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.

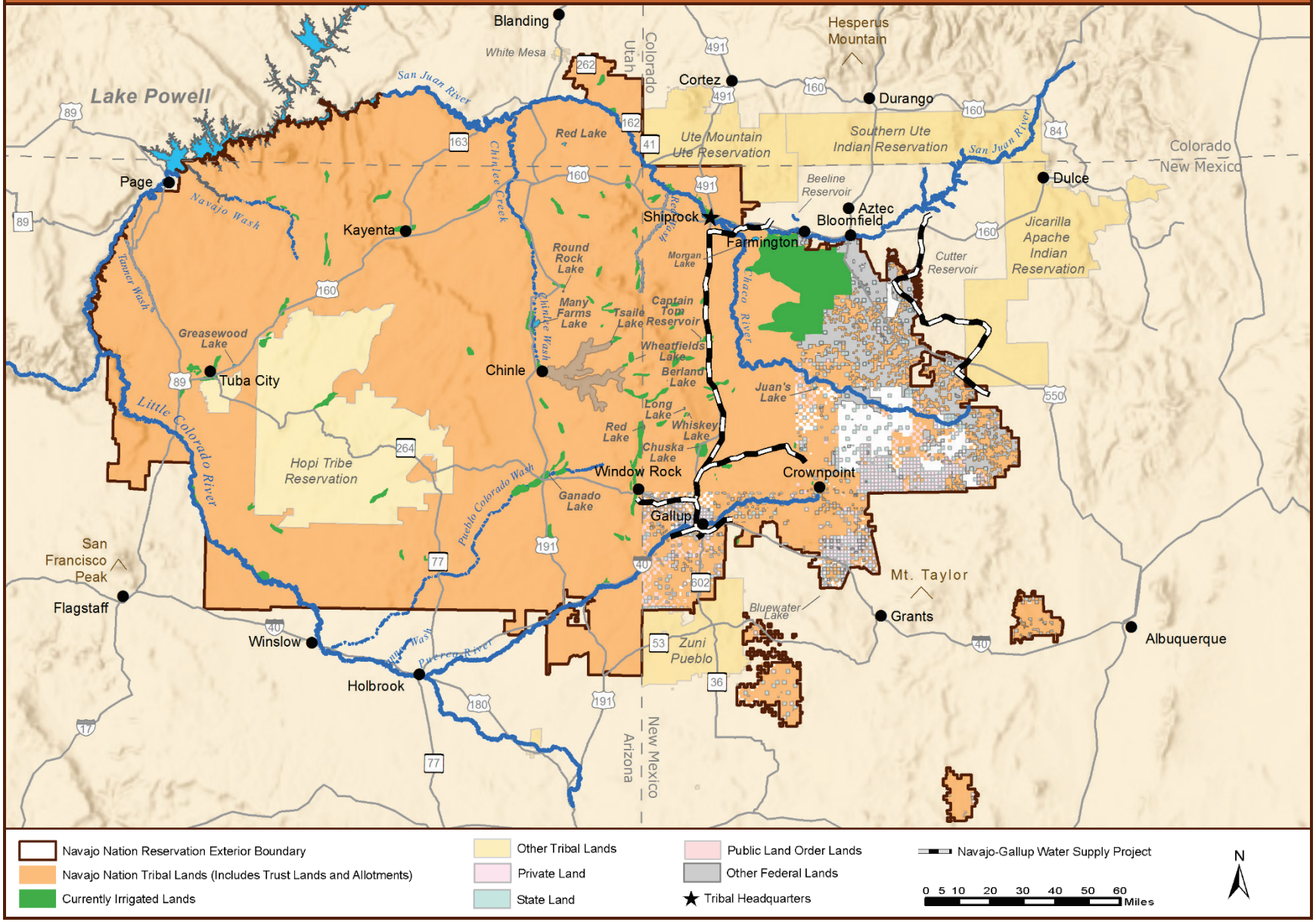
Figure 5.5-A presents a general location map with Reservation boundaries, communities, and other important features.

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.

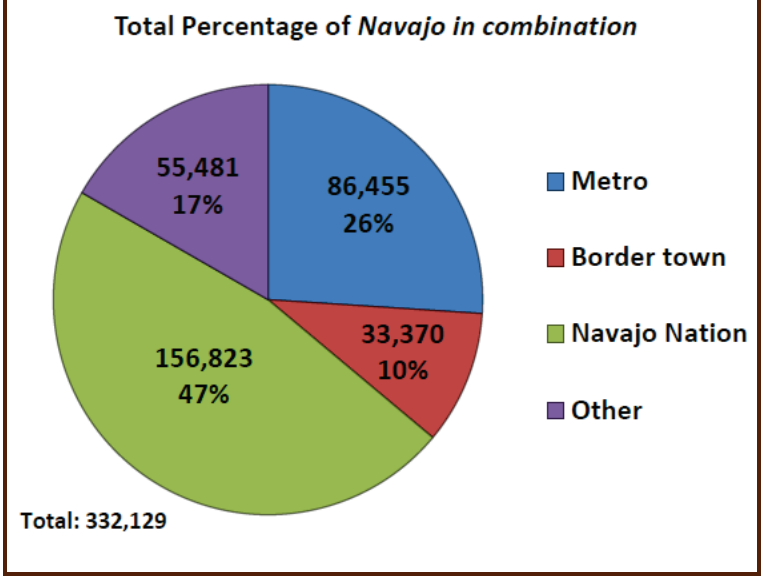
FIGURE 5.5-A
Navajo Nation Reservation Map



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.

