi Indian Tribe Current Average Annual Water Use in California

| State | Water Use Category | Diversion (AFY) | Estimated Current Consumptive Use (AFY) |
|---|---|---|---|
| California | AG | 27 | 14 |
| | DCMI | 270 | 145 |
| | ENV | 10 | 5 |
| **Total** | | **307** | **164** |

AG – Irrigated Agriculture and Livestock
DCMI – Domestic, Commercial, Municipal, and Industrial
ENV – Environmental, Cultural, and Recreational

## 5.7.5 Projected Future Water Development

The Tribe's future water development was assessed by first examining the location, quantity and type of current water use and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreases flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

The Tribe contemplated its future water development through 2060 by reviewing its current water use estimates and reflecting upon how these might change under the four scenarios. During this process, the Tribe considered such elements as the scenario conditions described in the storylines, current or future planned projects, anticipated changes in water use by category, and the extent and condition of existing water infrastructure and the need, as well as the cost, for new infrastructure to support water development. The Tribe contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges (TRAN).

From this examination, the Tribe extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared a quantified water development schedule for its reserved water right in California. Subsequently, the Tribe used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each development schedule is presented in the following sections.

### *5.7.5.1 Future Water Development Schedules*

The assumptions used to prepare each water development schedule are described below. The schedules are presented graphically in Figure 5.7-C and numerically in Table 5.7-G.

*Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. The Tribe currently diverts a small portion, approximately 307 AFY, of its 11,340 AFY reserved water right, mostly for DCMI purposes. Under Scenario A, the Tribe assumed that DCMI would continue to be the main water use. DCMI diversions would increase to 5,275 AFY by 2040 to support development in the southern part of the Reservation and increase another 20 percent between 2040 and 2060 for development in the northern part of the Reservation. AG use would double to 54 AFY by 2060, but AG efficiency would remain at 54 percent because of poor quality soils. ENV diversions would triple from the current 10 AFY to 30 AFY by 2060 because of increased riparian habitat restoration (assumed 25 acres by 2060). There would be no TRAN water use under Scenario A.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, the Tribe assumed that DCMI diversions would increase by 5,000 AFY through 2060 to support development on the northern and southern portions of the Reservation. AG diversions would increase by 10 percent through 2060. There would be no future ENV diversions and no TRAN water use.

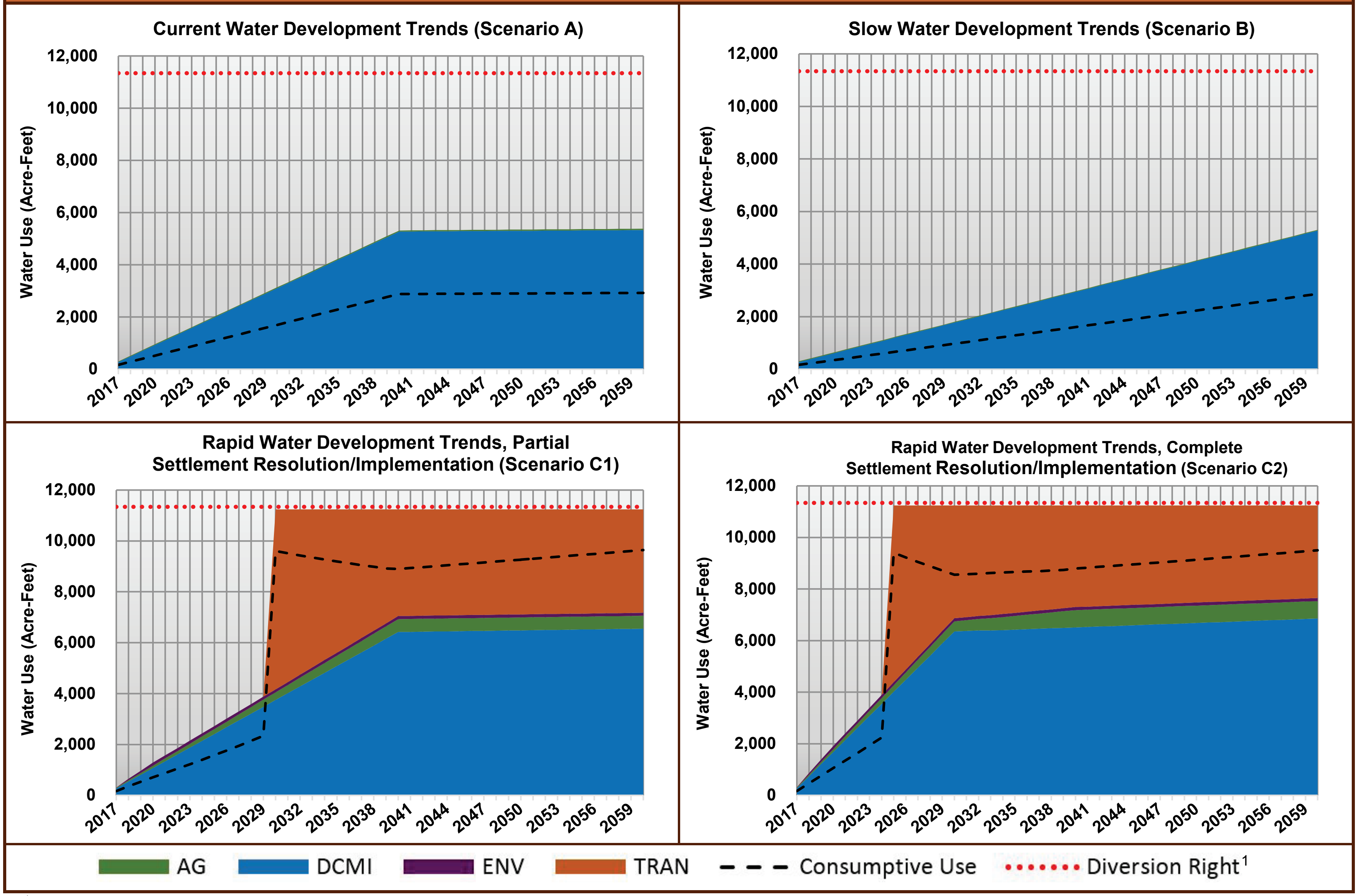
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities and increased funding availability leads to tribal economic development. Under Scenario C1, the Tribe assumed that, by 2040, DCMI diversions would increase by approximately 6,200 AFY for development of 300-500 new homes in the northern part of the Reservation and development of the southern portion of the Reservation. By 2060, DCMI diversion would be approximately 6,550 AFY. AG diversions would increase by 480 AFY by 2040 for the irrigation of an additional 60 acres of land. ENV diversions would increase to 120 AFY by 2040 for riparian habitat restoration. Diversions for TRAN would begin in 2030 allowing the Tribe to develop its full water right

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. Under this scenario, DCMI diversions would increase to approximately 6,500 AFY by 2030 for Reservation development. AG diversions would increase slightly over Scenario C1 to 675 AFY by 2060. ENV diversions would be similar to Scenario C1. Diversions for TRAN would begin in 2025 allowing the Tribe to develop its full water right.

**FIGURE 5.7-C**
Chemehuevi Indian Tribe Projected Future Development in California (Scenarios A, B, C1, and C2)




[1] Chemehuevi Indian Tribe's reserved diversion water right in California is 11,340 AFY.

### *5.7.5.2 Summary of Projected Future Water Development*

The Tribe's current water use and projected future water development under the Study's water development scenarios, and modeled for analysis purposes, is presented in Table 5.7-G.

**TABLE 5.7-G**
Summary of Chemehuevi Indian Tribe's Current Water Use and Projected Water Development in California [1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| Current Use | *AG* | 27 | 14 | 27 | 14 | 27 | 14 | 27 | 14 |
| | *DCMI* | 275[2] | 148 | 275[2] | 148 | 275[2] | 148 | 275[2] | 148 |
| | *ENV* | 10 | 5 | 10 | 5 | 10 | 5 | 10 | 5 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **312** | **167** | **312** | **167** | **312** | **167** | **312** | **167** |
| Use at 2040 | *AG* | 41 | 22 | 28 | 15 | 507 | 274 | 669 | 361 |
| | *DCMI* | 5,275 | 2,849 | 2,949 | 1,593 | 6,422 | 4,367 | 6,513 | 4,429 |
| | *ENV* | 21 | 11 | 0 | 0 | 120 | 65 | 120 | 65 |
| | *TRAN* | 0 | 0 | 0 | 0 | 4,191 | 4,191 | 3,938 | 3,938 |
| | **Total** | **5,337** | **2,882** | **2,977** | **1,608** | **11,240** | **8,897** | **11,240** | **8,793** |
| Use at 2060 | *AG* | 54 | 29 | 29 | 16 | 507 | 274 | 675 | 365 |
| | *DCMI* | 5,330 | 2,878 | 5,275 | 2,849 | 6,550 | 5,240 | 6,858 | 5,486 |
| | *ENV* | 30 | 16 | 0 | 0 | 120 | 65 | 120 | 65 |
| | *TRAN* | 0 | 0 | 0 | 0 | 4,063 | 4,063 | 3,587 | 3,587 |
| | **Total** | **5,414** | **2,923** | **5,304** | **2,865** | **11,240** | **9,642** | **11,240** | **9,503** |

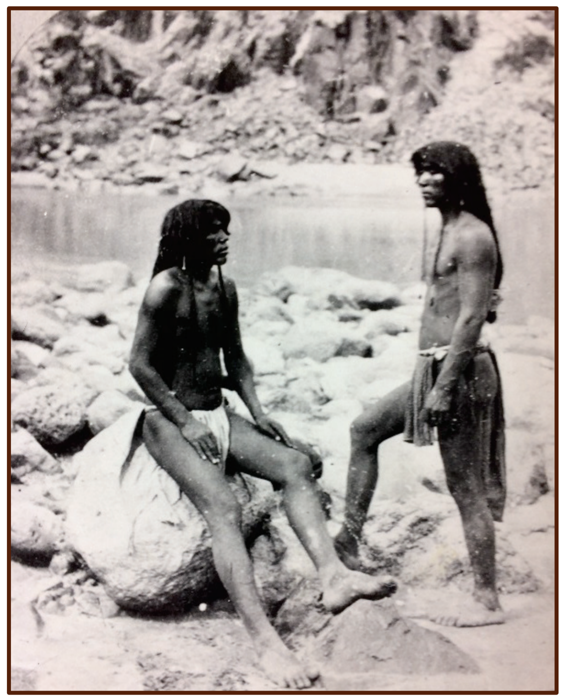
[1] Chemehuevi Indian Tribe's reserved diversion water right in California is 11,340 AFY.
[2] An additional 5 AFY of DCMI current use was modeled because of a new casino development planned for 2017.

## 5.8 Colorado River Indian Tribes

### 5.8.1 Introduction

The Colorado River Indian Reservation (Reservation) was established by the Act of March 3, 1865 (13 Stat. 559), setting aside lands for "Indians of the Colorado River and its tributaries." This broad, inclusive language contemplated situating numerous tribes in a single location, as was the practice of Congress at that time. The lands were originally occupied by the Mohave people ("Aha Makhav" - The Water People) which, when the Spanish arrived in the territory in the 16th Century, were the largest concentration of people in the American Southwest. Modern archaeological interpretations indicate the Mohave have lived along the Colorado River for a period in excess of 12,000 years.

The lands of the Reservation were originally occupied by two tribes, first the Mohave and later the Chemehuevi, who have inhabited the area on either side of the Colorado River for millennia. In the 1940s, and 1950s, families from two additional tribes, the Hopi and Navajo, were relocated to the Reservation, with the promise of plots of land to farm. Often, these families also received a 'home' to live in on their 10-acre parcel, consisting of a one-room bungalow salvaged from the former War Relocation Authority's Poston Camps I – III, the largest Japanese internment camp in Arizona during the World War II era.



Panambona and Mitiwara at Colorado River shoreline. Mohave Tribe. Date: 1871.
*Source: Smithsonian Institution, Bureau of American Ethnology; Photographer: Timothy H. O'Sullivan, taken during Colorado River Expedition of 1871, under Lt. George M. Wheeler.*

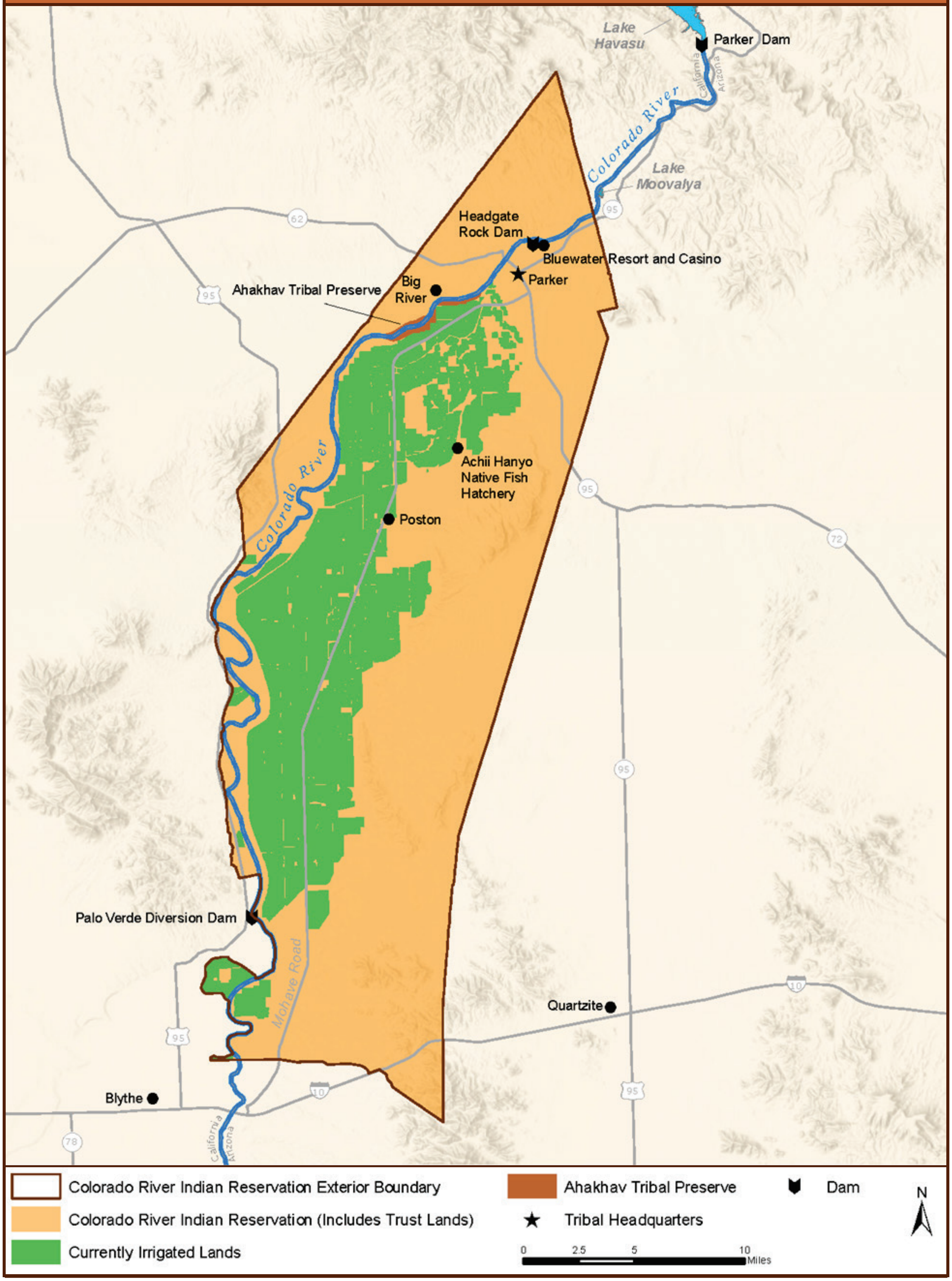
Located approximately 155 miles west of Phoenix, Arizona, the Reservation is 56 miles from north to south along the Colorado River with land in both Arizona and California. The Reservation includes approximately 300,000 acres of land, with the river serving as the life-sustaining cultural and economic focal point of the community.

The Reservation consists of 353 square miles of land in Arizona (La Paz County) and 66.7 square miles in California (San Bernardino and Riverside Counties). The Reservation includes over 113 miles of shoreline along the Colorado River.

The Colorado River Indian Tribes (CRIT or Tribes) include four distinct tribes - the Mohave, Chemehuevi, Hopi, and Navajo. There are currently about 4,277 Tribal members, and that number is increasing steadily. CRIT's water use planning takes this growth rate into account. The primary community on the Reservation is Parker, Arizona, which is located on a combination of land leased from the Tribes and land that is owned in fee. There are other, smaller communities within the reservation, including Poston, located 15 miles south of Parker.

Figure 5.8-A presents a general location map with Reservation boundaries, communities, and other important features.

**FIGURE 5.8-A**
Colorado River Indian Tribes Reservation Map



## 5.8.2 Physical Setting

### *5.8.2.1 Watersheds*

The Colorado River enters the Reservation at its northern boundary and flows toward the south. The reaches of the river affecting the CRIT are regulated by Parker Dam, Headgate Rock Dam, and Palo Verde Diversion Dam and by levees constructed and maintained by Reclamation. Additionally, the river banks have been stabilized to protect them from erosion at many critical locations.

### *5.8.2.2 Hydrogeology*

The Reservation is located on part of the floodplain of the Colorado River in an area of undifferentiated alluvial sediments and sedimentary rocks of Quaternary age that include floodplain deposits and fanglomerate deposits derived from the surrounding mountains. Numerous domestic and irrigation wells can be found throughout the area.

Primary Irrigation Canal - Colorado River Indian Reservation Irrigation Project
*Source: Colorado River Indian Tribes - Photo by: Maria de Los Angeles Guzman, Water Resources*

### *5.8.2.3 Climate*

The reservation is located where the Sonoran Desert meets the Mojave Desert. Wintertime highs are generally in the upper 60s to lower 70s (°F). Lows during the winter are between 40 °F and 50 °F. Highs in June, July, August, and September run in the 100 °F to 110 °F range, and days over 115 °F or even 120 °F are not rare.

The average annual precipitation is approximately 5.1 inches at Parker, Arizona, and 3.8 inches toward the southern end of the Reservation, near Blythe, California, with winter rains forming about 50 percent of the annual total precipitation. Winter rains are generally gentle, prolonged, and occur over a wide area. Sporadic, intense summer ‘monsoon’ rains occur from July through September.

## 5.8.3 Historical Use and Cultural Importance of Water

The Mohave people have been practicing floodplain and irrigated agriculture for over 4,000 years along the Colorado River. Early irrigation practices followed the River’s natural flood-cycle patterns, planting as the spring floodwaters receded. Later developments included hand-dug ditches and canals to divert water onto cultivated upland fields. The Tribes grew (and still grow) food and utility crops such as corn, mesquite, squash, and beans, as well as native trees for cultural uses.

Irrigation ditch-cleaning machinery in operation, Colorado River Indian Reservation.
Date: Unknown (approximately 1940 -1945).
*Source: Colorado River Indian Tribes - Library Archives*

Beginning in the 1870s, development of what has become the Colorado River Irrigation Project (CRIP) began. Authorized for construction in 1867, the CRIP was the first irrigation project built by the BIA. The CRIP currently serves 79,350 acres in Arizona. Recent agriculture trends have resulted in increased production of commercial crops such as alfalfa, cotton, soy, wheat and other vegetable commodities. Tribal members work their own assigned lands, or may lease their land. CRIT leases land to private and commercial farming enterprises. The Tribes also operates a large commercial farming enterprise known as CRIT Farms, managing 12,000 to 15,000 acres on average, with revenues benefiting the community at large.

As described in more detail below, the majority of CRIT water is now used in the irrigation of approximately 80,000 acres of Reservation farmland in Arizona and California. CRIT rotates several thousand acres into and out of production each year as good land stewardship dictates, and is actively developing new farmland on reservation lands in both Arizona and California.

Today, the relationship of the Mohave people to the land, water and environment is celebrated through song and ceremony. For thousands of years before the United States came into existence, ancestors of the Colorado River Indian Tribes left their footprints on the trails beside the Colorado River. Along the extensive system of trails beside the river, and at locations now inundated by the river, villages and significant cultural and gathering sites are evident, marked by petroglyphs and geoglyphs. The location, purpose and names of these sites are united through clan songs, language, and stories that express, communicate, and preserve their spirituality, cultural knowledge and history.

### 5.8.4 Colorado River Indian Tribes Water Supply

CRIT possesses present perfected federal Indian reserved water rights from the Colorado River mainstem pursuant to the decree in *Arizona v. California,* 547 U.S. 150 (2006) (commonly referred to as the 2006 Consolidated Decree). The amounts, priority dates, and states where the reserved water rights are perfected are presented in Table 5.8-A.

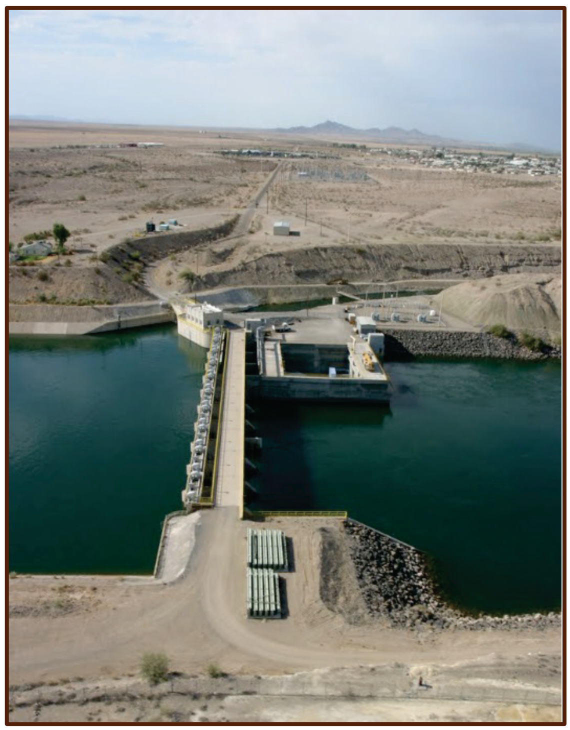
**TABLE 5.8-A**
Colorado River Indian Tribes Colorado River Decreed Water Right

| Reservation | State | Diversion Water Right (AFY)[1] | Net Acres | Priority Within State | Priority Date |
|---|---|---|---|---|---|
| Colorado River Indian Reservation | Arizona | 358,400 | 53,768 | 1 | Mar. 3, 1865 |
| | | 252,016 | 37,808 | 1 | Nov. 22, 1873 |
| | | 51,986 | 7,799 | 1 | Nov. 16, 1874 |
| | ***Subtotal*** | ***662,402*** | | | |
| | California | 10,745 | 1,612 | 1 | Nov. 22, 1873 |
| | | 40,241 | 6,037 | 1 | Nov. 16, 1874 |
| | | 5,860 | 879 | 1 | May 15, 1876 |
| | ***Subtotal*** | ***56,846*** | | | |
| **Total** | | **719,248** | **107,903** | | |

[1] Source: Consolidated Decree of March 27, 2006. The quantity of water in each instance is measured by (i) diversions or (ii) consumptive use required for irrigation of the respective acreage and for satisfaction of related uses, whichever of (i) or (ii) is less.

## 5.8.5 Current Water Use and Operations

CRIT has a strong farming and agricultural industry, including growing alfalfa, grains, cotton, seed crops, grasses, guayule, and melons. In recent years the Tribal economy has diversified into several additional areas. Sand and gravel production, real estate development, and retail stores have all become part of the Tribes' economic development activities. Over the past two decades, CRIT has focused greater attention on fostering tourism by opening the BlueWater Resort and Casino in Parker, Arizona which attracts both cultural and recreational visitors to the area.



Headgate Rock Dam - forms Lake Moovalya, houses 18MW hydro powerplant, and serves as an entry gate to the Colorado River Irrigation Project.
*Source: Colorado River Indian Tribes - Photo by: Maria de Los Angeles Guzman, Water Resources*

### *5.8.5.1 Irrigated Agriculture and Livestock Water Use Category*

As noted previously, CRIT has a strong farming and agricultural industry. With approximately 80,000 acres already developed for cultivation, and another 30,000 acres available for additional development, CRIT is able to utilize its water resources in a variety of ways to meet the challenges and opportunities that lie ahead for the Colorado River Basin (Basin).

Agriculture is predominately flood irrigated, with water supplied through an extensive canal system. In June 1942, the construction of Headgate Rock Dam and powerplant on the Colorado River created Lake Moovalya and allowed for gravity diversion from the river on-demand. Water from this diversion runs through an irrigation system that feeds the many farms on the Arizona side of the reservation.

CRIT presently utilizes the majority of its available water supply in agricultural production. As irrigation practices become more efficient, CRIT's capacity to put additional lands into production is improving, as is the overall efficiency of water use on the Reservation.

Individual ranchers, farmers, and area 4-H clubs raise small herds of livestock – predominantly sheep, but also cattle and horses. The aggregate water usage by livestock on the Reservation is estimated to be less than ten acre-feet per year (AFY).

Blue water into green fields - Colorado River Irrigation Project Canal feeding some of the 85,000 acres of developed farmland.
*Source: Colorado River Indian Tribes - Photo by: Maria de Los Angeles Guzman, Water Resources*

Table 5.8-B presents agricultural diversions for the period from 2009-2013. The diversion data incorporates Reclamation's annual Water Accounting Reports for calendar years 2009 through 2013 (Reclamation, 2016) and was supplemented with water use information provided by the Tribes for the purpose of the Tribal Water Study.

**TABLE 5.8-B**
Colorado River Indian Tribes Irrigated Agriculture and Livestock Diversions (2009 – 2013)

| Diversions by State | Year (AF) | | | | |
|---|---|---|---|---|---|
| | **2009** | **2010** | **2011** | **2012** | **2013** |
| Arizona | 636,657 | 631,097 | 642,077 | 635,087 | 607,437 |
| California | 3,896 | 3,896 | 3,896 | 3,896 | 3,896 |
| **Total** | **640,553** | **634,993** | **645,973** | **638,983** | **611,333** |

### *5.8.5.2 Domestic, Commercial, Municipal, and Industrial Water Use Category*

The Tribes operates a wastewater treatment facility, known as Joint Venture, in partnership with the Town of Parker, Arizona. This facility serves the majority of the commercial, industrial, municipal and residential customers on the Colorado River Indian Reservation. The Joint Venture facility uses 725,000 gallons of water daily in its 'pass-through' treatment process. Total annual inflow/outflow is about 812 acre-feet (AF) of water which is returned to the Colorado River.

Colorado River Sand & Rock is a major enterprise of CRIT that was established in October 1998. It supplies concrete ready mix, asphalt, sand, construction aggregate, and gravel products to customers in Arizona and California.

Parker, Arizona, Big River and Earp, California
*Source: Colorado River Indian Tribes - Photo by: Maria de Los Angeles Guzman, Water Resources*

Another major commercial water user on the Reservation is the Evoqua Water Technologies facility – a carbon filter re-processing plant which utilizes an average of 3.75 million gallons of water per month in its operations. The annual total equals about 132 AF of consumptive use.

Table 5.8-C presents municipal and industrial diversions for the period from 2009 through 2013. The diversion data incorporates Reclamation's annual Water Accounting Reports for the periods of 2009 through 2013 (Reclamation, 2016), which was supplemented with sector use information provided by the Tribes for the purpose of this Study.

**TABLE 5.8-C**
Colorado River Indian Tribes Domestic, Commercial, Municipal, and Industrial Diversions (2009 – 2013)

| Diversions by State | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| Arizona | 11,390 | 10,874 | 7,697 | 7,392 | 7,526 |
| California | 1,160 | 1,096 | 503 | 1,084 | 1,013 |
| **Total** | **12,550** | **11,970** | **8,200** | **8,476** | **8,539** |

### *5.8.5.3 Environmental, Cultural, and Recreational Water Use Category*

The Mohave people adhere to the wisdom of their Creator, as passed down by their elders through the oral tradition, advising them to maintain a relationship with the Creator by taking care of the land, the water, and the environment "because it takes care of you." The Tribes incorporate that sense of balance in their use of water so people, plants, and animals all have enough to live well, for generations to come.

As part of this approach, the Tribes have set aside significant areas of land in Arizona, such as the Bosque area toward the southern end of the Reservation, and the Ahakhav Tribal Preserve both for cultural resource purposes as well as to address conservation measures. The Tribes also participate in the Lower Colorado River Multi-Species Conservation Program (MSCP) in various ways, for example, by creating backwaters and habitat facilities such as the Achii Hanyo Native Fish Hatchery, to support populations of native and endangered species of plants, birds and fish. Table 5.8-D describes the amount of water diverted to support these efforts.

The Ahakhav Tribal Preserve was established in 1995, and currently uses approximately 1,325 AFY of water. The facility consists of 1,253 acres of wilderness area, about 250 acres of aquatic habitat, and a 3.5-acre park. The Preserve is centered along a reconstructed Colorado River backwater, which offers a variety of activities, including fishing, canoeing, birding, and swimming. The Preserve also features a 4.6-mile-long fitness trail, as well as a playground, landscaped picnic facility, and a spur trail planted with native mesquite, cottonwood and willow. The Preserve provides recreational and learning opportunities to the surrounding community and many visitors, and also serves as a nursery operation and a re-vegetated area for endangered and threatened plants and animals native to the Lower Basin. The Preserve provides a location for ongoing study of methods of re-vegetation and restoration that are then used throughout the Reservation and other locations that could benefit from the research.

The Bosque area serves as a native tree preserve and gathering site for traditional Tribal practices. In particular it is populated by extensive stands of mesquite trees which are spiritually, culturally and environmentally significant to the Mohave. This area is supported by a water table fed, in part, by agricultural tailwater from the southern end of the CRIP. After passing through the Bosque, much of that water reenters the Colorado River as direct and indirect return flow.

In cooperation with the U.S. Fish and Wildlife Service, the Tribes helped develop the Achii Hanyo Native Fish Hatchery (in the Mohave language, “Achii Hanyo” translates as “Fish Lake”) on reservation lands in Arizona. Baseline water use at Achii Hanyo is 208.6 AFY, and the facility purchases excess water from the CRIP of up to 100 AFY, depending on certain conditions. The facility serves as a rearing site for two native fish species – the razorback sucker (*Xyrauchen texanus*) and bonytail chub (*Gila elegans*) – which are both endemic to the Basin, and both are presently listed as endangered. Federal, State, and Tribal resource managers are working along the length of the lower Colorado River to conserve and facilitate the recovery of both native fishes. Propagation of both species in hatcheries produces fish to help re-establish natural populations. Achii Hanyo consists of sixty ponds, creating approximately 100 acres of rearing area. Its tailwater feeds wetlands to the south, before returning to the Colorado River system.

The Colorado River is the Reservation's greatest recreational asset and most scenic attraction. Facilities for swimmers, boaters and water skiers are located along the 113 miles of shoreline within the Reservation boundaries. Lake Moovalya, formed behind Headgate Rock Dam, provides a desirable location for camping, water skiing and fishing. The BlueWater Resort and Casino is located beside the River, just upstream from Headgate Rock Dam.

Bulldozer pushes boulder into breach, closing last remaining channel creating Lake Moovalya behind Headgate Rock Dam. Date: 11/08/1940.
*Source: Colorado River Indian Tribes Library Archives*

**TABLE 5.8-D**
Colorado River Indian Tribes Environmental, Cultural, and Recreational Water Use Diversions (2009 – 2013)

| Diversions by State | Year (AF) | | | | |
|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| Arizona | 1,534 | 1,534 | 1,534 | 1,534 | 1,534 |

### *5.8.5.4 Reservoirs*

Two reservoirs on the Reservation create headwater lakes for diversion intakes into two large irrigation systems – the CRIP and the Palo Verde Irrigation District's system – at the southwestern edge of the Reservation.

### *5.8.5.5 Water Use Efficiency and Conservation*

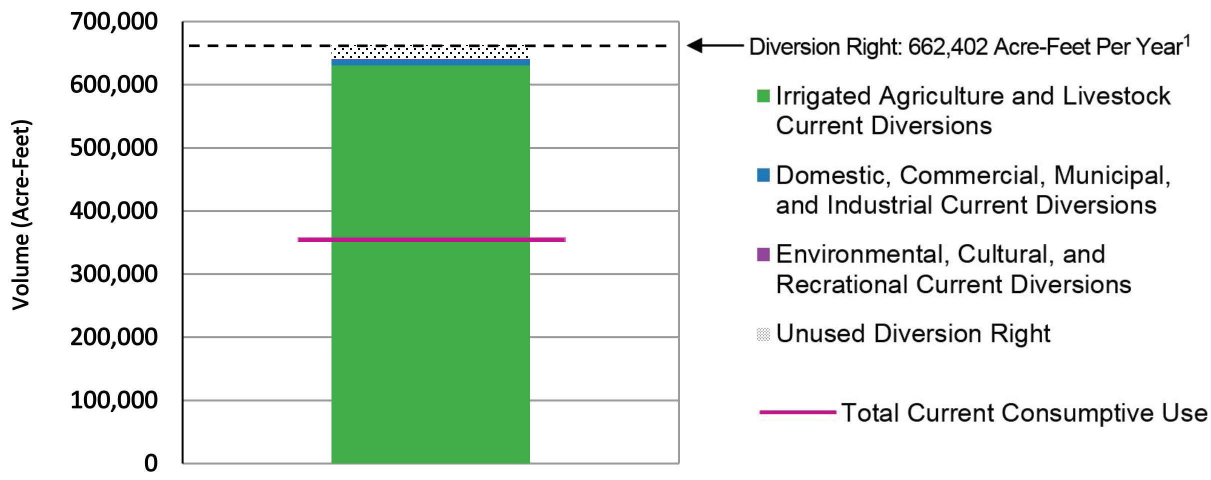
The operation and maintenance of the CRIP – including system efficiency improvements, such as machinery upgrades, measurement tools, and modernization efforts – is managed by the BIA. Supervisory Control and Data Acquisition (SCADA) measurement/control systems are being installed throughout the irrigation project to improve operational efficiency.

### *5.8.5.7 Summary of Current Water Use*

The Tribe's average annual water use for the period from 2009 through 2013 in Arizona is presented in Figure 5.8-B, for California in Figure 5.8-C, and the Tribe's average annual water use in both states is in Table 5.8-E. The average annual water use for the 2009 through 2013 period incorporates Reclamation's annual Water Accounting Report data (Reclamation, 2017), which was supplemented with water use information provided by the Tribes for the purpose of the Tribal Water Study. Therefore, comparisons between this report and the Water Accounting Reports will reflect those additional tribal data inputs. Consumptive use amounts were estimated using either efficiency factors in Reclamation's Water Accounting Report or standard engineering efficiencies.

