

**WATER RESOURCE
DEVELOPMENT STRATEGY
FOR THE NAVAJO NATION**



**NAVAJO NATION
DEPARTMENT OF WATER RESOURCES**

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**THE WATER RESOURCE DEVELOPMENT STRATEGY
FOR THE
NAVAJO NATION**

EXECUTIVE SUMMARY

The Navajo Nation has severe water infrastructure deficiencies that impact the health, economy, and welfare of the Navajo people. The lack of adequate domestic and municipal water is the greatest water resource problem facing the Navajo Nation. Given the limited tribal resources, and the limited federal budgets and authorizations, the water resource problems will become increasingly acute, intensifying the poor socioeconomic conditions on the Navajo reservation. The goals of this Water Resources Development Strategy for the Navajo Nation (Strategy) are to: describe current and projected water requirements, identify water resource infrastructure deficiencies, and present a strategy for addressing the deficiencies. The specific objectives of this document are to:

- Provide an overview of water supply and management.
- Describe water use and demand on the Navajo Nation.
- Identify water infrastructure deficiencies.
- Propose a long-term water resource development strategy for the Navajo Nation.
- Present a Plan of Action for implementing the strategy.

BACKGROUND

The Navajo reservation is the largest reservation in the United States, covering more than 27,000 square miles, an area larger than the state of West Virginia. The reservation is located in the Four Corners Region in Arizona, New Mexico and Utah (see Figure ES-1). The on-reservation population of approximately 172,000 is expected to increase to nearly 500,000 by the year 2040. Economic conditions on the reservation are in a desperate state. With more than 50 percent of the population living below the federal poverty levels, the poverty and unemployment rates on the Navajo reservation are among the worst in the United States.

The total domestic water consumption on the reservation is approximately 12,000 acre-feet annually. Per capita water use on the reservation ranges between 10 and 100 gallons per day depending upon the availability and accessibility of the water supply. By comparison, the average per capita use for neighboring non-Indian communities in Arizona is 206 gallons per day. Assuming the on-reservation water users achieve parity with the neighboring non-Indian communities, the on-reservation municipal water demand will increase to an average per capita water use of 160 gallons per day and exceed 89,000 acre-feet by the year 2040.

Figure ES-1 : Map of the Navajo Nation

Approximately 40 percent of the Navajo population on the reservation is without tap water in their homes and hauls water long distances to provide water for their families. In 1993 Northwest Economic Associates evaluated the cost of water hauling on the Navajo reservation. Families which haul water for domestic purposes spend the equivalent of \$22,000 per acre-foot of water compared with \$600 per acre-foot for typical suburban water users in the region. This water is among the most expensive in the United States for a sector of the population that is among the poorest. Additionally, these water haulers often rely on non-potable water sources such as stock tanks for potable purposes. Those that do have running water depend on public water supply systems that are deteriorating and are struggling to generate adequate revenues for maintenance. Many of these water systems have exceeded the maximum sustainable withdrawal capacity of their source aquifer, 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. It also contributes to a high incidence of disease and infection attributable to waterborne contaminants. This chronic condition places large financial burdens on federal programs that treat diseases and illnesses that could be prevented if adequate safe water supplies were available. In a report to Congress by the Comptroller General, it was noted that reservation families living in homes with unsatisfactory environmental conditions (*e.g.*, inadequate drinking water) placed four times the demand on Indian Health Service primary health care systems as those with satisfactory conditions.

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 development, 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 placed one of its highest priorities on developing reliable water supplies. Accordingly, the Navajo Nation has drafted the water resource development strategy discussed below.

WATER RESOURCE DEVELOPMENT STRATEGY FOR THE NAVAJO NATION

The *Water Resource Development Strategy for the Navajo Nation* includes:

- Establish a water resource development task force, which will coordinate technical and fiscal resources of the Navajo Nation and Federal agencies.
- Prepare a reservation-wide needs assessment and prioritizing projects.
- Develop regional water supply projects.
- Develop and rehabilitate local water supply and distribution systems.
- Completing NIIP and continue to address deficiencies in water storage facilities.

The Strategy includes development of several large regional water supply projects and rehabilitation of local multipurpose delivery systems that treat and deliver water to domestic, municipal, industrial and agricultural users. The Strategy does not address the needs of the Navajo Nation to develop new irrigation projects, or to rehabilitate all of the historically used but currently abandoned irrigation

projects. Those projects are needed for the Navajo Nation to achieve full economic self-sufficiency. However, because the viability of such projects is subject to ongoing and potential litigation, the strategy for developing all of those lands is not included in the *Water Resources Development Strategy for the Navajo Nation*. For similar reasons the water requirements of large, single purpose industrial users such as power generating stations, and the water required for ceremonial purposes are also beyond the scope of this document.

Water Resource Development Task Force

To address these problems the leaders of the Navajo Nation are committed to providing capital and manpower resources, and to developing partnerships. However, due to the magnitude of the deficiencies, sufficient water resource development is beyond the financial capabilities of the Navajo Nation and the federal agencies authorized to address these needs. For example, based on current funding levels the Indian Health Service has a twenty-year backlog of sanitation deficiencies on the reservation. Similar budget constraints face the other federal agencies with the authorities to address commercial, industrial and agricultural needs.

A water resource development task force will enable the Navajo Nation and the federal agencies to coordinate planning and construction activities, and to use available fiscal and technical resources more effectively. Where appropriate, the Navajo Nation will seek increased federal appropriations, and new or expanded agency authorizations.

Reservation-wide Needs Assessment and Project Prioritization

To effectively seek increased federal funding and expanded authorities to address deficiencies, the Navajo Nation must first systematically identify the full scope and need on the reservation. With assistance from the federal agencies, the Navajo Nation will prepare a reservation-wide assessment of the local needs. To break the needs assessment into manageable parts, the reservation will be assessed regionally. The regions will be based on the locations of the proposed regional water supply projects, growth centers and jurisdictional boundaries. The needs assessment will include an appraisal of the water systems necessary to:

- Put all of the municipal water supplied by the proposed regional projects to beneficial use
- Provide for domestic and municipal needs served by local systems not connected to the Proposed regional systems
- Improve water service to families not connected to public water systems
- Provide the infrastructure for selected agricultural endeavors
- Optimize water conservation and wastewater reuse

This effort will include studying the fee structures to ensure the operation, maintenance, repair, and replacement of these systems. The information compiled will enable the Navajo Nation to prioritize and sequence the proposed water development projects. The assessments and the resulting appraisals will be pursued through Reclamation's existing authorization to perform general studies.

Regional Water Supply Projects

The cornerstone of the Strategy is several large, regional water supply projects (see Figure ES-2) 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.

The proposed regional water supply projects will convey domestic water to approximately 67 of the 110 chapters on the reservation. By the year 2040 these systems will provide capacity to serve domestic water to more than 80 percent of the projected population of 500,000. The proposed regional projects are estimated to cost more than \$600 million to construct. These projects include, but are not limited to:

- C-Aquifer Ganado Groundwater Project
- Central San Juan River Pipeline
- Farmington to Shiprock Pipeline (also referred to as the Navajo Municipal Pipeline)
- Lake Powell-Peabody Pipeline
- Navajo-Gallup Water Supply Project
- Three Canyon Water Supply Project
- Western Navajo Pipeline

Local Water Supply and Distribution Systems

Even with the large regional projects, without additional local infrastructure, there will be inadequate conveyance and treatment capacity to deliver potable water from the regional systems to many of the water users. Even with the regional projects and the associated local distribution systems fully in place, approximately 40 percent of the chapters will rely on other water supply sources and facilities. Many of these areas have systems that require rehabilitation, and many areas require new systems.

For areas where distribution systems are infeasible, community wells need to be upgraded and/or constructed to improve access for water haulers. The rehabilitation and development of local irrigation and livestock water systems is also an important component of the Strategy.

Figure ES-2 : Proposed Regional Water Supply Projects

Completing NIIP

The Navajo Indian Irrigation Project (NIIP) was authorized in 1962 through Public Law 87-483 for the principal purpose of furnishing irrigation water to approximately 110,630 acres of land. NIIP has not realized its full economic potential. The Navajo Nation has made several specific suggestions to realize NIIP's potential, including: 1) increasing the annual construction funds to complete both the distribution systems and on-farm components in a shorter period of time, 2) vertically integrating to increase tribal employment, 3) adequately funding the operation and maintenance. The Navajo Nation, BIA and Reclamation have assembled a team to develop a long range plan for NIIP.

FUNDING

The combined cost of the regional projects and the local systems may exceed \$2 billion. The Navajo Nation will prioritize its resources to share in the cost of this initiative. The Navajo Nation will commit staff, equipment and materials where possible. However, developing the essential water infrastructure will require large capital investments well beyond the current economic means of the Tribe. Additional funding will be pursued through other avenues including:

- Navajo Water Rights Settlements
- Existing Federal Authorities and Annual Appropriations
- New Federal Authorities
- Federal Discretionary Funds
- Federal Grant Programs
- Federal Loan Programs
- State, Municipal, and Private Resources

PLAN OF ACTION

It is premature to establish firm, reliable cost estimates for implementing the Strategy. It is also too early to present project specific schedules. The costs and schedules will be evaluated during the reservation-wide water resource development needs assessment. However, implementing the Strategy to enable the Navajo Nation to achieve parity with its non-Indian neighbors may cost \$2 billion. This amount is a huge investment by any standards, but must be compared with the returns. For instance, closing the average per capita income gap between the Navajo Nation and the United States by only 1 percent would, over 40 years, generate \$800 million in direct benefits to the Navajo Nation and indirect benefits to the Federal government.

The Plan of Action depends, in part, on the success and timing of ongoing and future water rights settlement negotiations. The regional projects, if all funded and constructed simultaneously, would demand huge, annual appropriations. Congress may be unwilling to appropriate such large sums and may require the Navajo Nation to prioritize and sequence these projects. As these projects get

closer to reality, the Navajo Nation will assess the budget realities and develop an appropriate schedule. This long-term Strategy may take 40 to 50 years to implement.

The Navajo Nation recognizes its leadership role in Tribal water development. The Navajo Nation will work to ensure that its divisions work together under a single plan, and dedicate staff and resources toward its implementation. However, due to the magnitude and complexity of the deficiencies, to make significant inroads, the Navajo Nation must rely on budgets and expertise of several federal agencies. A water resource development task force will coordinate technical and fiscal resources. This will reduce agency redundancy and enable the agencies to utilize their combined resources more effectively. The Task Force will be established before the end of fiscal year 2000. To focus this group, the NDWR will delineate the regional areas to be assessed, and develop a prioritization approach. The regions will be based on the service areas of the regional projects, growth centers, and jurisdictional boundaries.

For the Plan of Action, the Navajo Nation, in partnership with Reclamation, will strive to complete the feasibility studies for the Navajo-Gallup Water Supply Project, as authorized by Congress, by fiscal year 2001. Assuming a feasible project results, the project will be submitted to Congress for construction authorization in fiscal year 2002. The Little Colorado River Settlement projects follow a similar time table. The Navajo Indian Irrigation Project and the Safety of Dams programs will continue to be very important Navajo priorities.

At the conclusion of the regional needs assessments, the full scope of the water related needs on the reservation should be better understood. These assessments should be completed within the next three to five years. Beginning in fiscal year 2001, the Navajo Nation will seek approximately \$300,000 per year of annual appropriations from Congress under Reclamation's current general studies authority. The needs assessments will identify and assess potential projects at an appraisal level. The appropriate authorization for feasibility design and construction will be pursued. The necessary feasibility studies will also be pursued to address the areas that will not be served by the proposed regional systems.

The Water Resources Task Force should be established before the end of fiscal year 2000. To focus this group, the NDWR will delineate the regional areas to be assessed, and develop a prioritization approach. The regions will be based on the service areas of the regional projects, growth centers, and jurisdictional boundaries.

1. GOALS AND OBJECTIVES

The Navajo Nation has been waging an uphill battle for many years to maintain and modernize its water resource infrastructure. However, it has become increasingly clear that, given existing agency resources, budgets and authorizations, many of the water infrastructure deficiencies on the reservation will continue to go unattended. Without increased action by the Navajo Nation and the federal agencies, the problems will become increasingly acute. The Navajo Department of Water Resources (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 this *Water Resources Development Strategy for the Navajo Nation* (Strategy). This activity was partly funded by Reclamation's Upper Colorado and Lower Regional Offices through their Native American Affairs programs under Cooperative Agreement #1425-97-FC-32-00018.

This document provides enough background for the reader to understand the barriers that retard the development of essential water delivery infrastructure. The broad goals of this Strategy are to: describe the current and projected water requirements, identify infrastructure deficiencies, and present a Strategy and a Plan of Action for addressing the deficiencies. The specific objectives are to:

- Provide an overview of water supply and management on the reservation, including descriptions of the Tribal entities that play key roles.
- Identify water use and demand on the Navajo Nation. This document will focus on the current level of water use and the anticipated water demands that are, or may be, unmet. These unmet needs include specific categories of water use, as well as specific water management objectives.
- Based on current and future water demands, identify water infrastructure deficiencies.
- Propose a long-term water resource development strategy for the Navajo Nation. The focus of this Strategy will be primarily, but not exclusively, on a plan by which the Navajo Nation can effectively seek and use technical and financial resources for development and rehabilitation of desperately needed water infrastructure on the reservation.
- The Navajo Nation will work with the cognizant federal agencies, including but not limited to the Bureau of Indian Affairs (BIA), the Bureau of Reclamation (Reclamation), Indian Health Services (IHS), the Army Corps of Engineers, and the U.S. Department of Agriculture, to develop an interagency consensus on a Plan of Action. This Plan of Action will be presented to Congress, particularly the New Mexico, Utah and Arizona delegations, with the intent of securing a financial commitment from Congress. This plan will include long-term schedule and funding projections for meeting the Navajo Nation's broad water resource needs.

The Strategy includes developing several large regional water supply projects and rehabilitating local multipurpose delivery systems that treat and deliver water to domestic, municipal, industrial

and agricultural water users. The Strategy does not address the needs of the Navajo Nation to develop new irrigation projects, or to rehabilitate historically used but currently abandoned irrigation projects. Those projects are needed for the Navajo Nation to achieve full economic self-sufficiency. However, because the viability of such projects is subject to ongoing and potential litigation, the strategy for development of those projects is not included in the *Water Resource Development Strategy for the Navajo Nation*. For similar reasons the water requirements of large, single purpose industrial users, like power generating stations, and the water requirements for ceremonial purposes are beyond the scope of this document.

2. INTRODUCTION

The Navajo reservation was established in 1868, and has been expanded through a series of executive orders to become the largest Indian reservation in the United States. Larger than the state of West Virginia, the Navajo Nation encompasses more than 27,000 square miles including portions of Arizona, New Mexico and Utah (see Figure 2.1). The Navajo Nation is divided into 110 chapters, which are areas of local government (see Figure 2.2). According to the Navajo Division of Community Development, in 1999 the population on the reservation was 172,399.

Even after more than 100 years of federal trusteeship, the Navajo Nation faces serious economic and social challenges. In 1997 the Navajo Division of Economic Development indicated that the median family income was only \$11,885 while the U.S. median family income was more than \$30,000. The average per capita income for the Navajo Nation was less than \$5,600 while the per capita income for the State of Arizona was approximately \$22,000. More than 50 percent of the Navajo families on the reservation lived below the federal poverty levels, compared with less than 13 percent of the general U.S. population, making it among the most impoverished regions in the United States. The Navajo unemployment rate on the reservation is 58 percent, compared to an unemployment rate for the U.S. of approximately 5 percent. These disparities show no sign of narrowing, and while the surrounding regional economy has boomed, these gaps in income, unemployment and poverty have widened.

The Navajo Nation also faces serious water resource problems. Many homes lack indoor plumbing. More than 50 percent of Navajo homes lack complete kitchens and more than 40 percent of Navajo households rely solely on water hauling to meet daily water needs. Data from the Navajo Tribal Utility Authority (NTUA) demonstrate that Navajos use far less water per capita, yet pay among the highest water rates in the region (see Figure 2.3). The low per capita water use is part of a larger pattern of a low economic standard of living.

Safe drinking water is a precondition for health promotion and disease prevention. The lack of clean, safe water results in a higher incidence of disease, poor health, and fire protection. In 1996, President Clinton noted that “the number one health problem in the developing world is the absence of clean, safe water.” Without access to safe drinking water, people are forced through a revolving door of expensive medical treatment and unhealthy conditions. In a report to Congress by the Comptroller General, it was noted that families living in homes with satisfactory environmental conditions placed only one fourth of the demands on IHS primary health care delivery systems than families living in homes with unsatisfactory conditions. Biological contaminants like coli form bacteria, giardia, and crypto sporidium can only be controlled by proper water source protection, treatment and distribution systems. Children living in homes without access to safe, affordable, and dependable drinking water are especially vulnerable.