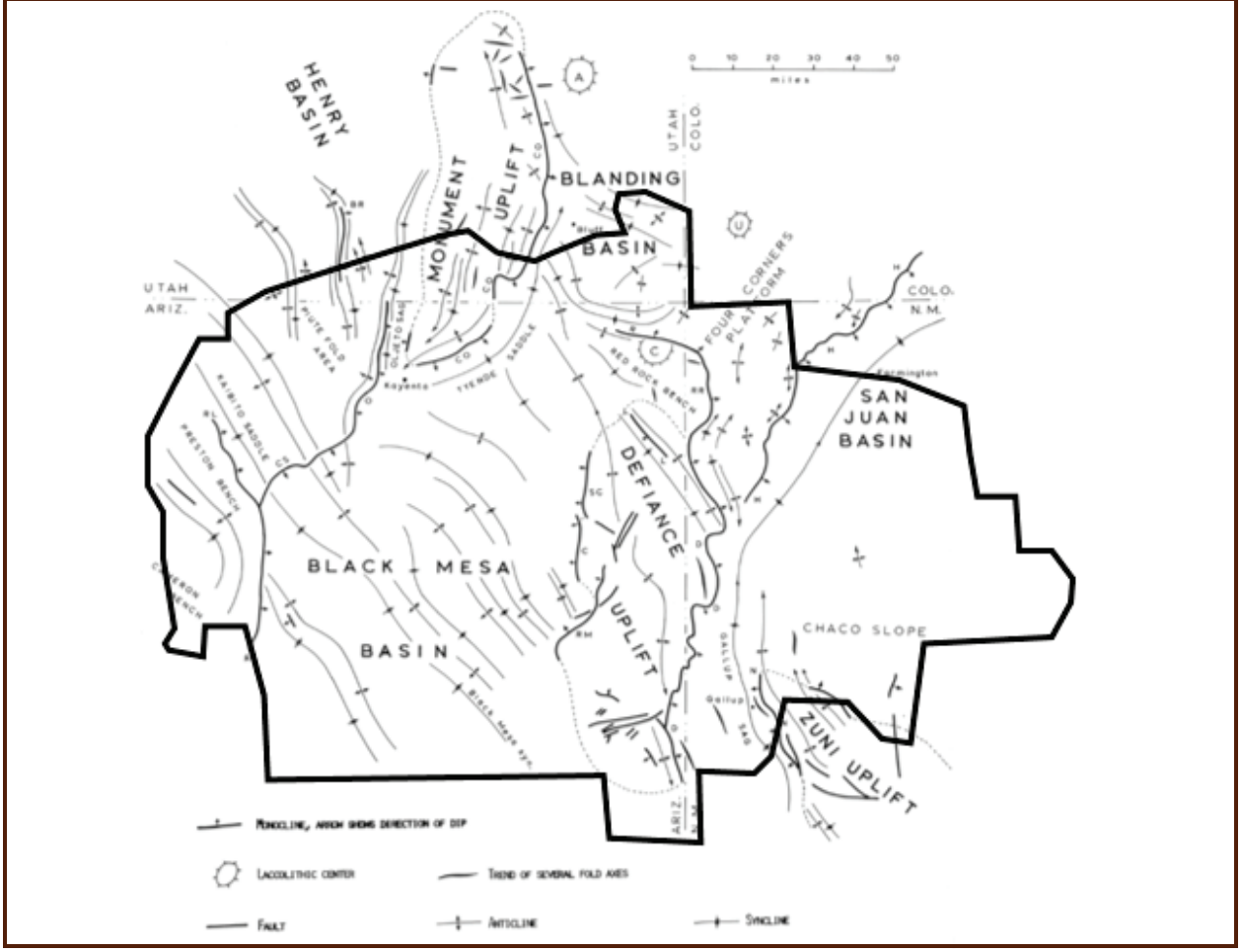
5.5.2 Physical Setting

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)

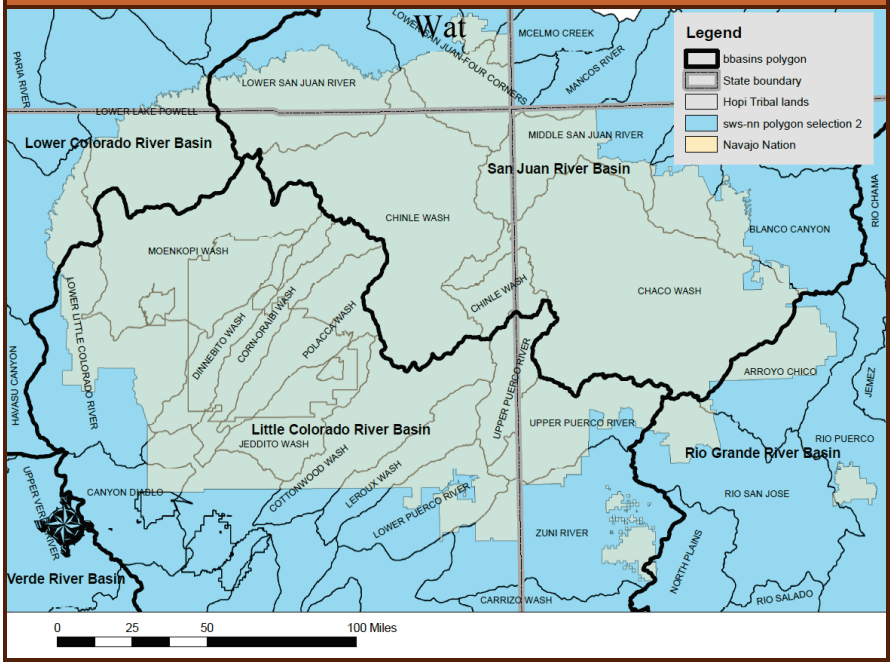


See the Disclaimer and Introduction to Chapter 5.0.

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.