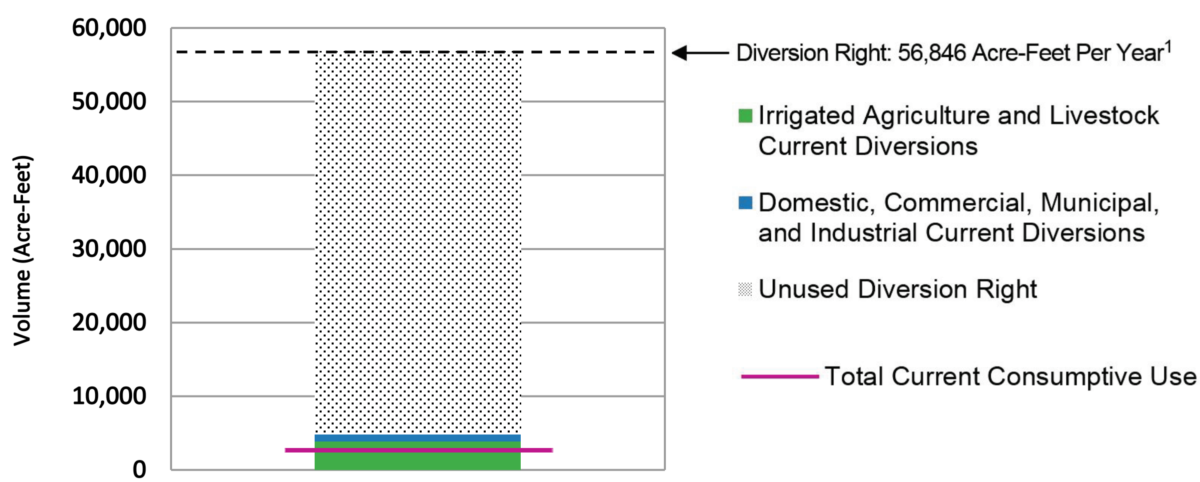

*See the Disclaimer and Introduction to Chapter 5.0.*

**FIGURE 5.8-B**
Colorado River Indian Tribes Current Average Annual Water Use in Arizona (2009 – 2013)




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 662,402 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 99,375 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

**FIGURE 5.8-C**
Colorado River Indian Tribes Current Average Annual Water Use in California (2009 – 2013)




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 56,846 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 8,528 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

**TABLE 5.8-E**
Colorado River Indian Tribes Current Average Annual Water Use by State (2009 – 2013)

| State | Water Use Category | Diversion (AFY) | Estimated Current Consumptive Use (AFY) |
|---|---|---|---|
| Arizona | AG | 630,471 | 348,598 |
| | DCMI | 8,976 | 4,963 |
| | ENV | 1,534 | 848 |
| | ***State Subtotal*** | ***640,981*** | ***354,409*** |
| California | AG | 3,896 | 2,154 |
| | DCMI | 971 | 534 |
| | ***State Subtotal*** | ***4,867*** | ***2,688*** |
| **Total** | | **645,848** | **357,097** |

AG – Irrigated Agriculture and Livestock
DCMI – Domestic, Commercial, Municipal, and Industrial
ENV – Environmental, Cultural, and Recreational

### 5.8.6 Tribal Water Use Challenges

*Aging Infrastructure*

The CRIP was constructed over the course of many decades, beginning in the 1870s. The northern sections are older, and thus suffer more from both design limitations and simple aging problems. Unlined canals, deteriorating gates and turnouts, and imperfect alignments to the terrain all translate into inefficiencies that are not as evident in modern, well-designed, and properly maintained irrigation systems. The high cost to repair infrastructure, including lining canals, reconstructing gates and turnouts, and realigning reaches of the system, limit the Tribes' ability to realize the full potential value of its water.

Diversion Dam, Headgate Rock area.
*Source: Colorado River Indian Tribes Library Archives*

*High Cost of Additional and Replacement Infrastructure*

The CRIP now delivers nearly all of the Tribes' Arizona apportionment of Colorado River water onto presently farmed acreage. However, it does so inefficiently. The Tribes, therefore, face the challenge of identifying critical inefficiencies to determine the most cost-effective solution to improve long-term economic return for its water. Key questions are whether to repair inefficient sectors of the system, add to the system, or to install more water-efficient delivery systems on portions of the land now served by the CRIP. None of these options are simple, or inexpensive.

Unlined section of Main Canal - example of older construction methods and area of potential improvement.
*Source: Photo by: Maria de Los Angeles Guzman, Water Resources*

The Parker Valley, where the majority of CRIT's irrigable Arizona lands are located, is large, relatively flat, and would allow for significant additional cropland development. The CRIP design could likewise accommodate significant expansion as well. However, the costs associated with expansion of the system to develop more acreage is also significant, and prohibitive under present market conditions.

Flood-irrigation systems are inherently inefficient, with expected but significant losses to return flow, tailwater spill, and evaporation; however, if well-operated, those inefficiencies are manageable. Further complicating the matter, the CRIP suffers from additional inefficiencies due to outdated design characteristics, failing infrastructure, and operational shortfalls.

*Lack of Infrastructure on the California Side of the Reservation*

CRIT is allocated 56,846 AFY of water to serve its irrigable acreage in the state of California. CRIT utilizes approximately 10 percent of that amount at present, leaving 50,000 AFY of water in the river. CRIT's unused water is utilized by a junior contract holder without benefit to the Tribes. The Tribes' challenge is to put that as yet unused water to work for the benefit of its membership as soon as practicable. The high cost of land development is a hurdle that must be overcome, but the value of the lost water, even at the artificially low agricultural rates presently controlling the marketplace, has reached a level sufficient to make that investment a prudent one.

*Limited Marketing Opportunities*

As noted previously, CRIT's water allocation was adjudicated in the line of cases known as *Arizona v. California*, which describes the quantity of water CRIT may divert from the Colorado River as follows:

> *(i) 719,248 acre-feet of diversions from the mainstream or (ii) the quantity of mainstream water necessary to supply the consumptive use required for irrigation of 107,903 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less[.]*

The Court quantified the federal Indian reserved water right based on the practicably irrigable acreage on the Reservation and expressly stated that the uses by the Tribes are not limited to agriculture. The transfer of water for use off-reservation is not addressed by the Court.

*Outdated Pricing Models*

The CRIP, though large and productive, nonetheless suffers from significant operational and maintenance shortfalls. Some of the needed repairs are the result of extended use and maintenance that has been deferred, due to a lack of both financial and human capital. O&M charges for water delivery at the CRIP are below market rates charged at all similar irrigation projects. This chronic underfunding has profound implications for the Tribes' financial future.

*Shortage of Skilled Personnel*

The Reservation is located in a rural area of Arizona and California. In addition to the challenges the BIA faces in attracting and keeping skilled personnel to operate and maintain the CRIP, the Tribes also have a limited workforce to draw from. Lack of trained individuals with the skills unique to irrigation system management results in reduced operational oversight, slower response to maintenance needs, and lower system efficiency.

### 5.8.7 Projected Future Water Development

CRIT's future water development was assessed by first examining the location, quantity and type of current water use and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of plausible future water development outcomes.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreases flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to more rapid tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

CRIT contemplated its future water development through 2060 by reviewing its current water use estimates and reflecting upon how these might change under the four scenarios. During this process, the Tribes considered such elements as the scenario conditions described in the storylines, current or future planned projects, anticipated changes in water use by category, the extent and condition of existing water infrastructure and the need, as well as the cost, for new infrastructure to support water development. CRIT contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges (TRAN).

From this examination, CRIT extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared a quantified water development schedules for its reserved water rights in both Arizona and California. Subsequently, CRIT used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each development schedule is presented in the following sections.

#### *5.8.7.1 Future Water Development Schedules*

The assumptions used to prepare each water development schedule are described below. The schedules are presented graphically for Arizona in Figure 5.8-D and numerically in Table 5.8-F. Water development schedules for California are presented graphically in Figure 5.8-E and numerically in Table 5.8-G.

## Arizona

*Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. In Arizona, CRIT is currently diverting nearly all of its reserved water right for agricultural purposes (630,471 AFY). Under Scenario A, the Tribes assumed that this agricultural use would continue; however, efficiency would increase to 70 percent by 2040 and 75 percent by 2060, increasing consumptive use. DCMI use and efficiency, as well as ENV water use, would remain constant through 2060. There would be no TRAN water use under Scenario A.

*Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, CRIT assumed that agricultural diversions would not change as they are currently maximized, but efficiency would decrease to 50 percent by 2060 because irrigation system maintenance and improvements would not be completed. This would slightly decrease consumptive use through 2060. DCMI diversions would not change; however, efficiency would decrease to 50 percent by 2060. There would be no change in ENV use through 2060 and no TRAN use.

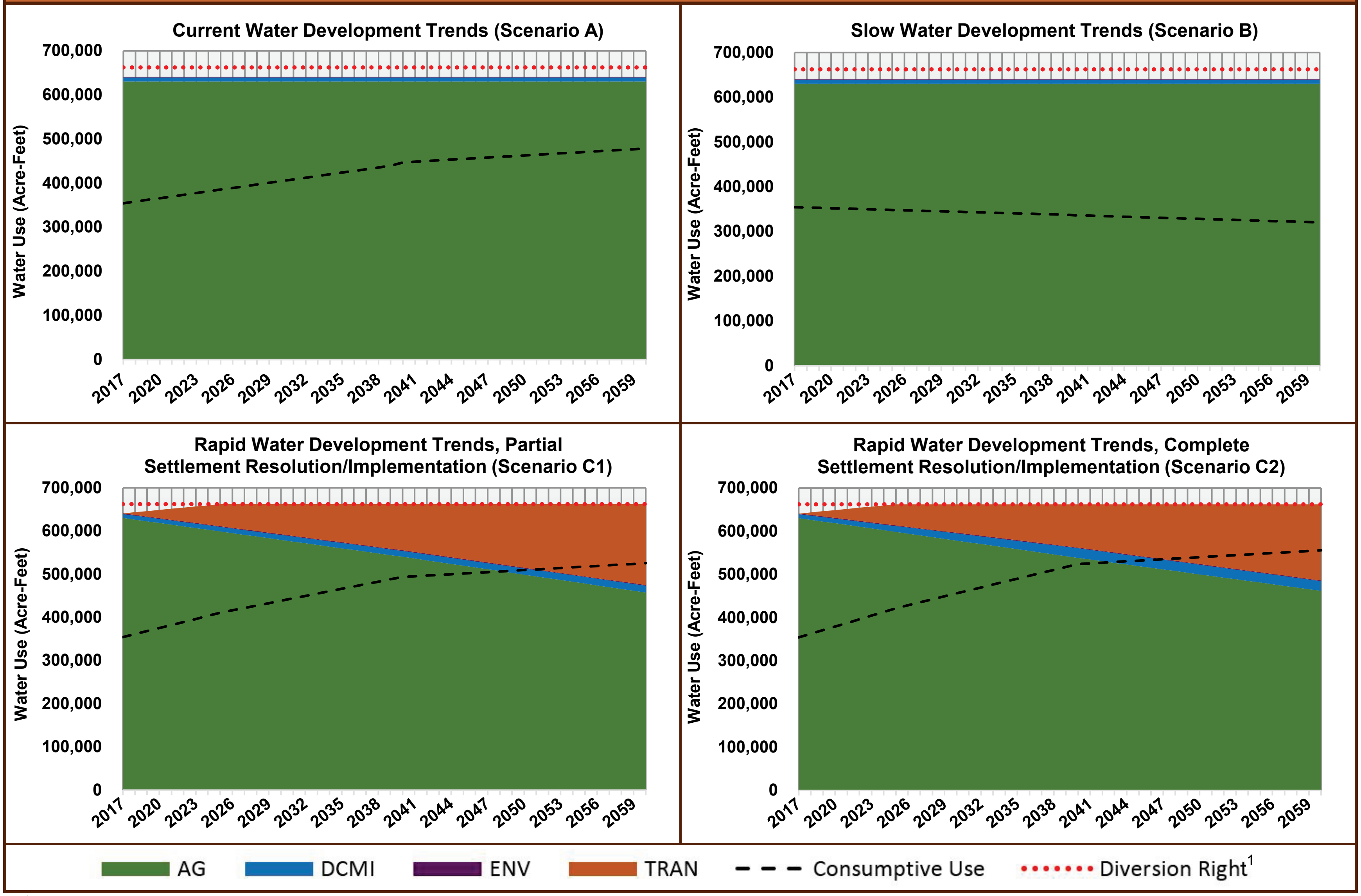
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. Under Scenario C1, CRIT assumed that agriculture would remain the largest water user and efficiency would increase to 75 percent by 2040 and 80 percent by 2060, increasing consumptive use. Agricultural diversions would gradually decrease through 2060 as DCMI use and TRAN increase. DCMI diversions would increase 150 percent by 2040 and 175 percent by 2060, also contributing to an increased consumptive use. CRIT assumed that 150,000 AFY would be transferred off the Reservation by 2060. There would be no change in ENV use.

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. Under this scenario, CRIT assumed that agriculture would continue to be the largest water user and efficiency would increase to 80 percent by 2040 and 85 percent by 2060, again increasing consumptive use. As in Scenario C1, DCMI diversions would increase 150 percent by 2040 and 175 percent by 2060. There may be an increase in small and medium sized enterprises and perhaps energy companies. CRIT assumed that 150,000 AFY would be transferred off the Reservation by 2060. There would be no change in ENV use.

**FIGURE 5.8-D**
Colorado River Indian Tribes Projected Future Water Development in Arizona (Scenarios A, B, C1, and C2)




[1] The Colorado River Indian Tribes' diversion right in Arizona is 662,402 AFY.


*See the Disclaimer and Introduction to Chapter 5.0.*

## California

### *Current Water Development Trends (Scenario A)*

Scenario A assumes that current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same. In California, CRIT is currently diverting approximately 3,896 AFY for agricultural purposes. Under Scenario A, CRIT would divert its full reserved water right of 56,846 AFY by 2040 to irrigate an additional 4,700 acres for agriculture. Agricultural efficiency would increase to 70 percent by 2040 and remain at 70 percent until 2060. DCMI diversions would increase 15 percent by 2040 and an additional 10 percent by 2060. CRIT assumed that in the future, housing in California would be occupied more permanently than it is now. There would be no ENV or TRAN water use through 2060.

### *Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, CRIT assumes that there would be no change from current water use.

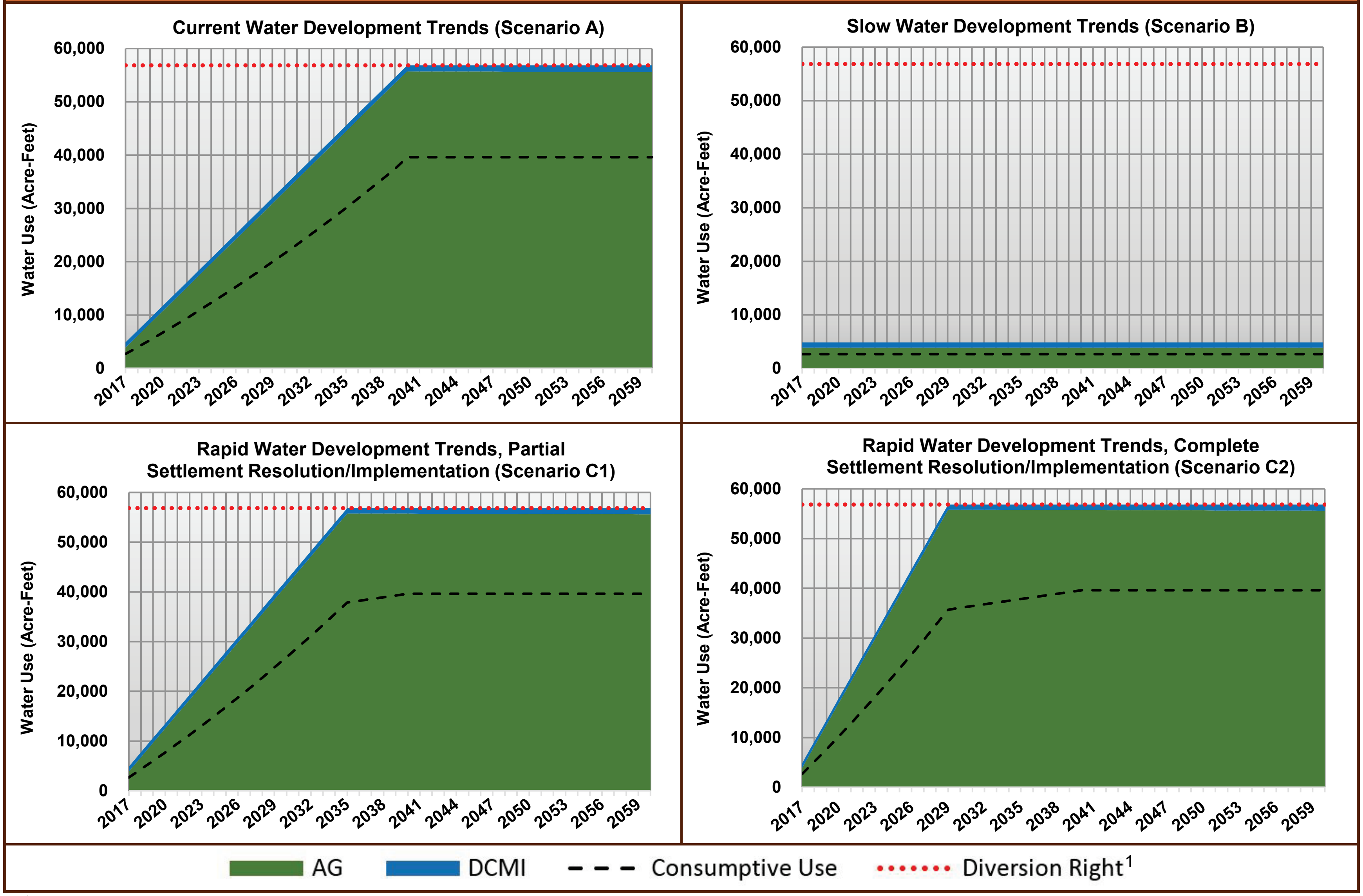
### *Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities, and increased funding availability leads to tribal economic development. Under Scenario C1, CRIT would divert its full reserved water right of 56,846 AFY by 2035 to irrigate additional acreage faster than under Scenario A. Agricultural efficiency would increase to 70 percent by 2040 and remain at 70 percent until 2060. As in Scenario A, DCMI diversions would increase 15 percent by 2040 and an additional 10 percent by 2060. There would be no ENV or TRAN water use through 2060.

### *Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. Under this scenario, CRIT contemplated an even faster rate of agricultural development and would divert its full reserved water right of 56,846 AFY by 2029. All other water uses would be similar to Scenario C1.

**FIGURE 5.8-E**
Colorado River Indian Tribes Projected Future Water Development in California (Scenarios A, B, C1, and C2)




[1] The Colorado River Indian Tribes' diversion right in California is 56,846 AFY.

### *5.8.7.2 Summary of Projected Future Water Development*

CRIT's current water use and projected future water development under the Tribal Water Study's water development scenarios, and modeled for analysis purposes, is presented for Arizona in Table 5.8-F and for California in Table 5.8-G.

**TABLE 5.8-F**
Summary of Colorado River Indian Tribes Current Water Use and Projected Future Water Development in Arizona[1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| Current Use | *AG* | 630,471 | 348,598 | 630,471 | 348,598 | 630,471 | 348,598 | 630,471 | 348,598 |
| | *DCMI* | 8,976 | 4,963 | 8,976 | 4,963 | 8,976 | 4,963 | 8,976 | 4,963 |
| | *ENV* | 1,534 | 848 | 1,534 | 848 | 1,534 | 848 | 1,534 | 848 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **640,981** | **354,409** | **640,981** | **354,409** | **640,981** | **354,409** | **640,981** | **354,409** |
| Use at 2040 | *AG* | 630,471 | 441,330 | 630,471 | 330,753 | 540,427 | 405,320 | 538,241 | 430,593 |
| | *DCMI* | 8,976 | 4,963 | 8,976 | 4,709 | 13,464 | 7,405 | 22,336 | 12,285 |
| | *ENV* | 1,534 | 848 | 1,534 | 848 | 1,534 | 848 | 1,534 | 848 |
| | *TRAN* | 0 | 0 | 0 | 0 | 106,977 | 80,233 | 100,291 | 80,233 |
| | **Total** | **640,981** | **447,141** | **640,981** | **336,310** | **662,402** | **493,806** | **662,402** | **523,959** |
| Use at 2060 | *AG* | 630,471 | 472,853 | 630,471 | 315,236 | 457,660 | 366,128 | 462,061 | 392,752 |
| | *DCMI* | 8,976 | 4,963 | 8,976 | 4,488 | 15,708 | 8,639 | 22,336 | 12,285 |
| | *ENV* | 1,534 | 848 | 1,534 | 848 | 1,534 | 848 | 1,534 | 848 |
| | *TRAN* | 0 | 0 | 0 | 0 | 187,500 | 150,000 | 176,471 | 150,000 |
| | **Total** | **640,981** | **478,664** | **640,981** | **320,572** | **662,402** | **525,615** | **662,402** | **555,885** |

[1] The Colorado River Indian Tribes' diversion right in Arizona is 662,402 AFY.

**TABLE 5.8-G**
Summary of Colorado River Indian Tribes Current Water Use and Projected Future Water Development in California[1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| Current Use | *AG* | 3,896 | 2,154 | 3,896 | 2,154 | 3,896 | 2,154 | 3,896 | 2,154 |
| | *DCMI* | 971 | 534 | 971 | 534 | 971 | 534 | 971 | 534 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **4,867** | **2,688** | **4,867** | **2,688** | **4,867** | **2,688** | **4,867** | **2,688** |
| Use at 2040 | *AG* | 55,729 | 39,010 | 3,896 | 2,154 | 55,729 | 39,010 | 55,729 | 39, 010 |
| | *DCMI* | 1,117 | 614 | 971 | 534 | 1,117 | 614 | 1,117 | 614 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **56,846** | **39,624** | **4,867** | **2,688** | **56,846** | **39,624** | **56,846** | **39,624** |
| Use at 2060 | *AG* | 55,617 | 38,932 | 3,896 | 2,154 | 55,617 | 38,932 | 55,617 | 38,932 |
| | *DCMI* | 1,229 | 676 | 971 | 534 | 1,229 | 676 | 1,229 | 676 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **56,846** | **39,608** | **4,867** | **2,688** | **56,846** | **39,608** | **56,846** | **39,608** |

[1] The Colorado River Indian Tribes' diversion right in California is 56,846 AFY.

## 5.9 Quechan Indian Tribe

### 5.9.1 Introduction

The Fort Yuma-Quechan Reservation (Reservation) is located along the Colorado River near Yuma, Arizona. The Reservation was established by Executive Order of President Chester A. Arthur on January 9, 1884. Reservation lands encompass portions of Arizona and California, and share a border with Mexico's Baja California. Encompassing 45,000 acres, the Reservation is bisected on the south by Interstate 8 (I-8), and Imperial Irrigation District's All-American Canal runs from its northeast to southwest corners. The Tribe's headquarters are located on the old Fort Yuma grounds in California, along the Reservation's southern boundary and directly across the Colorado River from the City of Yuma.

The Reservation encompasses a portion of the ancestral home of the Quechan People. Their aboriginal villages were located in or near the Colorado River's floodplain, which allowed annual floods to deposit rich soil from upriver. This ended with development of dams and diversions upstream from the Quechan homeland, which essentially cut off the historical flows to the area. According to the most recent data from the Quechan Indian Tribe (Quechan or Tribe) Enrollment Office, the Quechan population totals 3,870 members. Approximately 2,022 live on or adjacent to the Reservation.

Figure 5.9-A presents a general location map with Reservation boundaries, communities, and other important features.

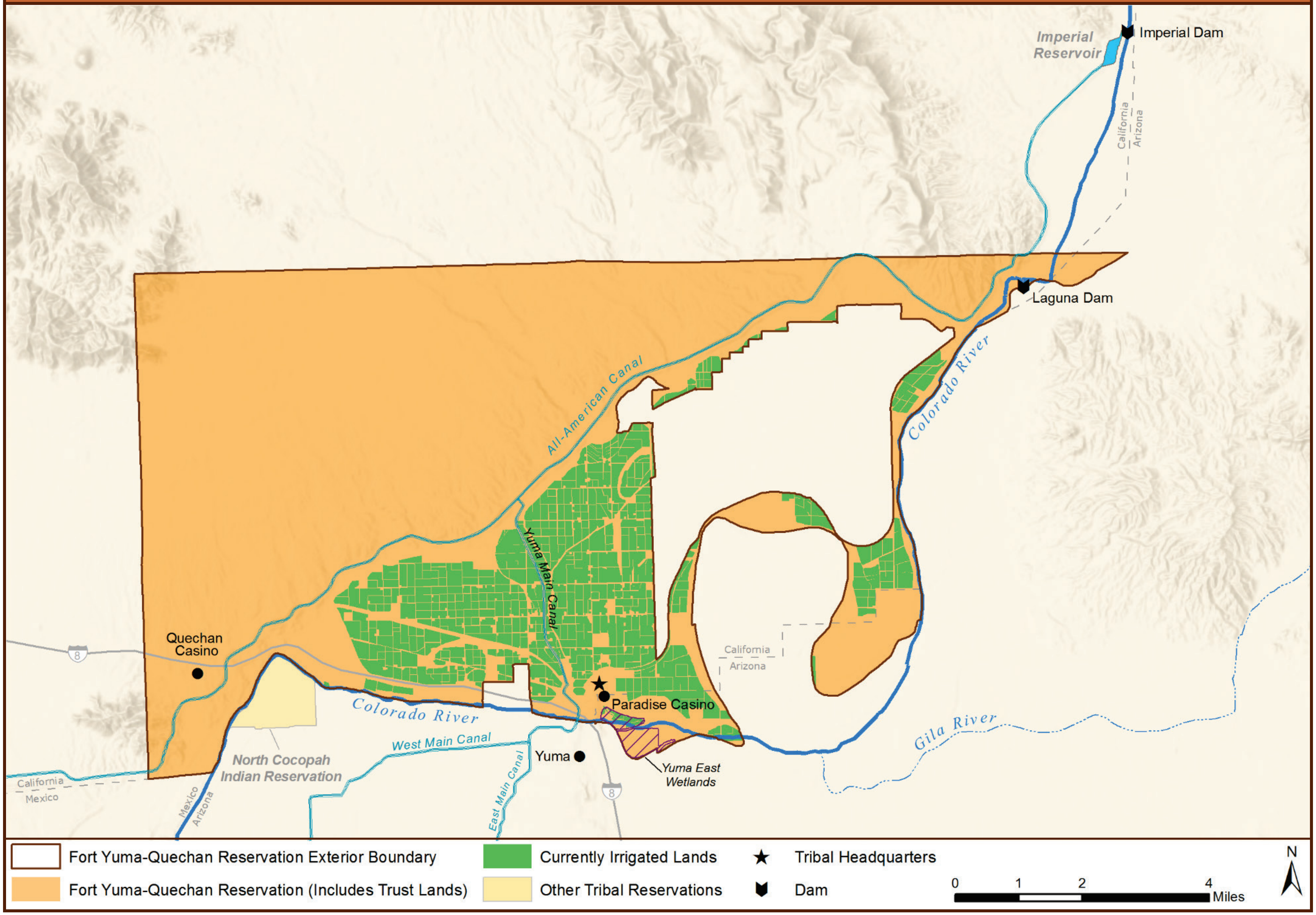
### 5.9.2 Physical Setting

The Fort Yuma Indian Reservation is located along the Colorado River in the southeastern corner of California and southwest corner of Arizona. The elevation on the reservation ranges from 125 to 1025 feet above mean sea level (MSL). The land below the All-American Canal (AAC) ranges from 125 to 180 feet MSL. The irrigable land above the canal on the reservation ranges from 180 to 500 feet MSL. Topography varies considerably, with the northwestern portions of the Reservation being rugged and mountainous, while the majority of the irrigable lands are located south of the AAC on nearly level floodplains.

#### *5.9.2.1 Watersheds*

The Colorado River roughly parallels much of the eastern and southern borders of the Reservation. Flows in this reach of the River are regulated by Imperial Dam while Laguna Dam regulates sluicing flows. The Reservation is cross-cut by major Colorado River distribution canals, including the AAC and the Yuma Main Canal, as well as many smaller irrigation and drainage ditches.

**FIGURE 5.9-A**
Fort Yuma-Quechan Reservation Map






*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.9.2.2 Hydrogeology*

The Reservation is located on part of the floodplain of the Colorado River in an area of undifferentiated alluvial sediments and sedimentary rocks of Quaternary age that include floodplain deposits and fanglomerate deposits derived from the surrounding mountains. Numerous domestic and irrigation wells can be found throughout the area.

#### *5.9.2.3 Climate*

The climate in the Reservation area is extreme in summer and mild in winter. Summer high average daily temperatures range from 104 to 108 °F. The area is almost entirely frost free. The average annual precipitation at the closest monitoring station (5.5 miles northeast) in nearby Yuma is only 2.86 inches with the majority falling in late summer and winter (Western Regional Climate Center, 2006). Spring and early summer are generally dry with some months receiving almost no precipitation.

### 5.9.3 Historical Use and Cultural Importance of Water

Historically the Quechan made good use of the Colorado River's natural annual flooding process to develop a robust agricultural economy. They lived in settlements scattered north and south of the River, and eastward along the Gila River. The number and precise locations of these settlements shifted from year to year and even from season to season within the year. The geographical arrangement of the settlements was thus closely geared to the condition of the rivers and the techniques of bottomland horticulture. The threat of enemy attack may have also been a factor. The settlements were gradually abandoned after the Reservation was created, and families moved within the Reservation boundaries to receive individual ten-acre plots of farmland allotted to them by the federal government.

Today, that agricultural use continues, although water is also used for domestic, commercial, municipal, and industrial purposes.

As for most tribes in the Basin, water is central to the Quechan Tribe's culture and heritage. The location of their ancestral settlements near the Colorado River meant that the River was a central part of their life, giving them a natural setting and irrigation for growing food and for sustaining their culture.

### 5.9.4 Quechan Indian Tribe Water Supply

As finally decreed by the United States Supreme Court (Supreme Court) in *Arizona v. California*, 547 U.S. 150 (2006) (commonly referred to as the 2006 Consolidated Decree), federal Indian reserved water rights for Colorado River water were quantified for the Fort Yuma-Quechan Indian Reservation in Arizona and California with a priority date of January 9, 1884. The amounts, priority dates, and states where the reserved water rights are perfected are presented in Table 5.9-A.

**TABLE 5.9-A**
Quechan Indian Tribe Colorado River Diversion Right

| Reservation | State | Diversion Water Right (AFY)[1] | Net Acres | Priority Within State | Priority Date |
|---|---|---|---|---|---|
| Fort Yuma-Quechan Reservation | Arizona | 6,350 | 952 | 1 | Jan. 9, 1884 |
| | California | 71,616 | 10,742 | 1 | Jan. 9, 1884 |
| **Total** | | **77,966** | **11,694** | | |

[1] Source: Supreme Court Consolidated Decree of March 27, 2006. (547 U.S. 150). The quantity of water in each instance is measured by (i) diversions or (ii) consumptive use required for irrigation of the respective acreage and for satisfaction of related uses, whichever of (i) or (ii) is less.

AFY – Acre-feet per year

## 5.9.5 Current Water Use and Operations

Largely an agricultural community, the Tribe and allottees lease some lands to other farmers. The Tribe also operates two casinos on the Arizona and California portions of the Reservation.

In addition to farming, the Reservation utilizes tourism and related business to support its economy. The relatively warm winter temperatures make the site a desirable winter vacation spot from November to March. To serve its members and a large population of winter visitors the Tribe manages an education complex, a small grocery store, two casinos, a utility company, a fish and game department, police department and court, two housing subdivisions, individual home sites, and an out-patient facility serving both Quechan and the Cocopah Indian Tribe.

Water for agricultural use on the Reservation is primarily diverted from the Colorado River at Imperial Dam and delivered through the Yuma Project Reservation Division-Indian Unit. Other agricultural lands on the Reservation are irrigated by water pumped directly from the Colorado River and from groundwater. Water used for domestic purposes on the Reservation is pumped from groundwater. The Tribe has other small uses at homestead sites south of Yuma, Arizona. Water use is documented in Reclamation's Colorado River Accounting and Water Use Reports: Arizona, California, and Nevada (Water Accounting Reports) (Reclamation, 2017).

### *5.9.5.1 Irrigated Agriculture and Livestock Water Use Category*

Based on Reclamation's Water Accounting Reports, the average diversion for the Yuma Project Reservation Division – Indian Unit for the period from 2009 through 2013 at Imperial Dam was 42,768 acre-feet per year (AFY), primarily for agriculture and related uses. Ranch 5 is served by Yuma Project Reservation Division infrastructure but is not part of the Indian Unit and Reclamation has reported diversions to Ranch 5 separately in the past. From 2009 through 2013, the average diversion to Ranch 5 (in both Arizona and California) was 880 AFY. The average reported diversion from 2009 through 2013 to agricultural lands that pump water from the Colorado River and groundwater, which are all in California, was 2,873 AFY. The Tribe is concerned that the methods used to estimate water use may be inaccurate and is in the process of implementing a flow measurement and monitoring program to increase and improve the data available for water accounting purposes.

#### 5.9.5.2 Domestic, Commercial, Municipal, and Industrial Water Use Category

Based on Reclamation's Water Accounting Reports, the Tribe's average domestic, commercial, municipal, and industrial use for the period from 2009 through 2013 was 795 AFY. This use includes water for the casinos, housing, and other Tribal municipal demands.

#### 5.9.5.3 Environmental, Cultural, and Recreational Water Use Category

In 2004, habitat restoration activities began at the Yuma East Wetlands, located along the Colorado River near downtown Yuma, Arizona. The Tribe partnered with the City of Yuma, Yuma Crossing National Heritage Area, the Arizona Game and Fish Commission, and multiple federal and state agencies to restore 373 acres of habitat. Invasive salt cedar stands were cleared, backwater channels and shallow marshes were excavated, and native riparian and marsh vegetation were planted.

As part of the project the Tribe was able to develop a cultural park on the reservation side of the river and the City of Yuma was able to develop a municipal park on its side of the river.

Yuma East Wetlands
*Source: Bureau of Reclamation*

In 2013, the Lower Colorado River Multi-Species Conservation Program entered into a partnership with the Tribe, City of Yuma, the Arizona Game and Fish Commission, and the Yuma Crossing National Heritage Area to support the long-term management of the Yuma East Wetlands. The Yuma East Wetlands is now a mosaic of different vegetation communities, including cottonwood willow, honey mesquite, and marsh. The project is located within the Pacific Flyway, a major migration route for hundreds of species of birds, including southwestern willow flycatcher, yellow-billed cuckoo, and Sonoran yellow warbler. Marsh birds, such as the endangered Yuma clapper rail and western least bittern, have colonized the created habitat. Other species, like the western red bat, western yellow bat, and Yuma hispid cotton rat have also been confirmed to be using the site's restored cottonwood-willow land cover type.