These grim statistics threaten the survival of the Navajo Nation. According to the Division of Community Development, due to the stagnation of development in Navajo country, the Navajo Nation is losing population to off-reservation communities, the Four Corners Area, and the other 46 states. Between 1980 and 1990 the Navajo off-reservation population in New Mexico, Arizona, and Utah grew by 125 percent, the Navajo population in the other 46 states grew by 71 percent, while

the on-reservation population grew by only 22 percent. Without reducing the out-migration, by 2012 more than half of the Navajo people may be living off of the Navajo reservation.

The lack of infrastructure, the lack of economic development and the sustained poverty are closely connected. Throughout the arid southwest, and especially on the Navajo Nation, a reliable water supply is essential for jump starting and sustaining economic development. The Navajo Nation has identified economic development growth centers throughout the reservation. These economic development centers represent large population bases which have the potential to benefit from an economy of scale in infrastructure development. Accordingly the Navajo Nation will focus resources in these locations to stimulate economic growth.

Creating an adequate water infrastructure does not guarantee sustained economic growth, nor a narrowing of the disparities between the Navajo people and the rest of the Nation. It is however, a necessary prerequisite. And, if even modest steps can be taken, the benefits will be compounded. If improved water infrastructure can close the income gap by just one percent, the direct benefits to the Navajo Nation, and the indirect benefits to the federal government, will be worth tens of millions of dollars annually. For example, the Navajo Nation captures less than 8 percent of the \$660 million annual tourism revenue in the Four Corners Area. If an enhanced tourist infrastructure increases that percentage to 12 percent, the Navajo Nation economy could generate an additional 26 million dollars annually.

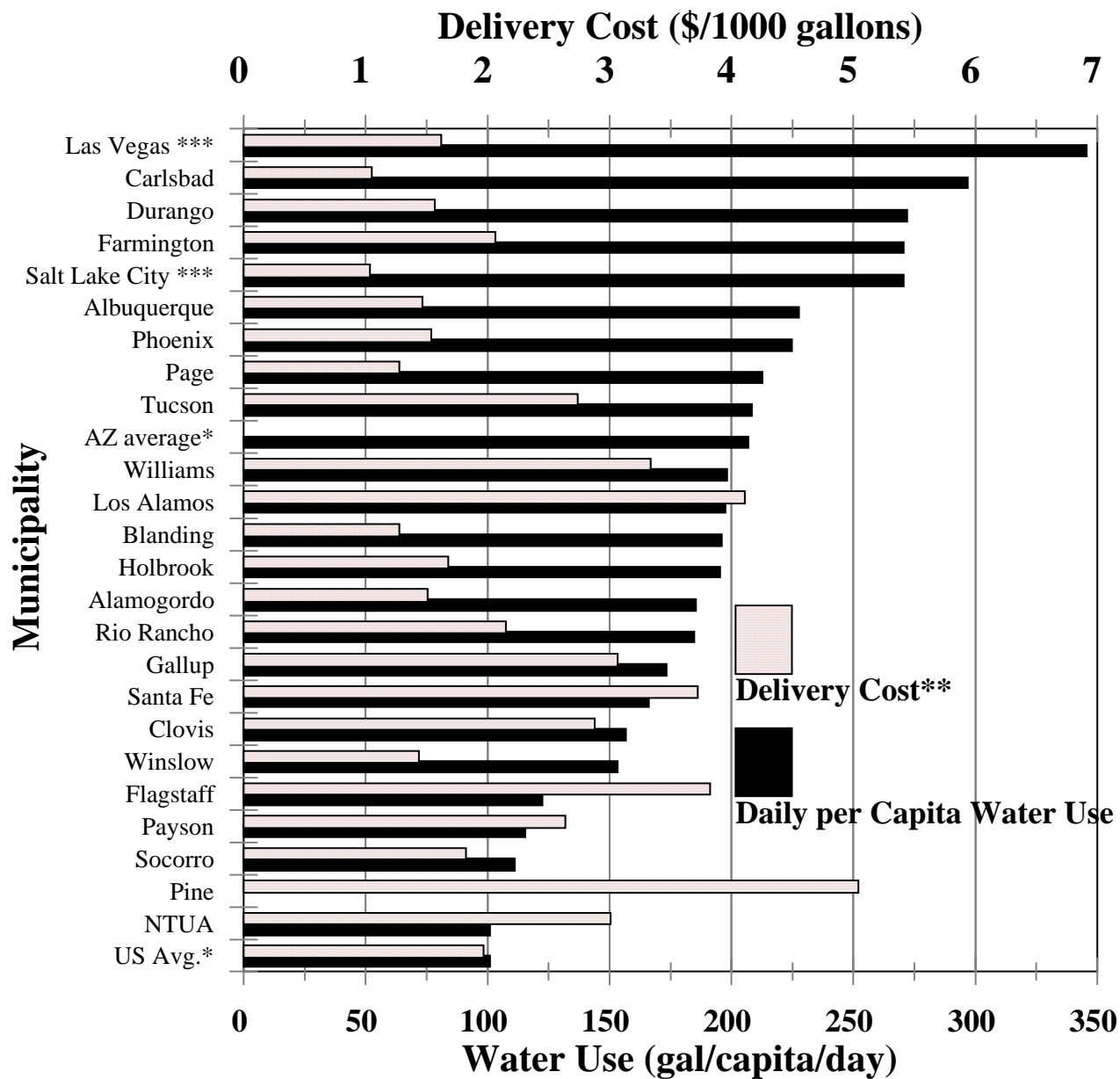
Current annual municipal water production on the Navajo reservation is approximately 15,000 acre-feet. Assuming that the economic and social condition can be improved, and that out-migration can be reduced, by the year 2040 the population of the Navajo Nation is projected to be approximately 500,000. If the disparities in water use between the Navajo people and the rest of the Nation can be reduced, the total annual municipal water demand on the reservation will exceed 89,000 acre-feet. This demand may require a sixfold increase in system capacity. Overcoming the legacy of economic neglect and the readily apparent deficits in infrastructure will require a very aggressive water development program.

The funds needed to build the core delivery components of the large regional water projects may be partly met through settlements of the Navajo Nation's water rights. However, a concurrent and coordinated effort is needed to meet the needs that the regional water projects do not meet. This coordinated effort will require the skills and special expertise of several federal agencies and tribal departments. This Plan of Action is presented as the conclusion of this document.

Figure 2.1 : Map of the Navajo Nation

Figure 2.2 : Navajo Nation Chapter map

Figure 2.3 : Regional Water Use and Unit Delivery Costs



* US average per capita from APWA, Arizona average per capita use from USGS Circular 1200, US average water rate from Western States Water Circular #1283.

** Average unit delivery cost for 18,700 gallons per month (25 ft³) for residential use.

*** Salt Lake City and Las Vegas service areas extend beyond city limits. Per capita water use is the reported value, not calculated.

3. WATER RESOURCE MANAGEMENT

The objective of this section is to present an overview of water resources and the existing water resource management on the Navajo reservation.

3.1 Water Resource Overview

The Navajo reservation is bounded by the San Juan River on the north, the Little Colorado River on the south, and the main-stem of the Colorado River on the West. The Navajo lands on the eastern side of the reservation are in the Rio Grande Basin. Largely ephemeral washes emanating on the reservation, such as the Chaco, Rio Puerco, and Pueblo Colorado contribute to the flows of these major river systems. The surface waters of the Navajo Nation are shown in Figure 3.2. For municipal water, the most important aquifers are the Coconino (C) Aquifer, the Navajo (N) Aquifer, and the Dakota (D) Aquifer, the Morrison (M) Aquifer, the Mesa Verde Aquifer, and numerous alluvial aquifers. The wells associated with these aquifers are roughly delineated in Figure 3.1. The rivers, washes, and aquifers constitute the waters of the Navajo Nation which are under the jurisdiction of the Navajo Nation Water Code and are subject to the Navajo Nation's water management.

3.1.1 Groundwater

Groundwater is the most heavily utilized and dependable municipal water source for the Navajo Nation. It is found in three major water bearing formations (see Table 3.1 and Figure 3.1) as well 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.

Table 3.1 : Major Aquifers of the Navajo Nation

Aquifer	Total Storage* (million acre-feet)	Information Source
Coconino	413	ADWR 1989
Navajo	290	USGS 1997a
Dakota	50**	DOI 1993
San Juan Unit	1.18**	NWNMCOG 1994

* Total Storage used instead of recoverable volume because studies on sustainable withdrawals are inconclusive

** Estimated recoverable volume, not total storage volume.

Figure 3.1 : Navajo Nation Groundwater Wells Sorted by Aquifer

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 non-indian communities in the Little Colorado River basin.

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.

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 Two Grey Hills rely on the Mesa Verde Aquifer. The Glorietta Aquifer and the Gallup Sandstone provide water to many of the neighboring non-Indian 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. Dilcon, 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.

3.1.2 Surface Water Hydrology

Surface water sources for the main reservation include the mainstream of the Colorado River, the Little Colorado River, the San Juan River, and ephemeral streams and washes. Surface water development is hindered by a variety of practical and legal constraints. When describing surface water uses the terms diversions and depletions need to be differentiated. A diversion is the withdrawal of water from a surface source. A depletion is the difference between the diversion and any return flows to the surface source. The terms may not be used interchangeably because the volume of water depleted may be less than the volume diverted. Much of the hydrologic accounting in the Colorado River Basin for the “Law of the River” is based on depletions, not diversions. The major rivers are:

- Colorado River
- Little Colorado River

- San Juan River
- Tributary Washes
- Other River Systems

Colorado River - The Western Water Policy Review Commission (Pontius, 1997) reports that the average annual flow of the Colorado River at Lee's Ferry is between 13 and 15 million acre-feet. The Navajo Nation water rights in the mainstream of the Colorado River remain unquantified. For the Navajo Nation, access to mainstream water is limited by legal, physiographic, and environmental factors. These limitations may complicate the ability of the Navajo Nation to fully exercise its water rights even though the date of establishment for the reservation precedes most other users. Significant pumping and pipeline costs may also limit the use of Colorado River water. Another limiting factor is the federally mandated protection of endangered species including the humpback chub, razorback sucker, Colorado pikeminnow (formally known as the Colorado squawfish) and bonytail chub.

Little Colorado River - The Arizona Department of Water Resources (ADWR 1994) estimates the median annual flow of the Little Colorado River at the reservation border is 162,900 acre-feet and the median undepleted flow is 222,450 acre-feet. The erratic flow regime and high sediment load of the Little Colorado River create challenges to water development. Ongoing water rights negotiations may result in funding for critical tribal water development in this basin.

San Juan River - According to reports from the San Juan River Recovery Implementation Program (Holden, 1999) the median annual flow of the San Juan River at Bluff, Utah is 1,620,000 acre-feet. The Navajo Nation has the paramount water claim from the San Juan River, but these water rights are unquantified. A limiting factor for water development in this basin is the protection of the endangered Colorado pike minnow and the razorback sucker. The presence of these species may reduce the water availability for the Navajo Nation and may restrict future development.

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 the 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.

Figure 3.2 : Surface Waters of the Navajo Nation

3.1.3 Surface Water Storage

The reservoirs on the Navajo Nation provide storage for irrigation water, recharge to the alluvial systems that the Navajo Nation relies on for domestic water supply, critical wildlife habitat, and recreation. A search of the NDWR data identified more than 20 significant storage facilities. A reservoir was considered significant if it has a surface area greater than 200 acres, is included in the NDWR Plan of Operation, or is stocked by the Navajo Department of Game and Fish. The lakes and reservoirs have a combined surface area greater than 8,000 acres and a combined storage capacity greater than 100,000 acre-feet. These facilities are presented in Table 3.2.

Table 3.2 : Significant Reservoirs on the Navajo Reservation

NAME	ACRES	NAME	ACRES
Asaayi	37	Juans Lake	343
Antelope Lake	9	Long Lake	397
Aspen Lake	9	Many Farms Lake	1,000
Beeline Reservoir	213	Morgan Lake	1,228
Berland Lake	8	Red Lake	1,100
Blue Canyon	100	Red Lake	502
Bluewater Lake	609	Round Rock Lake	84
Canyon Diablo	470	Todacheene Lake	100
Captain Tom Reservoir	75	Trout Lake	9
Chevelon Canyon Lake	249	Tsaile Lake	415
Chuska Reservoir	83	Wheatfields Lake	315
Cutter Reservoir	104	Whiskey Lake	100
Ganado Lake	335	Window Rock	10
Greasewood Lake	269	TOTAL	8,173

3.2 Water Resource Management Framework

The Navajo Nation operates under a three-branch governmental structure including the Executive, Legislative and Judicial Branches (see Figure 3.3). The Executive Branch operates under the direction of an elected president and vice-president. Within the Executive Branch, two divisions, the Navajo Nation Division of Natural Resources (see Figure 3.4) and Navajo Nation Environmental Protection Agency (NNEPA), manage the Navajo Nation's water resources. The executive directors of these programs are appointed by the President of the Navajo Nation. These programs are described in more detail in sections 3.2.1 and 3.2.2.

Figure 3.3 : Navajo Nation Organizational Chart

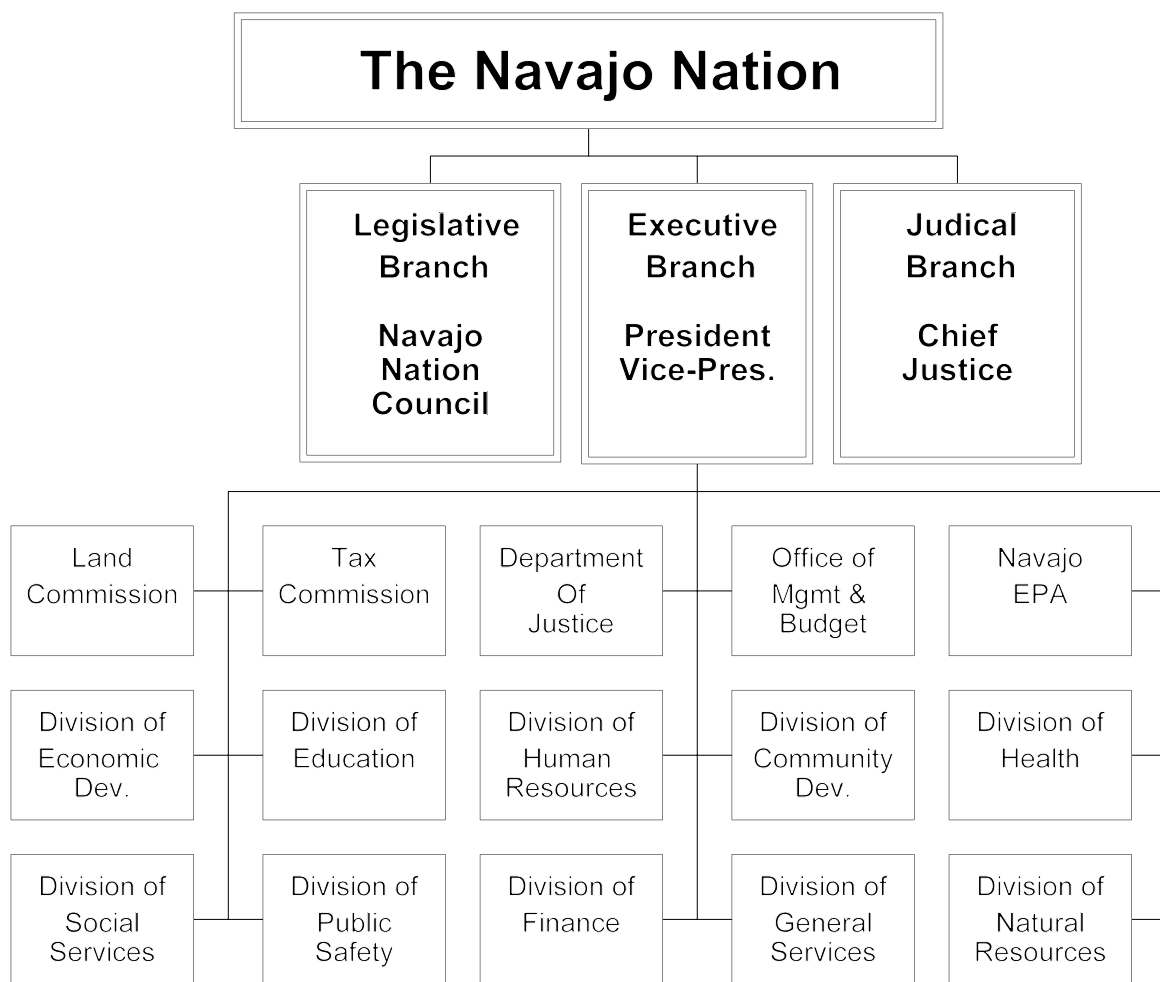
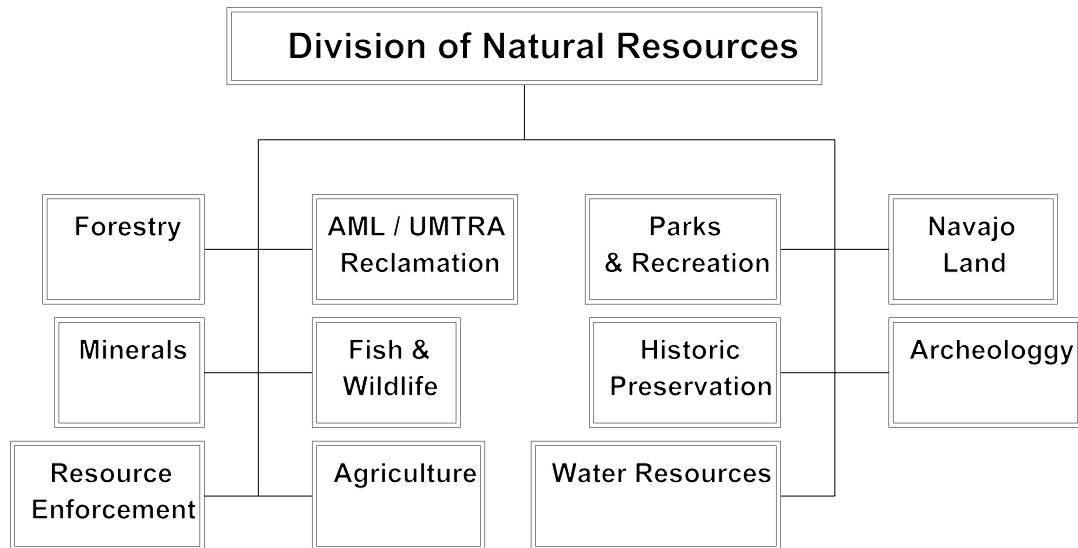