Alluvial Aquifers

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

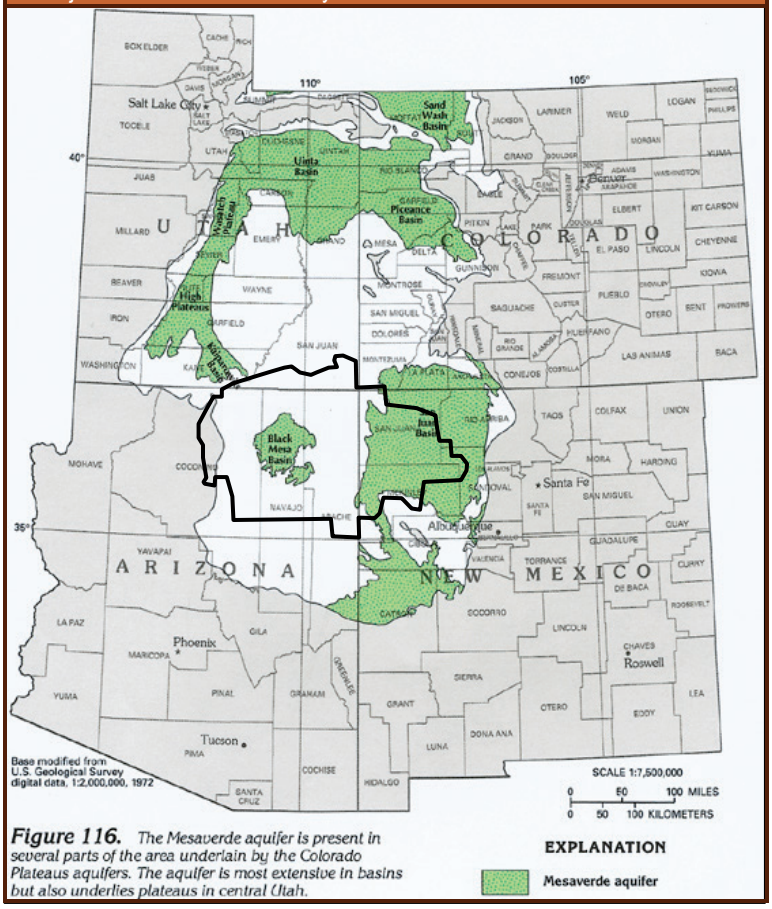


Figure 116. *The Mesaverde aquifer is present in several parts of the area underlain by the Colorado Plateaus aquifers. The aquifer is most extensive in basins but also underlies plateaus in central Utah.*

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).

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-F
Dakota-Glen Canyon aquifer system on the Colorado Plateau (USGS, 1996) with Navajo Nation exterior boundary for reference

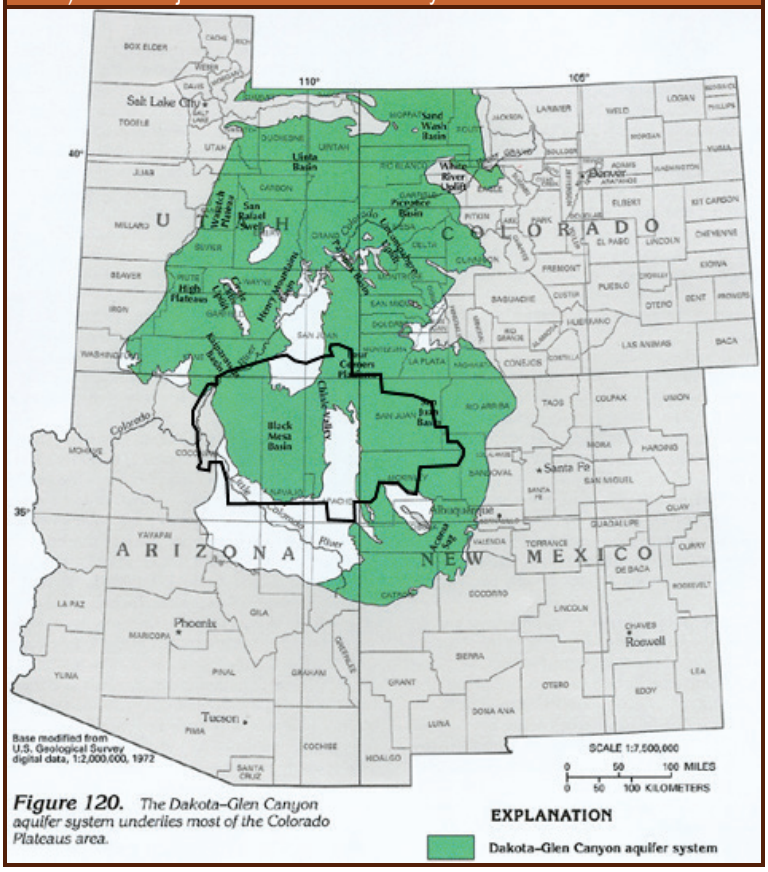
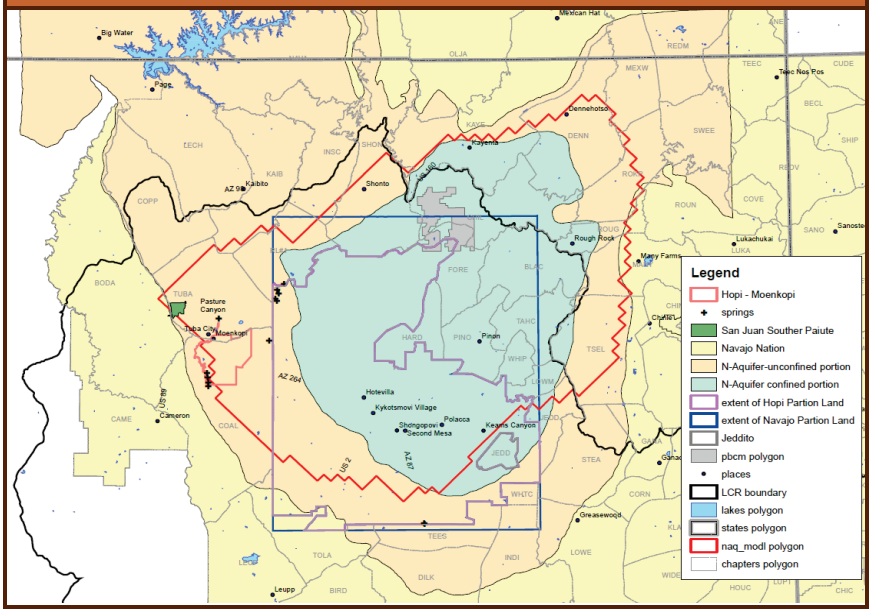


Figure 120. The Dakota–Glen Canyon aquifer system underlies most of the Colorado Plateaus area.

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.