The Tribe provides roughly 1,250 acre-feet of water per year for the Yuma East Wetlands project from its Arizona allocation recognized in the 2006 Consolidated Decree.

#### 5.9.5.4 Diversion by The Metropolitan Water District of Southern California

Pursuant to the 2006 Consolidated Decree, the Metropolitan Water District of Southern California (MWD) is entitled to divert up to 13,000 AFY of water allocated to Quechan, if Quechan chooses to forbear using that water in any one year. In 2013, MWD was entitled to divert the full 13,000 AFY.

#### 5.9.5.5 Reservoirs

There are no reservoirs on the Fort Yuma Reservation.

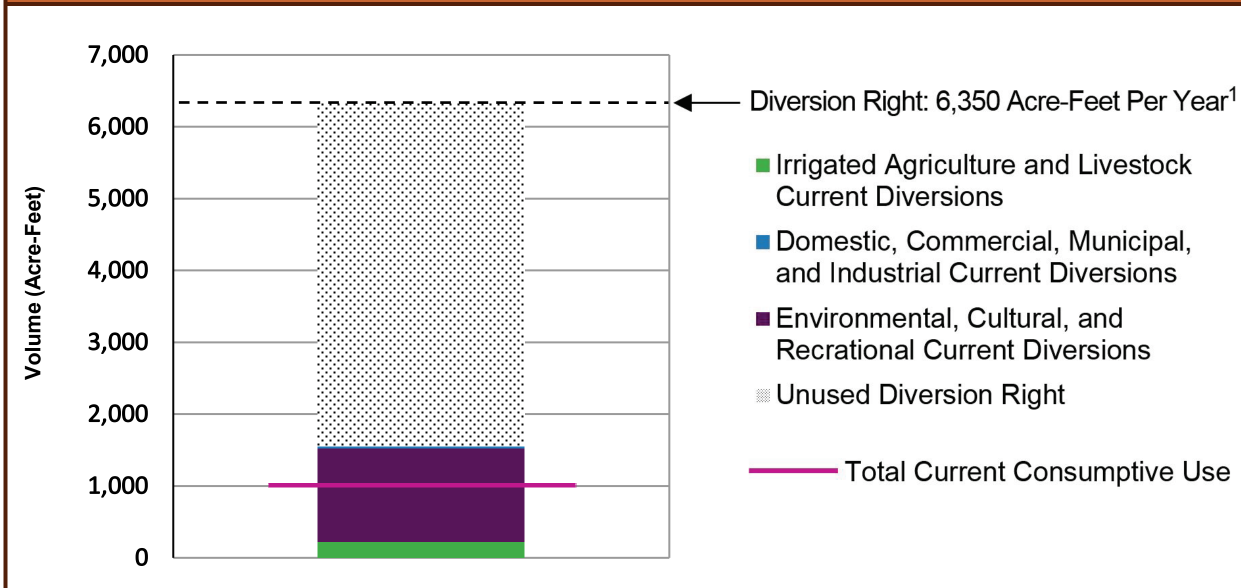
### 5.9.5.6 Water Use Efficiency and Conservation

The Tribe is currently developing a water management program to address these and other issues concerning water use and management.

### 5.9.5.7 Summary of Current Water Use

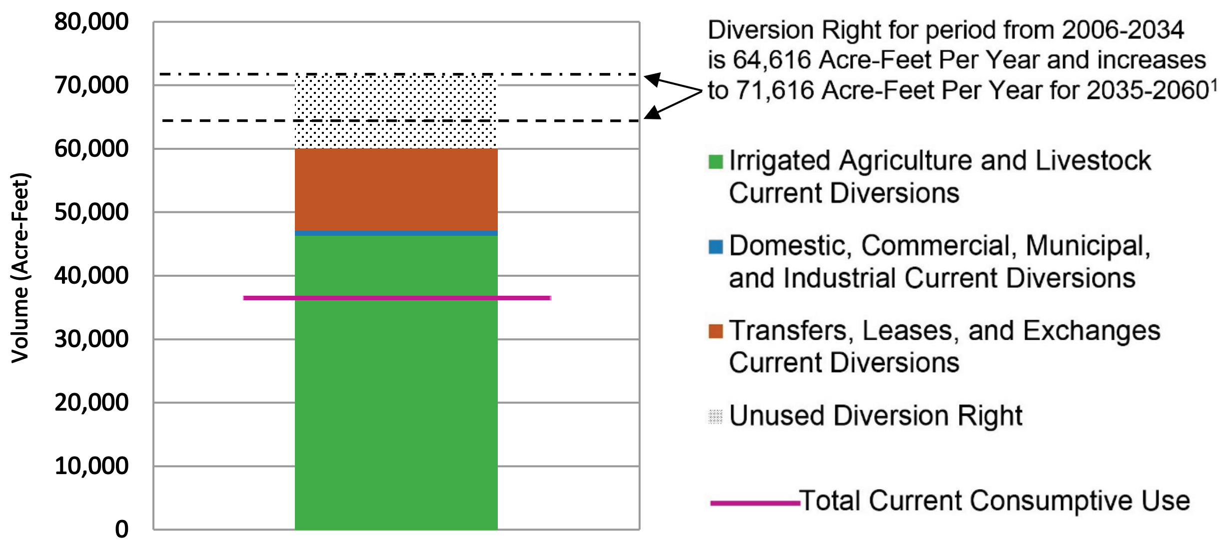
The Tribe's average annual water use for the period from 2009 through 2013 in Arizona is presented in Figure 5.9-B, for California in Figure 5.9-C, and in Table 5.9-B for both states. The average annual water use for the 2009 through 2013 period incorporates Reclamation's Water Accounting Report data, which was supplemented with water use information provided by the Tribe for the purpose of the Tribal Water Study. Therefore, direct comparisons between this report and the Water Accounting Reports would be inapposite. Consumptive use amounts were estimated using either efficiency factors in the Water Accounting Report or standard engineering efficiencies.

**FIGURE 5.9-B**
Quechan Indian Tribe Current Average Annual Water Use in Arizona (2009 – 2013)




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 6,350 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 952 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

**FIGURE 5.9-C**
Quechan Indian Tribe Current Average Annual Water Use in California (2009 – 2013)




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 71,616 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 10,742 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

**TABLE 5.9-B**
Quechan Indian Tribe Current Average Annual Water Use by State (2009 – 2013)

| State | Water Use Category | Diversion (AFY) | Estimated Current Consumptive Use (AFY) |
|---|---|---|---|
| Arizona | AG | 224 | 145 |
| | DCMI | 30 | 20 |
| | ENV | 1,300 | 845 |
| | ***State Subtotal*** | ***1,554*** | ***1,010*** |
| California | AG | 46,297 | 23,149 |
| | DCMI | 795 | 395 |
| | TRAN | 13,000 | 13,000 |
| | ***State Subtotal*** | ***60,092*** | ***36,554*** |
| **Total** | | **61,646** | **37,554** |

AG – Irrigated Agriculture and Livestock
DCMI – Domestic, Commercial, Municipal, and Industrial
ENV – Environmental, Cultural, and Recreational
TRAN – Transfers, Leases, and Exchanges

### 5.9.6 Tribal Water Use Challenges

Barriers to greater use of tribal water include legal and policy level constraints of the federal government placing obstacles in the way of inter-state and inter-basin transfers of water and limitations on the Tribe's ability to dedicate water to off-Reservation instream flows.

### 5.9.7 Projected Future Water Development

The Tribe's future water development was assessed by first examining the location, quantity and type of current water use and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreases flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

The Tribe projected its future water development through 2060 by reviewing its current water use estimates and reflecting upon how these might change under the four scenarios. During this process, the Tribe considered such elements as the scenario conditions described in the storylines, current or future planned projects, and anticipated changes in water use by category. The Tribe contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges (TRAN).

From this examination, the Tribe extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared quantified water development schedules for its water rights in Arizona and California. The Tribe used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each development schedule is presented in the following sections.

#### *5.9.7.1 Future Water Development Schedules*

Future water development schedules were developed by the Tribe. The assumptions for each schedule are described below and the schedules presented graphically in Figure 5.9-D for Arizona and 5.9-E California, and numerically in Tables 5.9-E and 5.9-F.

## Arizona

*Current Water Development Trends (Scenario A)*

If current trends in on-Reservation water development, governance, funding, and resolution of tribal claims remain the same, by 2060 the total water Arizona diversions on the Fort Yuma Reservation will increase to full development of the Tribe 6,350 acre-foot right. The AG water diversions would increase from 227 AFY to nearly 2,200 AFY by 2025 and remain relatively constant through 2060. DCMI water diversions would remain small and relatively consistent through 2060. ENV water diversions, including those currently used at the Yuma East Wetlands, would more than triple by 2060.

*Slow Water Development Trends (Scenario B)*

Future water development under Scenario B is the same as Current Trends (Scenario A).

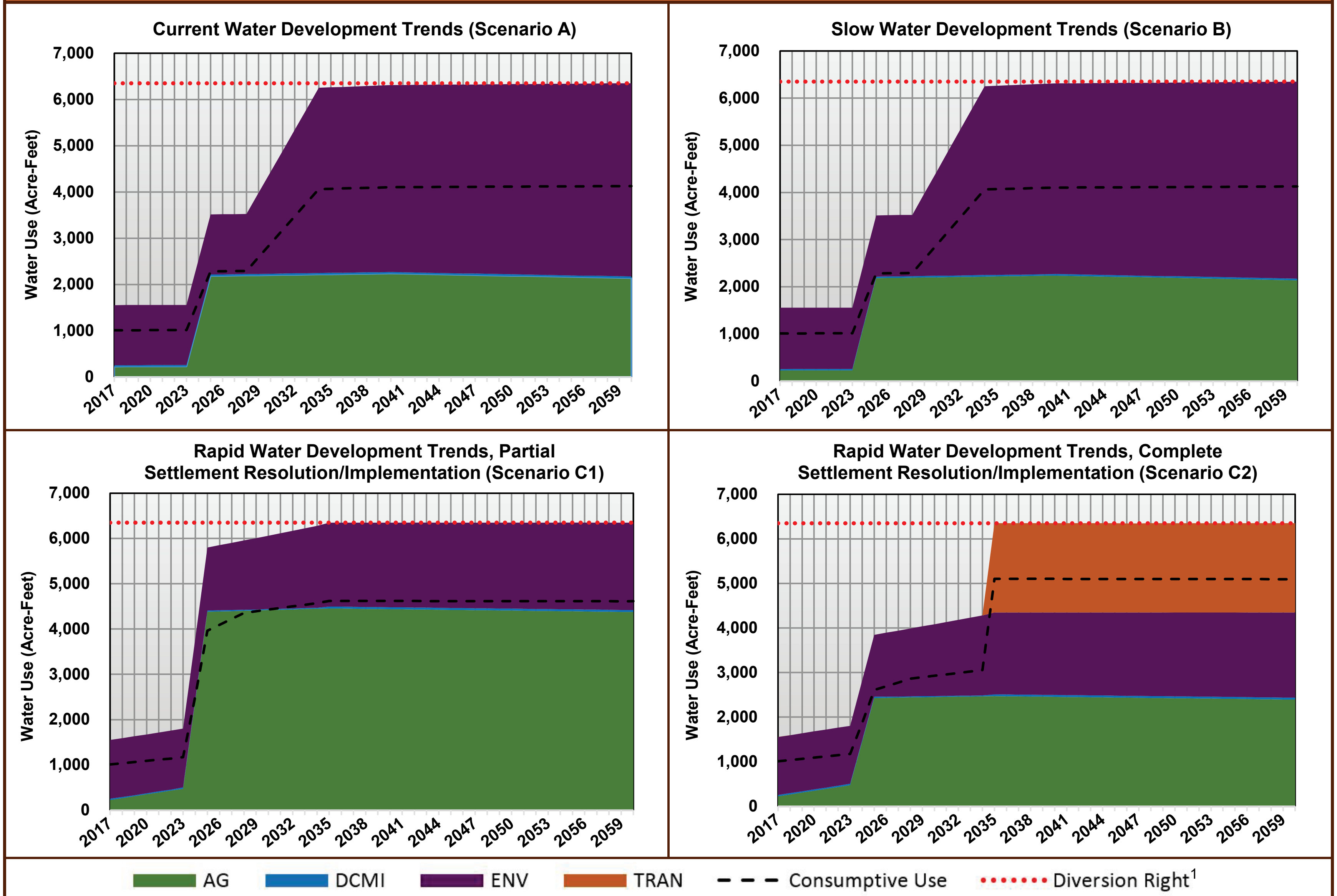
*Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, increased funding availability leads to tribal economic development. The Tribe assumed that additional agricultural lands would be developed by 2024, increasing AG water diversions from 473 AFY to nearly 4,400 AFY by 2025. In addition, irrigation efficiencies increase approximately 12 percent. DCMI water diversions would remain small and increase slightly through 2060; efficiencies increase about 20 percent. ENV water diversions, including those currently used at the Yuma East Wetlands, would increase about 45 percent by 2060.

*Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering increased flexibility in the off-reservation use of the Tribe's decreed rights, which further increases water development opportunities. Under this scenario, Quechan assumed that AG water diversions increase five times by 2025 to approximately 2,400 AFY and remain relative constant through 2060. DCMI diversions increase by approximately 40 percent by 2060 and become more efficient. ENV use would increase about 45 percent by 2016. The largest water use change in this scenario is that the Tribe anticipated that the regulatory framework would change allowing it to divert 2,000 AFY for transfers.

**FIGURE 5.9-D**
Quechan Indian Tribe Projected Future Water Development in Arizona (Scenarios A, B, C1, and C2)




[1] Quechan Indian Tribe's decreed diversion right in Arizona is 6,350 AFY.

## California

The Fort Yuma Reservation is near full utilization of its California Colorado River water right, for agricultural, DCMI and Metropolitan forbearance uses. Given the continuing drought and even modest population growth, full utilization is likely in the near future.

### *Current Water Development Trends (Scenario A)*

If current trends continue in the Tribe's California water diversions, AG water diversions would remain relatively constant, DCMI water use would increase 30 percent, and ENV water diversions would remain constant. Water transfers would increase by 55 percent in 2035.

### *Slow Water Development Trends (Scenario B)*

Future water development under Scenario B is the same as Current Trends (Scenario A).

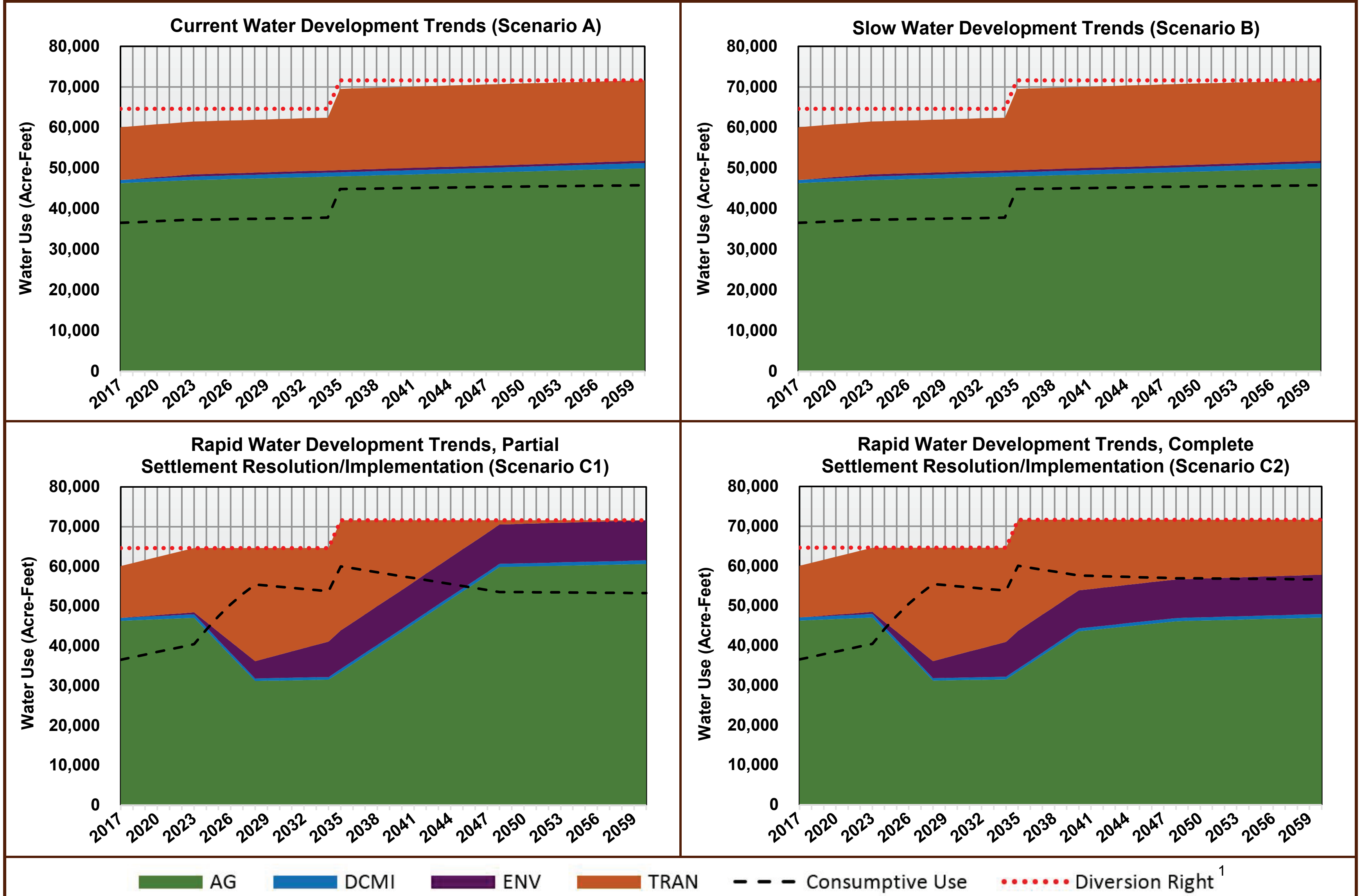
### *Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, increased funding availability leads to tribal economic development. The Tribe assumed that additional agricultural lands would be developed between 2035 and 2048, increasing AG water diversions from 47,055 AFY to nearly 60,000 AFY by 2048. Irrigation efficiencies would increase approximately 25 percent. DCMI water diversions would remain small and relatively consistent through 2060; however, efficiencies would also increase about 25 percent. ENV water diversions would increase to nearly 10,000 AFY by 2035. Water transfers would reach a maximum of approximately 27,000 AFY by 2035 and decrease to 0 AFY by 2060.

### *Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on Scenario C1 by considering increased flexibility in the off-reservation use of the Tribe's decreed rights, which further increases water development opportunities. The Tribe assumed that AG water diversions would fluctuate between 47,055 and 31,515 AFY between 2023 and 2060, depending on use by other sectors; irrigation efficiencies would increase approximately 25 percent. DCMI water diversions would remain small and relatively consistent through 2060; however, efficiencies would also increase about 25 percent. ENV water diversions would increase to nearly 10,000 AFY by 2060. Water transfers would reach a maximum of approximately 27,000 AFY by 2040 and decrease to approximately 14,000 AFY by 2060.

**FIGURE 5.9-E**
Quechan Indian Tribe Projected Future Water Development in California (Scenarios A, B, C1, and C2)




1 Quechan Indian Tribe's decreed diversion right in California is 64,616 AFY (2006-2034); 71,616 AFY (2035-2060).

### *5.9.7.2 Summary of Projected Future Water Development*

The Tribe's current water use and projected future water development under the Tribal Water Study's water development scenarios, as modeled for analysis purposes, is presented in Table 5.9-E and 5.9-F.

**TABLE 5.9-E**
Summary of Quechan Indian Tribe Current Water Use and Projected Future Water Development in Arizona[1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| Current Use | *AG* | 224 | 145 | 224 | 145 | 224 | 145 | 224 | 145 |
| | *DCMI* | 30 | 20 | 30 | 20 | 30 | 20 | 30 | 20 |
| | *ENV* | 1,300 | 845 | 1,300 | 845 | 1,300 | 845 | 1,300 | 845 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **1,554** | **1,010** | **1,554** | **1,010** | **1,554** | **1,010** | **1,554** | **1,010** |
| Use at 2040 | *AG* | 2,236 | 1,453 | 2,236 | 1,453 | 4,439 | 3,374 | 2,455 | 1,866 |
| | *DCMI* | 33 | 21 | 33 | 21 | 43 | 32 | 43 | 32 |
| | *ENV* | 4,043 | 2,628 | 4,043 | 2,628 | 1,868 | 1,214 | 1,852 | 1,204 |
| | *TRAN* | 0 | 0 | 0 | 0 | | | 2,000 | 2,000 |
| | **Total** | **6,312** | **4,102** | **6,312** | **4,102** | **6,350** | **4,620** | **6,350** | **5,102** |
| Use at 2060 | *AG* | 2,137 | 1,389 | 2,137 | 1,389 | 4,376 | 3,326 | 2,393 | 1,819 |
| | *DCMI* | 36 | 23 | 36 | 23 | 44 | 33 | 44 | 33 |
| | *ENV* | 4,177 | 2,715 | 4,177 | 2,715 | 1,930 | 1,255 | 1,913 | 1,243 |
| | *TRAN* | 0 | 0 | 0 | 0 | | | 2,000 | 2,000 |
| | **Total** | **6,350** | **4,127** | **6,350** | **4,127** | **6,350** | **4,614** | **6,350** | **5,095** |

[1] Quechan Indian Tribe's decreed diversion right in Arizona is 6,350 AFY.

**TABLE 5.9-F**
Summary of Quechan Indian Tribe Current Water Use and Projected Future Water Development in California[1]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| Current Use | *AG* | 46,297 | 23,149 | 46,297 | 23,149 | 46,297 | 23,149 | 46,297 | 23,149 |
| | *DCMI* | 795 | 395 | 795 | 395 | 795 | 395 | 795 | 395 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 13,000 | 13,000 | 13,000 | 13,000 | 13,000 | 13,000 | 13,000 | 13,000 |
| | **Total** | **60,092** | **36,544** | **60,092** | **36,544** | **60,092** | **36,544** | **60,092** | **36,544** |
| Use at 2040 | *AG* | 48,372 | 24,186 | 48,372 | 24,186 | 43,583 | 33,123 | 43,583 | 33,123 |
| | *DCMI* | 1,066 | 533 | 1,066 | 533 | 746 | 560 | 746 | 560 |
| | *ENV* | 535 | 348 | 535 | 348 | 9,756 | 6,341 | 9,577 | 6,225 |
| | *TRAN* | 20,000 | 20,000 | 20,000 | 20,000 | 17,531 | 17,531 | 17,710 | 17,710 |
| | **Total** | **69,973** | **45,067** | **69,973** | **45,067** | **71,616** | **57,555** | **71,616** | **57,618** |
| Use at 2060 | *AG* | 49,968 | 24,984 | 49,968 | 24,984 | 60,635 | 46,083 | 47,035 | 35,747 |
| | *DCMI* | 1,297 | 649 | 1,297 | 649 | 903 | 677 | 903 | 677 |
| | *ENV* | 552 | 359 | 552 | 359 | 10,078 | 6,551 | 9,894 | 6,431 |
| | *TRAN* | 19,799 | 19,799 | 19,799 | 19,799 | 0 | 0 | 13,784 | 13,784 |
| | **Total** | **71,616** | **45,791** | **71,616** | **45,791** | **71,616** | **53,311** | **71,616** | **56,639** |

[1] Quechan Indian Tribe's decreed diversion right in California is 64,616 AFY (2006-2034); 71,616 AFY (2035-2060).



*See the Disclaimer and Introduction to Chapter 5.0.*

# 5.10 Cocopah Indian Tribe

## 5.10.1 Introduction

The Cocopah Indian Reservation (Reservation), which borders Mexico, Arizona and California, is comprised of approximately 6,500 acres in three noncontiguous bodies of land known as the North, West and East Reservations. The Reservation was originally established in 1917 by Executive Order No. 2711, and the 1985 Cocopah Land Acquisition Act (Public Law (P.L.) 99-23) expanded the acreage by an additional 4,200 acres. The Reservation is located in Yuma County along the Colorado River just 13 miles south of Yuma, AZ, and 15 miles north of San Luis, Mexico.

As recently as the 1960s, a number of tribal families lived in traditional arrow weed-thatched homes. In the late 1970s and 1980s, the Tribe began acquiring additional land, constructing homes, installing utilities, developing an infrastructure system and initiating economic development. Currently, there are about 1,000 enrolled Cocopah Indian Tribe (Cocopah or Tribe) members who live and work on or near the three Reservations.

The Cocopah Casino, Cocopah Resort & Conference Center, and Cocopah Korner are located on the East Reservation. The Cocopah Museum is located near the Tribal Headquarters on the West Reservation. The Cocopah RV & Golf Resort is located on the North Reservation. The Cocopah Rio Colorado Golf Course is located in Somerton, Arizona.

Figure 5.10-A presents a general location map with Reservation boundaries, communities, and other important features.

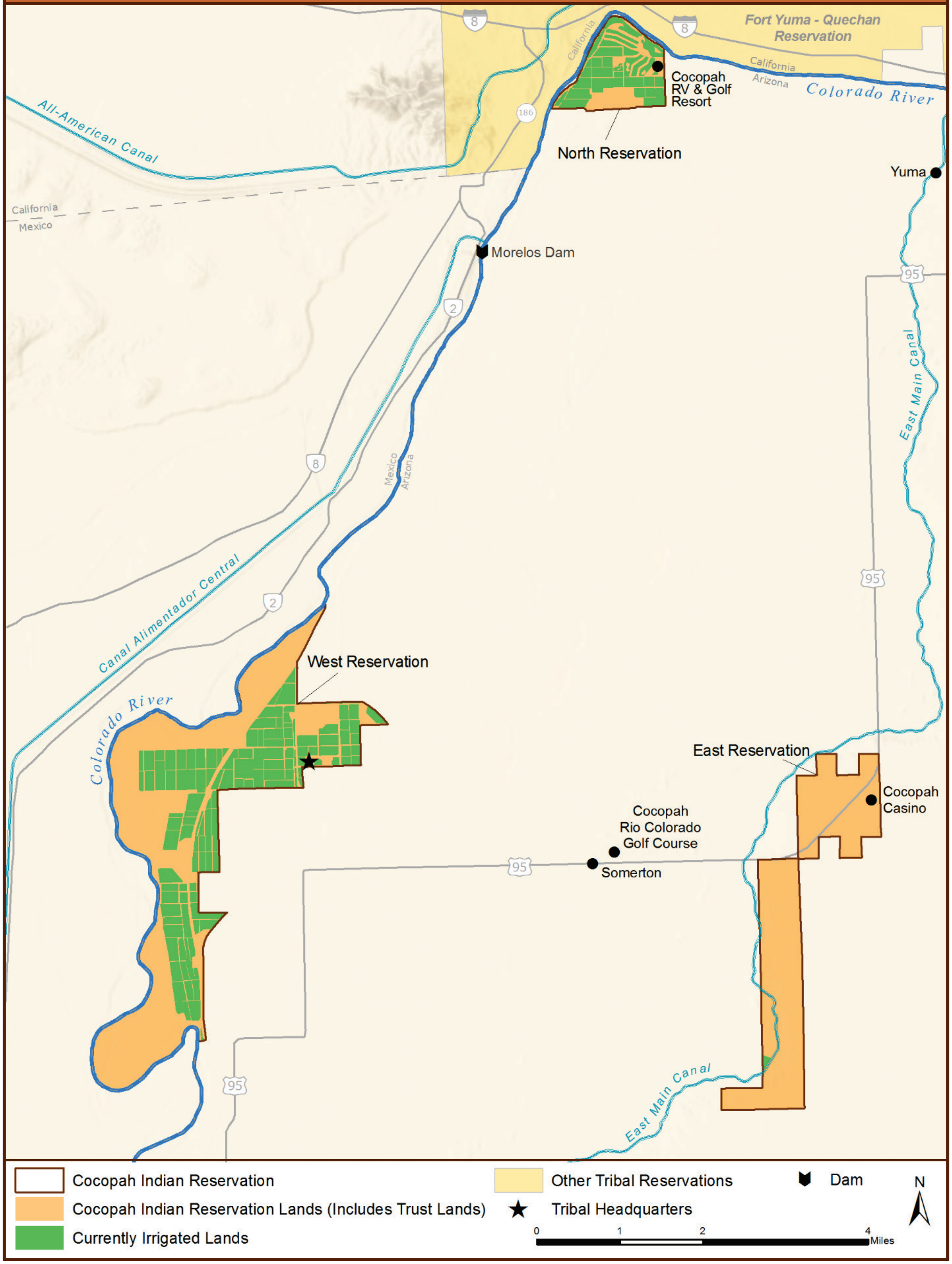
## 5.10.2 Physical Setting

The West and North Cocopah Reservations lie to the east of the Colorado River in the historic floodplain with the West Reservation bordering the Colorado River in the unchannelized portion of the river below Morelos Dam. The North Reservation abuts the Colorado River just above Morelos Dam. The East Reservation is across the Yuma valley, east of Somerton, primarily on the Yuma Mesa.

### *5.10.2.1 Watersheds*

The Colorado River roughly parallels much of the western borders of the Cocopah North and West Reservations. Flows in this reach of the river are regulated mainly by Imperial Dam where Colorado River water is diverted to California through the All-American Canal. At Morelos Dam, the Canal Alimentador Central diverts most of the remaining River flow pursuant to the Mexican Water Treaty of 1944. The River below Morelos Dam, which constitutes the western boundary of the West Reservation, becomes a dry river bed except during flood events.

**FIGURE 5.10-A**
Cocopah Indian Reservation Map






*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.10.2.2 Hydrogeology*

The Reservation is located on part of the floodplain of the Colorado River in an area of undifferentiated alluvial sediments and sedimentary rocks of Quaternary age that include flood plain deposits. Numerous domestic and irrigation wells can be found through the area, which for the most part are unaccounted for by Reclamation and do not contribute return flows to the Colorado River.

#### *5.10.2.3 Climate*

The climate on the Cocopah Reservation area is extreme in the summer and mild in the winter. Summer high average daily temperatures range from 104 to 108 °F. The area is almost entirely frost-free. The average annual precipitation in nearby Yuma is only 2.86 inches with the majority falling in the late summer and winter. Spring and early summer are generally dry with some months receiving almost no precipitation.

### 5.10.3 Historical Use and Cultural Importance of Water

The Cocopah (Kwapa), also known as the River People, have long lived along the lower Colorado River and delta. For centuries, the Cocopah people have maintained their traditional and cultural beliefs through various political environments and ever-changing landscapes.

The Cocopah Indian Tribe is one of seven descendant Tribes from the greater Yuman language-speaking people who occupied lands along the Colorado River. Cocopah Tribal ancestors also lived along the lower Colorado River region near the river delta and the Gulf of California. The Cocopah people had no written language.

Journals kept by travelers along the Colorado River and migrants into the West documented the Cocopah people. Spanish explorer Hernando de Alarcon, a member of Coronado's marine expedition, traveled the river in 1540 and described members of Cocopah as tall, well-built people who carried wooden maces and bows and arrows. The men wore loincloths and the women wore willow bark skirts. The explorer and his crew were offered gifts of shells, beads, well-tanned leathers and food.

Don Juan de Onate and Father Escobar sailed up the river, leading 30 soldiers on an expedition west to the Colorado River and south to the Gulf of California in 1604, where there were estimated to be about 6,000 to 7,000 Cocopah people living along the delta and the lower Colorado River. Fellow travelers, such as Father Kino, Father Garces, fur trapper James O'Patte, military men and ethnographers, kept colorful records from 1540 to 1917.

Westward expansion in the 1840s and the discovery of gold in California in 1849 brought many migrants through the area near the mouth of the Colorado River and the Grand Canyon region. The strategic importance of the Yuma river crossing was recognized by the U.S. government, and the U.S. Army established Camp Independence in 1850 to protect the entry route through the Tribe's territories. The following year the camp was moved to the site of an old Spanish Mission later named Fort Yuma, which still stands today.

Throughout the mid-1800s and early 1900s, the Tribe effectively resisted assimilation to an established reservation and maintained its social, religious and cultural identities.

In the last half of the nineteenth century, the steamboat business became important to the Cocopah people. Cocopah men, known for their skillful river navigating, were valued riverboat pilots.

Historical records show that the Cocopah domain once included portions of Arizona, southern California and Baja, and Sonora, Mexico. In 1848, the Treaty of Guadalupe Hidalgo divided the U.S. and the Republic of Mexico (Mexico) as well as the Cocopah lands between the two countries.

President Woodrow Wilson signed Executive Order No. 2711 in 1917 which established the initial Cocopah Reservation. In 1985, the Cocopah Tribe gained an additional 4,200 acres, including the North Reservation, through the Cocopah Land Acquisition Bill signed by President Ronald Reagan (P.L. 99-23).

Historically, the Cocopah was a flood way, agricultural society. They lived on the delta and meandered with the river planting panic grass and squash and gathering, hunting and fishing. The Colorado River delta was the most prolific and diverse region in the world for flora and fauna. This all changed with the coming of the European settlers. First, the political geography changed and the Tribe was divided between the U.S. and Mexico, and the Tribe could no longer meander with the river. Then, the river changed. It was dammed and the water slowly taken until the river no longer traveled to the Sea of Cortez. The Colorado River became essentially a dry river bed from Morelos Dam to the Sea, some 69 miles, right through the heart of the Cocopah territory. In the meantime, the Tribe had been placed on a few hundred acres of ground on the West Reservation, next to the river. The River was eventually taken from them and the Tribe was left with dirt. What to do? Create another homeland? Become farmers? The river and the water, the life of the Tribe was gone. Only the federal Indian reserved rights to a little water to farm their land is left. Cocopah (Kwapa) are known as the river people, but there is no river left. They have had a centuries old way of life taken from them.

### 5.10.4 Cocopah Indian Tribe Water Supply

As shown in Table 5.10-A, Cocopah possesses present perfected federal Indian reserved water rights from the Colorado River mainstream pursuant to the decree in *Arizona v. California* and supplemental decrees (1979 and 1984).

The priority 4 decreed right for the Cocopah Indian Reservation is unique along the lower Colorado River because of its fairly recent priority date (1974). The 1984 Supplemental Decree in *Arizona v. California* recognized the decreed right for the Cocopah Reservation dated June 24, 1974, and amended paragraph two of Article II (D) of the 1964 Decree to reflect this 1974 water right.

**TABLE 5.10-A**
Cocopah Indian Tribe Colorado River Reserved Diversion Water Right

| Reservation | State | Diversion Water Right (AFY)[1] | Net Acres | Priority Within State | Priority Date |
|---|---|---|---|---|---|
| Cocopah Indian Reservation | Arizona | 1,140 | 190 | 1 | 1915 |
| | | 7,681 | 1,206 | 1 | Sept 27, 1917 |
| | | 2,026 | 318 | 4 | June 24, 1974 |
| **Total** | | **10,847** | **1,714** | | |

[1] Source: U.S Supreme Court Consolidated Decree of March 27, 2006. (547 U.S. 150). The quantity of water in each instance is measured by (i) diversions or (ii) consumptive use required for irrigation of the respective acreage and for satisfaction of related uses, whichever of (i) or (ii) is less.