Figure 3.4 : Navajo Nation Division of Natural Resources Organizational Chart

The 88-member Navajo Nation Council was established in 1938 and represents the 110 Chapters of the Navajo Nation. The Legislative Branch has 12 standing committees, including the Resources Committee. The Resources Committee consists of eight members of the Navajo Nation Council and represents the Navajo Nation. The Resource Committee works in cooperation with the President of the Navajo Nation and the Intergovernmental Relations Committee of the Navajo Nation Council, on proposed legislation or actions affecting resource issues, natural resources development and research and energy resources. The Resources Committee also provides legislative oversight authority for the Division of Natural Resources, District Grazing Officers, Eastern Navajo Land Board and Farm Boards, and over all matters affecting Navajo resources.

The purpose of the Resources Committee is to insure the optimum utilization of all resources of the Navajo Nation and to protect the rights, interests, and freedoms of the Navajo Nation and people to such resources. The Resources Committee is authorized to delegate to appropriate Executive Branch officials within the Division of Natural Resources, the authority to adopt resolutions, regulations or policies affecting the natural resources of the Navajo Nation, to oversee and regulate all activities within Navajo Nation lands, and to issue the cease and desist orders and/or assess fines for violations of its regulations and orders. The Resources Committee must approve all regulations governing the designation and use of the Nation's natural resources, water development projects, land leases and land withdrawals for acquisition of rights-of-way. Council Resolution CN-72-92 further describes the Resource Committee plan of operation.

3.2.1 Navajo Nation Department of Water Resources

The Navajo Nation Department of Water Resources (NDWR) is the primary department within the Navajo Nation Division of Natural Resources responsible for water resources. The NDWR (see Figure 3.5) operates under the direction of the department director and is composed of:

- Dam Safety Branch
- Operation and Maintenance
- Technical Design and Construction Branch
- Water Code Administration
- Water Management Branch

Dam Safety Branch - With a staff of approximately 22, the Dam Safety Branch is responsible for overseeing construction repairs on unsafe dams, providing general maintenance and monitoring of existing dams, surveying and land withdrawal, and developing safety plans, emergency action plans, and early warning systems. The monitoring programs include staff gages to measure water levels, pizometers to measure uplift pressures, and weirs to measure outflow and seepage losses. The Dam Safety Branch operates under a P.L. 93-638 contract with the BIA Safety of Dams program. The Dam Safety Branch relies on the BIA for funding. In recent years the BIA has provided \$300,000 of funding annually. However, the annual operating expenditures are approximately \$800,000. The difference has been paid for by rapidly diminishing carryover funds from past years.

Operation and Maintenance Branch - The Operation and Maintenance Branch, with a staff of 58, is responsible for operating 27 public water systems, eight irrigation projects, and more than 900 windmills. This branch has an annual operating budget of \$2.1 million. These funds come almost entirely from Tribal General Funds.

Technical Design and Construction Branch - The Technical Design and Construction Branch has a staff of 44. The Technical Design and Construction Branch is responsible for planning, designing, constructing, and rehabilitating water facilities for livestock, domestic, and irrigation including wells, pipelines, dams, erosion control structures, irrigation systems, diversions, water storage tanks, and stock-ponds. This branch provides well drilling and construction support for the NDWR facilities. This branch maintains construction equipment to support construction, mechanical repair, and transportation services for NDWR. The annual operating budget of \$2 million is from a P.L. 93-638 contract with the BIA, Tribal General Funds, and several community block grant programs.

Water Code Administration - The Navajo Nation Water Code was adopted by the Navajo Nation Council in 1984. Through water use permitting, the NDWR Water Code Administration quantifies and accounts for the beneficial consumption of water within the Navajo Nation. Permitting ensures that water is available for newly permitted water uses and that new water users do not conflict with existing and traditional water users. Through water well permitting the NDWR collects and analyzes data on the groundwater aquifers of the Navajo Nation. This data and its analysis are essential for monitoring the short term and long term aquifer trends. The NDWR also facilitates future groundwater development by providing geohydrologic information. The Water Code Administration is responsible for administering a water use fee structure that balances the need for

protecting and managing the water resources with the needs of a robust business environment. The Water Code has a permanent staff of three and an annual budget of \$160,000.

Water Management Branch - The Water Management Branch (WMB) is responsible for monitoring the Navajo Nation’s water resources, protecting its water rights, restoring its watersheds and managing its water resources. This branch has a staff of 25 and an annual operating budget of \$1.9 million. The WMB maintains water resource databases and provides hydrologic information needed to serve the interests of the Navajo people. The WMB maintains networks of monitoring wells, stream gages, weather stations, and snow survey courses (see Table 3.3 and Figure 3.6). These networks require a technical staff to collect, reduce, analyze, and distribute the data.

Figure 3.5 : Navajo Department of Water Resources Organizational Chart

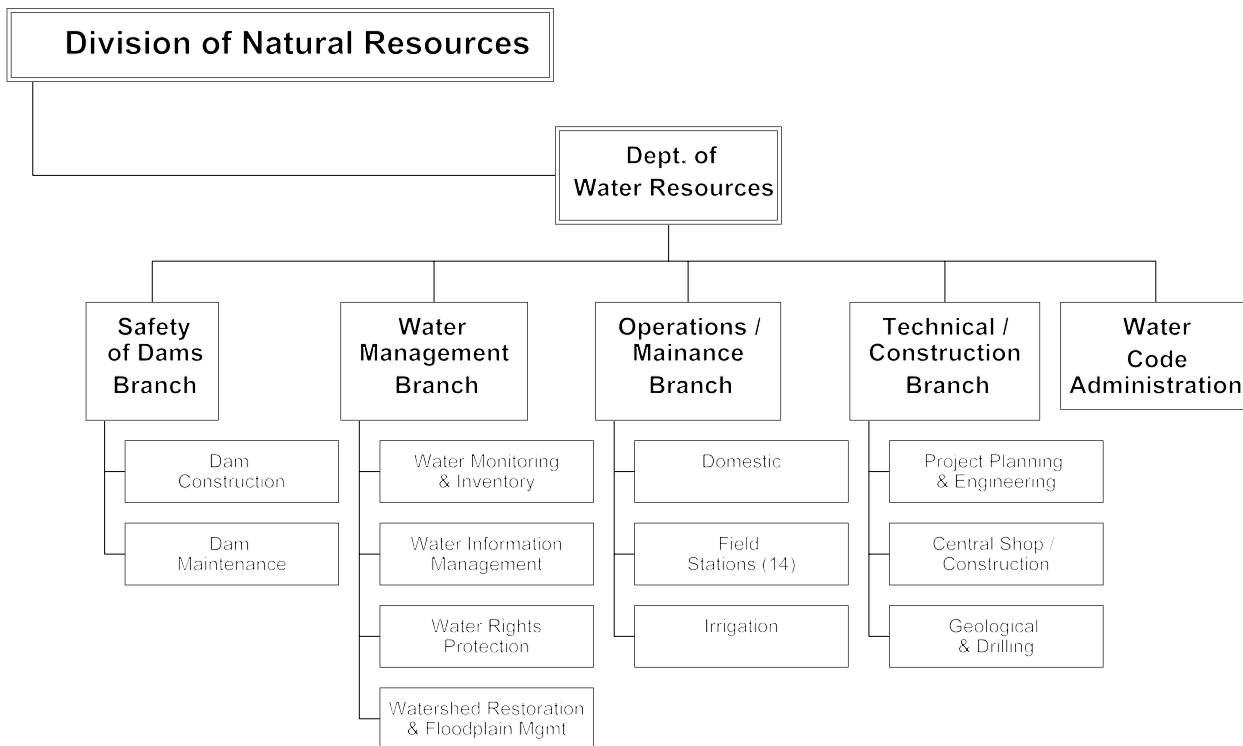


Figure 3.6 : Navajo Nation Water Monitoring Networks

Table 3.3 : Hydrologic Monitoring Networks Operated by the Navajo Nation

Network	Active Stations May 1999
Stream Gaging Stations	9
Automated Weather Stations	19*
Recording Rain Gages	20*
Snow Courses	9*
Monitoring Wells	200
Precipitation Storage Gages (Rain cans)	137*

*The Navajo Nation climate data supplements 149 weather stations on the reservation operated by the National Weather Service.

The WMB is committed to meeting the USGS and National Weather Service (NWS) standards in terms of station configurations, data reduction protocols and accessibility. The data is processed and stored in databases at the WMB and incorporated into the existing Geographic Information System database. This database consists of more than 200 coverages and may be used to analyze crop water requirements, drought response, reservoir operations and flood plain management. The WMB also maintains a library with more than 6,000 water resource related publications.

In addition to the hydrologic monitoring networks, the WMB maintains an extensive database of groundwater well information, which is the primary data resource for groundwater information on the Navajo Nation. This database includes more than 8,000 well records (see Figure 3.1). The Water Code Administration provides data on new wells based on the information documented in the well drilling permits and the water use permits. The information in the well database can be displayed in an ARCVIEW format for local residents and agencies interested in drilling new wells or studying groundwater trends.

According to NDWR's five year operating plan, problems common to all of the NDWR branches include:

- Inadequate and declining tribal general revenue funds
- Little or no reinvestment of water revenues for water related projects
- Antiquated infrastructure and equipment without replacement funding
- Ineffective or inefficient utilization of outside agency funding and expertise
- Poor project coordination with other departments and outside agencies
- Inadequate professional and support staff causing project inefficiencies and delays, poor enforcement, and inability to meet the growing needs of water resource management on the reservation

3.2.2 The Navajo Environmental Protection Agency

The Navajo Environmental Protection Commission was established in 1972. In 1995 the Navajo Nation Environmental Protection Agency (NNEPA) became a separate regulatory entity within the Executive Branch of the Navajo Nation government. The NNEPA is charged with protecting human health, welfare, and the environment of the Navajo Nation. In April 1995 the Navajo Nation Council passed the Navajo Nation Environmental Policy Act which provides guidance for NNEPA and instills the Navajo philosophy regarding the protection of Mother Earth. The mission of NNEPA is as follows:

With respect to Dine values, protect, preserve, and enhance our Navajo environment for present and future generations by developing, implementing and enforcing strong environmental laws; and to foster public awareness and cooperation through education.

The Navajo Nation has also enacted the Navajo Nation Clean Water Act, Water Quality Standards, and Discharge Elimination System Program. The NNEPA has a staff of approximately 70 are organized in three departments including: Surface and Groundwater, Waste Regulatory Compliance, and Air and Toxics. The Surface and Groundwater Department manages the National Pollution Discharge Elimination System, Public Water System and Underground Injection Control Programs. The NNEPA has an application pending with USEPA Region 9 for the delegation of regulatory authority.

3.2.3 The Navajo Tribal Utility Authority

The Navajo Tribal Utility Authority (NTUA), created in 1966, is the largest public water purveyor in the Navajo Nation. The mission of NTUA is to provide its customers with electricity, natural gas, water, wastewater treatment and related services at competitive prices while contributing to the economy of the Navajo Nation, consistent with the improvement of the health and welfare of the residents of the Navajo Nation and the employment of the Navajo people. NTUA, under the direction of the management board, operates as a tribal enterprise under the oversight of the Navajo Nation's Economic Development Committee. Utility prices are determined by an operating tariff set by the board and ratified by the Resources Committee. Utility prices apply reservation-wide without regard to the specific system operation and maintenance costs incurred.

NTUA has five district offices throughout the reservation and operates on an annual budget of \$63 million (including electricity, water, gas and wastewater) and employs approximately 550 people, predominantly tribal members. NTUA operates and maintains 93 public water systems, including 1,300 miles of water lines, 24,000 water connections, and 12,000 wastewater connections, delivering more than 12,000 acre-feet of residential water and 3,300 acre-feet of commercial water annually. NTUA water systems serve approximately 55 percent of the on-reservation population.

3.3 Cooperating Federal Agencies

Federal agencies provide critical assistance in the form of expertise and funds for the water resource development on the Navajo Nation. These agencies include:

- Indian Health Service (IHS)
- U.S. Department of Agriculture (USDA)
- U.S. Bureau of Indian Affairs (BIA)
- U.S. Environmental Protection Agency (EPA)
- U.S. Army Corps of Engineers (Army Corps)
- U.S. Bureau of Reclamation (Reclamation)

Congress does not provide any single agency with adequate resources to meet the entire water resource needs of the Navajo Nation. In spite of the efforts of these agencies, the financial and technical resources available are inadequate to meet the enormous challenges. This situation is complicated by the size and geography of the Navajo Nation which creates splintered jurisdictional areas within most of the agencies, making effective outreach to the Navajo Nation more difficult. For example, Reclamation maintains at least seven offices with some level of responsibility for the reservation. Additionally, policies and programs from one agency to another are often inconsistent. To overcome these financial, technical, and jurisdictional challenges, innovative partnership strategies are being forged between the Navajo people, the Navajo Nation, and the various federal agencies. These partnerships will more effectively utilize existing resources, and better align agency policies and programs. These agencies are described in the following sections.

3.3.1 Indian Health Service

The IHS has authority (P.L. 86-121) to provide essential water supply and storage facilities for communities and homes on the reservation. The IHS program targets potable water for domestic purposes. The 1999 sanitation deficiency list includes 785 water, waste water and solid waste projects with a cost of more than \$380 million. At current funding levels, IHS has a twenty-year backlog of projects. This list will continue to grow, placing an even larger burden on IHS and the Navajo Nation to meet the need for domestic water. Due in part to limited funding, for systems that do have the priority and receive funding, IHS will typically design for a demand of only 100 gallons per capita per day. This rate is approximately one half of the non-Indian per capita use in Arizona.

Under its current authorization, 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 often forced to carry the technical and financial burden of developing their own water supplies which is very expensive. 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 a water supply can only be addressed by creating an adequate water infrastructure. IHS is well positioned to leverage additional funds through cooperative efforts with tribal programs and other federal agencies.

3.3.2 U.S. Department of Agriculture

The USDA provides several rural water development programs. These programs provide grants and loans to qualifying domestic water purveyors. Several of these programs fund circuit riders who assist small water users associations to comply with Safe Drinking Water Act standards and provide technical assistance to improve operation and maintenance. These programs are overwhelmed by the needs that they are designed to address. Even under the best of circumstances these programs are very competitive. In addition, due to cost sharing requirements and other program constraints, many of the Navajo systems and Navajo water users fail to qualify.

P.L. 566 authorizes the USDA to design and implement small watershed restoration programs. Through this authority the Natural Resources and Conservation Service (NRCS) is able to staff a field office in St. Michaels, Arizona. One such restoration program on the Navajo Nation is the Asaayi Watershed Restoration Plan. The NRCS conducted a reservation-wide ranking process. Based on the outcome of that ranking process, a watershed restoration plan was prepared. This plan includes minor improvements to Asaayi Dam. It also includes structural and nonstructural treatments upstream from Asaayi Dam. These treatments will extend the life of the dam, improve the quality of the water, and restore riparian areas.