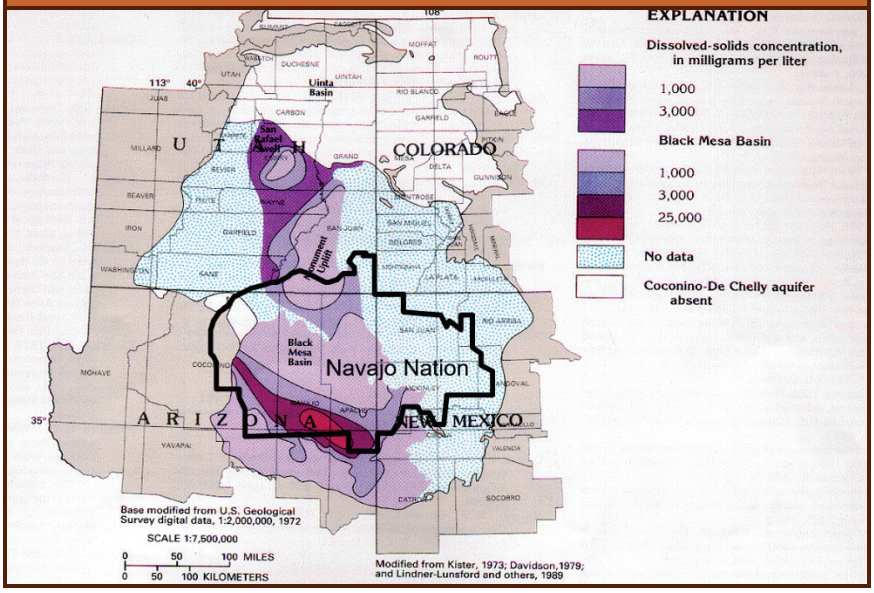
Pursuant to the Surface Mining, Control and Reclamation Act of 1977, a Cumulative Hydrologic Impact Assessment (CHIA) was performed in 1989 and updated in 2016 by the Office of Surface Mining Reclamation and Enforcement. Hydrologic concerns identified as part of the CHIA are related to the industrial 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

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.

FIGURE 5.5-H
Extent and Total Dissolved Solids Concentration of C Aquifer



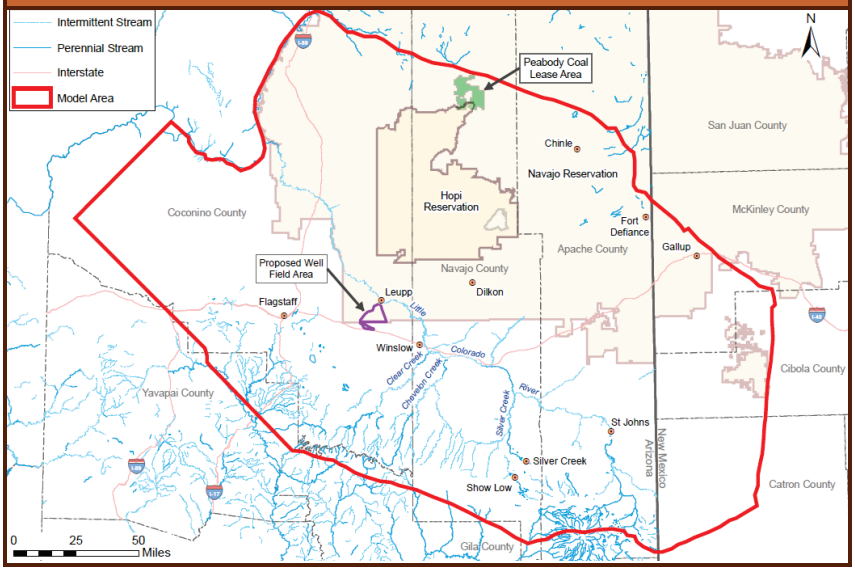
On the eastern edge of Arizona, the De Chelly Sandstone is uplifted by the north-northwest trending Defiance Anticline. Monoclines on either side of this ridge dip to the west and east under younger rocks in the Black Mesa (Arizona) and San Juan (New Mexico) Basins, respectively.

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

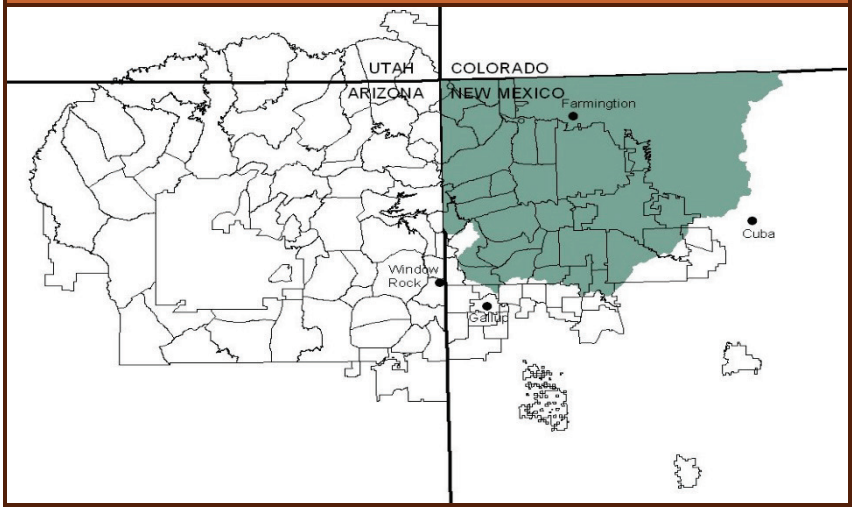
The Navajo Nation negotiated proposed settlement agreements to the Little Colorado River Basin of Arizona in 2010 and 2012 but those agreements were never realized. The 2010 agreement also included a proposed Lower Basin mainstem Colorado River allocation that was not realized. Currently, the adjudication 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.

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.

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

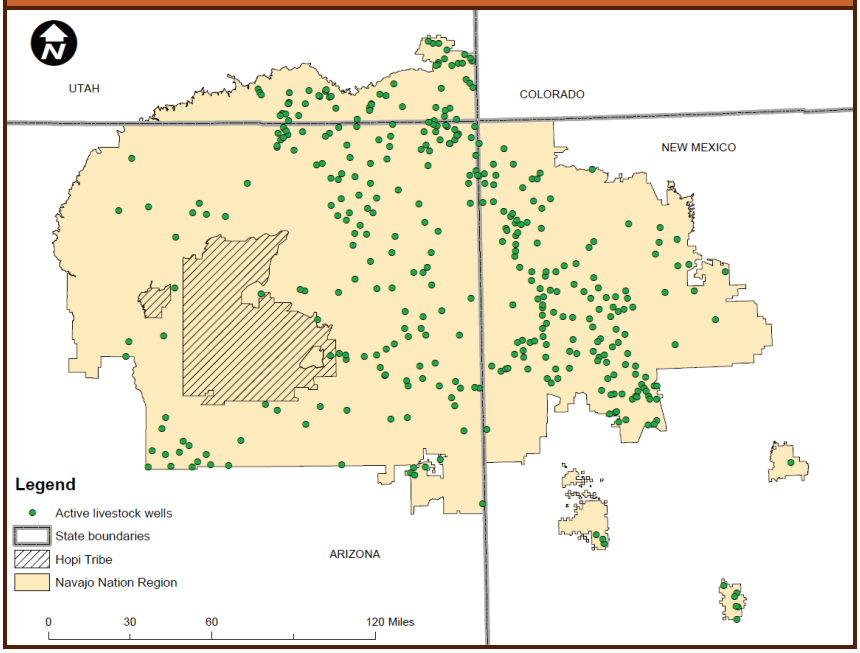
The majority of the Navajo Nation's current water use is for agricultural irrigation, although approximately 11 percent is used for domestic, commercial, municipal, and industrial purposes.