In addition, Cocopah has an unresolved claim to federal Indian reserved water rights from the Colorado River mainstream pursuant to the *Winters Doctrine* for approximately 3,600 additional acres of land transferred in Trust to the Tribe on April 15, 1985.

> "That, subject to all valid existing rights, all right, title and interest of the United States in the following described tracts of land shall be held by the United States in trust for the Cocopah Indian Tribe of Arizona and shall be part of the Reservation of such Tribe"[1]

There was no mention of water by Congress. Yet the land is practically useless without it. The *Winters Doctrine* reserves federal reserved water rights for Indian tribes by necessary implication. That is, when creating reservations through treaties, executive order, or statutes, the U.S. would not have reserved land for the tribes without the water right necessary to make the land suitable as a homeland.[2] The priority date is based on the establishment of a reservation, (or the date of land acquisition for after acquired land).[3]

Thus, the Tribe has an unresolved claim to federal Indian reserved water rights for all the land that was conveyed to the Tribe on April 15, 1985. This is in addition to the 10,847 acre-feet per year (AFY) which is set forth in the Consolidated Decree of March 27, 2006. These reserved water rights entitle the Tribe to the amount of water necessary for the primary purpose of the Reservation as a homeland. This is usually measured by that water which would irrigate all "practicably irrigable acreage" of the reservations. This amounts to unresolved claim of an additional approximate 22,928 AFY with a priority date of April 15, 1985 as seen below in Table 5.10-B.

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[1] Public Law 99-23 99 Stat. 47.
[2] *Winters v. United States,* 207 U.S. 564 (1908).
[3] *Cappert v. United States,* 426 U.S. 128, 138 (1976).

**TABLE 5.10-B**
Cocopah Indian Tribe Colorado River Unresolved Diversion Claim Pursuant to the Winters Doctrine

| Reservation | State | Unresolved Diversion Claim(AFY)[1] | Net Acres | Priority Within State | Priority Date |
|---|---|---|---|---|---|
| Cocopah Indian Reservation | Arizona | 22,928 | 3,623 | 3-4 | April 15, 1985 |

## 5.10.5 Current Water Use and Operations

Current water use (essentially all for agricultural purposes) on the Reservations is approximately 6,500 AFY. Cocopah uses groundwater which is of questionable potability and is unaccounted for by Reclamation. Until infrastructure is developed to transport river water throughout the Reservation, the Tribe is limited to its current development level.

The Tribe receives some of its irrigation water from canals which are part of the Yuma County Water Users system. This system, which was built prior to Cocopah's first reserved water right priority date of 1915, irrigates a portion of the West Cocopah Reservation. The Tribe also has several wells on the west side of the West Reservation that irrigate property along the River that is between the River and the levee (inside the levee), adjacent to the Colorado River. The water pumped from these wells is not included in the annual Colorado River accounting process, as these wells are located south of the Yuma administrative divide, which extends east from the Northerly International Boundary (NIB) with Mexico. The section of the lower Colorado River which forms the international boundary between the United States and Mexico from the NIB to the Southerly International Boundary (Limotrophe section), is outside Reclamation's water accounting area (Fed. Reg., 2008).

The North Reservation, north of the NIB, is located inside the levee, and is irrigated solely with wells as the Reservation has no infrastructure for water deliveries. Because the North Reservation is north and east of the NIB, the water pumped from these wells is included in Reclamation's annual Water Accounting Report. The Tribe has approximately 140 acres of prime farmland on the east edge of the Reservation with a separate reserved water right established by the Powers Settlement in 1954 which is not included in this summary.

The East Reservation, which was enlarged in 1985 by 4,200 acres, has no infrastructure for irrigation. Housing has been developed along the Yuma Project's East Main Canal, and a casino, bowling alley and service station/food mart have been developed on the far-east side of the Reservation. Between the housing and the casino are approximately 2,000 acres of undeveloped ground.

#### *5.10.5.1 Irrigated Agriculture and Livestock Water Use Category*

Agriculture is a major economic resource for Cocopah. The Tribe, which leases its farmland to other farmers, keeps about 2,400 acres of land under irrigation. Approximately 600 acres of the North Cocopah Reservation along the Colorado River north of Morelos Dam includes water for the Tribe from wells located next to the river.

The Tribe has not developed most of the land on the East Reservation because of lack of infrastructure (canals) to transport the water. All of the land is outside of irrigation districts and associations, which provide the necessary infrastructure. See photographs in this section, which demonstrate this condition.

A view to the north from the East Cocopah Reservation boundary abutting Unit B Irrigation District. (Note the trees being cultivated in Unit B.)
*Source: Cocopah Indian Tribe*

#### *5.10.5.2 Domestic, Commercial, Municipal, and Industrial Water Use Category*

With the acquisition in 1985 of an additional 4,200 acres of land, Cocopah established several businesses including a convenience store, gas station, smoke shop, R.V. Park, two golf courses, and the Cocopah Speedway.

The Tribe also operates the Cocopah Casino on Highway 95 on the East Cocopah Reservation. The water supply for this business comes from the ground water wells on the East Reservation. The well water has total dissolved solids concentrations of approximately 2,500 parts per million.

A view from the East Cocopah Reservation to the West and the Yuma County Water Users' Association.
*Source: Cocopah Indian Tribe*

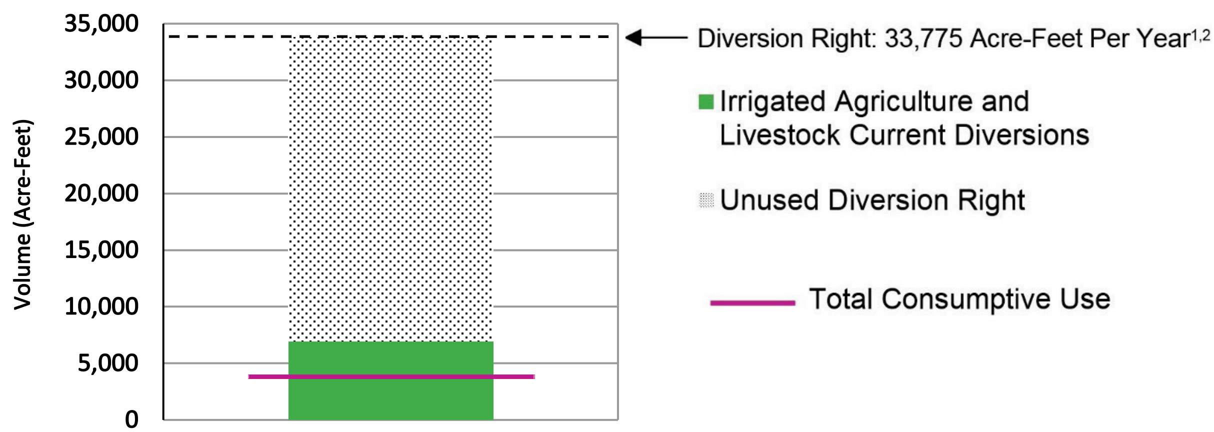
A view of the East Cocopah Reservation looking east along Highway 95.
*Source: Cocopah Indian Tribe*


*See the Disclaimer and Introduction to Chapter 5.0.*

#### *5.10.5.3 Summary of Current Water Use*

Cocopah's average annual water use for the period from 2009 through 2013 in Arizona is presented in Figure 5.10-B and Table 5.10-C. The average annual water use for the 2009 through 2013 period is consistent with Reclamation's Colorado River Accounting and Water Use Reports: Arizona, California, and Nevada (Water Accounting Report) (Reclamation, 2017) and was supplemented with water use information provided by the Tribe for the purpose of the Tribal Water Study. Consumptive use amounts were estimated using either efficiency factors in the Water Accounting Report or standard engineering efficiencies.

**FIGURE 5.10-B**
Cocopah Indian Tribe Current Average Annual Water Use in California (2009 – 2013)




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water is measured by (i) annual diversions not to exceed 10,847 acre-feet or (ii) the quantity of mainstream Colorado River water necessary to supply the consumptive use required for the irrigation of 1,714 acres and for the satisfaction of related uses, whichever of (i) or (ii) is less.

[2] Includes Cocopah Indian Tribe's unresolved diversion claim of 22,928 AFY in Arizona.

**TABLE 5.10-C**
Cocopah Indian Tribe Current Average Annual Water Use By State (2009 – 2013)

| State | Water Use Category | Diversion (AFY) | Estimated Current Consumptive Use (AFY) |
|---|---|---|---|
| Arizona | AG | 6,973 | 3,835 |
| **Total** | | **6,973** | **3,835** |

AG – Irrigated Agriculture and Livestock

### 5.10.6 Tribal Water Use Challenges

The biggest challenge to fully using Tribal water resources is unbuilt infrastructure. With access only to existing delivery systems, the Tribe is left with a partially developed homeland. Only with further development of the resources of their homeland can the Tribe realize increased incomes, productivity, and economic status.

The lack of a policy to confirm that Cocopah's federal Indian reserved water right is not subject to limitation on use is also a continuing challenge. The Tribe believes the water should be able to be used for multiple purposes ranging from agriculture and domestic uses to commercial and industrial uses. Additionally, the water should be able to be leased, banked, subject to a forbearance agreement, or sold. With no policies that would enable these activities to be implemented through extended use of existing reserved water rights, the Tribe faces a bleak future.

### 5.10.7 Projected Future Water Development

Cocopah's future water development was assessed by first examining the location, quantity and type of current water use and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development.

The Tribal Water Study's scenarios and associated themes are listed below. Detailed descriptions of these scenarios (storylines) were created to consider a wide range of possible water development outcomes. For additional information, including the scenario storylines, see *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreases flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

Cocopah contemplated its future water development through 2060 by reviewing its current water use estimates and reflecting upon how these might change under the four scenarios. During this process, the Tribe considered such elements as the scenario conditions described in the storylines, current or future planned projects, anticipated changes in water use by category, and the extent and condition of existing water infrastructure and the need, as well as the cost, for new infrastructure to support water development. Cocopah contemplated future development in the four water use categories: Irrigated Agriculture and Livestock Water Use (AG); Domestic, Commercial, Municipal, and Industrial Water Use (DCMI); Environmental, Cultural, and Recreational Water Use (ENV); and Transfers, Leases, and Exchanges (TRAN).

From this examination, the Tribe extrapolated likely future use if current trends (Scenario A) continued through 2060 and prepared a quantified water development schedules for its reserved water rights in Arizona. Subsequently, Cocopah used this same approach to prepare future water development schedules reflective of how the other scenario storylines (Scenarios B, C1, and C2) could affect its future water development. The documentation for each development schedule is presented in the following sections.

#### *5.10.7.1 Future Water Development Schedules*

Future water development schedules were developed by Cocopah for each scenario. The assumptions for each schedule are described below and the schedules presented graphically in Figure 5.10-C and numerically in Table 5.10-D.

##### *Current Water Development Trends (Scenario A)*

If current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same, by 2060 the total water diversions on the Cocopah Reservation could increase by approximately 55 percent to the full reserved diversion water right. The diversion increase would be mainly due to increased AG water use in the North Reservation where irrigation infrastructure currently exists and a 10 percent increase in DCMI use. Increase efficiencies in AG and DCMI water use would increase consumptive use by approximately 30 percent. The water development schedules assumes that two percent of the water right would be used for ENV purposes by 2060 and that there would be no TRAN water use.

##### *Slow Water Development Trends (Scenario B)*

Decreases in flexibility in governance of tribal water, levels of funding, and the resolution of tribal claims could slow tribal economic development in Scenario B. Under this scenario, the Cocopah Tribe prepared a water development schedule that shows full diversion of the Tribe's reserved water right by 2060 due to increases in AG water use. Agricultural efficiencies remain constant at 55 percent. No DCMI development or transfers were assumed. It was assumed that two percent of the water right was used for ENV purposes by 2060.

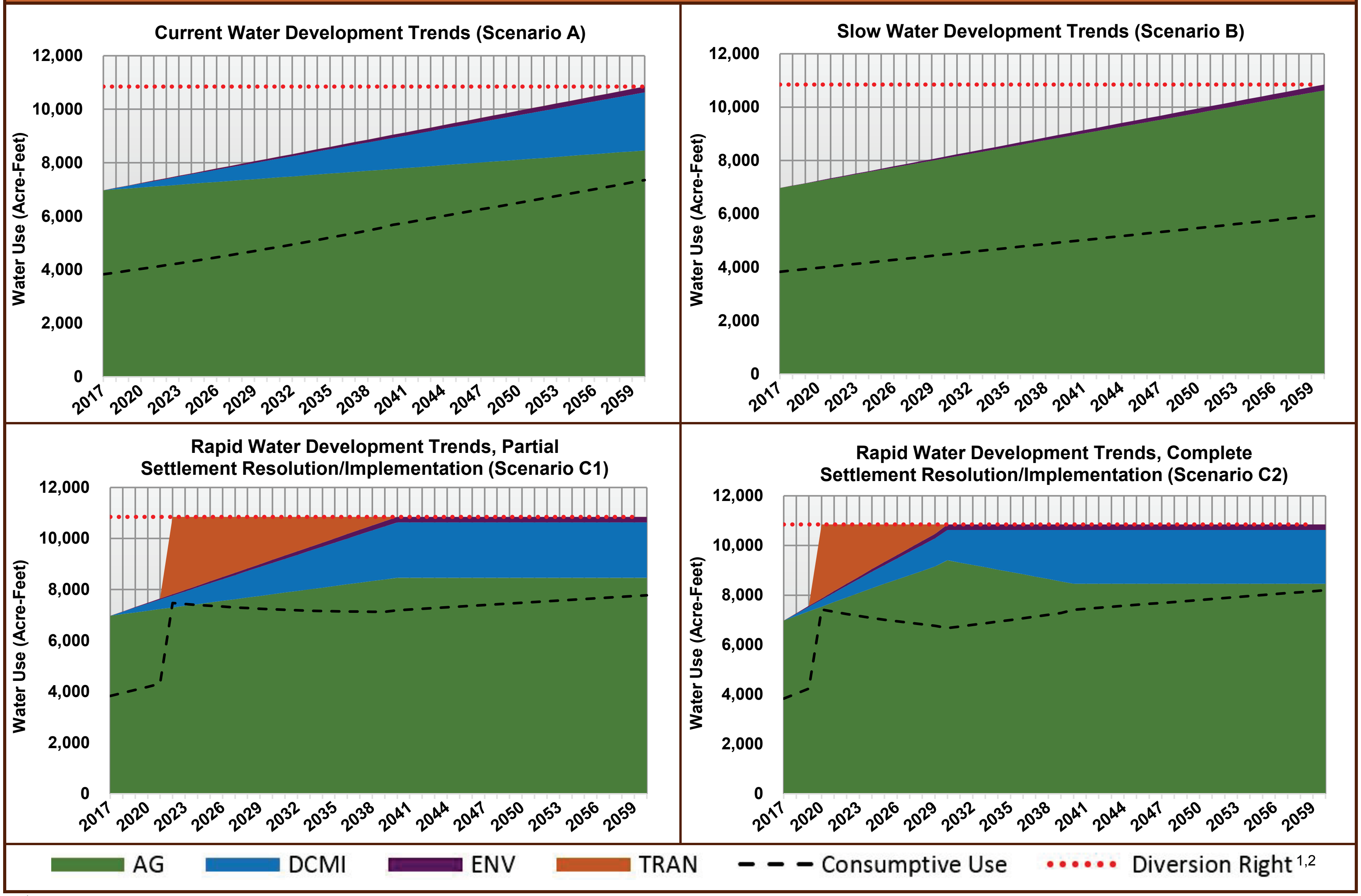
##### *Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)*

Under Scenario C1, a partial resolution of the claims and/or implementation of decreed or settled rights leads to increased flexibility in governance of tribal water allowing innovative water development opportunities and increased funding availability leads to tribal economic development. Under this scenario, diversion of the Tribe's full reserved water right occurs by 2022 due to the ability to transfer water. It was assumed that water transfers can begin by 2021 and are maximized to the full water right by 2022. The amount of water transferred decreases as Tribal AG and DCMI water use increases to full water right by 2040 (approximately 20 percent increase). In addition, both AG and DCMI efficiencies increase (AG to 70 percent; DCMI to 80 percent), so total consumptive use increases nearly 25 percent by 2040. ENV purposes continue to use two percent of the water right.

##### *Rapid Water Development Trends, Complete Settlement Resolution/Implementation (Scenario C2)*

Scenario C2 builds on scenario C1 by considering a complete resolution of claims and implementation of decreed or settled rights, which further increases water development opportunities. Under this scenario, TRAN use begins in 2019 to allow the Tribe to reach full diversion of its water right by 2020. The amount of water transferred decreases until 2030, when the Tribe uses its full water right for mostly AG and DCMI purposes. As DCMI water use increases through 2060, AG water use decreases. Both AG and DCMI efficiencies increase (AG to 75 percent; DCMI to 80 percent), so total consumptive use increases nearly 43 percent by 2060. ENV purposes continue to use two percent of the water right.

**FIGURE 5.10-C**
Cocopah Indian Tribe Projected Future Water Development in Arizona (Scenarios A, B, C1, and C2)




[1] Cocopah Indian Tribe's reserved diversion water right in Arizona is 10,847 AFY.

[2] Cocopah Indian Tribe's diversion unresolved claim of 22,928 AFY in Arizona was not included in the modeling for the Tribal Water Study.

### *5.10.7.2 Summary of Projected Future Water Development*

Cocopah's current water use and projected future water development under the Tribal Water Study's water development scenarios, and modeled for analysis purposes, is presented in Table 5.10-D.

**TABLE 5.10-D**
Summary of Cocopah Indian Tribe Current Water Use and Projected Future Water Development in Arizona[1,2]

| Water Use Timeframe and Category | | Scenario A (AFY) | | Scenario B (AFY) | | Scenario C1 (AFY) | | Scenario C2 (AFY) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use | Diversion | Consumptive Use |
| Current Use | *AG* | 6,973 | 3,835 | 6,973 | 3,835 | 6,973 | 3,835 | 6,973 | 3,835 |
| | *DCMI* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *ENV* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **6,973** | **3,835** | **6,973** | **3,835** | **6,973** | **3,835** | **6,973** | **3,835** |
| Use at 2040 | *AG* | 7,769 | 4,688 | 8,929 | 4,911 | 8,461 | 5,332 | 8,461 | 5,558 |
| | *DCMI* | 1,160 | 928 | 0 | 0 | 2,169 | 1,736 | 2,169 | 1,736 |
| | *ENV* | 116 | 64 | 116 | 64 | 217 | 119 | 217 | 119 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **9,045** | **5,680** | **9,045** | **4,975** | **10,847** | **7,187** | **10,847** | **7,413** |
| Use at 2060 | *AG* | 8,461 | 5,499 | 10,630 | 5,847 | 8,461 | 5,922 | 8,461 | 6,346 |
| | *DCMI* | 2,169 | 1,736 | 0 | 0 | 2,169 | 1,736 | 2,169 | 1,736 |
| | *ENV* | 217 | 119 | 217 | 119 | 217 | 119 | 217 | 119 |
| | *TRAN* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **10,847** | **7,354** | **10,847** | **5,966** | **10,847** | **7,777** | **10,847** | **8,201** |

[1] Cocopah Indian Tribe's reserved diversion water right in Arizona is 10,847 AFY.
[2] Cocopah Indian Tribe's diversion unresolved claim of 22,928 AFY in Arizona was not included in the modeling for the Tribal Water Study.

## 5.11 Summary

Current tribal water use and potential future tribal water development were summarized for both the Upper and Lower Basins. The Upper Basin summaries present water use and development information for the Ute Indian Tribe, Southern Ute Indian Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation, and Navajo Nation. The Lower Basin summaries present water use and development information for the Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe.

Partnership Tribes have reserved water rights, including unresolved claims, to divert nearly 2.8 million acre-feet per year (AFY) of water from the Colorado River and its tributaries. In the Upper Basin, Partnership Tribes have Federal Indian reserved diversion rights of 1,060,781 AFY and unresolved diversion claims of 762,345 AFY[1]. In the Lower Basin, the Partnership Tribes have decreed diversion rights to Colorado River water of 952,190 AFY and unresolved diversion claims of 22,928 AFY[2]. The Partnership Tribes' water rights, including unresolved claims, used for the Tribal Water Study are presented in Table 5.11-A for the Upper Basin and Table 5.11-B for the Lower Basin.

**TABLE 5.11-A**
Upper Basin Federal Indian Reserved Water Rights and Unresolved Claims

| Partnership Tribe | State | Settled or Adjudicated Diversion Right (AFY) | Unresolved Diversion Claim (AFY) |
|---|---|---|---|
| Ute Indian Tribe | Utah | 179,315 | 370,370 |
| Southern Ute Indian Tribe | Colorado | 128,939[1] | |
| Ute Mountain Ute Tribe | Colorado | 100,184[1] | |
| Jicarilla Apache Nation | New Mexico | 45,682.92 | |
| Navajo Nation | New Mexico | 606,660[2] | |
| | Utah | | 314,926[3] |
| | Arizona (Upper Basin) | | 77,049[4] |
| Total | | **1,060,780.92** | **762,345** |

[1] Southern Ute Indian Tribe's and Ute Mountain Ute Tribe's Animas La-Plata depletion rights of 16,525 acre-feet per year were converted into a diversion right by applying a 37 percent efficiency for a total of 44,662 AFY.
[2] Does not include Navajo Nation's tributary surface water right of 26,871 AFY.
[3] Navajo's proposed settlement for claims of 314,926 AFY in Utah is based on an annual diversion of 435 cubic feet per second from the San Juan River subject to a maximum depletion of 81,500 AFY. The diversion limit does not apply to diversions from groundwater or from Lake Powell, so long as total Navajo depletions in Utah do not exceed 81,500 AFY.
[4] Navajo's Upper Basin unresolved depletion claim in Arizona of 47,000 AFY was converted to an unresolved diversion claim for Tribal Water Study modeling purposes by applying a 61 percent efficiency for a diversion right of 77,049 AFY.

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[1] Does not include Ute Mountain Ute Tribe unquantified rights in Utah and New Mexico.
[2] Does not include Navajo Nation unquantified rights in the Lower Basin.

**TABLE 5.11-B**
Lower Basin Decreed Water Rights and Unresolved Claims

| Partnership Tribe | State | Decreed Diversion Right (AFY) | Unresolved Diversion Claim (AFY) |
|---|---|---|---|
| Fort Mojave Indian Tribe | Nevada | 12,534 | |
| | Arizona | 103,535 | |
| | California | 16,720 | |
| Chemehuevi Indian Tribe | California | 11,340 | |
| Colorado River Indian Tribes | Arizona | 662,402 | |
| | California | 56,846 | |
| Quechan Indian Tribe | Arizona | 6,350 | |
| | California | 71,616 | |
| Cocopah Indian Tribe | Arizona | 10,847 | 22,928[1] |
| **Total** | | **952,190** | **22,928** |

## 5.11.1 Current Tribal Water Use in the Upper and Lower Colorado River Basins

Each Partnership Tribe provided information on its current water use in terms four categories of water use: Irrigated Agriculture and Livestock Water Use; Domestic, Commercial, Municipal, and Industrial Water Use; Environmental, Cultural, and Recreational Water Use; and Transfers, Leases, and Exchanges. The tribes also estimated associated depletions in the Upper Basin or provided measured or calculated consumptive use values in the Lower Basin. Because of the differences among the Partnership Tribes in the availability and quality of data, current water use was considered either as an average water use over five recent years or a single recent representative year. This methodology did not provide a lengthy historical record of tribal water use, but is a good snapshot of recent water use, by category, for each Partnership Tribe and advances the understanding of tribal water use in the Basin.

Current tribal water use, by category, is presented graphically in Figure 5.11-A for the Upper Basin and 5.11-B in the Lower Basin and numerically in Tables 5.11-C and 5.11-D.

**FIGURE 5.11-A**
Current Tribal Water Use and Total Reserved Water Rights including Unresolved Claims in the Upper Colorado River Basin

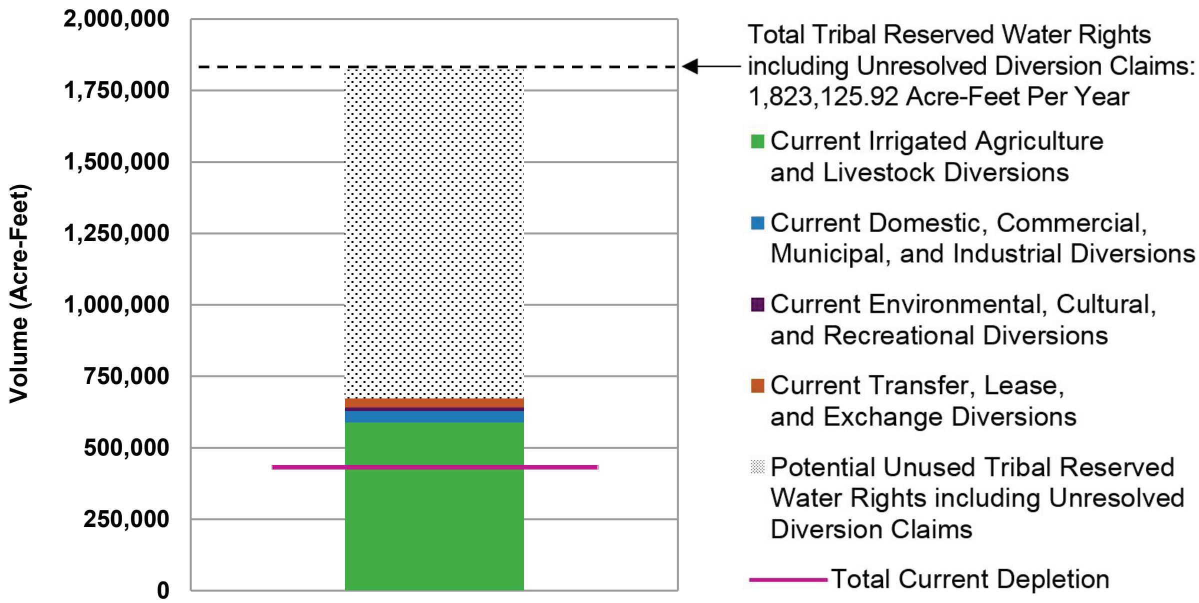
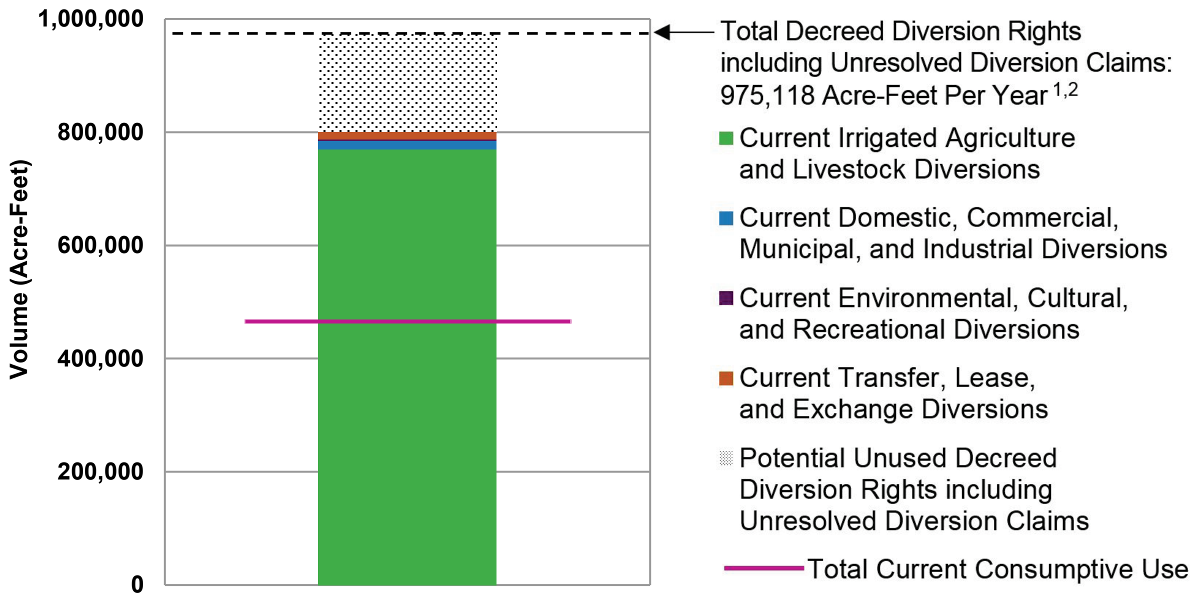



**TABLE 5.11-C**
Total Annual Current Tribal Water Use in Upper Colorado River Basin[1]

| Water Use Category | Current Use Diversions (AFY) | Current Use Depletions (AFY) |
|---|---|---|
| Irrigated Agriculture and Livestock Current Diversions | 588,689 | 363,997 |
| Domestic, Commercial, Municipal, and Industrial Current Diversions | 39,548 | 34,229 |
| Environmental, Cultural, and Recreational Current Diversions | 13,092 | 2,210 |
| Transfers, Leases, and Exchanges Current Diversions | 31,635 | 31,635 |
| **Total** | **672,964** | **432,071** |

[1] See previous sections of Chapter 5 for each Partnership Tribe's description of its current water use.

**FIGURE 5.11-B**
Current Tribal Water Use and Total Decreed Diversion Rights including Unresolved Claims in the Lower Colorado River Basin




[1] Source: Consolidated Decree of March 27, 2006. The quantity of water in each instance is measured by (i) diversions or (ii) consumptive use required for irrigation of the respective acreage and for satisfaction of related uses, whichever of (i) or (ii) is less.
[2] Includes Cocopah Indian Tribe's unresolved diversion claim of 22,928 AFY in Arizona.

**TABLE 5.11-D**
Total Annual Current Tribal Water Use in Lower Colorado River Basin[1]

| Water Use Category | Current Use Diversions (AFY) | Current Consumptive Use (AFY) |
|---|---|---|
| Irrigated Agriculture and Livestock Current Diversions | 769,208 | 441,381 |
| Domestic, Commercial, Municipal, and Industrial Current Diversions | 15,340 | 9,017 |
| Environmental, Cultural, and Recreational Current Diversion | 2,844 | 1,698 |
| Transfers, Leases, and Exchanges Current Diversions | 13,000 | 13,000 |
| **Total** | **800,392** | **465,096** |

[1] See previous sections of Chapter 5 for each Partnership Tribe's description of its current water use.

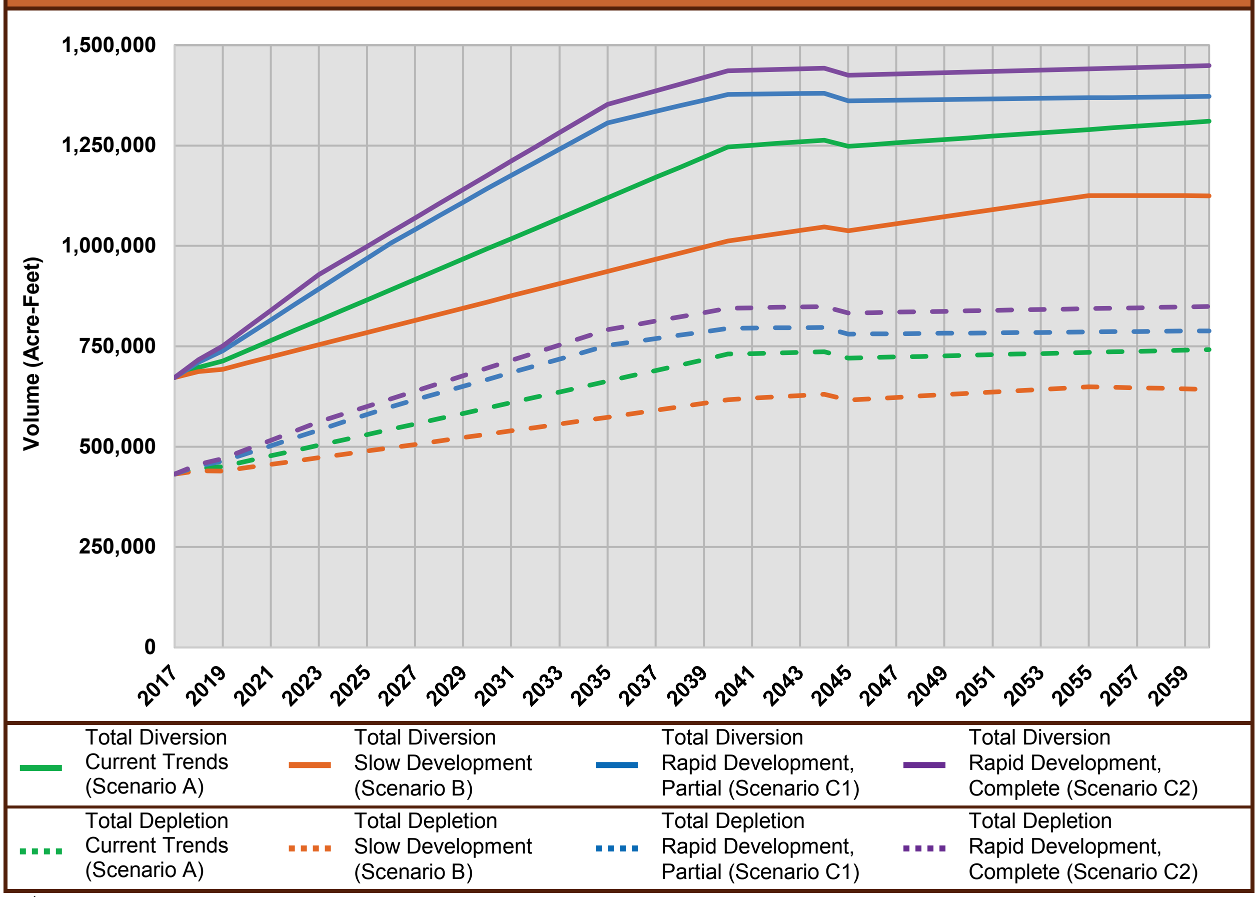
## 5.11.2 Future Tribal Water Development in the Upper and Lower Colorado River Basins

Each Partnership Tribe assessed its future water development by first examining the location, quantity and type of current water use and then, by applying the Tribal Water Study's scenario planning process, envisioning a range of future water development. The Tribal Water Study's scenarios and associated themes are listed below.

- **Current Water Development Trends (Scenario A):** Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B):** Decreased flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2):** Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights.