Another important authorization is the USDA Environmental Quality Incentive Program (EQIP). This program provides support to the priority projects of the five soil and water conservation district offices on the reservation. EQIP funds have assisted irrigators on the Ganado, Red Willow, and Shiprock irrigation projects with on-farm water conservation improvements.

The Navajo Nation has also applied for assistance under the USDA's Enterprise Zone program. Under this program qualifying areas can attain significant funding to address infrastructure and institutional needs. The areas that qualify have been identified as having special economic needs. In 1999, the Navajo Nation failed to gain enterprise zone status. However, several Navajo communities have gained status as enterprise communities. This status may result in improved access to USDA rural water development programs. The Navajo Nation has also applied for assistance from the USDA drought relief programs.

3.3.3 Bureau of Indian Affairs

Institutionally, the BIA represents the federal government's trusteeship on Indian reservations. The BIA administers its programs through the Navajo Regional office in Gallup, New Mexico, and five agency offices in Fort Defiance, Crownpoint, Shiprock, Tuba City, and Kayenta. Given its broad responsibility, the BIA's authorization can be interpreted to address every aspect of life on an Indian reservation. With respect to water the BIA has programs addressing unsafe dams, irrigation projects, environmental protection, natural resources, water rights, water planning and development, among others. Pursuant to the Indian Self Determination and Education Assistance Act (P.L.93-638), the responsibility of implementing many of these BIA programs has been delegated to the various tribes. Under this public law the BIA retains the residual trust responsibility and the tribes are encouraged to assume as much day-to-day programmatic responsibility as possible.

With respect to water resources, P.L. 93-638 has resulted in the expansion of tribal programs with a commensurate decline in the BIA's role. On the positive side, this change has brought the day-to-day decision making and accountability closer to the Indian community that the BIA and tribal governments serve. However, one result of this public law is that the technical expertise that the BIA once offered has significantly diminished, and what is available is shared by a larger number of tribal clients. This situation has resulted in a need for tribal programs to seek out technical assistance from federal agencies that have not traditionally had a significant role in Indian water development. Reclamation is a case in point. Reclamation has retained a high concentration of technical specialists in a wide range of water resources areas including design and construction that, provided adequate funding, can be utilized on a reservation. As a practical matter, it is very difficult for tribal programs to retain a large number of technical specialists, and they are often better served by tapping existing expertise offered by the federal agencies.

The most critical limitation to the BIA's role as a trustee is the overall lack of available resources. Several of the BIA's most important responsibilities have been under resourced for many years. For instance, the BIA has operational responsibility for irrigation projects throughout Indian country. However, years of deferred maintenance, primarily due to inadequate federal appropriations, have resulted in a maintenance deficit of hundreds of millions of dollars. This deficit makes it very difficult for the Navajo Nation, or any tribal community, to secure the resources it needs to adequately address problems. The BIA annually reviews the unmet needs on Indian reservations across the country, and every year the needs far outstrip the available resources. Consequently, new strategies and partnerships are needed to address these critical water resource problems in a timely manner.

3.3.4 Environmental Protection Agency

The EPA is authorized by the Clean Water Act to address non-point pollution concerns on the Navajo Nation. The EPA is also authorized by the Safe Drinking Water Act to monitor the water quality of public water supply systems. Recent EPA grants targeting Indian communities may become available to improve the Navajo Nation drinking water systems.

3.3.5 U.S. Army Corps of Engineers

The Army Corps is authorized by Congress to provide flood protection, environmental stewardship, and to construct civil works. The Navajo Nation spans three Army Corps districts with area offices in Los Angeles, San Francisco, Sacramento, Phoenix, and Albuquerque. Under authority of Section 206 of the Flood Control Act of 1960 through the Flood Plain Management Services Program, the Army Corps has prepared more than twenty flood plain studies on the reservation. However, although a great deal of flooding occurs on the Navajo Nation, no federally sponsored flood control projects using Army Corps authority have ever been constructed. The Army Corps, NDWR and other federal agencies prepared a Navajo Nation Comprehensive Watershed Management Plan of Study. Section 520 of the Water Resources Development Act of 1999 updated the Army Corps authorization to include a broader range of Army Corps expertise in conducting flood management

work on the Navajo reservation, and authorized \$12 million for this work. The Navajo Nation and the Army Corps are refining a work plan to carry out this work. The first phase will generate Probable Flood Prone Area Maps, delineate 100-year flood plain maps for seven growth areas on the Navajo Nation, and preparing a flood design manual.

3.3.6 Bureau of Reclamation

The mission 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." To achieve its mission, Reclamation has several programmatic authorizations to assist with regional and tribal water development needs. These programs include: water conservation and management, wastewater treatment and reuse, drought contingency planning and related assistance, Technical Assistance to States and Tribes, and Native American Technical Assistance. However, these authorizations generally do not provide significant funds for construction. Construction projects typically require specific congressional authorization.

The Navajo Nation spans both the Upper Colorado and Lower Colorado Regions. Reclamation Regional Offices are located in Salt Lake City, Utah and Boulder City, Nevada respectively. Programmatic responsibilities are generally delegated to the area offices. For the Upper Colorado Region, these Area Offices are in Provo, Durango (Western Colorado), and Albuquerque. In the Lower Colorado Region the Area Office is in Phoenix. The Farmington Construction Office in the Upper Colorado Region has been delegated significant responsibilities including construction of the Navajo Indian Irrigation Project and the construction associated with the BIA's Safety of Dams program. Staff at the Phoenix Area Office and the Farmington Construction Office have been designated as principal points of contact for the Navajo Nation for the Lower Colorado Region and the Upper Colorado Region respectively.

4. EXISTING WATER USES

The lack of water infrastructure, the lack of economic development, and the sustained poverty on the Navajo Nation are connected. The low per capita water use is part of a larger pattern reflecting a lower economic standard of living compared to the non-Indian communities in the region. The fact that the mean income of Navajo families is below the poverty line can be attributed, in large part, to the lack of water supplies within the reservation. Consequently, the current rates of water use are much less than the current water demand. The Navajo Nation recognizes a variety of beneficial water uses. This section presents an overview of the larger water uses of the Navajo Nation based on the following five water use categories. Ceremonial uses are beyond the scope of this document.

- Domestic and municipal
- Commercial
- Agricultural
- Mining and industry
- Recreation and wildlife

4.1 Domestic and Municipal Use

According to the NNEPA, in 1998 there were 237 public water supply systems on the Navajo reservation with approximately 29,000 connections (see Table 4.1). The majority of these systems rely on groundwater. NTUA is the largest supplier of domestic and municipal water on the Navajo Nation and operates 93 public water systems with more than 1,300 miles of water lines (see Figure 4.1), supplying more than 12,000 acre-feet of residential water and 3,300 acre-feet of commercial water per year. Assuming four people per household connection, NTUA serves approximately 96,000 people, most of whom are on the reservation. The largest NTUA system with 2,800 connections is the Window Rock system which serves the communities of Fort Defiance and St. Michaels. In 1996 NTUA estimated that this water system had an undepreciated value of \$210 million, a large percentage of which is nearing the end of its design life.

Another 5,000 connections are provided by a variety of smaller operators. The NDWR operates 27 public water systems that are largely subsidized by Tribal General 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. In addition to these systems, the BIA operates 56 water systems, almost all of which are associated with BIA schools and school-related housing. Approximately 50 smaller systems are operated by missions, trading posts, and private commercial operators. Assuming that half of these connections are primarily for residential users, these small operators serve approximately 10,000 people and deliver approximately 1,000 acre-feet per year.

Per capita water use on the Navajo reservation varies depending on the accessibility of the water supply. Billing data from NTUA indicates that the average water use on the NTUA systems is

approximately 100 gallons per person per day. According to the data from other metered systems by the IHS, water use on the non-NTUA systems ranges from 20 to 100 gallons per person per day.

Figure 4.1 : NTUA Water Supply Systems

It is estimated that the public water systems on the Navajo reservation serve approximately 110,000 people, or only 60 percent of the population. In a 1981 water resource report by Morrison Maierle Inc., the per capita water use for the 40 percent of homes without running water is estimated to be 10 gallons per day. This same rate of water use is cited in *Estimated Use of Water in the United States* (Murray, Richard C., USGS Circular 556, 1965). These water haulers create additional demands on the public water systems that maintain public water taps. A 1993 Northwest Economic Associates study evaluated the cost of water hauling on the reservation. The study concluded that families that haul water for domestic purposes spend the equivalent of \$22,000 per acre-foot compared with \$600 per acre-foot for a typical suburban water user in the region.

Table 4.1 : Navajo Reservation Public Water Supply Systems (1998)

Operator	Number of Systems	Number of Connections
Navajo Tribal Utility Authority	93	23,700
Navajo Department of Water Resources	27	767
U.S. Bureau of Indian Affairs	56	2,535
School Districts	12	644
Missions	7	193
Chapters	16	592
Trading Posts	11	146
Miscellaneous & Commercial	15	212
Total	237	28,789

Source: Navajo Nation Environmental Protection Agency Inventory, 1998

Historic data demonstrates that water use for non-Indian communities have generally increased over time and is presently about 206 gallons per capita per day in Arizona. This rate compares to a current average per capita use on the reservation between 10 and 100 gallons per day. This disparity in per capita water use can be directly correlated to the lack of community development and the difference in the economic standard of living on the Navajo reservation. If the Navajo people are to achieve a standard of living comparable with neighboring non-Indian communities, it must reassess future water demand on the reservation and explore options for providing adequate water to its people.

4.2 Commercial Use

In addition to residential water, NTUA provides approximately 3,300 acre feet of water to more than 200 commercial users, the non-NTUA systems provide more than 500 acre-feet, and NAPI uses approximately 2,000 acre-feet for food processing (see Table 4.2). The smaller commercial and industrial water users support critical services and contribute jobs and economic opportunities on the reservation. These small business users are an important component of the Navajo Nation's economy. Construction contractors use an additional 500 acre-feet of water from the NTUA sewage lagoons annually for dust abatement and construction. Special requirements are imposed by the NNEPA for the use of this water.

Table 4.2 : Commercial Water Use on the Navajo Nation (1995)

Description of Water Use	Annual Water Use (Acre-feet)
NTUA System Use	
Institutions	1,571
Miscellaneous	433
Government Offices	327
Construction	5
Trading Posts	46
Commercial	929
Sub-Total	3,311
Non-NTUA System Use	
Institutions	225
Government Contractors	150
Trading Posts	46
Commercial	75
Construction	74
Sub-Total	570
NAPI	
Food Processing	2,240
Contractors	55
Industrial	0
Sub-Total	2,295
Sewage Lagoons	519
TOTAL	6,695

Source: Navajo Nation Water Code Administration, 1995

The difficulty and expense of securing reliable water present significant obstacles for businesses operating on the reservation. To overcome these and other obstacles, the Navajo Division of Economic Development (NDED) has created incentives for economic development on the reservation. The NDED has identified economic growth centers which are focal points for infrastructure development, including water, to support new businesses (see Table 4.3 and Figure 4.2). Economic growth centers are communities with large populations and the potential to benefit from an economy of scale in infrastructure development.

Economic development of the growth centers has been bolstered by the passage of the Navajo Nation Local Governance Act in 1996. This legislation grants Chapters authorities similar to those of off-reservation municipalities. For example, local Chapters are encouraged to develop local land-use planning, zoning, taxation, bonding, revenue generation, ordinances, business site leases, and

infrastructure. The Chapters should now respond to problems and opportunities at a local level creating significant economic growth potential.

Table 4.3 : Economic Growth Centers for the Navajo Nation

Growth Centers	Current and Planned Development
Alamo	Commercial
Cameron	Tourist/Commercial/Industrial Development
Canoncito	Commercial
Chambers/Sanders	Commercial/Residential Development
Chinle	Industrial Park/Housing Authority Projects
Church Rock	Two Industrial Parks
Crownpoint	Industrial Park
Dilcon	Commercial
Ganado	Tourist/Commercial/Industrial Development
Kayenta	Commercial Growth/Retail and Services
Leupp	Industrial Park/Community Housing
Many Farms	Commercial development
Navajo	Commercial/ Sawmill
Ojo Amarillo (NAPI)	Commercial/Residential/Industrial
Pinon	Commercial/Residential Development
Ramah	Commercial
Shiprock	Industrial Park, Commercial
Tohatchi	Commercial / Tourist Development
Tsaile	Commercial Development
Tuba City	Industrial Park
Window Rock/Fort Defiance	Industrial Park/Government Facilities

Source: Navajo Nation Division of Economic Development, 1998

Figure 4.2 : Economic Growth Centers for the Navajo Nation

4.3 Agricultural Water Use

Agriculture has always played an important role in the culture and economy of the Navajo People. The three main categories of agriculture water use are:

- The Navajo Indian Irrigation Project
- Small Irrigation Projects
- Livestock

4.3.1 The Navajo Indian Irrigation Project

The Navajo Indian Irrigation Project (NIIP) was jointly authorized with the San Juan Diversion in 1962 through Public Law 87-483. This public law authorized the Secretary of the Interior to construct, operate, and maintain NIIP for the principal purpose of furnishing irrigation water to approximately 110,630 acres of land. NIIP consists of the initial land development, water distribution system, water delivery, roads, and other infrastructure. NIIP has a 1956 State Water Use Permit for 640,000 acre-feet and a 1974 contract with the Secretary of the Interior to divert 508,000 acre-feet of water. The boundaries of NIIP are shown in Figure 4.3.

In 1970 the Navajo Nation created the Navajo Agricultural Products Industry (NAPI) to run the agricultural business venture and oversee the operation of NIIP. NAPI is a tribal business enterprise, created to develop, farm, and operate the NIIP lands, and to operate and maintain the NIIP water delivery system. NAPI produces a variety of crops including corn, potatoes, alfalfa, and pinto beans. Its crops are marketed throughout the United States, Mexico, and international markets using the "Navajo Pride" trademark. NAPI provides approximately 250 permanent jobs and 800 seasonal jobs. Subcontractors, joint venture partners of NAPI, and independent truckers employ additional workers. NAPI channels \$55 million annually into the Navajo Nation economy.

In 1999 NAPI farmed 64,000 of the planned 110,630 acres which is only 60 percent of the authorized project. Based on current funding levels, it will take more than 18 years to complete NIIP. This slow completion rate delays the time when NIIP can provide all of the benefits that are envisioned. A revised completion schedule which would complete NIIP by 2012 has been developed by Reclamation, NAPI, and the BIA. Ultimately, NAPI may create more than 3,000 jobs as a vertically integrated corporate farm and provide a significant impact on the regional economy.

According to NIIP's recent 1999 Biological Opinion, with a unit depletion of 2.4 acre-feet per acre, NIIP will divert 360,000 acre-feet and deplete 270,000 acre-feet of San Juan River water per year when completed. In 1999 NIIP diverted 192,000 acre-feet, and depleted 156,000 acre-feet of San Juan River water. The vast majority of this water was directly used for irrigation. Other uses include approximately 2,240 acre-feet of water per year for food processing and 55 acre-feet per year for NIIP related construction activities. Most of the food processing water use is for cleaning produce.

Figure 4.3 : Navajo Indian Irrigation Project (NIIP)

4.3.2 Small Irrigation Projects

More than 400 years ago Navajos irrigated fields near the San Juan River and other places where the water supply was adequate. Three types of Navajo irrigation have been described: intercepting flood waters on land advantageously located on alluvial flood plains along the perennial and intermittent washes, diking flat lands so that spring floods can be retained on the land, and diverting water from perennial and intermittent streams through irrigation ditches to the fields. This document only addresses this last category of irrigated agriculture.

In 1994 the federal government amended the Little Colorado River Basin claims on behalf of the Navajo Nation. The amended claims for the Little Colorado River Basin included more than 60,000 acres of historically or recently irrigated land. Assuming that the entire reservation has a similar distribution of irrigated land, there may be 180,000 acres of recently or historically irrigated on the Navajo reservation.

Between 1910 and the late 1950's the U.S. Government built and expanded dozens of irrigation projects. In 1960, pursuant to Public Law 86-636, Congress transferred title and operation and maintenance responsibilities for the Navajo irrigation projects from the BIA to the Navajo Nation. In 1986 the NRCS conducted an inventory of irrigation projects across the reservation. The NRCS investigated 83 irrigation projects to determine existing conditions, consolidate resource data, and prioritize projects for possible rehabilitation. The NRCS determined that by 1950 these small projects irrigated 46,219 acres of land (see Figure 4.4). Since that time, due to inadequate management and inadequate funding for operation, maintenance and replacement, these systems have deteriorated. In 1986 only 16,670 acres, or 27 percent of the original project area, were farmed (NRCS 1986). However, the production from these projects is still important to the Navajo Nation. In 1989 Colorado State University estimated that the personal income from traditional agricultural crops was approximately \$2 million. Seven of the largest irrigation projects are specifically addressed by the NDWR Plan of Operation and include approximately 20,000 acres (see Table 4.4).