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

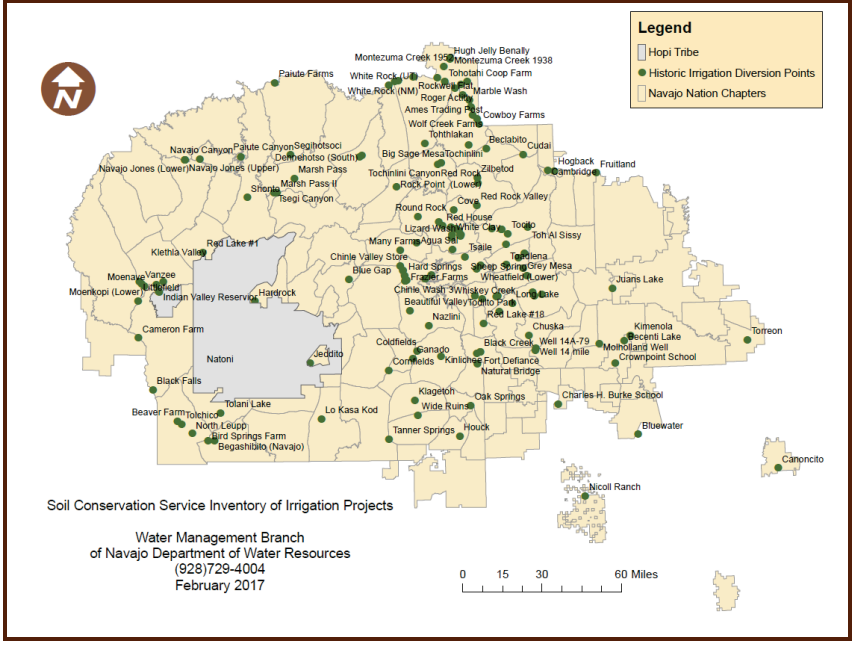


Congress transferred O&M responsibilities for the Navajo irrigation systems from the BIA to the Navajo Nation (NDWR, 2003).

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.

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.

FIGURE 5.5L
Navajo Nation Irrigation Projects Inventory by USDA SCS in 1986



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.

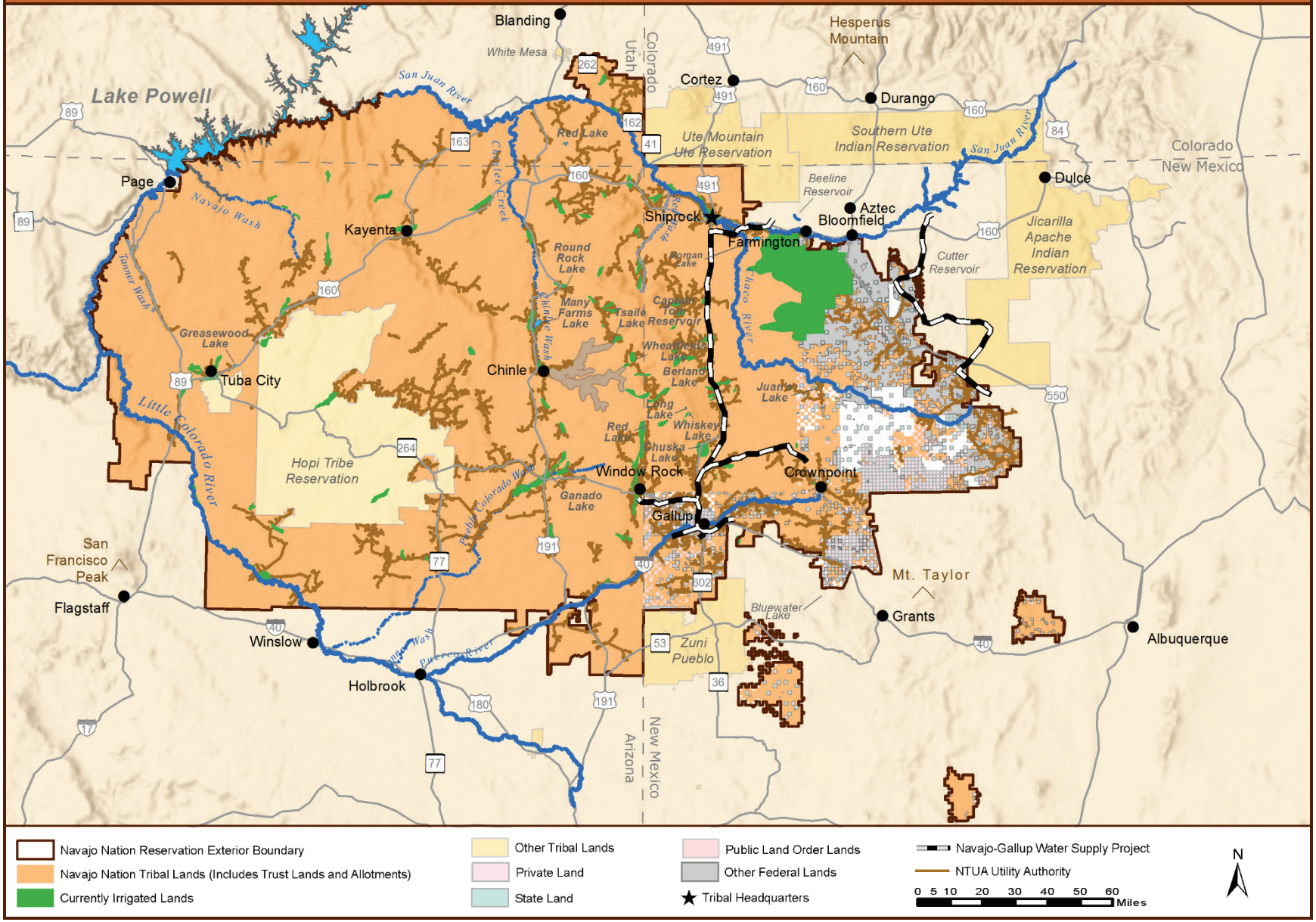
Navajo Tribal Utility Authority (NTUA) is the largest supplier of domestic and municipal water on the Navajo Nation and currently operates approximately 90 public water systems, delivering approximately 12,000 AFY of residential water serving approximately 65 percent of the on-Reservation population (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