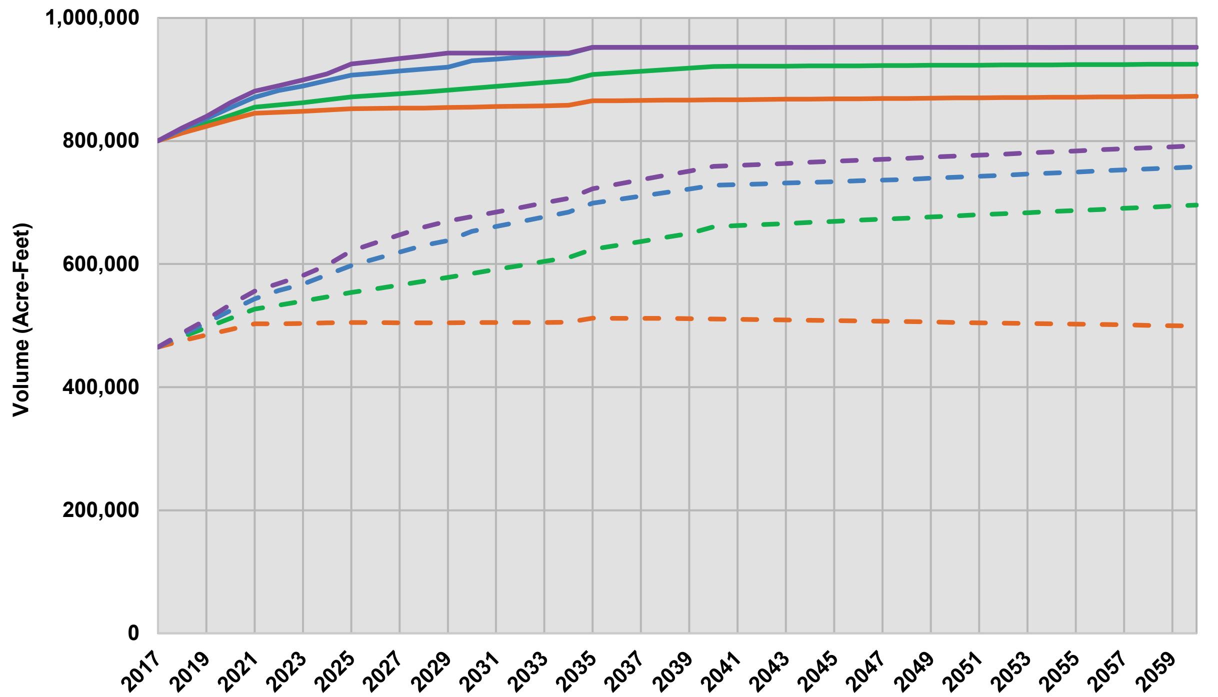
A summation of the potential future tribal water development through 2060, by scenario, is presented in Figure 5.11-C for the Upper Basin and 5.11-D for the Lower Basin.

**FIGURE 5.11-C**
Potential Future Tribal Water Development in the Upper Colorado River Basin[1]




[1] Includes unresolved claims.

**FIGURE 5.11-D**
Potential Future Tribal Water Development in the Lower Colorado River Basin[1]




| | | | |
|---|---|---|---|
| Total Diversion Current Trends (Scenario A) | Total Diversion Slow Development (Scenario B) | Total Diversion Rapid Development, Partial (Scenario C1) | Total Diversion Rapid Development, Complete (Scenario C2) |
| Total Consumptive Use Current Trends (Scenario A) | Total Consumptive Use Slow Development (Scenario B) | Total Consumptive Use Rapid Development, Partial (Scenario C1) | Total Consumptive Use Rapid Development, Complete (Scenario C2) |

[1] Does not include Cocopah Indian Tribe's diversion claim of 22,928 acre-feet per year in Arizona.

# 6 Assessment of System Effects Resulting from Development of Tribal Water

## 6.0 Introduction

A series of modeling simulations were performed to quantify effects to the Colorado River System resulting from a range of future tribal water development scenarios. A set of system reliability metrics (for example, key reservoir elevations, water deliveries to non-tribal water users, etc.) were identified to indicate the effects to the Colorado River System resulting from future water development by the Partnership Tribes.

This chapter describes the approach for conducting the effects assessment and an analysis of the results.

### ◇ Key Terms ◇

Key terms used in this chapter are defined below.

**Colorado River System** – The portion of the Colorado River and its tributaries within the United States.

**Diversion point** – Location on the Colorado River or its tributaries at which water is diverted for depletion or consumptive use.

**Hydrologic shortage** – Unmet demand that is not the result of any policy, such as prescribed shortage delivery reductions.

**Natural inflow** – Calculated as gaged flow corrected for the effects of upstream reservoirs and depletions.

**Policy shortage** – Unmet demand that is the result of a policy, such as prescribed shortage delivery reductions.

**Simulation set** – A collection of model simulations that share the same Tribal Water Development Scenario, Water Supply Scenario, and Reservoir Operation Policy.

**System reliability metrics** – Measurements that indicate the ability of the Colorado River System to meet water delivery needs under multiple future conditions.

**Trace** – A single model simulation

## 6.1 Approach

A framework was developed to assess the effects on the Colorado River System from varying levels of future tribal water development based on the Partnership Tribes' water development scenarios coupled with different hydrologic supply scenarios. The assessment approach adopted for the Tribal Water Study is similar to that used in the Colorado River Basin Water Supply and Demand Study (Basin Study) (Reclamation, 2012). This assessment was performed by following a five-step approach:

1. Identify tribal water development scenarios
2. Develop metrics to measure system effects
3. Configure Colorado River Simulation System (CRSS)
4. Develop modeling assumptions
5. Analyze results

### *6.1.1 Colorado River Simulation System*

The simulation of the Colorado River System under the tribal water development scenarios prepared for the Tribal Water Study was performed using CRSS. CRSS is Reclamation's primary long-term planning tool for studying river operations and projected future demand in the Basin. CRSS is implemented in the commercial modeling software RiverWare™ developed by the University of Colorado (Zagona et al., 2001).

CRSS simulates the operation of the major reservoirs on the Colorado River and provides information regarding the projected future state of the system on a monthly basis. Output variables include the amount of water in storage, reservoir elevations, releases from the dams, the amount of water flowing at various points throughout the system, and diversions to and return flows from water users throughout the system. The simulation centers around a mass balance (or water budget) calculation which accounts for water entering the system, stored in the system, and leaving the system under different policy scenarios.

The model input for the Tribal Water Study included monthly natural inflows, various physical process parameters such as evaporation rates for each reservoir, and future diversion and depletion schedules for water users in the Basin States and the United Mexican States (Mexico). Policy "rulesets" allow CRSS to simulate the operation of the Colorado River mainstream reservoirs, including Lake Powell and Lake Mead, and allow projections of water depletion under different hydrologic scenarios.

### *6.1.2 Five-Step Approach*

A five-step approach was used to assess potential effects to the Colorado River System resulting from future tribal water development. The following is a brief summary of each step and a description of how each fits within the overall assessment. These steps are described in detail in the identified sections.

#### *Step 1 – Identify Tribal Water Development Scenarios (Section 6.2)*

Four future water development planning scenarios were identified collaboratively with the Partnership Tribes as detailed in *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*. The identified planning scenarios were Current Water Development Trends (Scenario A), Slow Water Development Trends (Scenario B), and Rapid Water Development Trends (Scenarios C1 and C2). The tribal water development schedules were quantified to represent four plausible outcomes for future water development for the period from 2017 through 2060. The future water development schedules for each Partnership Tribe are presented in *Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development.*

#### *Step 2 – Develop Metrics to Measure System Effects (Section 6.3)*

Key system reliability metrics (metrics) that could be evaluated from CRSS output were identified to help understand effects to the system from future tribal water development. System reliability metrics considered in this Study included the ability to meet water delivery needs throughout the Basin under multiple future conditions.

#### *Step 3 – Configure Colorado River Simulation System (Section 6.4)*

CRSS and its associated inputs were configured to evaluate the Tribal Water Study metrics outlined in Step 2. These configurations included disaggregating the four tribal water development schedules for each Partnership Tribe as inputs in CRSS along with minor structural changes in CRSS to model Tribes' water use more accurately.

#### *Step 4 – Develop Modeling Assumptions (Section 6.5)*

Several modeling assumptions were needed to fully describe required model inputs. These assumptions included initial reservoir conditions, future water supply scenarios, reservoir operation policies, tribal water development schedules, and future water demand schedules for other water users.

#### *Step 5 – Analyze Results (Section 6.6)*

The metrics identified by Step 2 were evaluated and analyzed. To evaluate the metrics, CRSS was run using the Tribal Water Study's model configuration and assumptions. CRSS is a probabilistic model, so there are multiple future simulations analyzed for each metric. To understand the results, an analysis was conducted across the CRSS simulation outputs. Statistics for each metric were computed in order to explore how a metric changes in response to tribal water development, water supply, and reservoir operations policy.

## 6.2 Identify Tribal Water Development Scenarios

As previously described in *Chapter 4 – Methodology for Assessing Current Tribal Water Use and Projected Future Water Development*, four tribal water development scenarios were developed to capture the range of potential future water development for the Partnership Tribes. These scenarios incorporate the key influencing factors, and account for how these factors would be influenced under each scenario, given the scenario's respective theme. The scenarios and associated themes are listed below.

- **Current Water Development Trends (Scenario A)** – Current trends in on-reservation water development, governance, funding, and resolution of tribal claims remain the same.
- **Slow Water Development Trends (Scenario B)** – Decreased flexibility in governance of tribal water, levels of funding, and resolution of tribal claims slow tribal economic development. This results in a decline in the standard of living and delays resolution of tribal claims.
- **Rapid Water Development Trends (Scenarios C1 and C2)** – Increased flexibility in governance of tribal water allows innovative water development opportunities and increased funding availability leads to tribal economic development. This results in an increase in the standard of living, thereby contributing to the fulfilment of the purpose of the reservation as a homeland and supporting the future needs of tribal communities. Scenario C1 considers partial resolution of claims and/or implementation of decreed or settled rights; and Scenario C2 considers complete resolution of claims and implementation of decreed or settled rights within the Study timeframe.

## 6.3 Develop Metrics to Measure System Effects

Metrics were developed in collaboration with the Partnership Tribes to identify potential effects of tribal water development on the Colorado River System and non-tribal water users. Taking into account CRSS limitations, metrics were identified for both the Upper Basin and Lower Basin including water delivery shortages, Lake Powell inflow, Lake Powell elevation, Lake

Mead elevation, and water deliveries to non-tribal water users. Shortages were not evaluated on a per-tribe or a single water user basis, rather they are reported at the basin or sub-basin level. A majority of these metrics could be evaluated directly in CRSS; however, some required additional analysis of CRSS output or exploration of models other than CRSS such as StateMod, the State of Colorado's surface water allocation and accounting model capable of simulating various historical and future water management policies in a river basin (Colorado Water Conservation Board, 2017) .

The Tribal Water Study metrics are presented in Table 6-A, and described below.

**TABLE 6-A**
Metrics for Upper and Lower Basin System Effects Analysis

| | Variable | Measurement | Source |
|---|---|---|---|
| **Upper Basin Metrics** | Inflow to Lake Powell | Volume in acre-feet per year | CRSS Output |
| | Lake Powell Elevation | Elevation in feet above mean sea level | CRSS Output |
| | Upper Basin Shortage | Volume in acre-feet per year<br>Frequency of shortage volume per year | CRSS Output |
| | San Juan Sub-basin Historical Shortage Analysis | Volume in acre-feet per year | Additional Analysis |
| **Lower Basin Metrics** | Lake Mead Elevation | Elevation in feet above mean sea level | CRSS Output |
| | Lower Basin Hydrologic Shortage | Volume in acre-feet per year<br>Frequency of shortage volume per year | CRSS Output |
| | Water Deliveries to Lower Basin Non-Tribal Users | Volume in acre-feet per year | CRSS Output |
| | Lower Basin Present Perfected Rights Analysis | N/A | Additional Analysis |

### *6.3.1 Upper Basin Metrics and Analyses*

*Inflow to Lake Powell*

The volume of water flowing into Lake Powell in acre-feet per year (AFY), as simulated by CRSS. This volume was calculated on an annual time step, at the end of each calendar year.

*Lake Powell Elevation*

The annual December 31st elevation at Lake Powell (feet above mean sea level [msl]).

*Upper Basin Shortage*

Upper Basin water delivery shortage was defined as the total requested diversion minus actual diversion in a given year for sub-basins that include water use by Partnership Tribes. These sub-basins include the Green River Basin, San Juan River Basin, and the sub-basin composed of intervening flows above Lake Powell and below the San Juan River, San Rafael River, Green River, and Colorado River Basin near Cisco, Utah. Upper Basin shortage was calculated with respect to total requested diversion because Indian reserved water rights are typically diversion-based in the Upper Basin. Shortages were tracked for both Partnership Tribes and non-tribal water users and analyzed as an aggregate annual percent shortage of the requested water diversion. This percent was calculated by dividing the shortage volume by the requested diversion and multiplying by 100. These annual percent shortages were evaluated by frequency across all traces and the annual minimum, median, and maximum percent shortage of total requested diversion.

#### San Juan Sub-basin Historical Shortage Analysis

A limitation of CRSS is that it does not represent individual water rights and therefore may not accurately represent the distribution of water delivery shortages to Partnership Tribes versus non-tribal water users.

The San Juan sub-basin and its tributaries were selected to illustrate what effects could occur in the Upper Basin in times of shortage because tribes in this sub-basin have complex reserved water rights as set forth in tribal decrees filed in Colorado Water Division 7 (see *Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development* for additional detail). Additional analysis was performed based on output from the State of Colorado's water allocation and accounting model, StateMod. Water deliveries in Colorado's portion of the San Juan sub-basin for calendar years 2008 and 2012, which represent recent years with relatively high and low water supplies in the Colorado River Basin, respectively, were modeled with StateMod to identify where shortages occurred and how Partnership Tribes, specifically the Southern Ute Indian Tribe and Ute Mountain Ute Tribe, and non-tribal water users were affected. Water demands for tribal users were then increased to each tribes' full San Juan sub-basin reserved water right, and the StateMod model was run again with the 2008 and 2012 hydrology. Results were analyzed to determine how water deliveries changed between the two model runs. New Mexico water deliveries from the San Juan sub-basin and its tributaries were not included in this analysis. *Appendix 6-1 – Methodology for Conducting San Juan Sub-basin Historical Shortage Analysis* describes the methodology used to estimate historical shortages under current and development of full Indian reserved water rights in the San Juan Sub-basin in Colorado.

### 6.3.2 Lower Basin Metrics and Analyses

#### Lake Mead Elevation

The annual December 31st elevation at Lake Mead (feet above mean sea level [msl]).

#### Lower Basin Hydrologic Shortage

In CRSS, shortage is divided into two portions, hydrologic shortage and policy shortage. Hydrologic shortage is defined as the unmet demand in the Lower Basin and Mexico that is not the result of any policy, such as the prescribed shortage delivery reductions in the *Record of Decision for Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead* (2007 Interim Guidelines) (DOI, 2007) or Intentionally Created Surplus (ICS) activity. For example, under the 2007 Interim Guidelines, policy shortages for the Lower Basin are based upon Lake Mead's elevation, which is divided into three levels. If there is demand for 9.0 million acre-feet per year (MAFY) of water from the Lower Basin States and Mexico, but Lake Mead is below 1,025 feet, and only able to deliver 8.0

MAF of water, there would be a total hydrologic shortage of 1.0 MAF. Under the 2007 Interim Guidelines, Lake Mead would be operating under a level three shortage and annual deliveries to the Lower Basin would be reduced by 625 thousand acre-feet (KAF). This policy shortage would account for 625 KAF of the 1.0 MAF shortage volume, and the remaining 375 KAF of shortage would be labeled hydrologic shortage. For the hydrologic shortage analysis, shortages were not broken out by state or by tribal and non-tribal water users but reported as total Lower Basin and Mexico shortage because CRSS does not account for how shortage would affect individual water users. Shortages in the Lower Basin are calculated with respect to total requested consumptive use. Shortages were analyzed as an aggregate annual percent shortage of the requested consumptive use. This percent was calculated by dividing the shortage volume by the requested consumptive use, and multiplying by 100. These annual percent shortages were evaluated by frequency across all traces and the annual minimum, median, and maximum percent shortage of total requested consumptive use.

#### *Water Deliveries to Lower Basin Non-Tribal Users*

Water deliveries to non-tribal water users are defined as consumptive use by non-tribal water users in the Lower Basin and Mexico. This metric was not broken out by water user but reported as a combined Lower Basin and Mexico value. Water deliveries to non-tribal users were computed by summing all consumptive use in the Lower Basin plus Mexico and subtracting the Lower Basin Partnership Tribes' consumptive use per the tribal water development schedules for that year.

#### *Lower Basin Present Perfected Rights Analysis*

In the Lower Basin, additional post processing was performed to better understand the Present Perfected Rights (PPRs) of Lower Basin Partnership Tribes, and the effect of water delivery shortages to Partnership Tribes. Analysis of this metric explored whether the hydrologic shortage magnitude is great enough to affect tribal PPR water rights holders and was performed as a qualitative discussion of potential effects on Partnership Tribes under existing law.

## 6.4 Configure Colorado River Simulation System

For use in CRSS, the Partnership Tribes' future water development schedules were disaggregated by each tribe's diversion points as currently represented in CRSS. The disaggregation was determined by analyzing tribal use by sub-basin in the Upper Basin, and by state in the Lower Basin, with the assistance of each tribe.

To include the Partnership Tribes' water development schedules in CRSS, each Upper Basin reach and Lower Basin State were matched to the corresponding tribal water diversion points within CRSS. For some Partnership Tribes, assumptions had to be used to disaggregate their water use because of a limited availability of information. The first disaggregation approach used a ratio methodology and was applied when future use information by reach was limited. In this case, water use schedules for Slow Water Development Trends (Scenario B), and Rapid Water Development Trends Scenarios (C1 and C2) were assigned for each diversion point by preserving the Current Water Development Trends (Scenario A) water use ratio. For example, if a tribe has two agricultural water diversions on a reach, under Scenario A, 30 percent of the total agricultural water use was assigned to the tribe's first diversion point and 70 percent to the tribe's second diversion point. For all other scenarios, the future agricultural water use was disaggregated over the two diversion points using this same ratio. The second disaggregation approach was used when there were multiple types of water use at a single diversion point for a tribe. This methodology maintained the ratios of water use types currently in the official CRSS model, which presently relies on the 2007 Upper Colorado River Commission (UCRC) schedule provided by the Upper Division States for all of the future water development scenarios. In both approaches, total water use in a given reach or state was not allowed to exceed the Partnership Tribe's quantified water right for that reach or state.

For non-tribal diversion points in CRSS, water use schedules were broken out from annual to monthly time steps by distributing annual water use to each month based on the monthly coefficients from the original CRSS water use schedules before adding the tribal water development schedules.

A structural change was made to CRSS to improve water delivery priority modeling on the Duchesne River, Utah. Because the Ute Indian Tribe has a senior water right on the Duchesne River, their diversion point was moved from the aggregate reach located below the Starvation Reservoir to the aggregate reach above the Starvation Reservoir. This configuration ensured that the Tribe's demands were met before non-tribal demands.

## 6.5 Develop Modeling Assumptions

As with any modeling effort, assumptions needed to be made to use the model. Some assumptions made for this analysis included the model simulation period and initial reservoir conditions. Key model simulation assumptions included future hydrology (using multiple future water supply scenarios, described below), water demands, and reservoir operations policy. These assumptions are similar to those incorporated into the Basin Study modeling efforts.

The modeling simulation period selected was from January 2017 through December 2060. CRSS simulations must begin in January due to model constraints and because it was not yet January 2017 when modeling occurred, a projection of Colorado River System conditions was needed. Reservoir starting conditions for CRSS were taken from Reclamation's *Operation Plan for Colorado River System Reservoirs, August 2016 24-Month Study Report* (Reclamation, 2016) and are consistent with the Lake Powell and Lake Mead initial reservoir conditions used for the August 2016 CRSS simulation as reported in, *The Colorado River System: Projected Future Conditions 2017-2021,* (Reclamation, 2016b).

Modeling assumptions included future water supply, water demands, and reservoir operations policy. The future water supply scenarios selected from the Basin Study for the Tribal Water Study were the Observed Natural Flow and the downscaled Global Climate Model scenarios. The Observed Natural Flow scenario was selected because it captures the recently updated observed historical flows. The Global Climate Model scenario was selected because it provides the largest plausible range of future natural flows in terms of both magnitude and length of sequences of wet and dry spells. The Observed Natural Flow water supply scenario assumes that future hydrologic trends and variability are similar to the past approximately 100 years. It uses the indexed sequential method (Ouarda et al., 1997) to resample the observed natural flow data from the historical natural flow record. This method can only generate hydrology inputs with observed flow magnitudes and sequences, and preserves historical data statistics. The Global Climate Model water supply scenario assumes that future climate will continue to warm with regional precipitation and temperature trends represented through an ensemble of future downscaled global climate model projections and simulated hydrology. The Global Climate Model scenario contains traces from 16 general circulation models with three emissions scenarios, and provides runoff projections based on the World Climate Research Program's Coupled Model Intercomparison Project Phase 3 (CMIP3) (Maurer et al., 2007) projected climate assumptions (see Basin Study, *Technical Report B – Water Supply Assessment* [Reclamation, 2012a]).

Water demands were represented for the Partnership Tribes and non-tribal water users. The Partnership Tribes used their individually-identified water development schedules (Current Water Development Trends [Scenario A]; Slow Water Development Trends [Scenario B]; Rapid Water Development Trends [Scenarios C1 and C2]). Non-tribal water users' demands were held consistent throughout all four water development scenarios ensuring that differences in model results between scenarios were only the result of future water development by the Partnership Tribes. The Upper Basin non-tribal demands were obtained from the 2007 UCRC schedule. The Lower Basin non-tribal demands were those used for the 2007 Interim Guidelines. Lower Basin non-tribal demands were increased or decreased for each tribal water development schedule to ensure consumptive use in the Lower Basin did not exceed the annual normal apportionment, giving the Lower Basin States an annual scheduled consumptive use volume of 7.5 MAF.

Two different reservoir operation policy sets were evaluated. Both policy sets operated Lake Powell and Lake Mead according to the 2007 Interim Guidelines between 2017 through 2026. After the expiration of the 2007 Interim Guidelines in 2026, two operational assumptions were considered. The first was that the Shortage, Surplus, and Coordinated Operations provisions of the 2007 Interim Guidelines would be extended through the Tribal Water Study's timeframe of 2060 (*Interim Guidelines Extended* policy). The second was that the operating rules revert to the rules of the No Action Alternative from the *Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead Final Environmental Impact Statement* (2007 Interim Guidelines Final EIS) (Reclamation, 2007) (*Interim Guidelines Expire in 2026* policy). These two reservoir operation policy sets were also used for the Basin Study analysis.

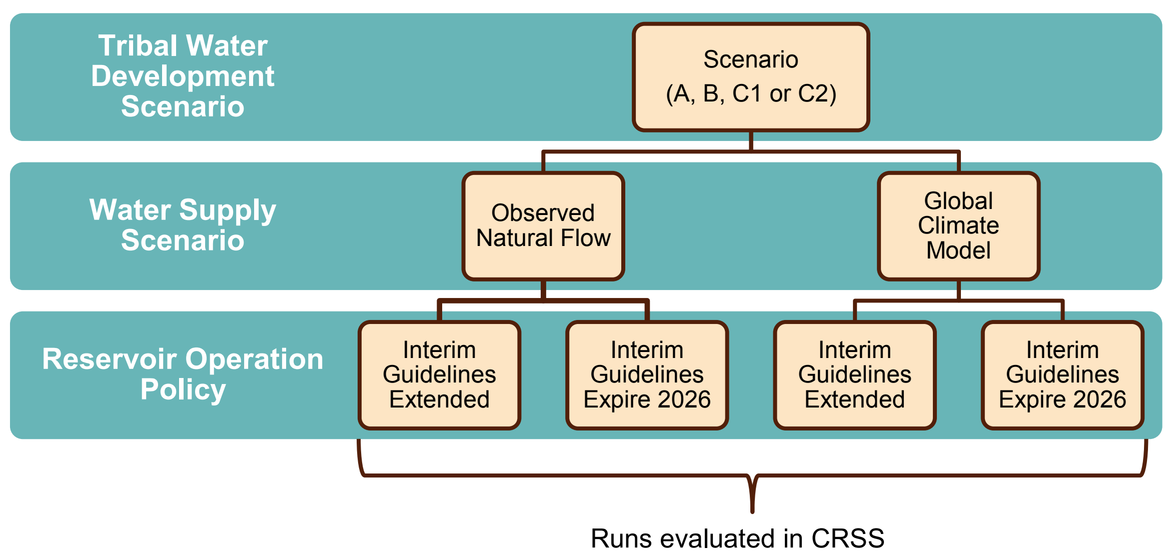
The reservoirs upstream of Lake Powell were operated to meet specific targets reflecting each reservoir's respective Record of Decision (ROD) for the entire modeling simulation period. Taylor Park, and Starvation reservoirs were operated in accordance with their existing rule curves (see *Appendix A, CRSS Model Documentation* [Reclamation, 2007]), but Fontenelle's operations rules in CRSS have been updated since the 2007 Interim Guidelines (Reclamation, 2012). In CRSS, the Aspinall Unit operations do not yet reflect the Record of Decision for the Aspinall Unit Operations Final Environmental Impact Statement (Reclamation, 2012b), and were operated in accordance with their previous rule curves, as published in the 2007 Interim Guidelines Final EIS) (see *Appendix A, CRSS Model Documentation* [Reclamation, 2007]). The operations rules for Navajo and Flaming Gorge reservoirs were modified in CRSS to meet specified downstream flow targets in accordance with the rules laid out in their respective RODs (Reclamation, 2006a and 2006b).

The four tribal water development scenarios were modeled with both water supply scenarios, and both reservoir operation policies, as shown in Figure 6-A. That is, each water development scenario was run with:

- Observed Natural Flow water supply scenario
    - *Interim Guidelines Extended* policy
    - *Interim Guidelines Expire in 2026* policy
- Global Climate Model water supply scenario
    - *Interim Guidelines Extended* policy
    - *Interim Guidelines Expire in 2026* policy

This provided a total of 4 simulation sets for each water development scenario. These four simulation sets were repeated for the four water development scenarios, which provided 16 simulation sets with a combined total of 1,752 simulations, also termed 'traces', which were evaluated in the analysis. Each trace reflected one combination of supply, development, and reservoir operation policy. Traces were grouped to explore the effects of tribal water development under the water supply scenarios, the tribal water development scenarios, and the reservoir operation policies.

**FIGURE 6-A**
Conceptual Representation of the Modeling Performed for a Given Development Scenario




## 6.6 Analyze Results

Upon configuring and simulating with the model, the 16 simulation sets provided 1,752 traces of data for analysis. These data were grouped by water supply scenario, tribal water development scenario, and reservoir operation policy and were analyzed for each metric to assess the effect of each tribal water development scenario. The following results are divided by Upper and Lower Basin, and contain the metrics and the results for the corresponding basin.

### *6.6.1 Upper Basin Modeling Results*

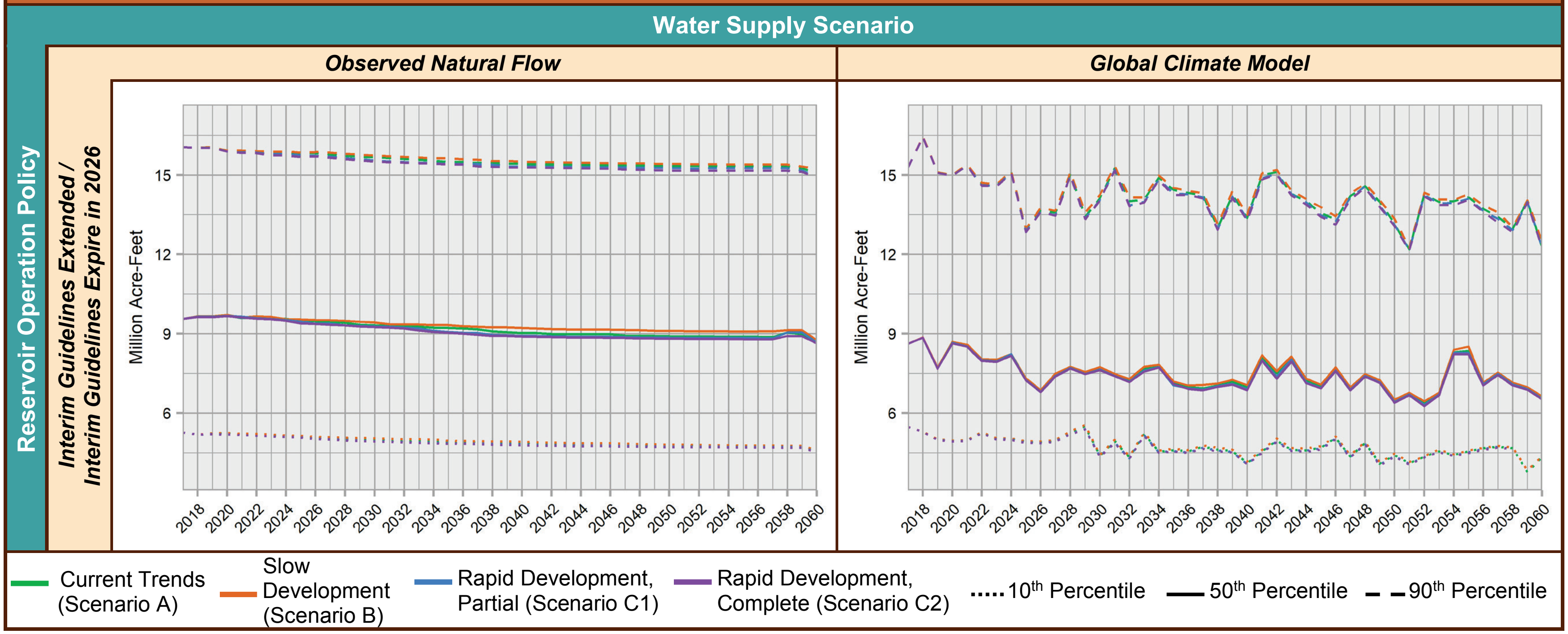
Figure 6-B is organized by supply scenario and Figure 6-C is organized by supply scenario and reservoir operations policy, with the Observed Natural Flow supply scenario used in the panels on the left, the Global Climate Model supply scenario used in the panels on the right, the *Interim Guidelines Extended* policy used in the panels on the top and the *Interim Guidelines Expire in 2026* policy used in the panels on the bottom. Figure 6-D is organized by supply scenario with the Observed Natural Flow supply scenario in the top panels and the Global Climate Model supply scenario in the bottom panels and further split by aggregate annual percent shortage as a frequency in the left panels, and as the minimum, median, and maximum aggregate annual shortage percent in the right panels.

#### *Metric – Inflow to Lake Powell*

Figure 6-B shows the inflow into Lake Powell across the model results. By 2060, the volume of water flowing into Lake Powell had annual ranges of 328 KAF for the Observed Natural Flow supply scenario (left panel) and 290 KAF (right panels) for the Global Climate Model supply scenario (right panels). These ranges resulted from differences between the inflow volume for Slow Water Development Trends (Scenario B), and Rapid Water Development Trends, Complete (Scenario C2). These scenarios define the range because they exhibit the slowest (Scenario B) and most rapid (Scenario C2) rates of tribal water development. A larger inflow volume range was experienced across water supply scenarios than across development scenarios, indicating the water supply scenarios exhibit more influence on inflow volume into Lake Powell than the tribal water development scenarios.

For this metric, the inflows for each water supply scenario do not vary by reservoir operating policy because these policies do not affect reservoir operations above Lake Powell. Therefore, Figure 6-B only shows results for the two water supply scenarios.

**FIGURE 6-B**
Annual Inflow into Lake Powell (2017 – 2060)



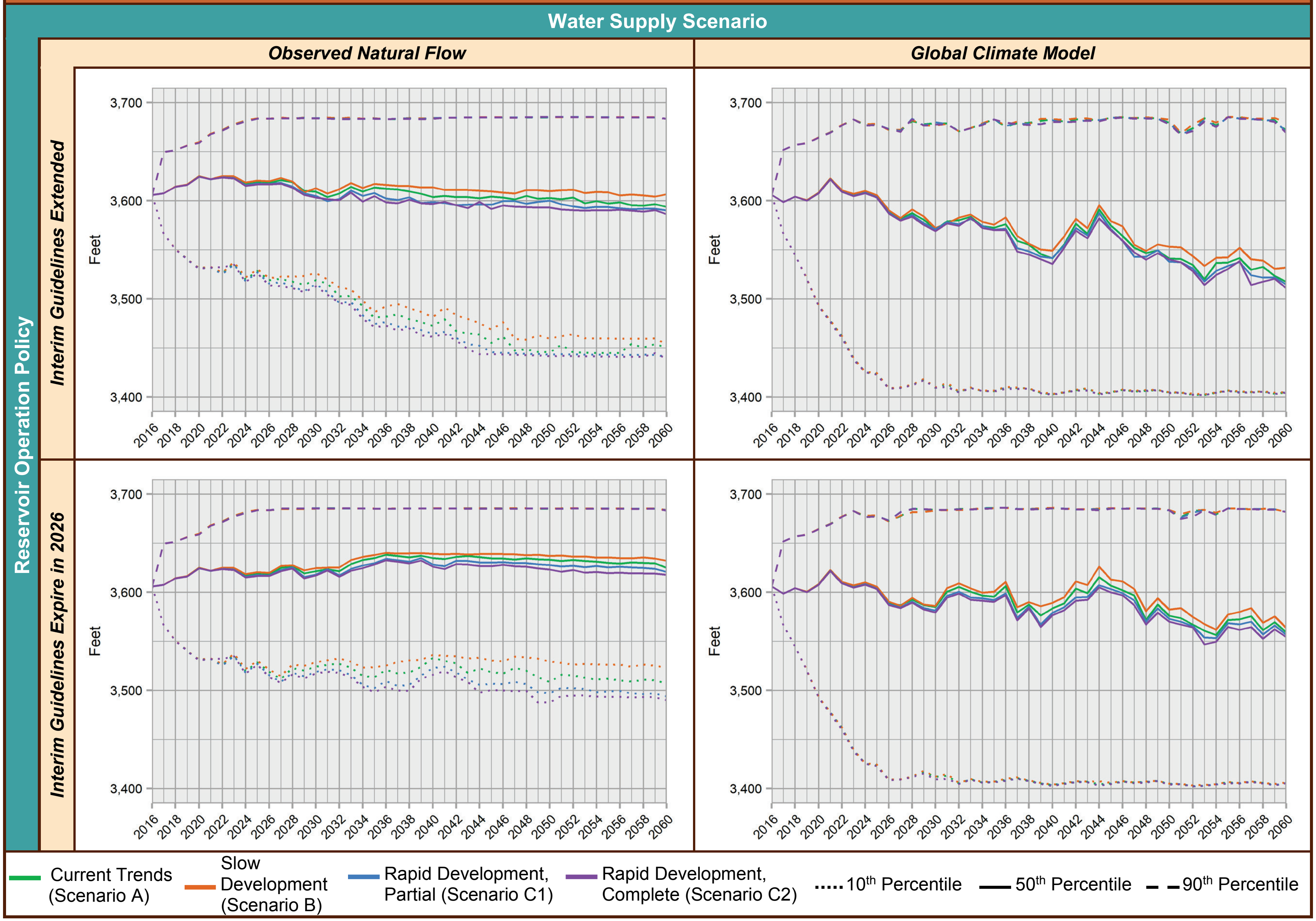
### *Metric – Lake Powell Elevation*

Figure 6-C shows Lake Powell elevation across results. At the 50th percentile (solid line), the tribal water development schedules show a range of Lake Powell elevations. This range was bounded by Slow Water Development Trends (Scenario B), and Rapid Water Development Trends, Complete (Scenario C2), and displays differences in elevation as large as 21 feet by 2060. This difference was due to Upper Basin tribal water development.