Table 4.4 : Irrigation Projects Operated by the NDWR

Irrigation Project	Project Land (Acres)	Annual Water Demand (Acre-feet)
Hogback	9,223	46,115
Fruitland-Cambridge	3,830	19,150
Cudei	627	3,135
Many Farms	2,000	10,000
Red Lake	1,102	5,510
Tsaile/Wheatfields	920	4,600
Ganado-Cornfields	2,210	11,050
Total	19,912	99,560

Source: SCS Inventory of Navajo Indian Irrigation Projects, 1986

Figure 4.4 : Irrigated Lands on the Navajo Nation (1950)

4.3.3 Livestock

The importance of livestock to the Navajo Nation cannot be overstated. In spite of droughts, harsh winters and fluctuating prices, raising livestock has historically been one of the few economic enterprises which has been successfully managed in the reservation environment. The NDED estimates that the value of cattle on the reservation is \$16 million, the value of sheep is \$3 million, the value of horses is \$625,000, and the value of goats is \$375,000. The total value of livestock exceeds \$20 million. The cultural importance of livestock to the local community goes far beyond its monetary value. Livestock have been integrated into the Navajo lifestyle for many generations.

The water for an estimated 300,000 permitted animal units comes primarily from shallow windmill-powered wells and rain-fed stock-ponds. The NDWR Operation and Maintenance Branch is responsible for the maintenance of approximately 900 windmills throughout the reservation. In 1993 the NDWR estimated that the water supply for livestock from the windmill powered wells was 865 acre-feet per year.

The Little Colorado River 1994 amended claim filed by the Federal Government on behalf of the Navajo Nation identified 2,422 stock-ponds in the Little Colorado River Basin with an estimated water use of 21,000 acre-feet. Assuming that the entire reservation has a similar density of stock-ponds, there are approximately 7,500 Navajo stock-ponds. These water sources are the first to be impacted during drought.

The Navajo Department of Agriculture recently estimated that the range is overstocked by approximately 50 percent. Overstocking adversely impacts water quality and supply, increases erosion and can lead to desertification of Navajo lands. Attempts to improve livestock water supplies should place a high priority on local participation and on the limits of the range to sustain them. As additional water development occurs, the Navajo economy can become more diversified decreasing the economic dependence on livestock.

The feedlot at NAPI raises 12,000 head of cattle which use 600 acre-feet of water annually from the NIIP canals. NAPI anticipates the construction of dairy farm, hog farm, and poultry operations, as well as an expanded feedlot lot for cattle and sheep.

4.4 Mining and Industrial Use

The Navajo Nation hosts a variety of industrial and mining water users, all of which require a reliable water supply. A report from the Auditor General identifies mining as the single most important revenue generating source on the reservation, often producing 75 percent of the total annual general tribal revenues. Regionally, the largest water users are coal mining, oil recovery and power generation, which use a combined total of approximately 158,000 acre-feet of water annually (see Table 4.5 and Figure 4.5).

Table 4.5 : Large Industrial Water Uses (1995)

Description of Water Use	1995 Annual Water Use (Acre-feet)
Coal Companies	
BHP - UII Navajo Mine	see Four Corners Generating Station
Peabody Western Coal Company	4,500
Pittsburgh & Midway McKinley Mine	100
Sub-Total	4,600
Oil Companies	
El Paso Natural Gas	64
Harkens	14
Mobil	844
Sirgo Brothers	14
Texaco	14
US Oil	14
Others	14
Sub-Total	978
Generating Stations	
Cholla Generating Station	13,400
Four Corners Generating Station	35,000
Mohave Generating Station	30,000
Navajo Generating Station	34,100
Plains Electric Generating Station	20,000
San Juan Generating Station	20,000
Sub-Total	152,500
Total	158,078

Source: Water Code Administration (1995)

Figure 4.5 : Large Industrial, Mining, and Commercial Water Uses

4.4.1 Coal Mining

Water is essential for mining on the Navajo reservation. Over the last five years, mining revenues have generated, on average, approximately \$56 million, or 55 percent, of the Navajo Nation's general revenues. In recent years mining revenue exceeded \$60 million. Coal mining generates approximately 10 percent of the annual employment on the Navajo Nation. However, coal revenues are on the decline, having dropped about 30 percent since 1996. The annual water use is presented in Table 4.5.

Peabody Western Coal Company (PWCC) is the largest mining water user on the reservation. The primary source for PWCC water is the N-aquifer. The largest PWCC water use is a slurry line from the Peabody Mine at Black Mesa to the Mohave Generating Station near Laughlin, Nevada. Additional water is used for dust control, construction, coal washing, reclamation, drinking, sanitation, and sediment ponds. From 1969 to 1993, the average annual water use for PWCC was 3,543 acre-feet (ADWR 1994). In 1993 PWCC used 3,704 acre-feet of water, which was 56 percent of the total withdrawal from the N-aquifer. PWCC also uses more than 100 surface water impoundments located on the PWCC lease.

Broken Hill Properties, Inc. (BHP), formerly Utah International, has a New Mexico State water permit and a Reclamation contract from Navajo Reservoir to divert 44,000 acre-feet of water and deplete 35,000 acre-feet. Most of this water is used for power generation at the Four Corners Generating Station and a portion of this water is used at BHP's Navajo Mine.

The Peabody and Midway Coal Company operates the McKinley mine in New Mexico. Water is used at this mine for reclamation and dust control. In 1995 the Water Code Administration estimated that this mine operation used 100 acre-feet of water.

4.4.2 Oil and Gas Production

SIRGO Brothers, Texaco, Harkens, US Oil, and Mobil use water on the reservation for secondary and tertiary petroleum recovery. In 1995 the NDWR estimated that the oil companies used approximately 900 acre-feet of water (see Table 4.5). Most of this water is non-potable groundwater, which is re-injected into oil-bearing formations. In fiscal year 1998, oil and gas revenues for the Navajo Nation were approximately \$17 million and contributed 20 percent of the Navajo Nation's General Revenue. However, revenues have declined about 40 percent since 1996.

4.4.3 Power Generation

Six power generating stations operate in the vicinity or on the reservation and deplete large quantities of water (see Table 4.5). Although much of this water is addressed by state water user permits or contracts with the Secretary of the Interior, these large users impact the waters of the Navajo Nation. These generators are described in the following sections.

- Cholla Generating Station
- Four Corners Generating Station
- Mohave Generating Station
- Navajo Generating Station
- Plains Electric Generating Station
- San Juan Generating Station

Cholla Generating Station - The Cholla Generating Station is located near Joseph City, Arizona and is operated by Arizona Public Service Company. Cholla Generating Station withdraws 13,400 acre-feet of groundwater annually from the Coconino Aquifer. The cones of depression created by this groundwater withdrawal affect the groundwater supply of the Navajo Nation.

Four Corners Generating Station - The Four Corners Generating Station is primarily owned by the Arizona Public Service and uses water obtained from BHP. BHP has a state water permit to divert 44,000 acre-feet of water and deplete 35,000 acre-feet from the San Juan River. According to U.S. Fish and Wildlife Service reports, the historic water depletion at the Four Corners Station has been approximately 31,000 acre-feet per year. The water is pumped directly from the San Juan River and stored in Morgan Lake.

Mohave Generating Station - The Mohave Generating Station near Laughlin, Nevada is operated by Southern California Edison. The facility has two coal power units and uses coal from the Peabody mine at Black Mesa and consumes approximately 30,000 acre-feet of water annually. Approximately 3,000 acre-feet are recovered from the coal slurry-line feeding the facility and the rest is obtained from contracts for mainstream water from the Colorado River.

Navajo Generating Station - The Navajo Generating Station near Page, Arizona is operated by the Salt River Project (SRP). The facility has three coal power units fired with coal from the Peabody mine at Kayenta and uses water from Lake Powell primarily for its cooling towers. SRP has a contract with Reclamation for 34,100 acre-feet of Upper Basin Colorado River water. The Secretarial contract must be renewed in 2016.

Plains Electric Generating Station - The Plains Electric Generating Station is located near Prewitt, New Mexico east of the Navajo Nation near Mount Taylor. This facility is in the Rio San Jose Basin which is a tributary of the Rio Grande. Plains Electric applied for a State water permit to withdraw 20,000 acre-feet of groundwater from the Glorieta and San Andreas Aquifer. The cones of depression created by this groundwater withdrawal indirectly effects the groundwater supply of the Navajo Nation.

San Juan Generating Station - The San Juan Generating Station is operated by the Public Service Company of New Mexico (PNM) and depletes an average of 20,000 acre-feet of water per year from the San Juan River. PNM has a contract with the Secretary of the Interior for the consumption of 16,200 acre-feet of water per year from Navajo Reservoir. This contract was signed in April 1968, amended in 1976 and 1977 and is up for renewal in 2005. PNM also has a grant of authority under a state permit allowing for the consumption of up to 8,000 acre-feet of water from BHP's water use permit. This 8,000 acre-foot allocation is included within BHP's water permit.

4.5 Recreation Use

The Navajo Nation is well situated to take advantage of numerous recreational opportunities. The Navajo Nation is home to several national parks and monuments including Canyon De Chelly, Chaco Canyon, Hubbles Trading Post, Navajo Nation Monument and Rainbow Bridge, and to Tribal parks including Monument Valley and Asaayi Recreation Area. Other near by attractions include Glen Canyon Recreation Area and Grand Canyon National Park share boundaries with the Navajo Nation. Many of these sites are shown in figure 4.6.

In addition to irrigation and domestic water supply, the Navajo Nation's reservoirs provide important wildlife habitat and recreation. The Navajo Nation Fish and Wildlife Department stocks trout in Wheatfields, Tsaile, Asaayi, Whiskey, Chuska, Trout, Berland, Aspen, Antelope, and Round Rock Reservoirs, and stock catfish in Tsaile, Ganado, Red Lake, Many Farms, Morgan, and Round Rock Reservoirs, and stock bass in Ganado, Red Lake, Many Farms, and Morgan Reservoirs. These lakes and reservoirs are shown in Figure 4.6. The Navajo Nation Fish and Wildlife Department issues more than 13,000 fishing, hunting, and boating permits which generate more than \$500,000 per year, excluding the incidental business revenues. The Navajo Nation Parks and Recreation Department reports that campgrounds and recreational facilities near reservoirs like Asaayi are booked solid from March through October. The Navajo Nation charges of \$2 per person per day for the use of these facilities.

The Arizona Department of Water Resources estimates that one angler day has a value of \$50 and that one acre of surface water has a potential recreation value of \$20,000 per year. If the reservoirs on the Navajo reservation were able to maintain minimum pools of 30 percent of the total surface area, the annual economic return could exceed \$20 million.

Figure 4.6 : Major Lakes, Reservoirs, and Monuments on the Navajo Nation

5. WATER INFRASTRUCTURE DEFICIENCIES

The objective of this section is to document the water infrastructure deficiencies on the Navajo Nation. The water requirements of new irrigation projects; large single purpose industries; and ceremonial uses are beyond the scope of this document. To simplify this presentation the water infrastructure deficiencies have been broken into the following four categories.

- Domestic and Municipal Water Systems
- Water Storage Facilities
- Agricultural Water
- Wastewater Treatment

5.1 Domestic and Municipal Water Systems

The lack of domestic and municipal water is the greatest water resource problem on the Navajo Nation. The water demand in the rural areas has not been adequately met by public water supply systems. Approximately 40 percent of families on the reservation depend on water hauling. No other region in the United States has such a large percentage of its population lacking in such a basic necessity as potable tap water in their homes. A clean, reliable supply of water is basic to human health. In a report to Congress by the Comptroller General dated March 11, 1974 it noted that Native American families living in homes with adequate sanitation facilities required only 25 percent of the medical services required by those living in unsatisfactory environmental conditions.

The IHS annually compiles an annual sanitation deficiency report on the water supplies on the reservation. In 1999 the IHS identified \$297 million in water system deficiencies, \$73 million in sewer deficiencies, and \$12 million in solid waste deficiencies. However, the annual IHS budget is only \$25 million per year. This lack of funding results in a 20 year backlog, and forces the IHS to engage in programmatic triage. For instance, the community water supply system at Navajo Mountain, which desperately needs improvements, ranks poorly on the sanitation deficiency list due to the lack of available of water and the high cost of developing a new water source. The IHS can only commit resources in the communities where water can be developed less expensively. Scarce funding forces the IHS to respond to immediate deficiencies, instead of larger, more efficient multipurpose projects which require longer, multi decade, planning horizons.

An adequate water supply is also a prerequisite for commercial and industrial development on the reservation. The economic problems are compounded because the IHS is not authorized to construct capacity for commercial and industrial users. To meet their needs new businesses must either improve existing systems, or build their own systems.

The NTUA water systems face critical economic problems. For many NTUA systems there are many miles of pipelines, but few connections per mile. On some of these water systems the operating cost exceeds the system revenue. The more costly NTUA systems are subsidized by larger, more cost efficient systems. For example, water treatment and delivery on the system at Halchito near Mexican Hat costs NTUA approximately \$6.00 per 1,000 gallons. However, by

current tribal regulation, NTUA can only charge its water users approximately \$3.00 per 1,000 gallons. Even so, Figure 2.3 shows that NTUA water rates exceed the water rates of the majority of surrounding non-Indian communities. Furthermore, NTUA does not have the financial resources to maintain an adequate depreciation fund. Consequently, funding may not be readily available when the 200 million dollars of existing NTUA infrastructure needs to be replaced.

As challenging as the current circumstances are, without dramatically improved water resource development efforts, the future may be bleaker. Based on an annual growth rate of 2.48 percent and a per capita water demand of 160 gallons per capita per day, the water delivery systems will need to provide six times more municipal water by the year 2040.

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 an area the size of West Virginia, resulting in large distances between water sources and water users, and extremely high unit operation and maintenance 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, 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 should have adequate economies of scale, and they will provide the core water infrastructure for more densely sited housing in the future.

5.2 Water Storage Facilities

The NDWR Plan of Operation includes 14 dams as listed in Table 5.1 and shown in Figure 4.6. The NDWR Safety of Dams Branch recently estimated that approximately 40 million dollars of improvements will be needed over the next five years to address operational deficiencies in these structures. These improvements include conducting deficiency verification analyses, developing standard operating procedures, preparing emergency action plans, establishing early warning systems, and addressing structural problems.

The Department of the Interior Dam Safety Program developed a nationwide technical priority rating system to assess the relative hazard and priority of dams under its jurisdiction. Twelve of the 14 dams in the NDWR Plan of Operation were ranked according to the 1998 technical priority rating (see Table 5.1). The Dam Safety Program is funded through annual BIA appropriations and, given the recent funding levels, is typically only able to address two projects nationwide per year. Many Farms Dam has the highest technical priority rating and is expected to be reconstructed in fiscal year 2000. Wheatfields Dam has the third highest priority ranking and may not be reconstructed until

fiscal year 2003 at the earliest. Lower ranking dams may not be addressed for several decades, if ever. In recent years the BIA has provided \$300,000 of annual funding to the Navajo Dam Safety program. However, the annual operating expenditures are approximately \$800,000. The difference has been covered by a rapidly diminishing carry-over funding which will be exhausted by 2002.

Table 5.1 : Reservoirs Included in the Safety of Dams Plan of Operation

Reservoir	BIA 1998 Technical Priority Rating	Capacity (Acre-feet)	Reservoir Area (Acres)	Upgrade Cost (Dollars)
Many Farms	7	31,000	1,000	\$13,357,000
Canyon Diablo	11	4,700	470	\$2,369,000
Wheatfields	13	5,700	315	\$7,199,000
Captain Tom	46	1,170	75	\$9,907,000
Round Rock	47	1,080	84	\$312,000
Window Rock	53	210	10	\$30,000
Red Lake	64	11,000	1,100	\$1,183,000
Tsaile	76	8,100	415	\$1,273,000
Cutter	80	8,780	104	\$1,722,000
Asaayi	89	682	37	\$1,854,000
Blue Canyon	109	1,900	100	\$270,000
Ganado	114	2,400	335	\$312,000
Todachinee	n/a	8,780	100	\$60,000
Whiskey Lake	n/a	7,458	100	\$60,000
Total	n/a	92,960	4,245	\$39,900,000

Note: upgrade cost includes: deficiency verification analysis, standard operating procedures, emergency action plan, early warning system, and construction.