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

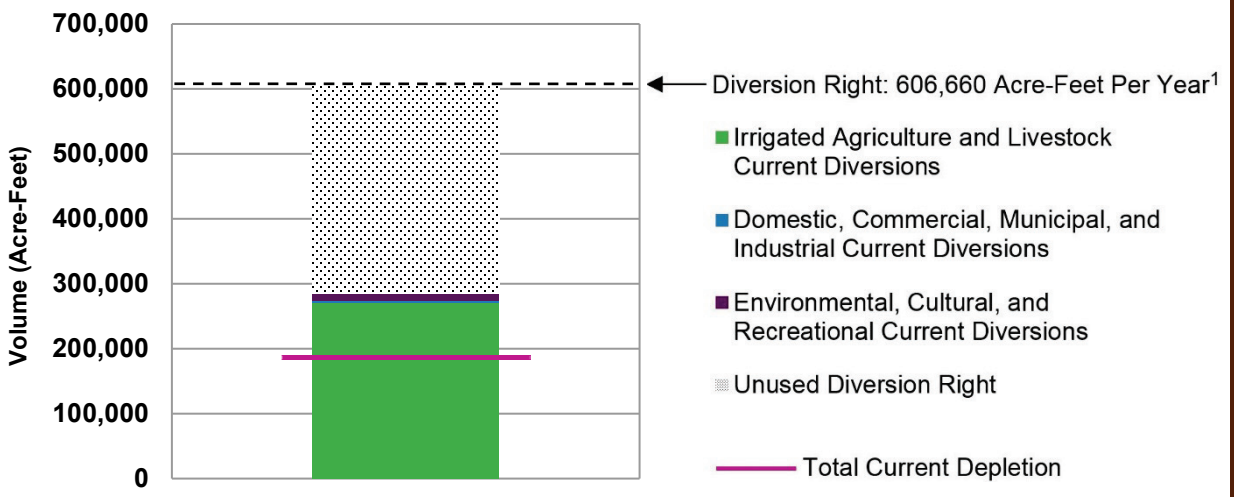
The reservoirs on the Navajo Nation provide storage for irrigation water, livestock, wildlife and recreation. There are more than 20 significant storage facilities (Table 5.5-H). A reservoir was considered significant if it has a surface area greater than 200 acres, is included in the NDWR Safety of 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

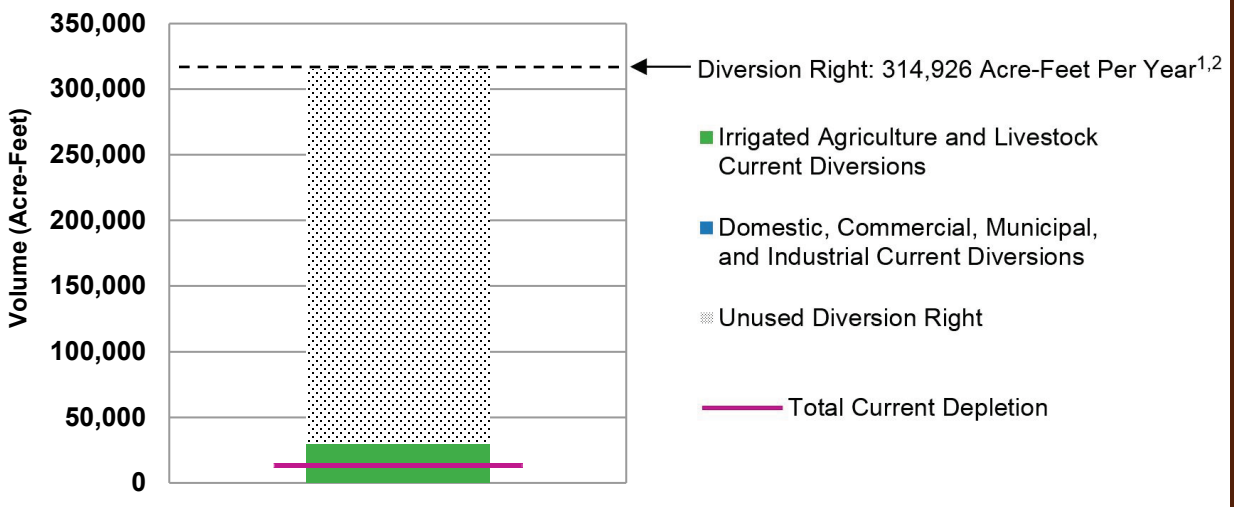
measurement on many smaller water sources, reasonable standardized assumptions were used to determine their diversion amounts. Depletion amounts were then derived from the diversion numbers using standard engineering efficiency estimates and assigned based on water use category and structure type.

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.

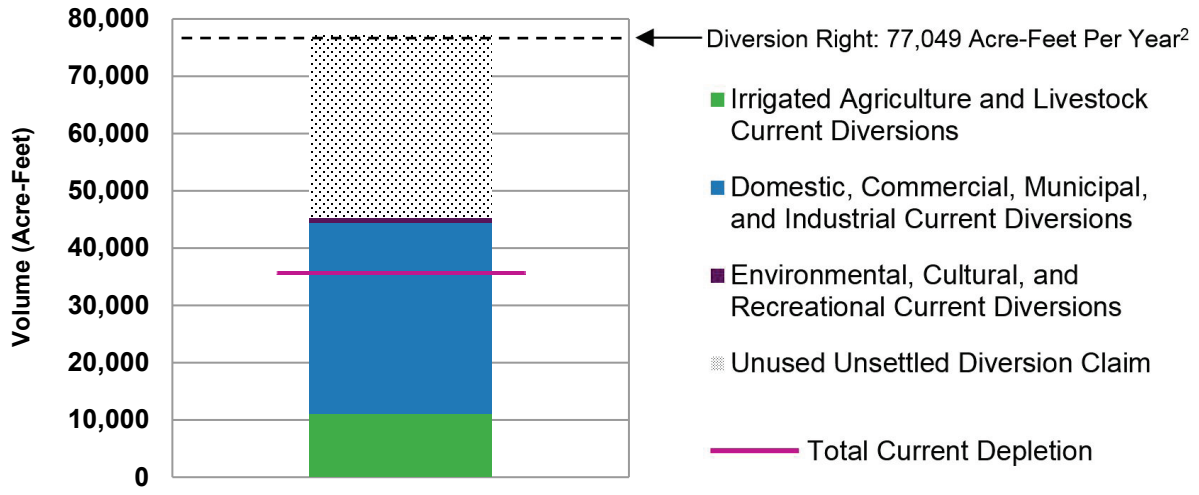
FIGURE 5.5-O
Navajo Nation Current Average Annual Water Use in Utah



[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.