Differences in elevations across the Observed Natural Flow supply scenario are more pronounced when Lake Powell is at lower water levels, such as those seen in the 10th percentile (dotted line). The 10th percentile represents the lowest 10% of elevations seen in the results for a given year. In Figure 6-C, the 10th percentile exhibits a range of 33 feet in the difference between Slow Water Development Trends (Scenario B) and Rapid Water Development Trends, Complete (Scenario C2), which again bound this range, by 2060. This comparison indicates that the system is more affected by Upper Basin tribal water development when water supplies are low.

Under the Global Climate Model scenario, the 10th percentile (dotted line) displays little effect from Upper Basin tribal water development, resulting in little to no range across the tribal water development scenarios. Under the Global Climate Model supply scenario this occurs because Lake Powell elevation is constrained as the reservoir approaches the dead pool elevation (3,370 feet), when the reservoir is unable to release water downstream.

**FIGURE 6-C**
Annual Lake Powell Elevation (2017 – 2060)

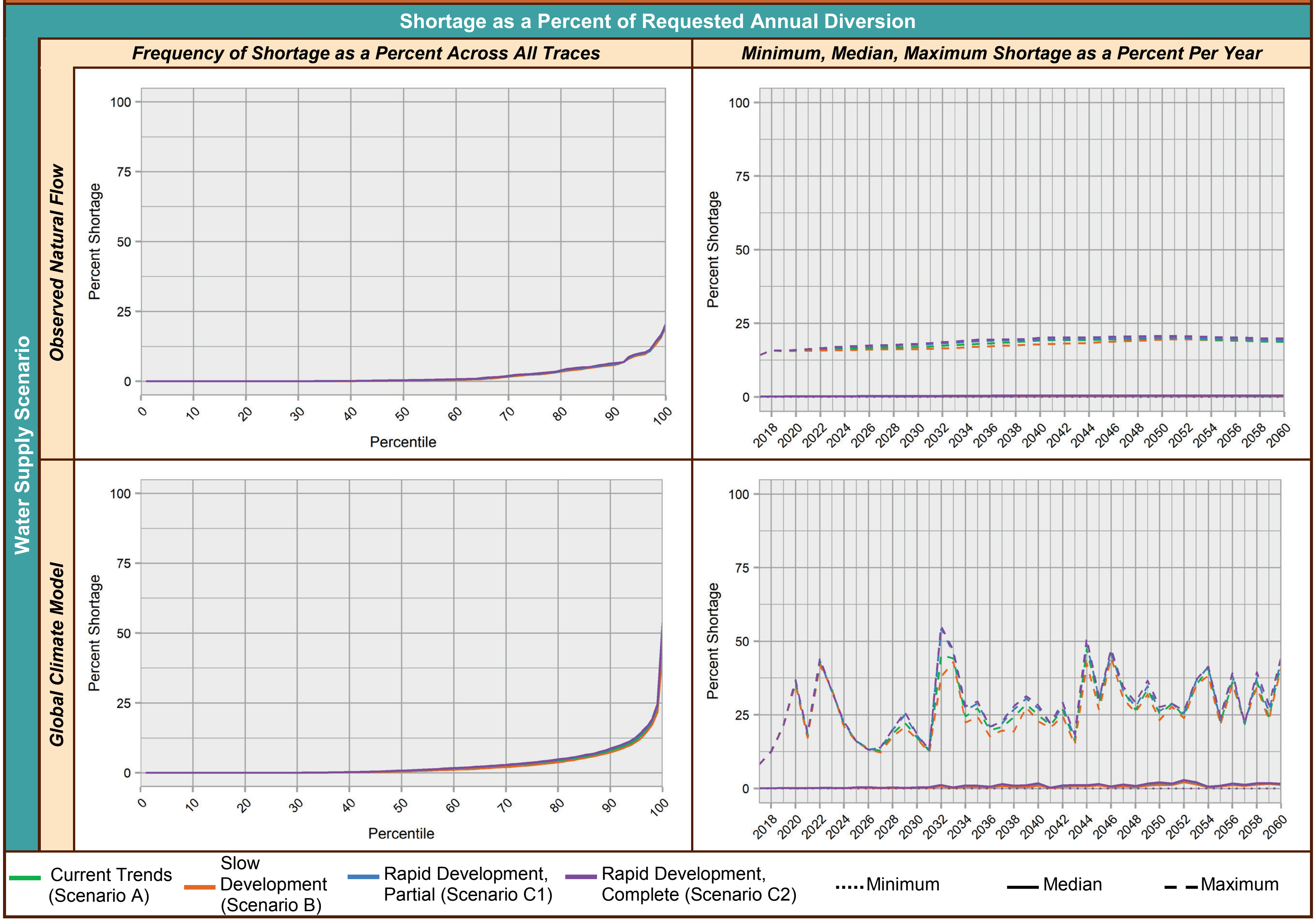


### *Metric – Upper Basin Shortage*

Figure 6-D shows the aggregate annual percent shortage. The percent shortage represents the percent of the requested annual diversion that was not delivered. This metric provides context regarding the severity of the shortage volume with respect to demand. The left panels show the percent shortage as a frequency across all traces and the right panels show the annual minimum, median, and maximum percent shortage in the Upper Basin, seen across all impacted Upper Basin sub-basins. These sub-basins include the Green River and San Juan sub-basins, and their intervening flows. This shortage is shown as a percent of annual diversion requested. Results are further split out by supply scenario, with the Observed Natural Flow supply scenario in the top two panels and the Global Climate Model supply scenario in the bottom two panels. Because the modeled reservoir operation policies do not effect reservoir operations above Lake Powell, the results produced by both policy sets are identical for each supply scenario.

The Upper Basin experiences some level of shortage in all years because its water supplies are more dependent on natural streamflows, which are fed directly by snowpack and rainfall, and are affected by localized drought patterns. Across the development schedules, the Upper Basin Shortage metric showed greater variability due to water supply than to tribal water development, with little difference seen between the development schedules.

**FIGURE 6-D**
Upper Basin Percent Shortage of Diversion Requested



### *San Juan Sub-basin Historical Shortage Analysis*

Tables 6-B and 6-C shows the depletion and shortage volumes for both tribal and non-tribal water use within Colorado's San Juan sub-basin for the years 2008 and 2012, respectively, as modeled using the State of Colorado's water allocation and accounting model, StateMod. Both the Southern Ute Indian Tribe and the Ute Mountain Ute Tribe have water rights in this sub-basin within the State of Colorado. Water uses within the New Mexico portion of the San Juan Basin were not considered for this analysis. Using each year's historical hydrology, water use was first modeled with the given year's actual tribal and non-tribal water use, and then a second model run was performed, in which tribal water use was increased to the Tribes' full reserved water right. This analysis was performed for both 2008 and 2012. The results were grouped geographically, with water use above the Archuleta USGS stream gage comprising one grouping, and water use between the Archuleta and Bluff USGS stream gage comprising the second grouping.

In the San Juan sub-basin, the year 2008 was a relatively wet year and the year 2012 was a relatively dry year. When compared to the average flow for the past 30 years (1985 to 2014), the year 2008 saw flows 134 percent greater than the average flow at the Archuleta stream gage and 122 percent greater at the Bluff stream gage. In contrast, the year 2012 saw flows 52 percent lower than average at the Archuleta stream gage and 48 percent lower at the Bluff stream gage. When moving from 2008 observed water use to the full development of tribal rights, the Tribes' water use increases, with depletions above Archuleta more than twice as large, and depletions from Archuleta to Bluff more than four times as large. Full development of tribal water rights did not cause additional tribal shortages above Archuleta; however non-tribal shortages increased by 246 acre-feet (AF) from the 2008 observed water use to the full development of tribal water rights, and increased by 6,310 AF in the 2012 analysis. From Archuleta to Bluff, the non-tribal shortages increased by 6,678 AF from the 2008 observed water use to the full development of tribal water rights, and increased by 13,571 AF in the 2012 analysis. Tribal shortages were also experienced in the Archuleta to Bluff reach when the Tribes' use was increased to full development of water rights, with the Ute Mountain Ute Tribe experiencing 3,681 AF of shortage in the 2008 and 2012 analyses. The non-tribal shortages seen in the 2012 analysis were larger than those seen in the 2008 analysis by approximately 20 to 24 percent, as the year 2012 experienced relatively dry conditions for the San Juan sub-basin.

**TABLE 6-B**
San Juan Basin in Colorado Depletion and Shortage Volumes for Tribal and Non-Tribal Water Users – 2008

| Location | Tribal Depletions | Non-Tribal Depletions | Total Depletions | Tribal Shortages | Non-Tribal Shortages | Total Shortages |
|---|---|---|---|---|---|---|
| ***2008 Current Use Results – San Juan and tributaries in Colorado (AF)*** | | | | | | |
| Above Archuleta | 19,778[1] | 128,121 | 147,889 | 0 | 3,155 | 3,155 |
| *Shortage as Percent of Use* | | | | *0%* | *14%* | *2%* |
| Archuleta to Bluff | 15,808[2] | 176,326 | 192,134 | 0 | 17,773 | 17,773 |
| *Shortage as Percent of Use* | | | | *0%* | *9%* | *8%* |
| ***2008 Tribal Full Water Right Use Results – San Juan and tributaries in Colorado (AF)*** | | | | | | |
| Above Archuleta | 42,656[1] | 127,875 | 170,530 | 0 | 3,401 | 3,401 |
| *Shortage as Percent of Use* | | | | *0%* | *3%* | *2%* |
| Archuleta to Bluff | 65,060[3] | 168,648 | 233,708 | 3,681[4] | 24,451 | 29,132 |
| *Shortage as Percent of Use* | | | | *5%* | *13%* | *11%* |

[1] Southern Ute Indian Tribe
[2] 12,863 AF Ute Mountain Ute Tribe; 2,945 AF Southern Ute Indian Tribe
[3] 44,074 AF Ute Mountain Ute Tribe; 20,986 AF Southern Ute Indian Tribe
[4] Ute Mountain Ute Tribe Shortages

**TABLE 6-C**
San Juan Basin in Colorado Depletion and Shortage Volumes for Tribal and Non-Tribal Water Users – 2012

| Location | Tribal Depletions | Non-Tribal Depletions | Total Depletions | Tribal Shortages | Non-Tribal Shortages | Total Shortages |
|---|---|---|---|---|---|---|
| ***2012 Current Use Results – San Juan and tributaries in Colorado (AF)*** | | | | | | |
| Above Archuleta | 19,778[1] | 95,117 | 114,895 | 0 | 26,637 | 26,637 |
| *Shortage as Percent of Use* | | | | *0%* | *22%* | *19%* |
| Archuleta to Bluff | 15,808[2] | 148,619 | 164,427 | 0 | 59,727 | 59,727 |
| *Shortage as Percent of Use* | | | | *0%* | *29%* | *27%* |
| ***2012 Tribal Full Water Right Use Results – San Juan and tributaries in Colorado (AF)*** | | | | | | |
| Above Archuleta | 42,656[1] | 88,807 | 131,463 | 0 | 32,947 | 32,947 |
| *Shortage as Percent of Use* | | | | *0%* | *27%* | *20%* |
| Archuleta to Bluff | 65,060[3] | 135,048 | 200,108 | 3,681[4] | 73,298 | 76,979 |
| *Shortage as Percent of Use* | | | | *5%* | *35%* | *28%* |

[1] Southern Ute Indian Tribe
[2] 12,863 AF Ute Mountain Ute Tribe; 2,945 AF Southern Ute Indian Tribe
[3] 44,074 AF Ute Mountain Ute Tribe; 20,986 AF Southern Ute Indian Tribe
[4] Ute Mountain Ute Tribe Shortages

### *6.6.2 Lower Basin Modeling Results*

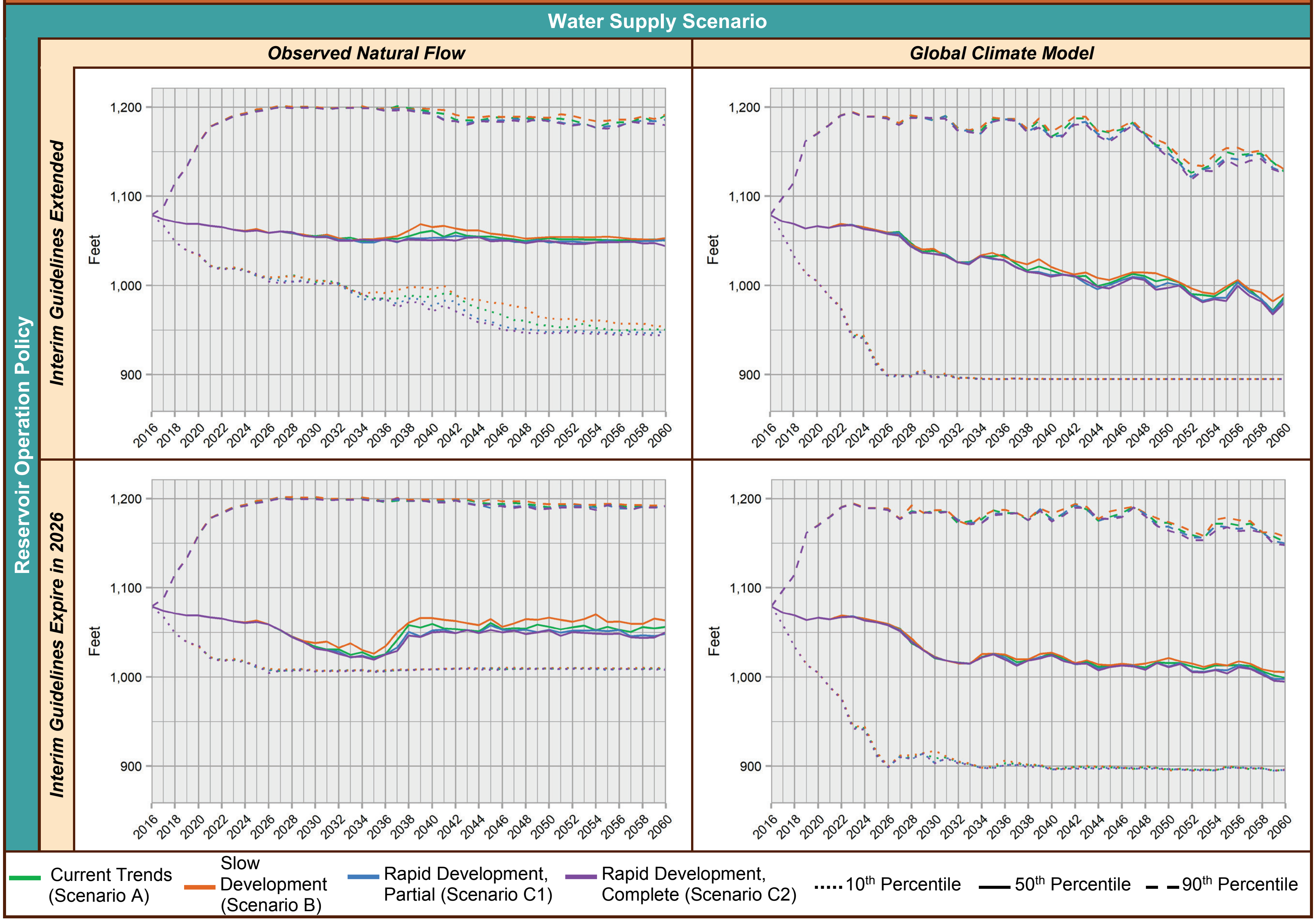
*Metric – Lake Mead Elevation*

Figure 6-E shows the Lake Mead elevations across the model results. The results were organized by supply scenario and reservoir operations policy, with the Observed Natural Flow supply scenario used in the panels on the left, the Global Climate Model supply scenario used in the panels on the right, the *Interim Guidelines Extended* policy used in the top panels and the *Interim Guidelines Expire in 2026* policy used in the bottom panels.

At the 50$^{th}$ percentile (solid line), the tribal water development schedules show a range of effects on Lake Mead elevations. This range was bounded by Slow Water Development Trends (Scenario B), and Rapid Water Development Trends, Complete (Scenario C2), and displays differences as large as 13 feet by 2060. This difference was driven by Upper Basin tribal water development, as was also seen at Lake Powell, because the Lower Basin uses its full normal apportionment and is not allowed to deplete above that apportionment. Tribal water development by the Lower Basin Partnership Tribes would move water use from non-tribal to tribal use as shown in Figure 6-H.

Lake Mead's elevation shows more differences as a result of water supply scenarios than it does as a result of Upper Basin tribal water development. At the 10$^{th}$ percentile (dotted line) there is generally little effect from Upper Basin tribal water development, resulting in little to no range across the tribal water development scenarios. Under the Global Climate Model supply scenario this occurs because Lake Mead elevation is constrained as the reservoir approaches the dead pool elevation (895 feet), when the reservoir is unable to release water downstream. When the Observed Natural Flow supply scenario is coupled with the *Interim Guidelines Expire in 2026* policy, this occurs because the elevation of 1,000 feet at Lake Mead is protected, constraining elevation variation after 2026. The Observed Natural Flow supply scenario under the *Interim Guidelines Extended* policy is the only scenario combination that does not exhibit these physical and policy constraints.

**FIGURE 6-E**
Annual Lake Mead Elevation (2017 – 2060)



### *Metric – Lower Basin Hydrologic Shortage*

Figures 6-F and 6-G shows the aggregate annual percent of hydrologic shortage. The percent of hydrologic shortage represents the percent of the requested annual consumptive use that was not delivered. This metric provides context regarding the severity of the shortage volume with respect to demand. The left panels show the percent of hydrologic shortage as a frequency across all traces and the right panels show the annual minimum, median, and maximum percent of hydrologic shortage in the Lower Basin, seen across all Lower Basin States and Mexico, for the Observed Natural Flow supply scenario (Figure 6-F) and the Global Climate Model supply scenario (Figure 6-G). The results were further split by reservoir operations policy, with the *Interim Guidelines Extended* policy results in the top panels and the *Interim Guidelines Expire in 2026* policy results in the bottom panels.

For the Lower Basin generally, little change is seen in the percent of hydrologic shortage frequency and minimum, and median percent of hydrologic shortages due to tribal water development. Hydrologic shortage was more influenced by variations in water supply, with percent of hydrologic shortages seen at an increased frequency and magnitude under the Global Climate Model supply scenario (Figure 6-G) than the Observed Natural Flow supply scenario (Figure 6-F). This is because the Global Climate Model supply scenario's traces contain more low water supply years than contained in the Observed Natural Flow supply scenario.

Under the Observed Natural Flow supply scenario, hydrologic shortage only occurred under the *Interim Guidelines Extended* policy, and occurred less than five percent of the time. Hydrologic Shortage did not occur under the Interim Guidelines Expire 2026 policy because after 2026, the reservoir operating rules reverted to the rules of the No Action Alternative from the 2007 Interim Guidelines Final EIS. This alternative prevents Lake Mead's elevation from declining below 1,050 feet with approximately an 80 percent probability. Should Lake Mead's elevation continue to decline, the alternative imposes further reduction to keep Lake Mead's elevation above 1000 feet. This shortage is called a "policy" shortage (while not representing official policy of the Department of Interior with regard to future determinations). Because of the flexibility of this policy to reduce the volume of downstream deliveries as needed, hydrologic shortage was never achieved under the Observed Natural Flow supply scenario.

Further, under the Observed Natural Flow supply scenario, tribal water development affected the percent of maximum hydrologic shortage magnitude when it occurred, as seen in Figure 6-F (upper-right panel), providing a range of hydrologic shortage percentages at the maximum value for each year (dashed line). This range was bounded by Slow Water Development Trends (Scenario B), and Rapid Water Development Trends, Complete (Scenario C2), and displays a difference of approximately 23 percent (or 2.07 MAF) on average.

**FIGURE 6-F**
Lower Basin Hydrologic Shortage as Percent of Requested Consumptive Use, Observed Natural Flow Water Supply Scenario

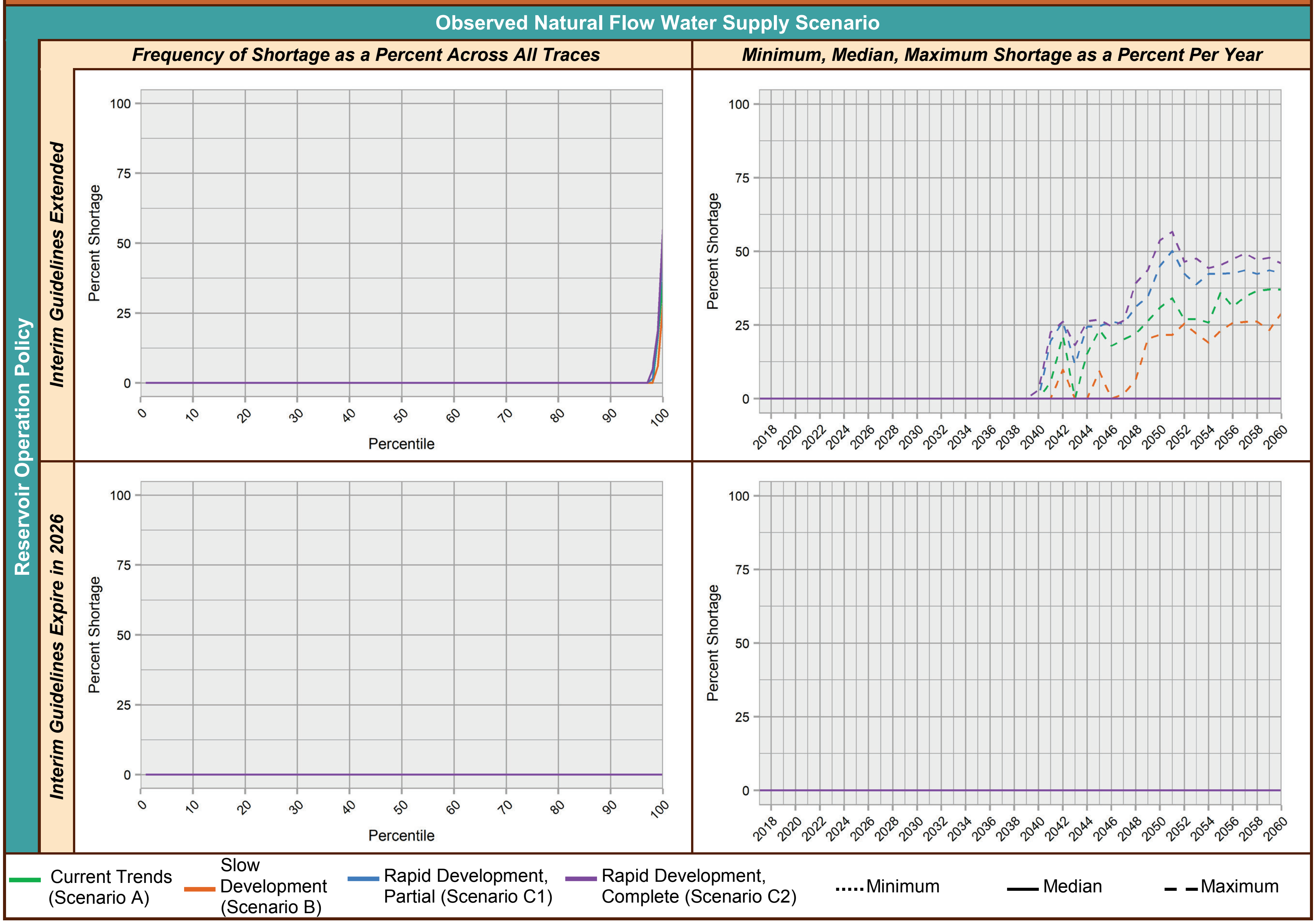
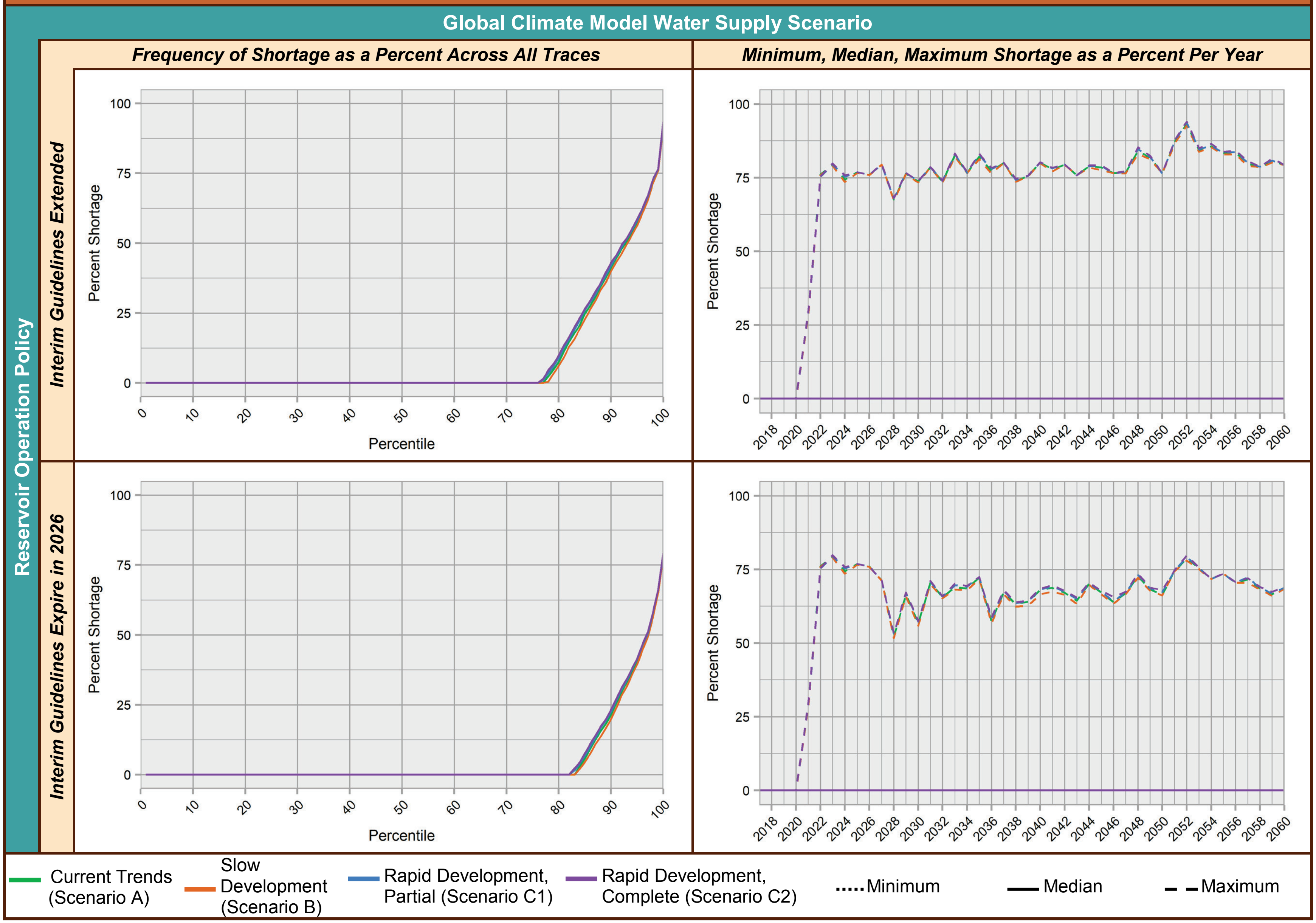


**FIGURE 6-G**
Lower Basin Hydrologic Shortage as Percent of Requested Consumptive Use, Global Climate Model Water Supply Scenario

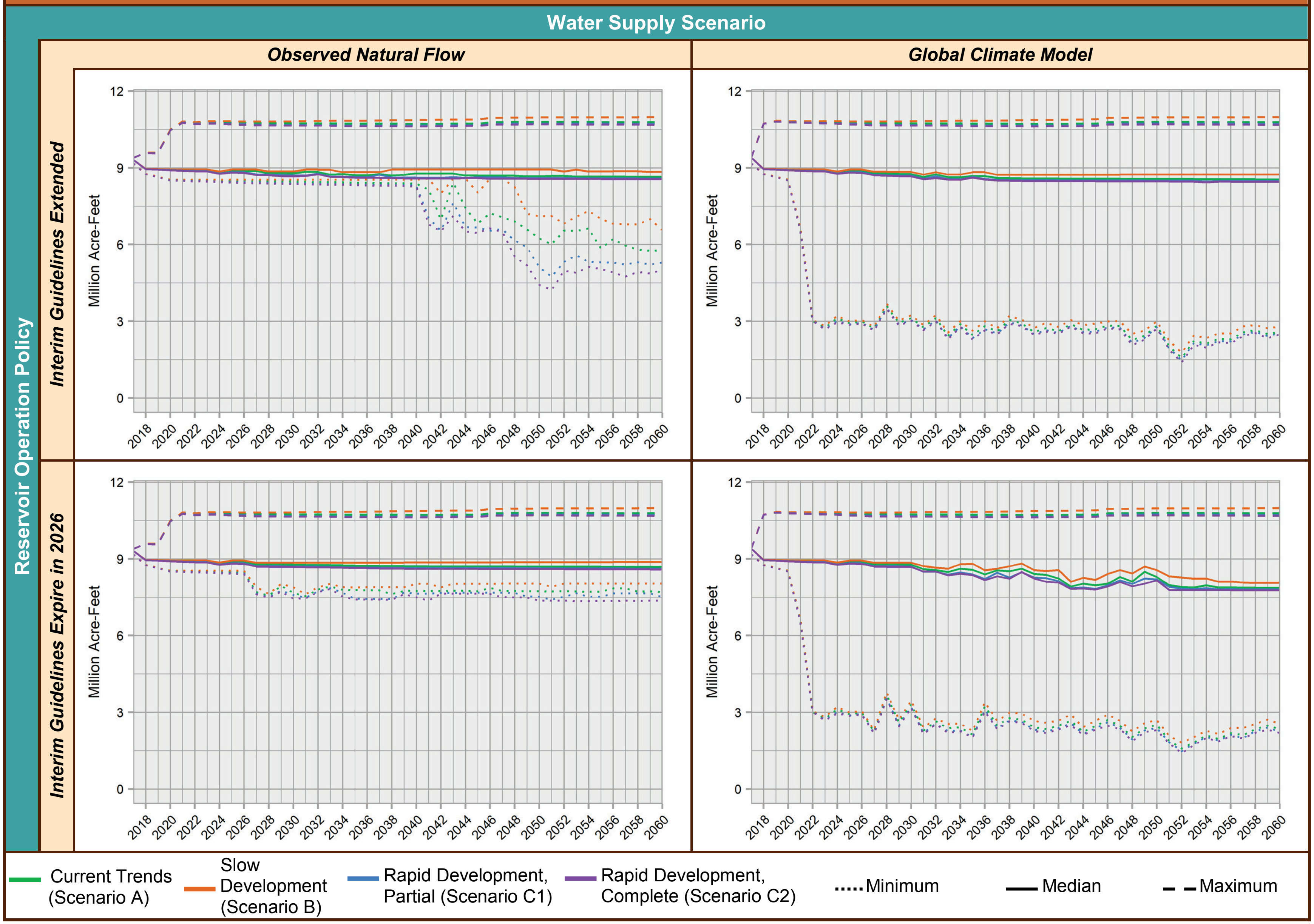


### *Metric – Water Deliveries to Lower Basin Non-Tribal Users*

Figure 6-H shows the annual consumptive use of non-tribal water users in the Lower Basin and Mexico. Results are split out by supply scenario and reservoir operations policy, with the Observed Natural Flow supply scenario in the left panels, the Global Climate Model supply scenario in the right panels, the *Interim Guidelines Extended* policy in the top panels, and the *Interim Guidelines Expire in 2026* policy in the bottom panels.

Less of an effect was seen to non-tribal water users under Slow Water Development Trends (Scenario B) than seen in Current Water Development Trends (Scenario A), and Rapid Water Development Trends (Scenarios C1 and C2). This was because Scenarios A, C1, and C2 contain faster rates of tribal water development than Scenario B. In Figure 6-H, a slight decreasing trend is seen at the median non-tribal consumptive use across all water development scenarios, which corresponds with a shift in water use from non-tribal use to tribal use as the Lower Basin Partnership Tribes develop their water. Again, more variability was seen with respect to the Global Climate Model water supply scenario than with the tribal water development scenarios.

**FIGURE 6-H**
Lower Basin Non-Tribal Consumptive Use



*Metric – Lower Basin Present Perfected Rights Analysis*

The Partnership Tribes in the Lower Basin have some of the most senior water rights on the Colorado River, and in the event of insufficient mainstream water to satisfy all deliveries, the Secretary shall first provide for the satisfaction in full of all rights of the Chemehuevi Indian Reservation, Cocopah Indian Reservation, Fort Yuma Indian Reservation (Quechan Indian Tribe), Colorado River Indian Reservation, and Fort Mojave Indian Reservation.[1] Shortage effects on tribes are therefore dependent on the severity of the shortage in the Lower Basin versus the level of tribal water development. For example, if the Partnership Tribes developed their water to their full diversion rights and historical efficiencies were assumed, tribal water consumptive use would be 722 KAF. Therefore, the Lower Basin's shortage would have to exceed 6.78 MAF for the Partnership Tribes to be affected. Shortages greater than 6.78 MAF were seen in less than one percent of all years, and only occurred under Global Climate Model water supply scenario.

## 6.7 Summary

This analysis quantified the effects on the Colorado River System due to a range of future tribal water development scenarios. These water development scenarios were evaluated over two future water supply scenarios - one that assumes future streamflow will reflect what has been experienced in the past 107 years (1906-2012) and one that assumes lower average future streamflow and longer drought cycles as projected by global climate models.[2] While the Colorado River System was affected by the Partnership Tribes' development of tribal water, the future water supply scenarios had the greatest effect on the System.