At least 14 other significant dams on the reservation need attention, but are not ranked by the Department of the Interior, nor are they explicitly included in the NDWR Plan of Operation. Although these dams may not pose immediate safety hazards, their function over time may be critically compromised. Alternative funding sources are needed to address the needs of the dams not covered under the dam safety program. One example of a dam in this category is Chuska Dam near Tohatchi, New Mexico. Chuska Reservoir provides water to the Red Willow Irrigation Project and it is stocked by the Navajo Nation Fish and Wildlife Department. Chuska Dam needs an improved outlet and additional protection for the spillway and embankment. Chuska Dam is an example of an innovative partnership combining the resources of several agencies. The Navajo Nation secured \$100,000 from the State of New Mexico, technical assistance from Reclamation's Farmington Construction Office, EQIP funding for on-farm system improvements, and in-kind construction support from the NDWR.

Given the geologic and the environmental concerns, developing new storage facilities is very difficult. However, the proposed regional water projects will require additional storage. The Three Canyon Project may require a 2,000 acre-foot reservoir on Chevelon Creek, a 3,000 acre-foot reservoir on Clear Creek, and storage from Blue Ridge Reservoir. The Navajo-Gallup Water Supply Project may require 8,000 acre-feet of storage at NIIP near the proposed Gallegos Reservoir, as well as a small terminus storage at the end of the trunkline. The Farmington to Shiprock Pipeline will require storage from the proposed Ridges Basin Reservoir or at Farmington. The other large projects will primarily rely on storage from either Lake Powell or Navajo Reservoir. They will also require storage for operational reliability and flexibility.

5.3 Agriculture Water

Agriculture has traditionally been the foundation of Navajo culture. Historically, the BIA constructed and maintained irrigation systems on the reservation. However, in recent years, BIA's budget has been progressively cut so that fewer funds are available for irrigation system construction and maintenance nationwide. Consequently, the existing systems on many reservations have deteriorated to such a state that many are no longer serviceable. This deterioration has led to the disintegration of many of the institutions that were established to oversee these operations. On the Navajo reservation agriculture water use can be divided into three categories: 1) NIIP, 2) the small irrigation projects, and 3) livestock. The unique problems associated with non-project, "Ak Chin" irrigation are beyond the scope of this document.

5.3.1 Navajo Indian Irrigation Project

NIIP is the preeminent water development project on the Navajo reservation. Today, thirty-eight years after the 1962 authorization, NIIP is only 60 percent complete. This unfulfilled promise has weighed heavily on several Navajo Nation administrations. In March of 1999 Reclamation, BIA and Navajo Agricultural Products Industry (NAPI) identified several issues which need to be addressed.

- Annual Construction Funding - The NIIP facilities are being constructed in 11 blocks of approximately 10,000 acres each. At the current rate of appropriations, completion may require up to an additional \$400 million over the next 15 years and may exceed the authorized ceiling. At the current level of funding, Block 11 will not be completed until 2012 and ancillary features, including the on-farm systems, may not be functional until 2018. These funding levels are significantly below the construction capabilities of Reclamation. Budgeting at funding levels below Reclamation's capability for design and construction: jeopardizes the functional life of installed but unused equipment awaiting follow-on installations, wastes resources, increases completion and rehabilitation costs, and is detrimental to Navajo economic development.

- To achieve a more effective and efficient project, the Navajo Nation is requesting that annual federal appropriations be increased to enable construction of NIIP's water delivery system in a shorter time period. Assuming that these financial and environmental challenges can be addressed, the Navajo Nation proposes a schedule that would complete Block 8 in fiscal year 2000, Block 9 in FY2002, Block 10 in FY2005 and Block 11 in FY2006. The drains, Gallegos Dam, and an automated System Control and Data Acquisition System would be completed in FY2009. The Navajo Nation, Reclamation, and the BIA have established a team to prepare a long range plan for the development of NIIP.
- On-Farm Development Funds - On-farm development, including land preparation and new sprinkler installations, is not keeping up with the current rate of construction. At the current rate of funding, it will take approximately 20 years to complete the remaining 550 sprinkler systems. Increasing the rate of funding for on-farm development must occur to allow on-farm development to keep pace with construction of the water delivery facilities. This increased rate will prevent completed canals, pumping plants, and pipelines from sitting idle for years awaiting the on-farm development
- Vertical Integration - NIIP has not satisfied its purpose of creating thousands of jobs for Navajo workers. This purpose may be achieved through a vertically integrated agribusiness enterprise. The Navajo Nation's goal is to increase tribal employment at NIIP by a factor of ten. The Navajo Nation and NAPI are exploring the possibility of a joint venture with R.D. Offut and Lamb-Weston for the construction and operation of a plant to process french fries and other frozen potato products. The proposed plant will have the capacity to process 600 million pounds of raw product annually.
- Funding for Operation, Maintenance, and Repair - The funding requirements for operation, maintenance, and replacement of NIIP facilities are not being met. The replacement of aging facilities, and increasing power costs are also of concern. The 1996 Operation and Maintenance Report for NIIP identifies \$6 to \$8 million of annual operation and maintenance need. However, NIIP only receives \$2 to \$4 million. Consequently, major maintenance and repair is being deferred. Serious problems could interrupt water deliveries causing major crop damage. The backlog of deferred maintenance continues to grow. Adequate funding is necessary to safeguard the NIIP investment.

5.3.2 Small Irrigation Projects

Throughout the country small farms are under stress. Fluctuating crop prices and high production costs make farming a challenge under the best of circumstances. However, compared to irrigation projects off of the reservation, the small Navajo irrigation projects have lower cropping intensities and productivity. According the 1986 NRCS inventory less than 30 percent of the land on 83 small Navajo irrigations projects was being farmed. Based on that inventory rehabilitating these projects may cost on average \$250,000 per project. A separate rehabilitation study by Reclamation of the Fruitland, Cudei and Hogback Irrigation Projects resulted in an estimated rehabilitation cost for those three projects of \$20 million.

Aside from funding shortfalls, the NRCS, Reclamation, BIA, NDWR and others have identified a number of problems facing the small irrigation projects including:

- On many of the small irrigation systems, the command areas were expanded beyond sustainable hydrologic limits. This situation results in general lack of water control, and inadequate and unreliable water for the irrigators.
- The small irrigation systems are trapped in a downward spiral of declining system revenues, which results in chronically deferred maintenance, which results in worse water control, which results in more idle lands, which results in declining system revenues.
- Local operating entities such as water users associations are not well established.
- New farming technology is not widely deployed.
- Establishing market windows is a difficult challenge for small producers.

The water resource development strategy must reverse this downward trend. Institutional changes must occur. Irrigators must be willing to organize water users associations through their local farm boards, and accept added responsibility for operation and maintenance. The Navajo Nation Tribal Council initiated the Local Governance Act which is intended to make decision making more accountable to local needs. The Council also approved a farm board plan of operation that allows irrigators to collect assessments for operation and maintenance of the irrigation projects. Establishing water user associations clearly fits this mandate. Once the water users are organized, partnerships can be more effectively developed to address the physical needs of the system.

5.3.3 Livestock

The NDWR is responsible for maintaining approximately 900 windmills and more than 7,500 stock-ponds on the reservation. The Operation and Maintenance Branch carries out this responsibility with Tribal General Funds. The large number of these facilities makes regular maintenance a daunting task. The total number of stock-ponds in an arid region is limited by the runoff and the suitability of the range. The livestock economy is also very vulnerable to price fluctuations and droughts.

5.4 Wastewater Treatment

Most of the scattered rural houses on the reservation have either septic systems or pit latrines. For clustered housing NTUA provides waste water treatment. Most of the NTUA systems have aerated sewage lagoons for water treatment. HKM & Associates estimated that the average cost to provide sewerage is \$13,000 per household plus engineering and contingency costs. Assuming 4.0 people per household, the Navajo Nation will need to construct more than 50,000 new homes by 2040 in the Chapters served by the regional water projects. The estimated capital cost of providing wastewater treatment to these new homes is \$620 million (excluding engineering, contingency, operation and maintenance costs). Much of this construction will be administered by the Navajo Housing Authority.

Future Navajo communities will need to make every reasonable effort to maximize the water supply. A commitment to water conservation and water reuse is essential. The opportunity for water conservation needs to be more fully explored. However, per capita water use rates on the reservation are already among the lowest in the region. Water conservation among the Navajo people who have virtually no irrigated lawns, and very few indoor amenities such as dish washers and clothes washing machines is virtually meaningless. Significant cost effective, water conservation opportunities may not be available due to the already low use.

The Navajo Nation and Reclamation are investigating water reuse opportunities. Reclamation is investigating the use of sewage lagoon water for irrigation at Ganado and for a wetland at Pinon. The LeChee Chapter, which is next to Page, Arizona, is very interested in developing a golf course using sewage lagoon water, and the Navajo Mountain Chapter is interested in incorporating water reuse for its new high school. The regional needs assessments will include the opportunities for water conservation and reuse.

6. WATER RESOURCE DEVELOPMENT STRATEGY

Access to adequate water is critical for economic growth and the survival of the Navajo culture. However, the problems surrounding water development on the Navajo reservation are beyond the technical and fiscal resources of any single agency. Consequently, the Navajo Nation is committed to a water resource strategy that combines tribal, federal, state and private resources. The Strategy integrates the resources of a number of partners into a common objective, and maximize the benefits of each agency's participation. The *Water Resource Development Strategy for the Navajo Nation* includes:

- Establishing a water resource development task force, which will coordinate technical and fiscal resources of the Navajo Nation and Federal agencies.
- Preparing a reservation-wide needs assessment and prioritizing water projects.
- Developing regional water supply projects.
- Developing and rehabilitating local water supply and distribution systems.
- Completing NIIP and continuing to address deficiencies in water storage facilities.

These components are described in the following sections.

6.1 Establishing a water resource development task force

The Navajo Nation recognizes its leadership role in tribal water resource development. The Navajo Nation will work to ensure that its divisions work together under a single plan, and dedicate staff and resources toward its implementation. However, due to the magnitude and complexity of the deficiencies, to make significant inroads, the Navajo Nation must rely on the budgets and expertise of several Federal agencies. A water resource development task force will coordinate technical and fiscal resources of the Navajo Nation and Federal agencies. This will reduce agency redundancy and enable the agencies to utilize their combined resources more effectively. Where there is no clear existing authority, or when programmatic funding is inadequate, Reclamation and the Navajo Nation will request authority to prepare feasibility studies. The Navajo Nation proposes to embrace Reclamation as a key partner to facilitate this process.

6.2 Preparing a reservation-wide needs assessment and prioritizing water projects

To effectively seek increased federal budgets and expanded authorities to address the deficiencies, the Navajo Nation must systematically identify the full scope and need. With assistance from the federal agencies, the Navajo Nation will prepare a reservation-wide assessment of the local needs. Reclamation will assist the Navajo Nation assess the water resource deficiencies throughout the reservation, and establish federal/tribal coalitions that can effectively construct the infrastructure identified in the needs assessments. To break the studies into manageable parts, the reservation will be assessed regionally. The regions will be based on the service areas of the major water supply projects and on jurisdictional boundaries.

The needs assessments will include appraisal level studies of the water systems necessary to:

- Put all of the municipal water supplied by the regional projects to beneficial use
- Provide for domestic and municipal needs served by local systems not connected to the proposed regional systems
- Improve water service to families not connected to water systems
- Provide infrastructure for selected agricultural uses
- Optimize water conservation and wastewater reuse. This effort will include evaluating fee structures to ensure adequate operation and maintenance.

The compiled information will enable the Navajo Nation to prioritize and sequence the proposed water projects. These assessments and the resulting appraisals will be pursued through Reclamation's existing authorization to perform general studies. The Navajo Nation will prepare a matrix that will assist in prioritizing projects based on realistic expectations for funding in the short and long term through existing agency authorities. The Navajo Nation will coordinate the resources that the agencies are able to commit. The matrix may include:

- economic benefits
- population
- susceptibility to drought
- cultural factors such as reducing off-reservation migration, resolution of social problems, increasing recreation opportunities, etc.
- political factors
- potential partners, including Tribal, Federal, State and private interests
- technical Analysis addressing engineering, cost estimates and environmental considerations
- federal agency budgets and authorizations

6.3 Developing Regional Water Supply Projects

The cornerstone of the water resource strategy is several large, regional water supply projects which will provide new and reliable water for domestic and municipal use. These regional projects include (see Table 6.1 and Figure 6.1):

- Three Canyon Water Supply Project
- Western Navajo Pipeline
- C-Aquifer Ganado Groundwater Project
- Navajo Gallup Water Supply Project
- Farmington to Shiprock Pipeline
- San Juan Central Navajo Pipeline

Table 6.1 : Regional Water Supply Projects Proposed by the Navajo Nation

Water Supply Project	Chapters Served in 2040	Population Served in 2040	Volume Delivered (AF/YR)	Estimated Cost (Million Dollars)
Three Canyon Water Supply Project	8	33,400	6,000	\$117
Western Navajo Pipeline	4	18,100	2,830	\$53
C-Aquifer Ganado Groundwater Project	6	40,000	7,800	\$50
Navajo-Gallup Water Supply Project	34	248,900	34,300	\$350
Farmington to Shiprock Pipeline	7	47,000	9,500	\$51
San Juan Central Navajo Project	8	18,700	3,400	\$40
Total	67	406,100	63,830	\$661

Notes:

1. The Three Canyon Project based on the May 8, 2000 project description and includes upgrades to NTUA systems
2. The C-Aquifer Project based on the May 10, 2000 project description and includes upgrades to NTUA systems.
3. The Farmington to Shiprock Pipeline cost estimate is based on serving 100% of the 2040 Shiprock demand.
4. This table excludes the Lake Powell - Peabody Pipeline.

Some of these projects are being pursued through the Little Colorado River settlement negotiations, the congressionally authorized Navajo-Gallup Water Supply Project feasibility studies, and the proposed and modified Animas-La Plata Project. These regional projects are described in the following sections. From the Navajo Nation's perspective, developing this essential water infrastructure is primarily the responsibility of the federal trustee. However, existing programs established specifically to provide for trust responsibilities are overwhelmed. This situation delays, or indefinitely postpones, significant implementation. In addition, many of these regional projects require off-reservation infrastructure and water supplies that are not typically within the programmatic capability of the current water development agencies on the reservation.

In addition to pursuing these regional projects through agency programs, some of these projects may be partly funded through the federal water rights settlements. The Navajo Nation has unquantified water rights in several basins. The quantification of these federally reserved water rights can require very lengthy and expensive litigation. In the Little Colorado River Basin, instead of litigating these water rights, the Navajo Nation is attempting to negotiate a settlement with the non-Indian parties.

Figure 6.1 : Regional Water Supply Projects

Negotiated settlements may accelerate the completion of these projects. However, these projects will still require additional programmatic funds. Programmatic funding refers to the Federal programs, administered through agencies like the BIA, to fund infrastructure development. Although the settlements may not address the full range of water resource needs of the Navajo Nation, they may fund core systems around which annual programmatic resources can build. Further funding shortfalls may be pursued through new congressional appropriation authorizations, agency loan programs, or partnerships with potential project beneficiaries.

6.3.1 Lake Powell to Peabody Pipeline

As a part of a Little Colorado River Settlement, the Hopi Tribe has proposed a pipeline from Lake Powell to the Peabody Coal Mine on Black Mesa which will reduce the mine's dependence on N-Aquifer water for its slurry line to the Mohave Generating Station near Laughlin, Nevada. This project would also provide 500 acre-feet to Tuba City, 500 acre-feet to the Hopi Village of Moenkopi, and approximately 5,000 acre-feet to the coal mine. It would eventually convey water to villages on the Hopi reservation. Depending on the specific configuration and capacity, this facility may provide the opportunity to convey water toward a number of Navajo communities including Shonto, Tonalea (Red Lake), Kaibeto, Inscription House, and Kayenta. Depending on the configuration, the project may cost \$127 million. However, because the details of such a project are subject to ongoing multiparty negotiations, this project has not been explicitly included in the Strategy document.

6.3.2 Three Canyon Water Supply Project

The parties to the Little Colorado River Adjudications are engaged in negotiations to resolve the Indian and non-Indian claims to water in the Little Colorado River Basin. The settlement negotiations have been premised on the development of a "grand fathering" agreement by which the Navajo Nation subordinates its reserved water rights to existing upstream non-Indian water users. In consideration for this subordination, the federal and state must support and fund the construction of the Three Canyon Project through a Little Colorado River Settlement. During the last three years Reclamation and NDWR conducted several studies of this project, including an assessment of the alluvial components of the project as well as various project configurations. This process has resulted in a project definition which appears to be satisfactory to the non-Indian parties, the Navajo Nation, and the U.S. Fish and Wildlife Service. A detailed project history is given in the NDWR Draft Technical Memorandum *Three Canyon Water Supply Project* dated March 24, 1999.