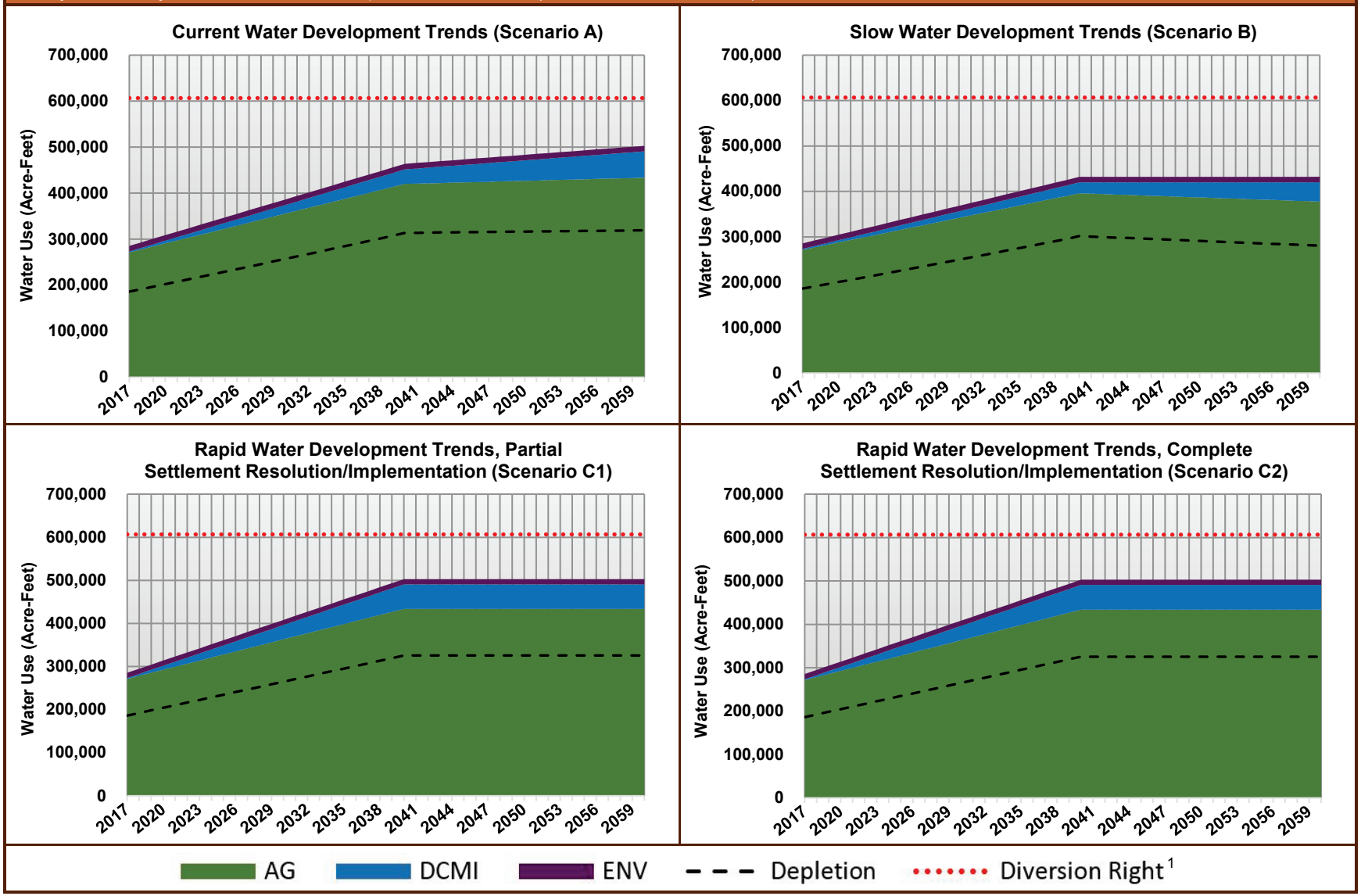
Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)

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.