In the Upper Basin, the tribal water development scenarios produced a range of Lake Powell inflow volumes by 2060, with the Observed Natural Flow supply scenario exhibiting an average annual inflow difference of 328 KAF across the tribal water development scenarios, and the Global Climate Model supply scenario exhibiting a range of 290 KAF. At Lake Powell, this translated into a 21-foot difference in elevation across the tribal water development scenarios at the 50$^{th}$ percentile. The effect of tribal water development on Lake Powell's elevation was more pronounced in traces that were water stressed, providing a 33 foot range across the tribal water development scenarios at the 10$^{th}$ percentile. However, Upper Basin shortage showed little variation due to tribal water development, and the shortage frequency and volume showed greater sensitivity to changes in water supply than it did to tribal water development.

In the Lower Basin, effects on water availability for all users due to tribal development were caused by tribal development in the Upper Basin. This is because the Lower Basin uses its full normal apportionment, and for this analysis, the Lower Basin was not allowed to deplete above that apportionment. The tribal water development in the Lower Basin was accounted for as a change in water use from non-tribal to tribal, and did not affect the overall water availability to the Lower Basin, but did affect the water availability to non-tribal users. Variations in Lake Mead elevation were seen across the tribal water development scenarios, with a 13-foot range in

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[1] *Arizona v. California,* 547 U.S. 150, 167 (2006).

[2] Recent modeling efforts in the Colorado River Basin have focused on flows based on the climate from 1988 to 2015, which encompasses the current drought period. The average flow in the Colorado River at Lees Ferry used in the Tribal Water Study was 14.9 MAF, while the average flow for the 1988 to 2015 period was 13.2 MAF, which is 13 percent lower. The average flow 2017 through 2060 at Lees Ferry under the Global Climate Model was projected as 13.6 MAF.

elevation at the 50th percentile by 2060. Shortage volumes in the Lower Basin were primarily influenced by water supply, with little to no variation seen due to the tribal water development scenarios when modeled with the Global Climate Model supply scenario. The deliveries to non-tribal users were affected more by Current Water Development Trends (Scenario A) and two Rapid Water Development Trends (Scenarios C1 and C2) than they were by the Slow Water Development Trends (Scenario B). This is because Scenarios A, C1 and C2 included faster rates and larger volumes of tribal water development than did Scenario B.

The water supply scenarios had a noticeable influence on the metrics evaluated when the Colorado River System was water stressed. This was best exhibited with the Global Climate Model supply scenario, which contains more years of reduced supply than the Observed Natural Flow supply scenario. When the Colorado River System experienced high levels of water stress, the magnitude of shortages were large enough to minimize the influence of tribal water development seen on the metrics as compared with the water supply scenarios effects. In these instances water users in the Upper Basin, both the Partnership Tribes and non-tribal, could experience shortages regardless of the level of tribal water development. The effect of the water supply scenarios were particularly noticeable at Lake Powell. Under the Observed Natural Flow supply scenario, the range between the current, rapid, and slow water development scenarios was moderate for the Lake Powell inflow and elevation metrics. Under the Global Climate Model's supply scenario, water supplies were more stressed and the range between the tribal water scenarios for these same metrics was minimal because effects to the system were not due to tribal water development but rather due to restricted water availability.

# 6 Assessment of System Effects Resulting from Development of Tribal Water

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*Page*



## Figures



## Tables

## Appendix

# Appendix 6A
# Methodology for Conducting San Juan Sub-basin Historical Shortage Analysis

# Appendix 6A – Methodology for Conducting San Juan Sub-basin Historical Shortage Analysis

The following methodology was used to estimate shortages under current and full tribal entitlement depletions in the San Juan sub-basin in Colorado for the Tribal Water Study. The State of Colorado's water resources planning model StateMod, developed as part of the Colorado Decision Support System, was used to represent the current water uses and water rights in Colorado (Colorado Water Conservation Board, 2017). StateMod is a water allocation model which determines availability of water to individual user demands and projects based on hydrology, water rights, and operational rules and practices.

StateMod's "historical" San Juan model data set, representing historical diversions and uses for the 1909 through 2013 hydrologic period, has been calibrated to confirm that the model adequately represents Colorado water administration, project operations, and water use practices. StateMod's "baseline" data set represents current uses and water rights as if they had been in place for the full 1909 through 2013 hydrologic study period. Current Southern Ute Indian Tribe and Ute Mountain Ute Tribe water uses are represented in the baseline model data based on their actual diversion location, irrigation water requirements, and water rights. Depletions and shortages are an output from the model simulation. Current depletions and shortages for both tribal and non-tribal water users were reported from the model output for the representative hydrologic years 2008 and 2012. The calibrated historical model, baseline model inputs, and results are presented in the San Juan/Dolores River Basin Water Resources Planning Model User's Manual, July 2016.

A "full tribal use" model was developed for the Tribal Water Study that included increased demands representing full use of the Southern Ute Indian Tribe's and Ute Mountain Ute Tribe's reserved water rights, with limitations based on their Consent Decrees. The non-tribal water demands were not changed from the baseline data set. Current depletions and shortages for both tribal and non-tribal water users were reported from the model output for the representative hydrologic years 2008 and 2012. Water uses under the Animas-La Plata Project are not represented in StateMod. These uses were added for the purposes of the Tribal Water Study analysis and full tribal depletion entitlements were assumed to be always met.

# 7 | Challenges and Opportunities Related to Development of Tribal Water

## 7.0 Introduction

The Partnership Tribes hold a significant amount of federal Indian reserved water rights, including unresolved claims, from the Colorado River and its tributaries.[1] Also, some tribes hold rights that are not federal reserved water rights. Although each Partnership Tribe has a unique water use history and specific water use barriers, through the Tribal Water Study process, the Partnership Tribes identified nine categories of challenges to currently using reserved water rights as well as challenges to future water development. Describing the challenges fostered the collective exploration of opportunities to overcome the challenges and potential future actions that could advance the opportunities.

This chapter presents and describes the nine categories of challenges, discusses the associated opportunities and identifies future potential actions. The challenges categories are as follows:

- Administrative and Legal Constraints
- Responding to Colorado River Basin Water Supply Challenges
- Data Collection and Tools for Water Management
- Agricultural Water Use Challenges
- Domestic, Commercial, Municipal, and Industrial Water Use
- Establishment of Continuous, Sustainable Funding
- Diverse Geography of Tribal Reservations
- Cultural and Environmental Challenges to the Use of Tribal Water
- Socioeconomic Considerations

## 7.1 Administrative and Legal Constraints

### *7.1.1 Challenges*

Over the past 150 years, the Partnership Tribes have experienced challenges gaining recognition of and, in some instances, understanding their reserved water rights by federal regulators, federal and state water managers, and the public at large. This has present implications, both for the Partnership Tribes and for all other Basin stakeholders. For instance, Partnership Tribes in the Basin have a significant claim to a substantial amount of water, which they fully intend to develop and use, but which junior users are currently using; once Partnership Tribes fully use and develop their reserved water rights, those junior water users will be affected.

The doctrine of Indian reserved water rights, also known as the *Winters* doctrine, holds that when Congress reserves land for an Indian reservation, Congress also impliedly reserves water to fulfill the purpose of the reservation. *Winters v. United States*, 207 U.S. 564, 577 (1908). This 1908 United States Supreme Court decision affects the water rights of nearly everyone in the Basin due to the fact that Indian reserved water rights have a priority date of either the date the

[1] See Section 3.0 of *Chapter 3 – The Tribes of the Ten Tribes Partnership*.

reservation was created or time immemorial which makes them senior to almost every other water right in the Basin.

Although *Winters* recognized federal Indian reserved water rights and set the stage for resolving Indian water rights claims, these claims are being resolved at a slow pace. Indeed, fewer than half of the tribes in the Basin have fully settled or adjudicated their reserved water rights. One challenge preventing tribes from fully settling or adjudicating their reserved water rights in the Basin is the slow resolution of water claims in general – whether that is through an adjudicatory or settlement process. Another challenge is obtaining sufficient funding necessary to facilitate a comprehensive negotiated resolution of a tribe's reserved water rights. The fact that many tribes have yet to resolve their water rights claims creates many challenges for both tribal and other water users in the Basin, the most significant of which is the uncertainty it creates in regard to water availability to water users.

Moreover, while some Partnership Tribes have successfully navigated the process for obtaining quantified water rights either through adjudication or settlement, significant issues remain in fully using those water rights. Partnership Tribes may not have the expertise, funding or resources for comprehensive water management planning and implementation. Local entities may be hesitant to partner with tribes on water development opportunities because of differing regulations, taxation options, and sovereign immunity considerations. Even within a reservation, the various forms of land status such as trust allotments, restricted fee, and individual assignments may complicate an otherwise straightforward water development opportunity and further slow progress towards water development.

When a Partnership Tribe's reservation is located in more than one state, complicated issues of how and where the tribe can use its water arise. The state line is an arbitrary boundary to tribes. Indeed tribal member's homes may be located on the reservation but within two states. Partnership Tribes contend they have the right to use their water anywhere within their reservation regardless of state lines. However, if the reservation crosses state lines, the tribe is often restricted in its ability to use its full reserved water rights. Water management among states is not coordinated, which complicates permitting, water accounting and other administrative processes. In addition, the tribe may be subject to multiple state adjudications or settlement processes, which may result in a portion of the tribe's reserved water rights being fully adjudicated in one state, but not in another.

Other challenges arise when a tribe's reservation consists of areas within both the Upper Basin and the Lower Basin. The tribe may be restricted from using its water across Basin boundaries within the reservation. Because the Navajo Reservation covers areas of Utah, Arizona and New Mexico, the Navajo Nation has reserved water rights in the Upper Basin and unresolved claims to water in both the Upper Basin and the Lower Basin but may not use water allocated to the Upper Basin in the Lower Basin and vice versa.

Another challenge involves the ability to voluntarily transfer (such as through transfers, leases, water banking, exchanges, and deferral and forbearance agreements) a portion of a tribe's reserved water rights for off-reservation uses. This could provide a potential source of revenue for a tribe in water short areas, but there are obstacles to such transfers.

### *7.1.2 Opportunities*

To address these challenges, Congress, federal and state agencies, and the general public will need to consider more fully the nature and importance of Indian reserved water rights not just in general but also with regard to (1) the intricacies of each tribe's settled or adjudicated water rights and (2) unresolved claims. The Partnership Tribes intend to take advantage of more opportunities to educate other partners in the Basin and elsewhere about the importance of Indian reserved water rights and how timely and full recognition and understanding of these rights can assist with addressing water challenges in the Basin as a whole. An increased understanding of reserved water rights could help reduce conflict, highlight opportunities for collaboration and lead to innovative partnerships between tribes and state or federal agencies.

There are currently successful water transfer arrangements in place in the Basin involving Indian reserved water rights and other communities. For example, the United States Supreme Court's Consolidated Decree in *Arizona v. California*, 547 U.S. 150 (2006), included a recognition of the Quechan Indian Tribe's right to choose to forebear the development of some of its then- unused federal Indian reserved water rights in California in favor of allowing that water to flow to the Metropolitan Water District of Southern California (MWD). In exchange for obtaining this additional water supply for its customers, MWD agreed to pay the Quechan Tribe on a per acre-foot (AF) basis for the amount of water forborne by the Tribe each year, up to 13,000 AF per year.

The Colorado River Indian Tribes (CRIT) fallow farm land to leave water in Lake Mead as part of the Pilot System Conservation Program. The CRIT entered a forbearance agreement with Reclamation that includes the methodology for measuring reduced consumptive use and corresponding reductions in diversions to the reservation, field verification of fallowed lands, and payment schedules. Funding is provided by Reclamation, Central Arizona Water Conservation District, Metropolitan Water District of Southern California, Southern Nevada Water Authority and Denver Water under the terms of the 2014 Funding Agreement.[2]

The Jicarilla Apache Nation (Jicarilla), too, has reserved water rights that it subleases to a number of different entities for off reservation use subject to the approval authority of the Secretary of the Interior. Jicarilla subleases water to a variety of entities and for a variety of purposes including energy production, private industry, recreation, and conservation.[3] Jicarilla also takes delivery of 6,500 AF of Colorado River water via the San Juan-Chama Project for use in the Rio Grande Basin. Marketing its water provides a source of revenue for Jicarilla; at the same time, downstream users in water short areas benefit as well.

These examples demonstrate that voluntary modifications of tribal water use patterns can be used to help meet the demands of other water users. The Partnership Tribes are hopeful that the information obtained through the Tribal Water Study will provide an opportunity to evaluate and pursue establishing a variety of voluntary use options such as transfers, leases, water banking, exchanges, and deferral and forbearance agreements, which offer opportunities for Partnership Tribes as well as other communities to develop mutually beneficial use of tribal water. Certainly, treating recognition of Indian reserved water rights as a high priority can lead to

[2] Retrieved from: https://www.usbr.gov/lc/region/programs/PilotSysConsProg/pilotsystem.html

[3] Jicarilla Apache Tribe Water Rights Settlement, Public Law No. 102-441, 106 Stat. 2237 (1992) and Contract between the Jicarilla Apache Tribe and the United States (Dec. 8, 1992).

solutions in the Basin in a time when water is scarce and the Basin as a whole is faced with serious imbalances in supply and demand.

The Partnership Tribes are also hopeful that the Tribal Water Study will provide an opportunity for them to be included in regional water planning in order to facilitate tribal water development, minimize conflict, and improve overall reliability of the Colorado River System.

The Partnership Tribes plan to work on structuring grant funding opportunities to support the development of internal technical and legal expertise to assist with tribal water planning and management.

### *7.1.3 Potential Actions*

- Pursue the full resolution of all Indian water rights claims
- Explore the development of a permanent funding mechanism for implementation of tribal water settlements
- Explore revising DOI Criteria and Procedures for Indian Water Rights Settlements to place greater emphasis on the federal trust responsibility and less emphasis on potential federal liability
- Work with federal and state agencies to prioritize the identification of legal and regulatory constraints to full use of tribal water, and to design ways to overcome constraints and to broaden opportunities that enable Partnership Tribes to put their water to full beneficial and economic use
- Address statutory and regulatory prohibitions to interstate water management and use
- Inform other communities that a substantial amount of tribal water is going to be re-directed for tribal use and coordinate efforts to work with Partnership Tribes to develop regional solutions, thereby reducing the likelihood of conflict
- Develop and draft proposed policy changes addressing legal and regulatory constraints, as well as proposed legislation that allows for water management flexibility for Partnership Tribes
- Explore opportunities for federal agencies and Partnership Tribes to work together to develop the expertise, funding and/or resources for comprehensive water management planning and implementation
- Explore ways for Partnership Tribes to use their water that otherwise may be constrained by the Law of the River

## 7.2 Responding to Colorado River Basin Water Supply Challenges

### *7.2.1 Challenges*

For decades, Reclamation and others have recognized and documented the challenges and complexities of ensuring a sustainable water supply and meeting future demands in an over-allocated and highly variable system such as the Colorado River. This challenge is magnified for the Partnership Tribes who seek to fully use their reserved water rights. Future challenges arise from the likelihood of continued population growth and the significant uncertainty regarding an adequate future water supply. As water demand for municipal and agricultural uses increases to serve the demands of growing populations, ensuring the availability of water for non-consumptive uses such as the environment, recreation, and hydropower becomes increasingly challenging, especially because water supply uncertainty is further compounded by the potential effects of climate variability. Evidence indicates increased future climate variability in the Southwest, which may include longer, more extreme dry (and wet) periods than previously observed.

In addition to the long-term challenges identified in the Basin Study (Reclamation, 2012), current extended drought conditions in the Basin have further highlighted the urgency for ensuring Colorado River sustainability for the Partnership Tribes. The past 19 years of drought in the Basin has resulted in increased water management challenges with total Basin storage declining from nearly full to about 50 percent of capacity. The risk of reaching critically low elevations at Lake Powell and Lake Mead over the next decade nearly doubled over the past 10 years.

In the Upper Basin, most tribes depend on water supplies that are more reliant on the natural stream flows fed directly by snowpack than rainfall. These supplies are more likely to be impacted by localized drought patterns. Therefore, Partnership Tribes in this area experience seasonal and yearly flow variations that can result in reduced water deliveries. Upper Basin tribal lands frequently experience an insufficient water supply. In addition, Partnership Tribes with land in multiple sub-basins do not have the infrastructure to move or use water on all parts of their reservations. Indeed, for Partnership Tribes whose reservations are located in multiple states, the current Law of the River and the terms of Indian water rights settlements may result in limitations on their ability to move water where needed on their own reservation lands.

These challenges demonstrate the critical need for on-reservation water storage facilities throughout the Upper Basin. The construction of reservoirs or water projects in the Upper Basin helps provide a more reliable annual water supply. Still, the lack of adequate precipitation to fill the reservoirs coupled with high temperatures can lead to water shortages, especially in late summer. In watersheds without storage facilities, seasonal flow variations frequently do not correspond with crop water demands. Risks related to the imbalance between water supply and the timing of the supply could increase with continuing climate variability.

Partnership Tribes in the Lower Basin have some of the most senior water rights on the Colorado River. In the event of insufficient mainstream water to satisfy all deliveries, the United States Supreme Court held:

> [T]he Secretary of the Interior shall, before providing for the satisfaction of any of the other present perfected rights except for those listed herein . . . first provide for the satisfaction in full or all rights of the Chemehuevi Indian Reservation, Cocopah Indian Reservation, Fort Yuma Indian Reservation [Quechan Indian Tribe], Colorado River Indian Reservation and Fort Mojave Indian Reservation . . . .[4]

Often supply shortages are experienced locally on various parts of the reservations. The Partnership Tribes frequently do not have the internal financial or technical resources to construct needed, large-scale watershed storage facilities. Federal Indian irrigation projects have failed to construct the proper infrastructure, including storage facilities, on many reservations to ensure an adequate and reliable water supply. Further, little infrastructure exists on reservations

[4] *Arizona v. California,* 547 U.S. 150, 167 (2006).

to move water between basins within the reservation or, where authorized, to move water off reservation.

### *7.2.2 Opportunities*

Addressing current and future water supply challenges will require diligent planning and will not be resolved through any single approach. Because Partnership Tribes hold senior water rights, opportunities exist at local, reservation, regional, and Basin-wide levels for tribes to help other Basin water users balance the many competing interests to ensure adequate, reliable water supplies throughout the Colorado River System, while creating economic benefits for their respective communities. Local efforts could include encouraging water reuse, increased agricultural and domestic, commercial, municipal, and industrial conservation, and relatively simple actions such as rainwater harvesting. Reservation-wide efforts such as new or improved storage, stormwater capture, or groundwater recharge facilities would help reduce supply risks. Developing innovative funding and partnership structures could help address the resource and funding needs for these types of projects. Broader efforts such as the Navajo-Gallup Water Supply Project provide long-term sustainable water supplies for multiple communities and support regional economies, and serve as an example of how the needs of tribal and other water users may be addressed in the years ahead.

Future opportunities could include flexibility in the management and operation of reservoirs to help maintain reliable water deliveries and power generation, support environmental needs, and manage flood control. Partnership Tribes, in conjunction with federal, state and independent water authorities, researchers and economists can study the societal and environmental benefits attributable to non-consumptive uses to identify an economic value for those uses which will lend itself to more apt comparison with other use types. This in turn will aid more informed policy development. Policy and management flexibility may also aid significantly in the ability of Partnership Tribes to leverage early priority water rights, creating cooperative opportunities for greater Colorado River System efficiency, reliability and economic benefits for users throughout the Basin.

### *7.2.3 Potential Actions*

- Repair, rehabilitate or improve aging infrastructure
- Develop and fund on-reservation conservation measures
- Construct/improve storage facilities to permit or enhance tribal access to storage
- Pursue tribal representation on the Upper Colorado River Commission and greater tribal input on Reclamation’s long-term planning in the Lower Basin
- Pursue tribal representation in state-wide agencies (such as the Interstate Stream Commission in New Mexico)
- Draft and propose appropriate legislation to authorize the interstate use of a tribe’s reserved water rights
- Initiate efforts to value benefits accruing from non-consumptive uses in monetary terms Basin wide

## 7.3 Data Collection and Tools for Water Management

### *7.3.1 Challenges*

Tribal governments and communities face significant challenges in improving tools and methods for effective management of their water resources. The Partnership Tribes divert their water allocations directly from the Colorado River and its tributaries, from hydrologically-connected groundwater, from federal water projects, or from a combination of these sources. Regardless of the water delivery source, the Partnership Tribes cannot effectively manage what they do not monitor.

Data collection and other tools available to measure water flows and monitor water quality for water management should be enhanced in both the Upper and Lower Basins. Water use accounting in the Upper Basin is currently inconsistent and measuring capabilities are limited or nonexistent in some tributaries. While water accounting on the Colorado River in the Lower Basin is more robust and is updated with new modeling approaches and systems for integrated gaging pursuant to the Secretary of the Interior's mandated Watermaster responsibilities in that Basin, there is always room for improvement and refinement in any hydrologic accounting system. Data collections, quality control, review, and publication of associated data have significantly improved over past record keeping. However, use of similar measurement technologies and the availability of quality data on some tribal lands are limited at this time.

Water monitoring for the Partnership Tribes is especially challenging given the cost constraints and the general remoteness of reservation lands. These challenges make it difficult to automate water meters, monitor water quality and flow conditions, detect leaks, and ensure pipeline integrity, all of which can generally improve delivery efficiency. Tribal infrastructure systems in rural areas also require remote monitoring and automation. Partnership Tribes see a critical need for additional stream gaging stations in the Basin, especially on tributaries in the Upper Basin, to monitor proper delivery and use. Likewise, the measurement of on-farm water deliveries at federal and state authorized irrigation projects needs improvement.

### *7.3.2 Opportunities*

Partnership Tribes can address some of these challenges by applying technological improvements that can make water monitoring in remote locations more feasible and cost-effective. Such improvements would make data available that could contribute to enhanced decision-making for rural tribal communities in efficiently using their finite water resources. Appropriately located stream gaging stations are crucial for managing and protecting tribal water resources. These sites provide the data necessary to model natural flows, develop river management plans and properly administer water diversions and storage water deliveries based on their seniority. Because the data often benefits other users, as well as tribes, it can be possible to enter into cooperative funding agreements between several entities to help offset the financial burden of installing gage stations. Better measurement and data collection, such as that currently employed in the Lower Basin, can allow for greater transparency and foster cooperative opportunities while reducing potential conflicts among users with different, but necessarily interrelated, interests.

To better reflect the needs of the Partnership Tribes, more tribal information and data could be incorporated into existing water-management systems and models. With significant allocations in the Basin, the Partnership Tribes continue their efforts to foster cooperation with adjacent communities, but a lack of tribal information in data systems is problematic for the tribes and other water users. Information on how tribes are affected by long-term trends and extreme events, such as droughts or floods, would be useful in evaluating water availability when it is most needed and in ensuring that water is not lost or wasted. Integrating accurate and up-to-date information from the Partnership Tribes would certainly allow for better management of the water.

### *7.3.3 Potential Actions*

- Develop coordinated accounting among state entities in the Upper Basin
- Explore the installation of more gages using cost-sharing agreements among Partnership Tribes, U.S. Geological Survey, Reclamation, and state entities
- Install instream gages and water meters where appropriate
- Implement water quality data collection on tribal lands generally and in response to events such as the Gold King Mine spill (while exploring the need for similar monitoring at sites throughout the Basin)
- Support rigorous accounting of water use throughout the Basin
- Encourage the use of measurement-based automation to help with the priority-based administration of diversions

## 7.4 Agricultural Water Use Challenges

### *7.4.1 Challenges*

Agriculture is the dominant use of Colorado River water, with approximately 70 percent of total Colorado River water used to support agriculture (Reclamation, 2015). Irrigated lands are an essential component for Partnership Tribes in pursuing economic development and self-determination using their water resources. These benefits are manifested in the form of individual tribal member farms, tribally-owned farm enterprise operations, or revenue generated through leasing tribal water and croplands to other producers. In order for agricultural operations to be economically viable and reach full potential yield, they must have access to reliable irrigation water deliveries in the amounts needed to satisfy crop demand.

Many federally operated Indian irrigation projects throughout the Basin struggle with outdated or poorly maintained infrastructure, inadequate staffing levels, and a lack of knowledgeable operators. Several of these projects started out in the late 19th century as primitive ditches serving only small tracts of land. These ditch systems evolved into larger irrigation projects, but often without the benefit of coordinated planning and use of modern engineering design. The result is that water delivery to project irrigators is often inefficient, inadequate, and unreliable. This, in turn, reduces crop yields, puts the overall economic viability of the operation at risk, and ultimately decreases the revenue of Partnership Tribes.

Also, significant competition for limited BIA and/or Reclamation funding available for irrigation rehabilitation work means that many systems must significantly raise operations and maintenance rates in order to address the maintenance issues. But tribal producers with agricultural operations already economically handicapped by backlogged deferred maintenance on these aging systems often cannot bear the higher operations and maintenance rates, leading to an economic stalemate.

Partnership Tribes often lack the monetary resources and/or technical expertise to independently maintain or rehabilitate major agricultural infrastructure, whether the projects are federally or tribally managed. Even if they have the capability, regulations governing federally owned projects make it difficult for tribes to perform their own improvements or install water efficiency measures on such projects. Partnership Tribes are hesitant to assume full operational responsibility for these projects without funding to address the large maintenance backlogs. Additionally, even if tribal irrigation infrastructure is not owned by the government, it can be difficult for tribes to finance the rehabilitation of existing or development of new agricultural facilities due to challenges in accessing capital markets. With most of their lands and natural resources held in trust by the federal government, tribes often lack the collateral or revenue streams necessary to establish credit ratings, issue bonds or secure loans.

One final challenge is that posed by water quality issues, both real and perceived. Salinity and selenium are both real concerns in the Basin. Often, significant amounts of water are required to "flush" fields to prevent salinity buildup. Plus, concerns regarding heavy metals from mine discharge and contamination from radioactive mine tailings are also a problem in the Basin and can hurt the market value of area crops due to perceived risk on the part of consumers.

### *7.4.2 Opportunities*

Given the senior priority of most federal Indian reserved water rights and the economic importance of agriculture in the Basin, there is significant opportunity for Partnership Tribes to leverage their irrigation resources for purposes of economic development. The senior nature of these water rights sustains or increases the value of tribal agriculture operations in times of water scarcity. Tribal farmlands equipped with modern, efficient irrigation infrastructure and data gathering equipment can allow Partnership Tribes to take advantage of market forces and obtain premium lease rates from tenant farmers or maximize their own production of high-value crops.

Partnerships with tenant-farming enterprises under development or improvement leases may require installation of irrigation efficiency measures. These measures will help upgrade Indian irrigation projects, increase yields for both tribal and other producers, and help bolster the economies of area communities. The Colorado River Indian Tribes' Irrigation Committee has been able to install on-farm irrigation improvements by accessing tribal-specific funds through the cost-share U.S. Department of Agriculture Natural Resources Conservation Service Environmental Quality Incentives Program (EQIP), and by partnering with tenant farmers to cover the user portion of the cost-share. Opportunities may also exist to partner with other water sectors to pay for irrigation improvements to boost production and lower water consumption in exchange for transfer of the conserved water.

Investing in irrigation system modernization and efficiency improvements could help increase yields, expand agricultural operations, or augment other uses – both on- or off-reservation. Allowing Partnership Tribes the ability to transfer or lease their water to producers with less reliable supplies could provide economic benefits to both parties by allowing non-tribal producers to use the water directly on their own lands, using existing irrigation infrastructure, while also generating revenue that Partnership Tribes could use to fund irrigation improvements on their lands. Developing tribal loan programs or capitalization mechanisms might allow revenue streams to be leveraged to finance larger irrigation investments.

Independent evaluation of each irrigation system's economic and operational potential might be advisable to help prioritize infrastructure needs, ensure that the proposed upgrades use appropriate, cost-effective, and resilient technologies, and that the project can reasonably support the ongoing maintenance of the upgrades. Indian irrigation projects were built for the benefit of the tribes and their members, yet they are often operated in a manner that does not reflect the tribes' best interests. Greater coordination among the Partnership Tribes, individual water users, and irrigation project staff can help ensure that project operations align with tribal goals, while also helping irrigators understand the physical and regulatory limitations of the Colorado River System. Contracts authorized under the Indian Self-Determination and Education Assistance Act of 1975 (Public Law 93-638), as amended, can help provide tribes with a direct role in the operation of tribal/federal irrigation projects as well as limited funding for project improvement.

Protecting water quality is crucial to sustaining the economic contributions of agriculture throughout the Basin. Continued support of the salinity control program, ongoing clean-up of old mine sites, and regular monitoring of water quality by independent entities are all important to ensure both the protection of Basin water and the transparency of those efforts.

### *7.4.3 Potential Actions*

- Ensure operations and maintenance fees and project funding for tribal and BIA-managed facilities are adequate to maintain irrigation facilities
- Increase tribal management and oversight of BIA Indian irrigation projects
- Explore the potential for removing barriers to or expanding contracts authorized under the Indian Self Determination and Education Assistance Act (Public Law 93-638) to allow Partnership Tribes to assume operational control of federally owned irrigation projects
- Engage outside/independent expertise to conduct economic analysis of Indian irrigation projects where needed to prioritize or evaluate the feasibility of further investment
- Examine and, if deemed helpful, propose changes to 25 CFR Part 171 to improve tribal participation in BIA irrigation operations
- Increase efficiency by implementing new technology and farming methods where practicable
- Seek ways to collaborate with other water users to increase irrigation system efficiencies
- Explore ways to work with the financial sector to create specific avenues for Partnership Tribes to better access capital markets
- Consider developing a tribal loan program specifically for agricultural infrastructure development, rehabilitation, and storage development

## 7.5 Domestic, Commercial, Municipal, and Industrial Water Use

### *7.5.1 Challenges*

Access to a clean, reliable supply of water is basic to human health and limited on some Partnership Reservations. The lack of water infrastructure, limited economic development, and sustained poverty can be correlated with the availability and use of tribal water supplies. Low per capita water use on some Partnership Reservations is often part of a larger pattern reflecting a lower economic standard of living compared to non-tribal communities. Reasons for inadequate supplies include the rural nature of some reservations, water infrastructure deficiencies, and contaminated or poor quality water supplies.

Low housing density on many reservations makes development of municipal systems economically and financially challenging. For example, on the Navajo Reservation, approximately 30 percent of the homes do not have access to drinking water systems and rely on water hauling to provide for everyday needs. During droughts, the population that hauls domestic water is at the greatest risk. They must travel longer distances to find public water systems that can provide water, or use non-potable water sources. These water haulers also create additional demands on the public water systems that maintain public water taps (Navajo Department of Water Resources, 2012).

Some Partnership Reservations have limited financial resources, making capital investments problematic and repayment capacities low. Widely dispersed reservation populations result in long distances between water sources and water users, and extremely high unit operation and maintenance costs. Typically, tribal water delivery systems have been severely underdeveloped and underfunded. Tribal municipal water projects have often been underfunded and go into disrepair due both to limited financial resources and a lack of technically trained individuals to operate and maintain these systems. Some federal funding programs, such as those offered by Reclamation, require the recipient to contribute matching funds that may exceed the financial resources available to Partnership Tribes. In addition, some reservations have not established funding mechanisms, such as a depreciation fund, to adequately repair and replace the existing water systems, many of which are at or near the end of their design life. These conditions result in expensive water and challenges generating adequate revenue to build and maintain water systems. Not only are Partnership Tribes unable to meet growing demands, they also struggle to operate and maintain existing systems. The inability to access or make full use of traditional forms of funding such as property taxes, rate increases, local or municipal assessments and municipal bonds also affects infrastructure development in tribal communities.

Water and infrastructure development within the Partnership Reservations for domestic, commercial, municipal or industrial use is often complicated by the different categories of land ownership. Checkerboard ownership patterns of fee and trust lands, fractionated ownership of allotted lands, varying tribal policies toward residential or individual land assignments, and other unique land designations within Partnership Reservations complicates the processes for obtaining infrastructure rights-of-way and satisfying other necessary clearances.

### 7.5.2 Opportunities

Improving access to safe and reliable water is important to the Partnership Tribes. Exploring new management opportunities and adopting emerging technologies may help build tribal capacity in operating, maintaining and managing sustainable drinking water systems.

New federal initiatives have been developed to improve access to safe drinking water in Indian Country, including an innovative strategy to boost water sustainability through the greater use of water-efficient and water reuse technologies, and to promote and invest in breakthrough research and development that reduces the price and energy costs of new water supply technology. At the federal level, many agencies have worked to improve access to safe drinking water and basic sanitation in Indian Country. In the past, a task force model has been used to coordinate federal efforts in developing water infrastructure, wastewater infrastructure, and solid waste management services in tribal communities. These efforts focused on streamlining agency policies, regulations and directives related to water services in order to reduce the administrative burden for tribal communities and facilitate access to funding. Other economic and training resources such as Tribal Economic Development Bonds, the Native American Water Association, and WaterOperator.org also assist Partnership Tribes in water management and infrastructure planning and funding.

Partnership Tribes can also take advantage of opportunities for innovation and wider adoption of technologies for more efficient water use. Providing assistance in rural, tribal areas with distributed water quality treatment systems, optimizing groundwater pumping times to lower energy costs, exploiting natural flows for small-scale hydro-generation energy projects, and using alternative energy sources such as solar power or other energy sources can help assure the availability of sufficient, high quality water supplies. For areas where distribution systems are not currently feasible, community wells and watering points can be upgraded or constructed to improve access for water haulers.

### *7.5.3 Potential Actions*

- Work with BIA to develop programmatic right-of-way agreements to simplify obtaining rights-of-way for domestic, commercial, municipal, and industrial projects
- Work with existing professional associations related to the development of tribal utility authorities to facilitate communication and idea sharing among various Partnership Tribes
- Improve access to federal expertise for financing water infrastructure
- Advocate for tribal waivers of the requirement for matching funds in federal water-related funding programs
- Create and improve relations with the adjacent communities and establish a forum for bringing tribal and other communities together to discuss issues of mutual concern
- Use a water-hauling truck service to provide more distribution points in rural areas

## 7.6 Establishment of Continuous, Sustainable Funding

### *7.6.1 Challenges*

Tribal governments and communities face unique challenges in their efforts to establish continuous and sustainable funding for water supply infrastructure and treatment. Partnership Tribes often face more difficulty than off-reservation state and local governments because they have limited access to traditional forms of funding such as property taxes, rate increases, assessments and municipal bonds.

The ownership status of tribal lands often makes it difficult to obtain funding. The land within a tribal reservation is titled to the United States and held in trust for the benefit of the tribe and its members; therefore, tribes do not assess property taxes against their own members or the United States as a state municipality might. Although tribal members and others living or engaging in business on the reservation may pay some fees to the tribal government, revenues from property taxes, fees for services, and assessments typically are not significant sources of revenue to support tribal infrastructure construction or maintenance. Additionally, there may be private holdings within a reservation, creating a checkerboard ownership pattern, but tribal jurisdiction to tax private land or impose assessments for services against those private land owners often is not clear and is therefore unlikely to generate significant reliable revenue.

Funding challenges faced by Partnership Tribes for water infrastructure are exacerbated by poverty in and around tribal lands. In turn, the lack of water infrastructure does little to ease, and often even prolongs already-existing levels of poverty.