The project description in this document is based on the technical memorandum prepared by NDWR entitled *Three Canyon Water Supply Project, Project Description (May 8, 2000)*. Based on that description, the project will convey water from the Clear, Chevelon and Jacks Canyon Creeks (Three Canyon Area) located south of the Navajo reservation to the southwestern portion of the reservation with water. The Project's surface and groundwater components have a firm annual yield for the Navajo communities of 6,000 acre-feet. An additional 3,000 acre-feet of water Blue Ridge

Reservoir may be available for the non-Indian communities in northern Gila County. The Chapters to be served are listed in Table 6.2.

The Project has seven major elements: 1) re-operation of Blue Ridge Reservoir, 2) an additional 3,100 acre-feet of storage on Clear Creek, 3) pumps and conveyance systems, 4) conjunctive alluvial groundwater supply, 5) regional water treatment plant, 6) upgrades to the existing NTUA distribution systems, and 7) other direct and indirect costs. The project has an estimated construction cost of \$117 million in 1999 dollars, of which, approximately \$74.4 million may be funded through the Little Colorado River Settlement. Additional upgrades to the Navajo Tribal Utility Authority public water systems in the Leupp and Dilcon service areas over the next forty years have an estimated present value of \$28.2 and the cost of the phased water treatment plant is \$14.5 million.

Table 6.2 : Chapters Served by the Three Canyon Water Supply Project

Chapters	1990 Census Pop.	1990 Census Pop. (Adj)	1990 Water Demand (AF/YR)	2020 Projected Pop.	2020 Water Demand (AF/YR)	2040 Projected Pop.	2040 Water Demand (AF/YR)
Leupp	1,520	1,718	394	3,570	640	5,827	1,044
Birdsprings	645	729	131	1,520	272	2,481	445
Tolani Lake	651	736	133	1,546	277	2,524	452
Subtotal: Leupp Spur	2,794	3,182	570	6,636	1,189	10,832	1,941
Dilcon	1,766	1,996	356	4,142	742	6,761	1,212
Teestoh	890	1,006	180	2,093	375	3,416	612
Indian Wells	1,177	1,330	239	2,781	498	4,540	814
Lower Greasewood	1,190	1,345	238	2,769	496	4,520	810
White Cone	866	986	177	2,057	369	3,357	602
Subtotal: Dilcon Spur	5,828	6,638	1,190	13,843	2,481	22,594	4,049
TOTAL	8,622	9,820	1,760	20,479	3,670	33,426	5,991

Notes:

1. Population projections from: *Economic Benefits of the Three Canyon Water Supply Project, Navajo Nation*, James P. Merchant, David Dornbusch & Company, Dec. 1999
2. Municipal demand assuming 160 gallons per capita per day.

6.3.3 Western Navajo Pipeline

The Western Navajo Pipeline Project is one of the proposed Little Colorado River settlement projects. This project description in this document is based on the technical memorandum prepared by NDWR entitled *The Proposed Western Navajo Pipeline and The North Central Arizona Water Supply Project* (October 16, 1998). The pipeline will distribute water from Lake Powell along a corridor between LeChee and Cameron. The initial phase of the project will convey approximately 2,800 acre-feet per year to serve nearly 18,000 people in LeChee, Coppermine, Bitter Springs, Cedar Ridge, Bodaway/Gap and Cameron (see Table 6.3). Reclamation has estimated the cost to be approximately \$53 million in 1999 dollars.

During the last three years the NDWR conducted several studies of this project. The initial reconnaissance level studies addressed the water supply and water demand in the service area. Subsequent technical memorandums described the general configuration of the project. In fiscal year 1999, pursuant to requests from the Navajo Nation and the federal Little Colorado River settlement team, Reclamation assessed the proposed intake structure and power requirements, and peer-reviewed the NDWR October 1998 technical memorandum. More analysis is required to identify the full scope and cost of the project. However, funding that may result from the water rights settlement will not be adequate to complete this project. Accordingly, the Navajo Nation must identify and secure additional funding, either programmatically or through partnerships with other water users.

Table 6.3 : Chapters Served by the Western Navajo Pipeline

Chapter	1990 Population	2040 Population	2040 Water Demand (acre-feet/year)
LeChee	1,787	6,081	1,091
Copper Mine*	480	1,635	293
Bodway Gap	1,870	6,365	1,142
Cameron	1,170	3,981	714
Total	5,306	18,062	3,239

* includes Coppermine, Cedar Ridge, and Bitter Springs.

6.3.4 C-Aquifer Ganado Groundwater Project

The C-Aquifer Ganado Groundwater Project is one of the proposed Little Colorado River settlement projects. The project description in this document is based on the technical memorandum prepared by NDWR entitled *C-Aquifer Ganado Groundwater Project, Project Description (May 10, 2000)*. Based on that description, the project will withdraw water from the C-Aquifer in the Ganado Area and convey it to distribution points in and around six Chapters in the Ganado Area. The project has an estimated construction cost of \$30.1 million in 1999 dollars which may be funded through a Little Colorado River Settlement. Additional upgrades to the NTUA public water systems have a present value of \$20.1 million which will be funded through programmatic resources.

The project consists of a well field in the vicinity of Ganado and distribution system to initially serve as far west as Steamboat, as far south as Wide Ruins, and as far east as Klagetoh Chapter (see Table 6.4). It will have a total firm yield of 5,500 acre-feet per year. The project components include: a well field composed of 28 C-Aquifer wells each with an average yield of 350 gallons per minute, pumps and conveyance systems, and upgrades to the NTUA systems.

Table 6.4 : Chapters Served by the C-Aquifer Ganado Groundwater Project

Chapter	1990 Population	2040 Population	2040 Water Demand (acre-feet/year)
Ganado	2,948	10,035	1,800
Kinlichee	1,492	5,077	911
Cornfields	621	5,654	1,014
Steamboat	1,661	2,115	379
Klagetoh	873	2,973	533
Wide Ruins	1,494	5,085	912
Total	9,089	30,939	5,549

6.3.5 Navajo-Gallup Water Supply Project

The Navajo-Gallup Water Supply Project will deliver water to the Navajo Nation and the City of Gallup, New Mexico. The City of Gallup desperately needs to augment its groundwater supply. The static water level at the City of Gallup's Yah-ta-hey well field has dropped by more than 800 feet since the 1970's and the City anticipates a one million gallon per day deficit during its peak summer demand by the year 2010. The City of Gallup serves as an important regional economic center to the surrounding Navajo and Zuni reservations. The project description in this document is based on the technical memorandum prepared by NDWR entitled *Navajo-Gallup Water Supply Project (May 22, 2000)*. The Chapters to be served are shown in Table 6.6

Two project configurations which are the product of more than 40 years of progressively refined analysis have been evaluated. The two configurations are the San Juan River Alternative (diverting water directly from the San Juan River below the La Plata River confluence) and the NIIP Alternative (Diverting water through the Navajo Indian Irrigation Project (NIIP) facilities with regulating storage at Moncisco Reservoir) The major project features of either configuration include:

- Service to the municipal subareas
- Groundwater supplies
- Water treatment
- Terminus storage
- Wastewater treatment
- Project right-of-way

For the San Juan River Alternative, the pipeline begins either the Hogback Diversion or PNM Diversion which are downstream of the La Plata River confluence and it proceeds along Highway N36 to Highway 666. The main pipeline serves communities along Highway 666 to Yah-ta-hey. For the NIIP Alternative, the pipeline begins at the proposed Moncisco Reservoir at NIIP and proceeds south to the existing El Paso Natural Gas pipeline corridor. The pipeline route follows the gas line corridor to the vicinity of Twin Lakes where it turns south to Yah-ta-hey.

From Yah-ta-hey the pipeline connects to a lateral to Window Rock and to the water distribution system for the City of Gallup. Spurs off of the Window Rock lateral will serve communities along Highway 64. The Gallup Area Navajo residents and surrounding Chapters will receive Project water conveyed through the City of Gallup's distribution system. Four spurs will connect to the main pipeline to service the Chapters between NIIP and Gallup. Storage tanks and water treatment are included in the Project.

The Navajo-Gallup Water Supply Project will deplete approximately 34,355 acre-feet of water annually from the San Juan River for municipal and industrial use. Approximately 6,400 acre-feet will be depleted in the Window Rock Area in Arizona, approximately 300 acre-feet of water will be depleted by NAPI to develop agribusiness food processing facilities, approximately 2,300 acre-feet will be depleted in the Shiprock Area, approximately 3,300 acre-feet will be depleted in the eastern part of the reservation between Cutter Reservoir and Torreon, approximately 7,500 acre-feet will be depleted by the City of Gallup, about 4,800 acre-feet will be depleted by Navajos in the Gallup Area, and the rest will be depleted in communities between Shiprock and Gallup. The Project will serve a population of 250,000 people in the year 2040. Water depletions for the Navajo-Gallup Project are shown in Table 6.5 and 6.6.

Table 6.5 : Potential Navajo-Gallup Water Supply Project Depletions
(Acre-feet per Year)

Source	NAPI	Cutter Lateral	City of Gallup	Navajo Corridor	Shiprock Area	Total
San Juan River Surface Depletion	300	3,300	7,500	20,900	2,355	34,355
Ground Water Depletion	0	300	0	3,300	0	3,600
Total Supply	300	3,600	7,500	24,200	2,355	37,955

The appraisal level estimate of the capital cost of conveying 34,355 acre-feet to meet the Project's purpose and need is \$339 million for the San Juan River Alternative and \$350 million for the NIIP Alternative.

Table 6.6 : Water Demand for the Navajo-Gallup Water Supply Project

Service Area	Chapter	1990 Population	2040 Population	2040 Demand (Ac-ft/yr)	2040 G.W. Production (Ac-ft/yr)	2040 SJR Depletion ¹ (Ac-ft/yr)
City of Gallup, NM	City of Gallup	19,154	46,736	7,500	0	7,500
Central Area, NM	Burnham	246	837	150	0	150
	Lake Valley	436	1,484	266	46	220
	White Rock	201	684	123	0	123
	Whitehorse Lake	610	2,076	372	31	341
	SUBTOTAL	1,493	5,082	911	77	834
Crownpoint, NM	Becenti	193	657	118	0	118
	Coyote Canyon	1,234	4,200	753	61	692
	Crownpoint	2,658	9,047	1,622	614	1,008
	Dalton Pass	313	1,065	191	0	191
	Little Water	638	2,172	389	0	389
	Standing Rock	251	854	153	77	76
	SUBTOTAL	5,287	17,995	3,226	752	2,474
Gallup Area, NM	Bread Springs	1,219	4,149	744	77	667
	Chichiltah	1,555	5,293	949	0	949
	Church Rock	1,780	6,059	1,086	123	963
	Iyanbito	974	3,315	594	153	441
	Mariano Lake	726	2,471	443	0	443
	Pinedale	609	2,073	372	307	65
	Red Rock	1,041	3,543	635	61	574
	SUBTOTAL	7,904	26,903	4,823	721	4,102
Huerfano, NM	Huerfano	511	1,739	312	67	245
	Nageezi	981	3,339	598	25	573
	SUBTOTAL	1,492	5,078	910	92	818
Rock Springs, NM	Manuelito	631	2,148	385	46	339
	Rock Springs	1,685	5,735	1,028	77	951
	Tsayatoh	1,433	4,878	874	46	828
	SUBTOTAL	3,749	12,761	2,287	169	2,118
Route 666, NM	Mexican Springs	711	2,420	434	0	434
	Naschitti	1,539	5,238	939	77	862
	Newcomb	651	2,216	397	46	351
	Sanostee	2,081	7,083	1,270	153	1,117
	Sheep Springs	660	2,246	403	69	334
	Tohatchi	1,607	5,470	980	307	673
	Twin Lakes	1,967	6,695	1,200	153	1,047
	SUBTOTAL	10,099	34,373	6,162	882	5,280
Torreon	Counselor	1,365	4,646	833	0	833
	Ojo Encino	596	2,029	364	16	348
	Pueblo Pintado	472	1,607	288	61	227
	Torreon	1,364	4,643	832	100	732
	SUBTOTAL	3,797	12,925	2,317	177	2,140
San Juan River ²		13,804	46,985	8,421	0	2,355
NAPI Industrial ³		n/a	n/a	7,274	0	300
TOTAL NEW MEXICO		66,779	208,837	43,831	2,870	27,921
Window Rock, AZ	Fort Defiance	6,187	21,059	3,774	767	3,007
	St. Michaels	5,580	18,993	3,404	0	3,404
TOTAL ARIZONA		11,767	40,052	7,178	767	6,411
PROJECT TOTAL		78,546	248,889	51,009	3,637	34,332

1 - Depletions assume zero return flow to the San Juan River.

2 - SJR depletions does not include Animas-La Plata Project water.

Congressional authorization for this project will require the resolution of several environmental, technical and financial obstacles. Assuming adequate funding in fiscal years 2000 and 2001, the Navajo Nation and Reclamation will pursue Section 7 consultation, conduct initial NEPA compliance work, optimize the project configuration and prepare a definite plan report. If funds are available the City of Gallup and the Navajo Nation will pursue congressional authorization for construction in fiscal year 2002.

6.3.6 Farmington to Shiprock Pipeline

The Shiprock Area is one of the fastest growing areas on the Navajo reservation. The Navajo Nation is concerned that the 30-year old pipeline which serves almost 60 percent of the current water uses in eight Navajo Chapters along the San Juan River needs to be replaced. A pipeline adequate for the 2040 demand is estimated to cost \$50.6 million in 1999 dollars. This concept is described in the NDWR technical memorandum entitled *Farmington to Shiprock Pipeline* dated 1998. These Chapters are shown in Table 6.7.

The Navajo Nation has supported the efforts of the Colorado Ute Tribes to obtain their water rights under the Colorado Ute Indian Water Rights Settlement Act. The Navajo Nation's support of the proposed modified Animas La Plata Project (ALP) and Senate Bill 2508 has been conditioned upon congressional authorization of a water line to convey the Navajo Nation's ALP water to Shiprock, New Mexico. This facility is described as the Navajo Municipal Pipeline in the *Animas La Plata Project Draft Supplemental Environmental Impact Statement* dated June 2000. Based on that draft document, Reclamation analyzed three alternatives for delivering 4,560 acre-feet (2,340 acre-feet of depletion) of municipal water from the ALP to the eight Shiprock area Chapters. The preferred conceptual plan would convey the Navajo Nation's ALP water through the City of Farmington's municipal system to the Shiprock. This pipeline would be 28.6 miles in length and it has an estimated cost of approximately \$26 million. The pipeline that will be authorized as part of the ALP is not adequate to convey all 7,600 acre-feet that could be diverted under the "Full" ALP, nor is it adequate to meet the entire Navajo demand in the project area through the year 2040.

Table 6.7 : Chapters Served by the Farmington-Shiprock Water Supply Project

Chapter	1990 Population	2040 Population	2040 Water Demand (acre-feet/year)
Beclabito	388	1,321	237
Cudei	495	1,685	302
Hogback	740	2,519	451
Nenahnezad	1,253	4,265	764
San Juan	540	1,838	329
Shiprock	8,100	27,570	4,942
Upper Fruitland	2,288	7,788	1,396
Total	13,804	46,985	8,421

6.3.7 Central San Juan River Navajo Pipeline

The Navajo Nation has proposed a central Navajo Pipeline from the San Juan River, near Mexican Hat, to Navajo communities located in Utah such as Monument Valley and Navajo Mountain. These areas are facing critical water shortages which are steadily growing worse as the population increases. The Navajo Nation anticipates increased tourism as a source of economic activity in the Monument Valley region. In the Navajo Mountain area, the Navajo Nation is committed to providing water to the school and the surrounding community. The existing infrastructure is inadequate to meet current demand and must be improved. Previous studies have investigated the San Juan River as a possible water source. Based on preliminary assessments, this project may serve eight chapters and a population of 20,000 on the Navajo reservation within the State of Utah. This regional system may cost \$40 million.

6.4 Developing and Rehabilitating the Local Water Infrastructure

The regional water supply projects will convey domestic water supplies to approximately 67 of the 110 chapters on the reservation, and will serve approximately 80 percent of the projected population of 500,000 by the year 2040. However, without additional local infrastructure, there will be inadequate conveyance and treatment capacity to deliver potable water from the regional systems to many of the water users. Even with the regional systems and associated local distribution systems fully in place, approximately 40 percent of the chapters will rely on alternative water supply sources and facilities. Many systems will require rehabilitation, and in many areas new systems are needed. For areas where distribution systems are infeasible, community wells will be upgraded to improve

access for water haulers. Rehabilitation and development of small, local agricultural irrigation and livestock water systems is also an important component of the strategy.