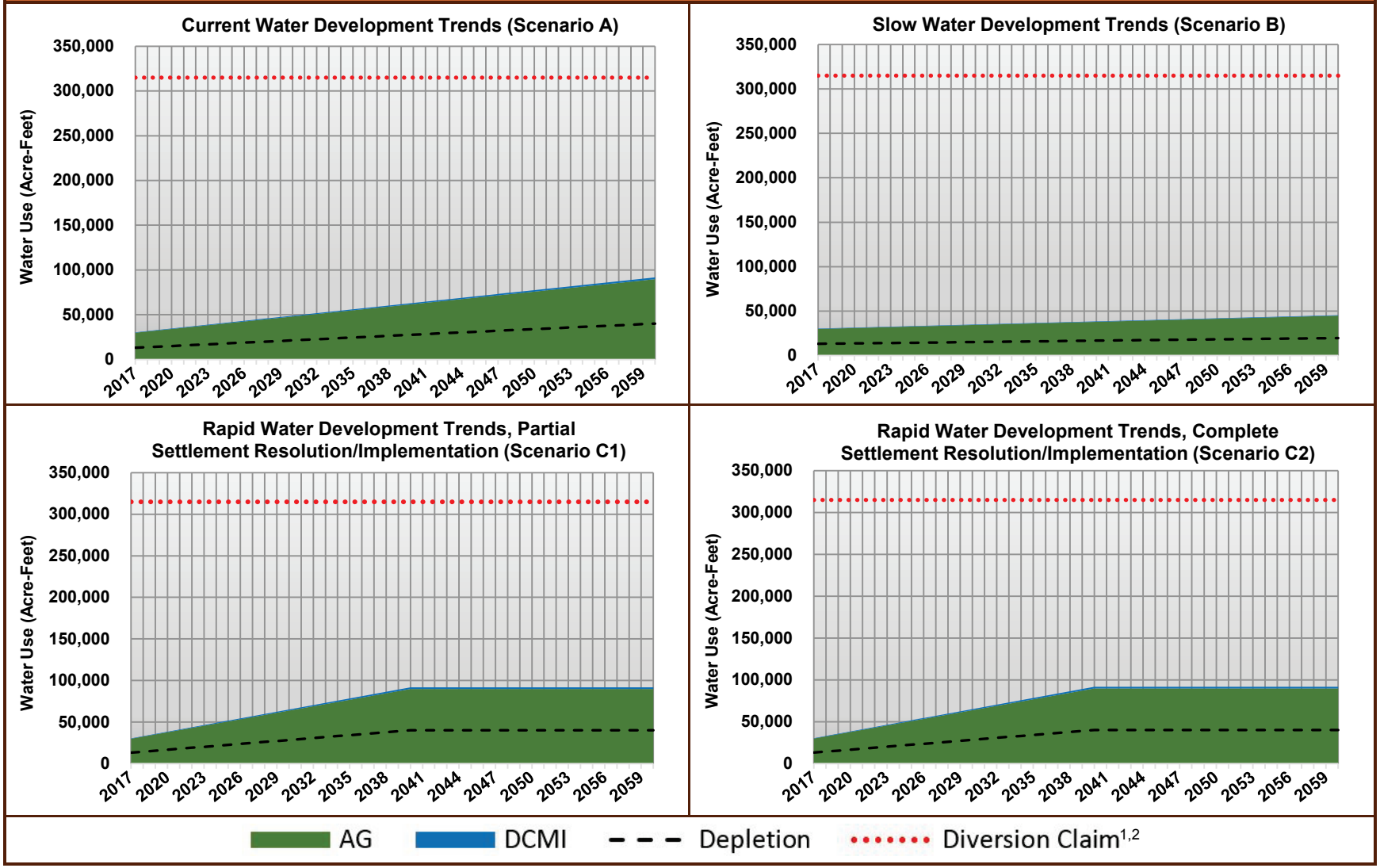
Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)

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.

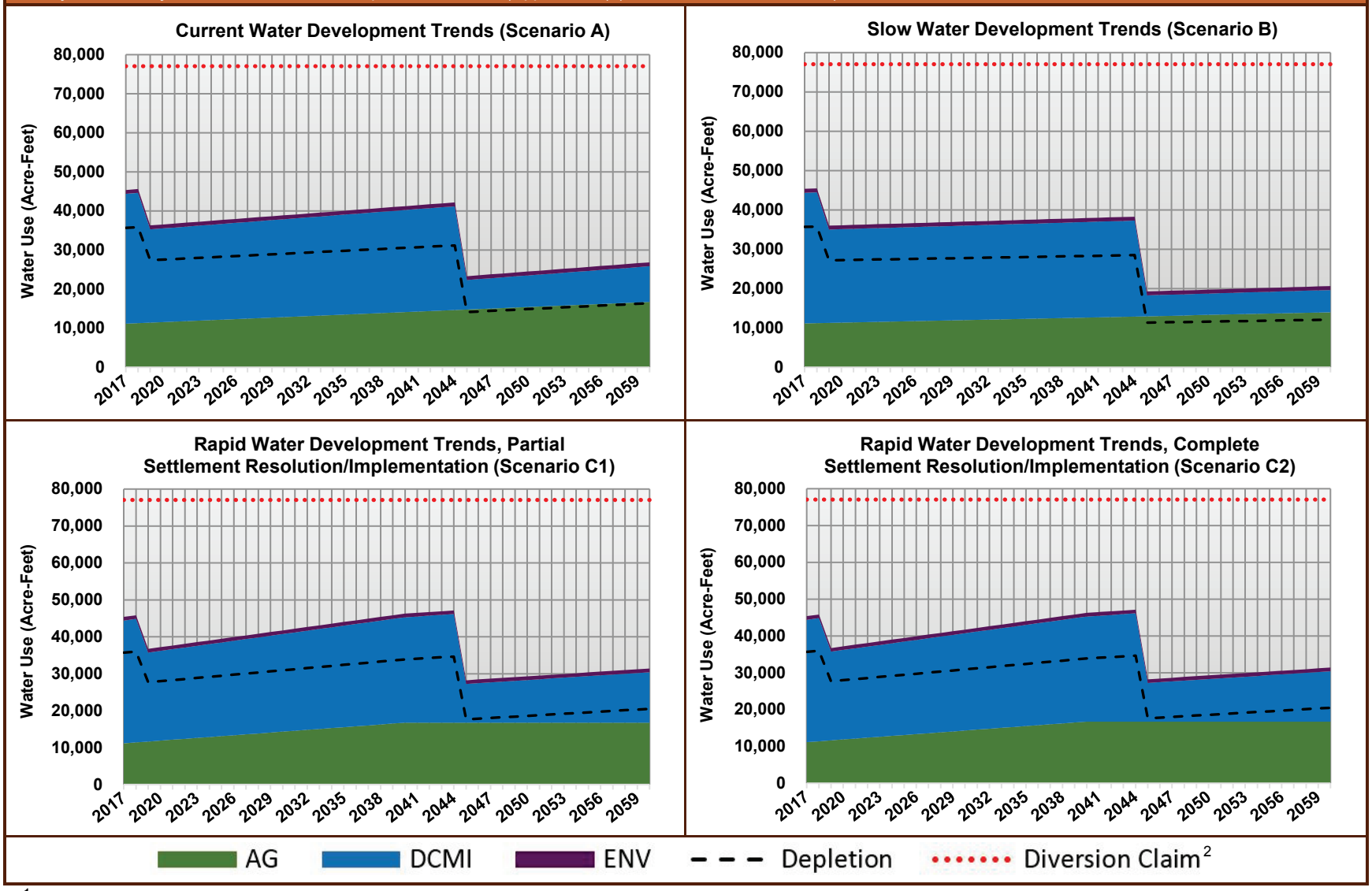
Rapid Water Development Trends, Partial Settlement Resolution/Implementation (Scenario C1)

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.

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.

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.