Statistics about levels of poverty and employment for Native Americans on and off tribal lands are not compiled on a systematic basis. In addition, the information that is available may not accurately reflect how poverty and unemployment rates truly affect Native American populations.[5]

Since 2009 tribes have been authorized to issue tax-exempt economic development bonds that may be used for water infrastructure.[6] Tribes may also issue tax-exempt bonds for essential governmental functions. However, Partnership Tribes have difficulty accessing bond markets and obtaining favorable ratings because of the lack of property to pledge as collateral and the lack of traditional streams of revenue for repayment. Plus, there are national limits under federal law on the total amount of tribal bonds that may be issued each year.

Historically, tribal water-related infrastructure was funded by the Indian Health Service and the BIA with some funding from the U.S. Department of Housing and Urban Development. Over time, the budgets for these agencies for assistance to tribes have seen significant reductions even as the need for these services has grown in proportion to expanding on and off-reservation populations.

Federal water programs with funding available to tribal or non-tribal governments are often difficult for tribes to access. The particular tribe in need of funding may not have available matching funds or may not meet one or more of the criteria for eligibility, such as documented utility easements or the ability to impose user fees for repayment. Competition for these funds is intense and Partnership Tribes often lack the trained personnel to prepare competitive applications.

### *7.6.2 Opportunities*

The Tribal Water Study provides the opportunity to broaden the understanding of the public about tribal water issues and to provide information to water managers throughout the Basin about tribal funding needs for water infrastructure. Little or inadequate attention is focused on the pressing needs for Native American populations in the United States.

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[5] For instance, the 2013 American Indian Population and Labor Force Report, U.S. Department of the Interior, Office of the Secretary, Office of the Assistant Secretary – Indian Affairs, January 16, 2014, available at: http://www.bia.gov/cs/groups/public/documents/text/idc1-024782.pdf, accessed September 21, 2016 (2013 Report) provides some of this information; however, it must be noted that the assumptions and the accuracy of the census and other data have been disputed by tribes and tribal organizations. According to this Report, on a national scale, only 49 to 50 percent of Native Americans living on or near reservations ages 16 and older are employed. The majority of these jobs are with the tribal or the federal government or through federally funded programs. The 2013 Report estimated the rate of poverty for Native American families in Arizona is approximately 31 to 33 percent. Unemployment statistics are not compiled for tribal populations, but the 2013 Report indicates the average percentage of tribal population of workforce age working in civilian jobs in Arizona to be 39.6 percent and in Colorado to be 51.1 percent. A high percentage of the tribal population indicates they are willing and available to work, but are not working.

[6] American Recovery and Reinvestment Act of 2009, Public Law 111-5.

Partnership Tribes may explore opportunities to develop or expand infrastructure that serves both tribal and other populations, which in turn may also expand options to obtain funding. For example, the Colorado River Indian Tribes operate a joint venture wastewater treatment plant with the City of Parker. The Navajo-Gallup pipeline obtained funding from multiple sources to supply water to the Navajo Nation, Jicarilla Apache Nation, and the City of Gallup, New Mexico. In addition, the Animas-La Plata Project in southern Colorado serves both tribal and other communities.

Many Partnership Tribes have their own tribal utility authorities that function independently. Wider use of tribal utility authorities may expand the professional staff working for tribes and create more opportunities to access alternative funding.

Additionally, modern technology for water treatment at the tap or at a personal level may make poor quality groundwater useable in the remote and dispersed households on tribal lands. However, the current cost of the technology may limit its usefulness.

### *7.6.3 Potential Actions*

- Conduct more detailed and comprehensive assessments of tribal water infrastructure demands to better inform funding agencies and promote increased funding through the federal budget process
- Formulate a strategy to build capacity within Partnership Tribes to write grants and to access assistance for grant writing
- Broaden the access to federal expertise to finance water infrastructure through specialized programs within the DOI and within the Environmental Protection Agency such as the Natural Resource Investment Center and Tribal Infrastructure Task Force
- Develop a tribal utility authority professional association to facilitate communication, training and the sharing of ideas among Partnership Tribes
- Solidify base funding and training opportunities for tribal program staff to develop and implement domestic and municipal water and waste water programs
- Identify business entities and neighboring non-tribal communities that may be able to facilitate tribal economic development that provides mutual benefits
- Explore options for generating on-reservation revenue that may be dedicated to infrastructure development, operation and maintenance costs, or as repayment for financing mechanisms

## 7.7 Diverse Geography of Tribal Reservations

### *7.7.1 Challenges*

Moving water to where it is needed is both geographically challenging and expensive. Doing so on tribal lands is no exception. The United States Supreme Court has acknowledged that: "It can be said without overstatement that when the Indians were put on these reservations they were not considered to be located in the most desirable area of the Nation." *Arizona v. California*, 373 U.S. 546, 598 (1963). Consequently, the variable topography and geographic conditions of reservations can make conveyance and application of water uniquely difficult and expensive.

In addition, the sometimes uneven history of the creation of reservations, including the 'islanding' of some reservation lands and 'checker-boarding' of privately owned lands amid lands reserved for tribes, complicates infrastructure development.

Further, many tribal nations have lands within multiple states, counties or even, as is true for the Navajo Nation, lands in both the Upper and Lower Basins. Moving water from one part of a reservation to serve another can therefore encounter not only physical barriers such as long distances, mountains, and land-ownership/rights-of-way hurdles, but regulatory barriers as well.

### *7.7.2 Opportunities*

Meeting these challenges while putting water resources to full beneficial use will involve seeking new water management efficiencies that can minimize the economic burden of trans-reservation development.

Going forward, Partnership Tribes can seek more joint venture opportunities with neighboring communities. For example, on the Colorado River Indian Reservation, a joint venture water treatment facility serves both the tribal community and the Town of Parker, Arizona. Water supply projects such as the Animas-La Plata Project, serving three tribes and numerous communities and water districts in two states, is another example of what the future will likely hold, as Partnership Tribes put their remaining water resources to work.

### *7.7.3 Potential Actions*

- Explore the economics of on-reservation versus off-reservation water use where geography is a significant physical or jurisdictional impediment to tribal water development which increases funding requirements
- Explore joint venture opportunities with neighboring tribal and other communities and agencies

## 7.8 Cultural and Environmental Challenges to the Use of Tribal Water

### *7.8.1 Challenges*

Partnership Tribes in the Basin, as elsewhere around the globe, face a number of competing concerns – both cultural and economic – when dealing with the use and stewardship of their water resources. The cultural significance of water in the worldview of native communities is captured by the shorthand phrase 'water is life,' some version of which can be heard in many languages, and in nearly every tribal nation. The reason for this is at once simple and profound; tribes everywhere recognize that water supports all life, and they genuinely respect this fact.

Water is also life to a number of different economic enterprises – from growing food, to raising livestock, to engaging modern commerce in the broader, and much more populous, marketplace of today. Modern tribal leaders balance these competing interests in concert with a resource management approach that respects tribal history, retains cultural values, supports the community's existing and growing economies, and sustains these natural resources for future generations. This delicate balance is complex, and presents ongoing challenges for tribal leaders and resource managers alike.

Even in cases where cultural values are preserved while undertaking some form of water development, tribes must also address many environmental challenges. For example, where

Partnership Tribes wish to develop water resources for the benefit of their communities, compliance with the Endangered Species Act and other environmental regulations may restrict their flexibility in water use and development.

Partnership Tribes presently engaged in development of their water resources, or contemplating future water development, face a disproportionate burden for Endangered Species Act compliance. Past development has left the Colorado River and its tributaries in precarious environmental condition, as growing demands have left little of the River's resources available for environmental mitigation purposes. The Colorado River's ability to support remaining riparian habitat and native species is now extremely limited with no surplus water to serve as a buffer for species on the brink. Moreover, since all tribal projects may have a federal nexus, complying with the Endangered Species Act and the National Environmental Policy Act, including the associated compliance costs, complicates the development process and weighs heavily on tribal projects. Finally, for Partnership Tribes who share Colorado River water sources with water users operating within a state-based water rights system, improvements in the quality of the water, including in-stream flow commitments, are difficult to ensure where state water right schemes may not recognize in-stream flows as a valid water right use.

Protecting tribal cultural values and using reservation streams in ways that ensure their health and environmental viability will continue to challenge Partnership Tribes as they seek to make full use of their valuable water resources.

### *7.8.2 Opportunities*

Partnership Tribes seek opportunities to maximize the use of their water resources for the benefit of their communities. The challenge posed by maintaining healthy flows can be alleviated somewhat by establishing environmental flow requirements with more certainty, identifying – through proven scientific data – both the quantity and quality of water required for environmental health. This reduces the 'trial and error' risk in developing practices to sustain endangered and threatened species and their habitats, and offers valuable information that can support sound decision-making in the design, development, and management of potential water projects.

Partnership Tribes may also improve the likelihood for success of their projects by supporting partnerships in inter-agency species programs, such as the Lower Colorado River Multi-Species Conservation Program, and minimize Endangered Species Act compliance costs by establishing tribal, state, and local river management plans to support minimum instream flow agreements. Similarly, partnering with non-government environmental organizations presents another area of opportunity for Partnership Tribes to address the needs of the environment along with the interests of their communities and other Basin water users.

Water development and management strategies on the Colorado River must engage all Basin users in recognizing the needs of the environment. The stakes are now too high for Partnership Tribes and all other water users to ignore these challenges.

### *7.8.3 Potential Actions*

- Ensure water resources within reservations are managed to protect ecosystems, including wildlife, riparian areas, recreation areas, designated instream flow requirements and wetlands

- Expand the use of categorical exclusions to reduce the burden of National Environmental Policy Act compliance on Partnership Tribes
- Preserve and ensure that environmental flows are part of water management plans to help protect natural and cultural values
- Negotiate river management plans with minimum instream flow requirements
- Partner with environmental organizations to restore waterways, wetlands and other habitats, where possible
- Consider including all decreed tribal water rights in the environmental baselines developed as part of consultations with the U.S. Fish and Wildlife Service pursuant to Section 7 of the Endangered Species Act
- Engage in public outreach/education to demonstrate the economic value of healthy waterways – including commercial, environmental, cultural, and recreational values to foster support for in-stream flows

## 7.9 Socioeconomic Considerations

### *7.9.1 Challenges*

Partnership Tribes seek to provide their community members with all necessary services and opportunities, and recognize that adequate water infrastructure is fundamental to virtually every aspect of community success. However, many tribal communities still struggle with poverty, and infrastructure development that has been historically delayed by the slow recognition, adjudication or settlement of Indian reserved water rights. Still, where water infrastructure has been completed, it usually serves as the economic heart of the community, supporting domestic, commercial, municipal and industrial activity, as well as significant agricultural enterprises. The tribal water infrastructure development that has occurred was usually built subject to the modest limits of each tribe's ability to pay for construction directly, and/or its ability to access federal funding when it was available for such projects.

Overall, there remains a lack of adequate water infrastructure across tribal lands. The limited availability of financial resources continues to delay construction of new water projects, and causes setbacks in addressing needed repairs or rehabilitation of existing infrastructure, further contributing to lingering poverty within tribal communities.

Inadequate, aging and poorly maintained water systems impede cost-effective delivery, increasing the unreliability of irrigation projects which are often the largest economic driver in tribal communities. Under these conditions, tribal farms may suffer from uncertain water availability, lower crop yields, or poorer quality agricultural end-products, forcing producers to seek ways to offset the additional costs these unfavorable conditions represent – either by paying less for cropland leases or simply taking their business elsewhere.

Likewise, where a tribe's economy relies on oil, gas, minerals, timber or gaming operations, the cyclical or irregular income stream from these enterprises complicates long-term water infrastructure planning, funding and construction.

Another complication is the lack of a steady, reliable pool of qualified personnel to operate the tribal water infrastructure and irrigation systems – even those built and operated by the federal government for the benefit of tribes. Reservations are often remote and, as in most rural areas, the available labor force is usually small. Federal funding, even when available to support additional personnel at prevailing wage and benefits rates, is not always a sufficient inducement to attract and retain a steady labor force. In many cases, education and training of tribal personnel have not provided sufficient numbers of qualified personnel to keep pace with the operational and maintenance needs of commercial-scale domestic and irrigation water systems.

### *7.9.2 Opportunities*

Partnership Tribes may take greater advantage of federal grants for education and training in water infrastructure design, engineering, construction, management, operations and other related programs which target low income and tribal communities; this could be a significant factor in addressing these limitations in Indian Country.

Partnership Tribes can also benefit by focused efforts to develop a skilled labor force from within their communities. Such efforts may include mentoring and training youth interested in careers in hydrologic engineering, management or operational areas.

### *7.9.3 Potential Actions*

- Develop educational programs to enhance farming/ranching techniques/opportunities
- Develop programs to encourage and train tribal participants in operating/monitoring irrigation systems
- Improve compliance with Tribal Employment Rights Office ordinances for tribal employment and job training
- Create and develop individual and collaborative tribal socioeconomic plans

## 7.10 Summary

The Partnership Tribes identified nine categories of challenges, opportunities, and potential future actions related to the current use of tribal water and potential future water development. It is recognized that the applicability of the opportunities and potential future actions are dependent upon the administrative management of each Partnership Tribe's water resources, the Tribe's physical location, and state and federal water law, and will need to be vetted in consideration of local economies and related factors[7]. However, the identified opportunities and potential actions are considered to have the potential to assist Partnership Tribes in overcoming water use challenges and benefiting water management throughout the Basin.

[7] Consistent with the purposes of this Study, the lists of potential future actions in this section are neither exhaustive nor constitute a statement of endorsement of any potential future action by Reclamation or the Department of Interior. Additionally, Reclamation recognizes that some potential future actions identified here could require substantial and meaningful discussions with all Basin stakeholders.

# 8 Study Limitations

## 8.0 Introduction

Although the technical approach of the Tribal Water Study was based on the best science and information available, as with all studies, there were limitations related to timeframes and resource constraints. The detail at which results are reported or the depth to which analyses were performed was also limited by the availability of data and the capability of existing models. However, these limitations present opportunities for additional research and development to improve available data, which may be pursued by Partnership Tribes and other interested parties as follow-up to or independent of the Tribal Water Study.

### 8.1 Ability to Assess Current Tribal Water Use

The availability of data related to current water use varies among the Partnership Tribes. For Partnership Tribes in the Lower Basin, Reclamation relied on recent annual records of diversions, returns and consumptive use data compiled in the annual *Colorado River Accounting and Water Use Reports: Arizona, California, and Nevada* (Reclamation, 2017). In the Upper Basin, water use is accounted for by each state. In some states, Indian water use accounting is conducted by BIA, particularly on federal Indian irrigation projects. Without a coordinated administration system, water use data are sometimes inconsistent or even nonexistent, particularly on tributaries, which often lack adequate stream gaging. This meant the Upper Basin Partnership Tribes had to rely on multiple sources for their water use data, including internal technical assessments used to develop consumptive use estimates.

The remoteness of some of the Partnership Tribes' reservations and the complexity of their water systems are two other factors that greatly affected the quality of the water use data. Most water administration still relies heavily on in-person site visits to record measurements and ensure the calibration of measurement devices. It is often not possible to visit remote sites with the frequency desired, leading to data that can still provide a reliable record of use, but lacks detail. For the purposes of the Tribal Water Study, each Partnership Tribe assessed its available data with input from local water managers and utility operators to determine current water use with as much accuracy as circumstances would allow. Because of the differences in the availability and reliability of use data, some Partnership Tribes chose to represent current water use by averaging use over a recent 5-year period. For others, a single recent representative year was selected. Although this methodology does not provide a lengthy historical record of tribal water use, it nonetheless is a good snapshot of recent water use, by sector, for each Partnership Tribe and advances the understanding of tribal water use in the Basin.

### 8.2 Ability to Assess Future Tribal Water Development and Effects on Colorado River Water Availability

The Partnership Tribes intend to make full use of their federal Indian reserved water rights (most of which are senior priority water rights) and have, or are in the process of, developing and implementing tribal water development plans. One of the objectives of the Tribal Water Study was to project future tribal water development and use through the year 2060 in order to provide other water users in the Basin with a better understanding of and more certainty about the future availability of Colorado River water with the full development of federal Indian reserved water rights. However, the ability to assess the effects on Colorado River water availability from the future development of tribal water was limited by the spatial resolution of Reclamation's Colorado River Simulation System (CRSS)[1], as discussed more thoroughly in *Chapter 6 – Assessment of System Effects Resulting from Development of Tribal Water.* The information provided by the Partnership Tribes accounted for water use on a much finer spatial resolution than is currently represented in CRSS. Therefore, the locations of tribal diversions within CRSS are estimated. This effort may provide an opportunity for future refinement of CRSS, and, as noted above, post-Study efforts to improve understanding of the specific areas of the Basin likely to experience those effects.

In addition, in the Upper Basin, Reclamation's CRSS model does not simulate the complex individual state water rights administration systems that would be needed to model shortages to individual water rights holders. In order to address whether the Partnership Tribes' unused federal Indian reserved water rights are used by other water users, CRSS would need to have water accounting abilities. CRSS is not a water accounting model, and therefore is not able to track senior priority federal Indian reserved water rights of the Partnership Tribes and their use on a per-user basis. Consequently, the ability to identify effects on a per-user basis was limited and results for the Upper Basin are reported at a sub-basin level. In the Lower Basin, CRSS does track shortages to individual water rights holders. However, uncertainties exist regarding its ability to accurately model operations at Lake Powell and Lake Mead if Lake Mead reaches elevation 1,025 feet, triggering consultation regarding water deliveries per the *Record of Decision for Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead* (DOI, 2007). Given this uncertainty, and to maintain a commensurate level of detail with reporting in the Upper Basin, impacts to users in the Lower Basin are reported at a Lower Basin level in this report.

Despite these limitations, the assessment of future tribal water development provides a plausible indicator of the effect of tribal water use on the water supply of the Colorado River. The assessment provides a useful advancement of Colorado River System knowledge for future planning efforts and for consideration when addressing future Colorado River water challenges.

[1] CRSS was the primary modeling tool used in the Tribal Water Study. It simulates the operation of the major Colorado River System reservoirs on a monthly time step and provides information regarding the projected state of the System in terms of output variables.

# 9 Future Considerations and Next Steps

The Tribal Water Study is the outcome of a commitment between Reclamation and the Partnership Tribes to engage in a joint study that would build on the scientific foundation of the Colorado River Basin Water Supply and Demand Study (Basin Study) (Reclamation, 2012). Based on the information jointly developed in the Tribal Water Study and through collaboration with Reclamation, this Study highlights the following observations, concerns, and considerations:

- The Tribal Water Study revealed disparities among the Partnership Tribes, and between the Partnership Tribes and other water users in the Basin. These disparities have created barriers to the full development of federal Indian reserved water rights that include access to funding and capital markets for development, the lack of - *and poor condition of* - existing infrastructure, the number of tribal members and reservation residents without access to clean drinking water and adequate sanitation, and legal restrictions.
- Partnership Tribes have reserved water rights, including unresolved claims, to divert nearly 2.8 million acre-feet of water per year from the Colorado River and its tributaries. These rights are, in general, the most senior water rights in the Basin and therefore some of the most protected from shortage. However, some tribal lands and many people living on the tribal reservations do not have water security. Tribal communities are among the most economically depressed and impoverished in the Basin. Water is only one factor in this economic disparity, but when thousands of residents on tribal lands lack access to clean water and adequate sanitation, the path out of poverty is more difficult.
- *Chapter 5 – Assessment of Current Tribal Water Use and Projected Future Water Development,* documented each Partnership Tribes' anticipated development and use of reserved water rights and identifies trends for full tribal water development. The different trends indicate the anticipated rate at which such development might proceed. None of the Partnership Tribes currently has the basic infrastructure or legal and administrative flexibility to fully use or realize the full economic value of its reserved water rights. It has been more than 50 years since the decision in *Arizona v. California,*[1] yet some Partnership Tribes still do not have their water rights fully quantified. However, the Partnership Tribes expect that all reserved water rights in the Basin will be recognized and resolved over time.
- The Tribal Water Study also provided a technical analysis of the potential effects of the full development of tribal water. The Partnership Tribes anticipate that this effort will promote cooperation and coordination with other Basin stakeholders as we address challenges related to growing demands and the potential for reduced supplies and imbalances in the Colorado River System. Government-to-government coordination among tribal, federal, and state governments and cooperation with other Basin water users are the preferred and most effective pathways to address these documented challenges and disparities in the coming years and decades.

[1] *Arizona v. California,* 373 U.S. 546 (1963).

- *Chapter 6 – Assessment of System Effects Resulting from Development of Tribal Water,* explains the methodology used to analyze the effects of the Partnership Tribes' water development within the Basin, as applied in the Colorado River Simulation System (CRSS), the commercial software *RiverWare*™, and the state of Colorado's *StateMod* program. The goal of the modeling was to provide a sound technical basis and projection of the likely future scenarios for tribal development in the Basin.

  Although many of the Partnership Tribes do not currently use all their reserved water rights and have not developed the yet unquantified water rights, such tribal water does not go unused. The Basin Study (Reclamation, 2012) confirmed that, in the absence of timely action, there are likely to be significant shortfalls between projected water supplies and demands in the Basin in coming decades. The full development of reserved water rights for tribal benefit will widen this gap; however, the modeling indicates that the effect of tribal water development in the Basin is not as significant as full development of the state apportionments in the Upper Basin and the projected effect of climate variability.

  A decade ago, Reclamation and the Basin States recognized the need for flexibility in the operations of the system with the adoption of the 2007 *Record of Decision for Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead* (DOI, 2007). Mechanisms developed for Reclamation contractors and state-based water rights do not easily adapt to federal Indian reserved water rights held by Tribes. The Tribal Water Study demonstrates the need to develop flexible mechanisms for the use of tribal water throughout the Basin, such as off-reservation use of tribal water, particularly in times of shortage. Some Upper Basin Tribes have this flexibility through their water settlements, and the Quechan Tribe has a forbearance agreement with a California contractor. After review of the Tribal Water Study's analysis, the Partnership Tribes strongly believe and conclude that all tribes need similar flexibility. Without such flexibility, other water users who currently rely on unused tribal water may be required to adjust to reduced supplies as tribes increase or fully develop their reserved water rights.

- *Chapter 7 – Challenges and Opportunities Related to Development of Tribal Water,* identifies challenges and opportunities for full development of reserved water rights. Addressing the administrative and legal constraints that create disparities in water development and use are priorities for the Partnership Tribes, as doing so holds the greatest potential to benefit the Partnership Tribes and other water users in the Basin.

  The Partnership Tribes are committed to – and will – develop their water resources and explore opportunities to partner with the federal government, states and other water users as opportunities arise. Where the Partnership Tribes are unable to develop their water resources to receive the full economic benefit of their rights within existing laws, the Tribes will work with other Basin stakeholders to pursue policy, regulatory, and statutory changes.

  Potential actions identified by Partnership Tribes to overcome the challenges to obtaining full development and use of each Partnership Tribe's reserved water rights for the economic, social, and cultural benefit of the Tribe and its members are identified in Chapter 7.

Table 9-A identifies the Partnership Tribes' priority actions to address the water use challenges identified in the Tribal Water Study. Potential future actions to fulfill Reclamation's commitments to increase opportunities for tribes to develop, manage, and protect their water and related resources are also identified. Reclamation will work with the Partnership Tribes to identify near-term activities to help address the water challenges in the Colorado River Basin.

**TABLE 9-A**
Opportunities for Potential Future Action Identified by the Ten Tribes Partnership and the Bureau of Reclamation
*The ordering of these lists does not imply a priority*

| Category | Ten Tribes Partnership | Bureau of Reclamation |
|---|---|---|
| Recognition and Use of Federal Indian Reserved Water Rights in the Basin | • Fully adjudicate or otherwise secure full legal recognition of federal Indian reserved water rights in the Basin.<br>• The Partnership Tribes will pursue appropriate legal, policy and regulatory avenues which allow tribes the flexibility to fully use their water and realize full economic benefit therefrom. | • Work with agencies and tribes to prioritize the identification of legal, policy, and regulatory constraints to full use of tribal water.<br>• Explore opportunities that enhance tribes' ability to put their water to full beneficial and economic use. |
| Continuous and Sustainable Funding | • Use existing studies and conduct additional economic and engineering assessments as needed to determine long-term tribal water infrastructure needs.<br>• Explore options for generating dedicated revenue to finance infrastructure development and operation, maintenance and replacement costs. This could include:<br>  ○ Determining whether operation and maintenance (O&M) fees and project funding for tribal and BIA-managed facilities are adequate to maintain irrigation facilities; and<br>  ○ Evaluating opportunities to increase tribal management and oversight of BIA Indian irrigation projects.<br>• Enhance access of Partnership Tribes to WaterSMART and other federal funding programs, including establishing tribal waivers for cost-share matching funds. | • Conduct comprehensive outreach to ensure that tribes are informed of Reclamation's technical assistance programs and WaterSMART funding opportunities.<br>• Partner with other federal agencies to understand and communicate funding opportunities available to tribes to develop the expertise, funding and/or resources for comprehensive water management planning and implementation. Facilitate enhanced coordination among existing programs, such as with U.S. Department of Agriculture.<br>• Explore ability to build tribal capacity regarding grant writing to increase competitiveness when applying for federal assistance. |
| Environmental Water Uses | • Work with state and federal partners to ensure that environmental flows are included in water management plans to help protect ecosystems and cultural values.<br>• Work with federal partners to address the Partnership Tribes' preferred approach of including existing Indian reserved water rights and future settlements in the environmental baselines developed as part of Endangered Species Act Section 7 consultations with the U.S. Fish and Wildlife Service so tribes are not disproportionately burdened with further compliance. | • Investigate opportunities for tribes to participate in water management for the protection or restoration of flows for environmental, recreational, and cultural purposes. |

**TABLE 9-A**
Opportunities for Potential Future Action Identified by the Ten Tribes Partnership and the Bureau of Reclamation
*The ordering of these lists does not imply a priority*

| Category | Ten Tribes Partnership | Bureau of Reclamation |
|---|---|---|
| Partnerships | • Establish mechanisms with federal partners to include tribes in the formal and informal discussions among the Basin States and between the Basin States and DOI concerning the management and operation of the Colorado River.<br>• Work to obtain tribal participation with the Upper Colorado River Commission.<br>• Work to obtain greater tribal input in Reclamation's long-term planning for the Lower Basin.<br>• Work with federal, state and local governments to include tribal representation in water management agencies.<br>• Foster and strengthen stakeholder relationships with non-governmental organizations working within the Basin.<br>• Foster and strengthen stakeholder relationships to facilitate local and regional planning as future tribal water development occurs.<br>• Create model programs for tribal development in cooperation with neighboring communities and entities. | • Build on the momentum and dialogue of the Tribal Water Study to increase the effectiveness of partnerships when new challenges and opportunities arise.<br>• Facilitate planning efforts among Basin water users, stakeholders, and tribes to develop regional and local water management solutions, thereby reducing the likelihood of conflict.<br>• Facilitate tribal involvement with DOI/Reclamation and Basin States discussions concerning management and operation of the Colorado River System.<br>• Continue to improve relations with tribes at a regional and local level with respect to water issues of mutual concern.<br>• Foster and strengthen stakeholder relationships with non-governmental organizations working within the Basin. |
| Conservation and Drought Management | • Develop and implement on-reservation conservation measures consistent with protecting the full extent of Indian reserved water rights for tribal benefit.<br>• Develop tribal drought management plans including response actions consistent with tribal priorities for the use of their water rights. | • Continue to include tribes as additional drought mitigation tools are explored in the Basin, including infrastructure improvements.<br>• Explore opportunities to assist tribes in water conservation efforts and system efficiency improvements, including targeted outreach and partnerships.<br>• Increase the integration of water/energy-efficiency programs and resource planning. |

**TABLE 9-A**
Opportunities for Potential Future Action Identified by the Ten Tribes Partnership and the Bureau of Reclamation
*The ordering of these lists does not imply a priority*

| Category | Ten Tribes Partnership | Bureau of Reclamation |
|---|---|---|
| Data Collection and Tools for Water Management | • Seek to implement state-of-the-art technology for collecting tribal water supply and use data.<br>• Develop coordinated and accurate water accounting systems among Partnership Tribes, state and federal entities in the Upper Basin.<br>• Refine CRSS to account for water use by the Partnership Tribes on a finer spatial resolution and to improve the understanding of the specific areas of the Basin likely to experience effects of future state and tribal water development.<br>• Work with state and federal partners to install additional stream flow gages using cost-sharing agreements among the Partnership Tribes, U.S. Geological Survey, Reclamation, BIA, and state entities to further the understanding of the effects of changing water supply on Partnership Tribes and future water development to non-tribal users. | • Explore developing or revising models to incorporate a finer spatial resolution than is currently represented in CRSS, which would more accurately locate tribal diversions.<br>• Explore developing the capability to track senior priority federal Indian reserved water rights of the Partnership Tribes and their use on a per-user basis.<br>• Facilitate coordinated and defensible water accounting throughout the Basin.<br>• Assist tribes to develop state-of-the-art technology to help with monitoring and measuring water supply and use data. |
| Educational Opportunities | • Seek venues to educate all Basin stakeholders about Indian reserved water rights and development.<br>• Partner with existing educational programs or develop new programs to teach or enhance farming and ranching techniques, and create related job opportunities.<br>• Partner with existing programs or develop new programs to encourage and train tribal participants in operating, monitoring, maintaining and replacing agricultural irrigation systems and municipal sanitation and distribution systems. Existing programs include:<br>○ WaterOperator.org<br>○ Native American Water Masters Associations (NAWMAs)<br>○ BIA Water Resources Technician Training Program<br>• Establish an online mechanism to provide a central location for Partnership Tribes to learn about educational and funding opportunities. | • Assist tribes to increase their capacity in water management, including partnering with other federal agencies providing water-related training and services for tribes. |

# Disclaimer

The Colorado River Basin Ten Tribes Partnership Water Study (Tribal Water Study) was funded jointly by the Bureau of Reclamation (Reclamation) and the ten federally recognized Indian tribes of the Ten Tribes Partnership (Partnership). The purpose of the Tribal Water Study was to conduct a comprehensive assessment of tribal water supplies for the Partnership Tribes. The Tribal Water Study includes documentation of the Partnership Tribes' current water use, projections of future water development, and the Basin-wide effects of full development of tribal water rights. The Tribal Water Study also identifies opportunities and challenges associated with the development of tribal water considering the future water supply and demand imbalances documented in the Colorado River Basin Water Supply and Demand Study. Although the Tribal Water Study identified potential legal and policy issues related to tribal water development and potential solutions to water imbalances, the Study was intended to view tribal water in the context of the federal Indian reserved water rights and current legal framework commonly and collectively referred to as the "Law of the River."

Reclamation and the Partnership expect the Tribal Water Study to encourage communication throughout the Basin and with the Partnership Tribes regarding system reliability challenges, the needs of all water users, and strategies that may be considered to meet demand equitably over time. Reclamation and the Partnership recognize the Tribal Water Study was constrained by funding, timing, technological and other limitations, which presented some policy questions and issues, particularly related to modeling, the treatment of federal Indian reserved water rights, and the provisions of the Law of the River. In such cases, Reclamation and the Partnership developed and incorporated assumptions to further complete the Tribal Water Study. Where possible, a range of assumptions were used to identify the sensitivity of the results to those assumptions.

Nothing in the Tribal Water Study, however, is intended for use against any of the tribes in the Colorado River Basin, including the Partnership Tribes; any Basin State; the federal government; or the Upper Colorado River Commission in any administrative, judicial or other proceeding for any purpose whatsoever, including, but not limited to evincing or supporting any legal interpretation of federal Indian reserved water rights or the Law of the River. As such, the assumptions contained in the Tribal Water Study or in any reports generated during the Study do not, and shall not, represent a legal position or interpretation of any of the water rights of the Partnership Tribes, by any Basin State, the federal government, or the Upper Colorado River Commission as it relates to the Law of the River. Furthermore, nothing in the Tribal Water Study is intended to, nor shall the Study be construed so as to, interpret, diminish or modify the water rights of any of the Partnership Tribes, any other tribe, any Basin State, the federal government, or the Upper Colorado River Commission under federal or state law or administrative rule, regulation or guideline. Reclamation and the Partnership continue to recognize the right of each of the Partnership Tribes and of each of the Basin States under existing law to use and develop the water of the Colorado River System.

# Glossary

**Colorado River System** – The portion of the Colorado River and its tributaries within the United States of America

**Demand** – Water needed to meet identified uses

**Depletion** – A use of surface water or groundwater due to human-caused activity, including interbasin transfers. Also termed consumptive use.

**Diversion** – Water withdrawn from the river system

**Diversion point** – Location on the Colorado River or its tributaries at which water is diverted for depletion

**Non-consumptive use** – Water used without diminishing the available supply

**Hydrologic shortage** – Unmet demand that is not the result of any policy, such as prescribed shortage delivery reductions

**Indian Country** – Indian Country is defined at 18 U.S.C. § 1151 as:

a. all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and, including rights-of-way running through the reservation;

b. all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a state; and

c. all Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same.

Consistent with the statutory definition of Indian Country, as well as federal case law interpreting this statutory language, lands held by the federal government in trust for Indian tribes that exist outside of formal reservations are informal reservations and, thus, are Indian Country.

**Influencing factor** – Factors that will likely have the greatest influence on the future of tribal development and use of water from the Colorado River and its tributaries over time

**Importance** – Being of great significance or value. Used to rate the importance of an influencing factor to tribal development and the use of water from the Colorado River and its tributaries relative to the remaining influencing factors.

**Key influencing factors** – The key driving forces that are identified as both highly uncertain and highly important

**Law of the River –** The treaties, compacts, decrees, statutes, regulations, contracts and other legal documents and agreements applicable to the allocation, appropriation, development, exportation and management of the waters of the Colorado River Basin are often referred to as the Law of the River. There is no single, universally agreed upon definition of the Law of the River, but it is useful as a shorthand reference to describe this longstanding and complex body of legal agreements governing the Colorado River.

**Mean sea level –** Elevation as established by the U.S. Coast and Geodetic Survey (now superseded by the Environmental Science Service Administration) at the time of the construction of Hoover Dam and Glen Canyon Dam.

**Natural inflow** – Calculated as gaged flow corrected for the effects of upstream reservoirs and depletion

**Policy shortage** – Unmet demand that is the result of a policy, such as prescribed shortage delivery reductions

**Return flow** – Water diverted from and returned to the river system

**Simulation set** – A collection of model simulations that share the same Tribal Water Development Scenario, Water Supply Scenario, and Reservoir Operation Policy

**System reliability metrics** – Measurements that indicate the ability of the Colorado River System to meet water delivery needs under multiple future conditions

**Trace** – A single model simulation

**Tribal** – Generally refers to the member tribes of the Ten Tribes Partnership, unless the context expresses otherwise.

**Uncertainty** – Imperfect or unknown information.  Used to rate the uncertainty of an influencing factor to tribal development and the use of water from the Colorado River and its tributaries relative to the remaining influencing factors.

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