These improvements are essential for conveying water from the regional projects to the places of use including homes, businesses, and farms and include: 1) construction and rehabilitation of the treatment, distribution and storage facilities needed to deliver water from the regional systems, 2) construction and rehabilitation of treatment, distribution and storage facilities for the small water supply systems that are not connected to the regional systems, 3) improvements in the water supply for residents beyond the reach of public water systems, 4) rehabilitation of selected small irrigation projects, and 5) water conservation and reuse.

6.4.1 Distribution Systems Associated with the Regional Projects

To ensure that the water from the regional water projects reaches the water users, additional upgrades to the existing treatment, distribution and storage facilities may be needed. The assessment will also identify economic, health and other benefits of water development for the growth centers. The data generated in these appraisals will be used to justify further, more in-depth analysis, and to prioritize potential projects.

For the domestic systems, the demand is based on a 40-year planning horizon and a water use rate of 160 gallons per capita per day. This water use rate is comparable to the water use rates of the surrounding non-Indian communities with developed water supply systems. Population projections are based on a growth rate of 2.48 percent. A robust economy, supported by an adequate water supply, will allow more Navajos to find livelihoods on the reservation and the resulting economic development will reduce dependence on federally funded socioeconomic programs.

6.4.2 Small Domestic and Municipal Systems not connected to the Regional Project

The regional water projects and the associated public water systems will reach 80 percent of the population and 60 percent of the chapters. Much of the remaining population is served by 90 small public water systems which need upgrades. These small systems share similar obstacles. They are remote with very limited access. They require long distances between the water sources and places of use. And, the water sources are extremely limited. These factors result in very expensive water. These problems are compounded by the fact that many of these small public water supply projects do not meet the established criteria for incorporation into NTUA operation. NTUA will not accept a system that has fewer than three water meters per mile or systems requiring major repairs. Many of the public water systems not operated by NTUA depend on tribal subsidies. As the tribal general funds decline, the ability of the Tribal government to maintain these subsidies decreases.

Because these water systems often only serve a few dozen connections, improvement efforts do not fit into traditional construction authorization processes. Developing separate appraisal and feasibility level studies for each project, and approaching Congress separately on behalf of each project would create an unmanageable administrative and political log jam. Furthermore, the remote

locations make it expensive to repeatedly mobilize technical expertise. For this Strategy, the Navajo Nation will request that Congress grant an overarching or omnibus authority to prepare feasibility studies to submit multiple projects for Congressional construction authorization.

The Navajo Mountain Chapter provides an example of a system that may not be readily served by one of the large regional water systems. However, it is also an example of several federal agencies creating an innovative partnership. Reclamation's Native American Affairs Program provided funds for emergency improvements which were carried out in part by NDWR in-kind resources. Reclamation also proved appraisal level assessments of the water supply alternatives and feasibility level reports of the preferred system improvements. IHS peer reviewed those work products and conducted additional geohydrologic investigations of potential water sources. Because this system is vulnerable to surface water contamination, the feasibility level reports were submitted to the EPA Indian Drinking Water set aside program. The feasibility studies will also become the basis for applications to the USDA rural water programs. In addition, the local water users have worked with the USDA programs to incorporate a water users association that will address the special operation and maintenance needs of the system.

6.4.3 Improving water service to water users without direct access to public water systems

Approximately 40 percent of the Navajo population hauls water to meet their daily needs. They frequently drive long distances to the nearest public water source. The cost of hauling water in pickup trucks can exceed \$22,000 per acre-foot, meaning that one of the poorest sectors of the population has the most expensive water. Sanitation is also a concern for water haulers. If potable water sources are difficult to access, water haulers frequently get water from non-potable sources such as stock tanks. Even if the water quality is adequate, unregulated taps frequently have unsanitary hoses and other conditions that render the water supply unsafe. Furthermore, households that rely on water hauling have less water available for personal hygiene, which also translates to an increase in health related problems.

Due to current funding levels, it is not possible for IHS to provide water from a public water supply system to every household on the reservation. The IHS sanitation deficiency listing demonstrates how costly it can be to serve some of these residences. The marginal unit cost of assuring a public water supply for 80 to 90 percent of the reservation homes is \$80,000. The marginal unit cost of assuring a public water supply for 90 to 95 percent of the homes increases cost to \$120,000. Due to funding shortfalls, homes with unit costs that exceed \$40,000 are considered by IHS infeasible to build. Because of these high costs, even by the year 2040, 10 to 20 percent may not be served by the public water supply systems.

The regional water projects will provide some indirect relief to the Navajo water haulers. For instance, the distance to reliable water taps will decrease for most Navajo water haulers and existing unregulated water hoses may be improved thereby enhancing sanitation. However, direct assistance to develop local water sources, possibly with solar pumps and cisterns, may be required. Reclamation recommended a joint study with the NDWR on this topic. The objective of the study is to define the nature and extent of the problem, and to pose solutions. The problem definition and

strategy would be based on IHS data, literature reviews, interviews, and field trips. The solution strategies developed would be provided to appropriate individuals and agencies for review to determine which options have the greatest chance of success. Based on the results of this effort, an action plan will be developed on how best to proceed and where to seek associated funds.

6.4.4 Small Irrigation Projects

As part of the regional needs assessments, the small irrigation projects will be assessed. These assessments will evaluate those projects that have the best chance of hydrologically, institutionally and agronomically sustaining themselves. Those projects with irrigators that are willing to organize a water users association through their local farm board, accept some responsibility for the operation and maintenance, and form of partnerships may have the best chance of succeeding. This approach is consistent with recent Navajo Nation Council directives intended to make decision making more accountable to local needs and oversight. The irrigation assessments will evaluate the following topics:

- Farming history
- Agricultural economics
- Water supply - surface water, groundwater, and reuse.
- Water conservation and management practices
- Capacity to pay water use assessments
- Capacity to incorporate a water users association
- System operation and overall irrigation efficiency
- Environmental Compliance - NEPA & cultural resources
- Budget requirements
- Preferred alternative
- Implementation plans
- Education needs
- Monitoring plans

The Ganado Irrigation System provides another model of the partnership between the federal agencies, the Navajo Nation and the local water users. Reclamation and NDWR developed an improved base map showing the facilities and farm plots. A water management plan funded through Reclamation's Water Management and Conservation Program described the water supply and demand, constraints on the systems, and alternatives. Based on those results a memorandum of understanding (MOU) was prepared between the NRCS, BIA, Reclamation, the National Park Service, the Navajo Nation, the farm board and the irrigators. The MOU clarified the specific roles of each of the partners. The irrigators, with the assistance of Colorado State University, developed a financial management plan for operating the system, and organized a water users association as a nonprofit corporation. The association has established an operation and maintenance fee schedule.

With the MOU in place, a technical assessment was conducted. Based on the recommendations from the Technical Assessment, Reclamation and the BIA are taking the lead on the NEPA compliance. The NRCS has worked with water users on the project to identify EQIP opportunities.

The EQIP on-farm improvements will be coordinated with the Reclamation-funded system rehabilitation NDWR is seeking funding to implement the preferred alternative. IHS provided assistance for improving canal safety and the National Park Services has assisted the efforts to reestablish the historic farming system. The general strategy for small irrigation projects is shown schematically in Figure 6.2.

6.4.5 Water conservation and water reuse

Future Navajo communities will need to make every reasonable effort to maximize the available water supply. Therefore, a commitment to water conservation and water reuse is needed. The Navajo Nation and Reclamation are investigating water reuse opportunities. An analysis of opportunities for water conservation and reuse of wastewater will be a component of the reservation-wide needs assessment and appraisals.

6.5 Completing the Navajo Indian Irrigation Project

NIIP has not realized its full economic potential. The Navajo Nation has made several specific suggestions to realize NIIP's potential, including: increasing the annual construction funds to complete both the distribution systems and on-farm components in a shorter period of time, vertically integrating to increase tribal employment, and adequately funding the operation and maintenance. The Navajo Nation, Reclamation, and the BIA have a team that is developing a long range plan for NIIP.

Figure 6.2 : Flow Chart for Creation of a Water Users Association

6.6 Dam Safety

The Department of the Interior Dam Safety Program developed a nationwide technical priority rating system to assess the relative hazard and priority of dams under its jurisdiction. The Navajo Nation has twelve dams that were ranked according to the 1998 technical priority rating. The Dam Safety Program is funded through annual BIA appropriations and, given the recent funding levels, is typically only able to address two projects nationwide per year. The Many Farms Dam has the highest technical priority rating and is expected to be reconstructed in fiscal year 2000. The Wheatfields Dam however, may not be reconstructed until 2003 at the earliest. Without a well funded Safety of Dam program, the lower ranking dams may not be addressed for several decades, if ever.

At least 14 other significant dams on the reservation need attention, but are not ranked by the Department of the Interior, nor are they explicitly included in the NDWR Plan of Operation. Although these dams may not pose immediate safety hazards, their function over time may be critically compromised. Alternative funding sources and partnerships are needed to address the needs of the dams not covered under the dam safety program.

7. PLAN OF ACTION

It is too early to establish firm, reliable cost estimates for implementing this Strategy. It is also too early to present project specific schedules. The costs and the schedules will be evaluated during the reservation-wide water resource needs assessment. However, implementing the Strategy to enable the Navajo Nation to achieve parity with its non-Indian neighbors may cost \$2 billion. This cost is a huge investment by any standard, but it must be compared with the returns. For instance, if these water projects contribute to closing the income gap between the Navajo Nation and the US average by only 1 percent, over 40 years, they would generate \$800 million in direct benefits to the Navajo Nation, and additional indirect benefits to the Federal government.

The Plan of Action depends in part on the success and timing of ongoing and future settlement negotiations. The regional projects, if all funded and constructed simultaneously, would demand huge, annual appropriations. In any specific year, Congress may be unwilling to appropriate such large sums and may require the Navajo Nation to prioritize and sequence these projects. As these projects get closer to reality, the Navajo Nation will assess the budget realities and develop an appropriate schedule. This long-term strategy may take 40 to 50 years to implement.

The Water Resources Task Force should be established before the end of fiscal year 2000. To focus this group, the NDWR will prepare a delineation of the regional areas to be assessed, and develop a prioritization approach. The regions will be based on the service areas of the regional projects, growth centers, and jurisdictional boundaries.

The reservation-wide needs assessments should be completed within the next three to five years. The Navajo Nation will seek approximately \$300,000 per year of annual appropriations from Congress, beginning in fiscal year 2001, under Reclamation's current general studies authority. At the conclusion of these appraisals, the full scope of the water related needs on the reservation should be better understood. The needs assessments will identify and assess potential projects at an appraisal level. The appropriate authorization for feasibility design and construction will be pursued. The necessary feasibility studies will also be pursued to address the areas that will not be served by the proposed regional systems.

For this Plan of Action, the Navajo Nation, in partnership with Reclamation, will strive to complete the feasibility studies for the Navajo-Gallup Water Supply Project, as authorized by Congress, by fiscal year 2001. Assuming a feasible project results, the project will be submitted to Congress for construction authorization in fiscal year 2002.

The Little Colorado River Settlement projects may follow a similar time table. The Navajo Nation is attempting to refine the analysis of the proposed settlement projects including the Three Canyon Water Supply Project, the C-Aquifer Ganado Groundwater Project, the Western Navajo Pipeline, and the Lake Powell-Peabody Pipeline for submitting to Congress as quickly as possible. The NIIP and the Safety of Dams programs will continue to be important Navajo priorities.

The Navajo Nation will prioritize its resources to share in the cost of this initiative. The Navajo Nation will commit staff, equipment and materials where possible. However, developing the

essential water infrastructure will require large capital investments well beyond the current economic means of the Tribe. Funding shortfalls will need to be pursued through other avenues including:

- Navajo Water Rights Settlements
- Existing Federal Authorities and Annual Appropriations
- New Federal Authorities
- Federal Discretionary Funds
- Federal Grant Programs
- Federal Loan Programs
- State, Municipal, and Private Resources

Navajo Water Rights Settlements - In the Navajo Nation's view, the construction of the facilities to meet on-reservation water resource needs is largely the responsibility of the federal trustee. However, due to the lack of federal programmatic resources, the infrastructure lags behind the demand. Therefore, project construction funds are being pursued through ongoing Indian water rights settlement negotiations and are being studied under existing congressional feasibility study authority.

The Navajo Nation has unquantified water rights in several basins. The quantification of these federally reserved water rights can require very lengthy and expensive litigation. Instead of litigating these water rights, the Navajo Nation has attempted to negotiate settlements with the non-Indian parties, to accelerate the completion of the proposed water development projects so that the benefits may begin to accrue as soon as possible. Although the projects that are a result of the settlements may not address the full range of water resource needs of the Navajo Nation, they will provide core systems around which the annual programmatic resources can build.

Existing Federal Authorities and Annual Appropriations - The Navajo Nation will work with the federal agencies using current federally mandated authority. These agencies include, but are not limited to the BIA, IHS, Reclamation, NRCS, USEPA, and Army Corps. These existing federal authorities and appropriations are sources of programmatic funding.

To more efficiently use the funds available, the Navajo Nation will establish a multi-agency task force. The task force will coordinate programs, leverage the limited budgets of each agency and reduce duplication. This effort will require the Navajo Nation to establish tribal water resource priorities, and commit tribal and federal organizations to those priorities. As an example, the Navajo Nation, several federal agencies and the local water users have joined in partnership in the rehabilitation of the Ganado irrigation system. Under leadership provided by the Navajo Nation, the partners executed a memorandum of understanding (MOU) that has allowed the agencies and local stakeholders to "pool" their resources in a common effort to rehabilitate the existing agricultural system. Through their separate authorities and programs, Reclamation and NRCS have planned and designed the delivery and on-farm systems. Through existing programs and authorities, the capital cost of the materials, including the pipe, concrete and appurtenant items will be provided primarily by Reclamation and NRCS, and to a lesser extent the National Park Service, through existing programs and authorities. The Navajo Nation, using the materials provided by Reclamation

and NRCS, has committed labor and equipment to construct the system designed by Reclamation/NRCS. As a copartner, BIA provided funds to prepare the requisite environmental assessments and cultural resource surveys. This project is a model for similar projects on the reservation.

New Authorities - The Navajo strategy will look to existing programs and authorities to implement much of the strategy. However, there will be gaps, in authorities and funding. The Navajo Nation, working in cooperation with its congressional delegation(s) and the federal agencies, will seek new study and construction authorities to meet the needs not addressed by other programs. Specifically, the Navajo Nation proposes an omnibus reservation-wide, feasibility study authority reservation-wide, to be administered by Reclamation, to identify, quantify and provide the requisite information to support new construction authority(s). Additionally, the Navajo Nation will pursue a "small construction" authority for minor infrastructure rehabilitation and construction. Where new, proposed projects exceed programmatic funding, or are greater than the proposed "small construction" cost threshold, project specific construction authorities will be sought.

Federal Discretionary Programs - A number of federal agencies administer programs that are not specifically targeted to the Native American community. These programs are being made more readily available to tribes. Generally, these programs are not designed for significant infrastructure development. However, there are opportunities to initiate modest construction projects. Examples include the NRCS EQIP program and Reclamation's Water Conservation and Management program.

Federal Grant Programs - The USEPA and USDA have modest grant programs to assist rural water users to comply with federal mandates. A number of the programs specifically address Tribal needs. Examples of such grant programs include EPA Safe Drinking Water Act and Drinking Water SRF Tribal Set Aside Grants, and USDA Rural Utility Source Native American Set Aside.

Federal Loan Programs - With infrastructure development, economic development will follow. As an example, the Navajo Nation economy only captures about 8 percent of the \$660 million annual tourism revenue in the Four Corners Region. If the Navajo Nation develops new infrastructure to accommodate the burgeoning tourism industry and increase that percentage to 12 percent, it would generate an additional \$26 million on the reservation annually. This change will enhance the Navajo Nation's ability to repay the cost of developing the infrastructure. Through its economic development plan the Navajo Nation will explore federal opportunities for borrowing, or constructing under a repayment commitment. Programs such as the Department of Agriculture's rural water development or Reclamation's small loan program will be explored.

State, Municipal and Private Resources - The Navajo Nation is committed to continuing its close working relationship with its neighbors and private investors to generate new opportunities for infrastructure and economic development. It proposes to enhance tourist amenities on the reservation, not in competition with its non-Indian neighbors, but to enhance region wide opportunity. It will encourage private enterprise to locate on the reservation and to tap the tribal labor pool. Both initiatives would infuse private capital into infrastructure development and improve the economic opportunities of tribal members. Examples of such cooperative efforts are the North Central Arizona Regional Water Study and the Navajo-Gallup Water Supply Projects.

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