Cost and Economic Update to 2007 Prices
of the Planning Report and
Draft Environmental Impact Statement
(Includes Appraisal-Level Alternative Designs and Cost Estimates)

Navajo-Gallup
Water Supply Project

New Mexico – Arizona

Navajo Nation **City of Gallup** **Jicarilla Apache Nation**

U.S. Department of the Interior
Bureau of Reclamation

November 2007

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

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

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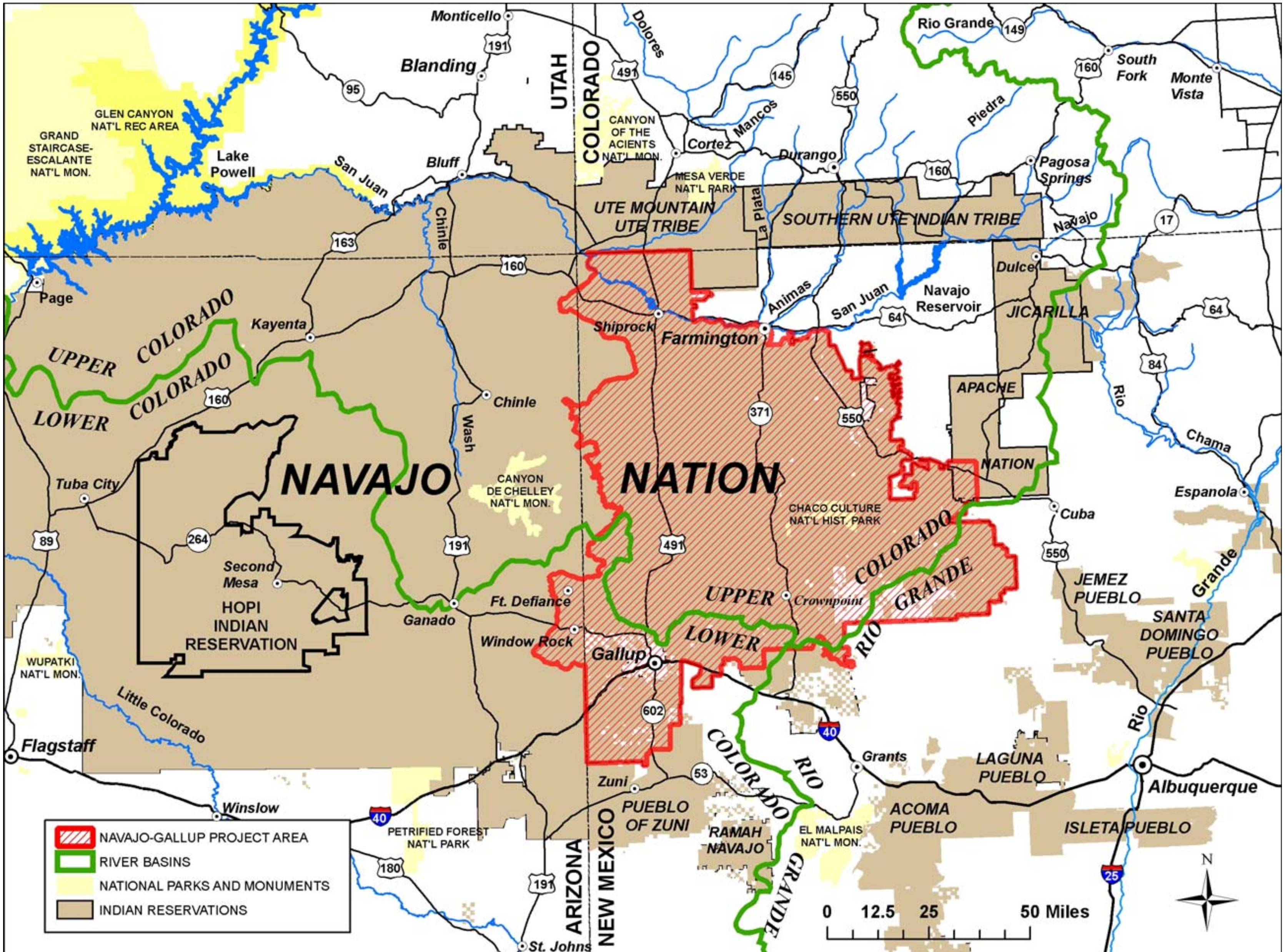

NAVAJO
NATION
HOPI INDIAN RESERVATION
UTAH
COLORADO
ARIZONA
NEW MEXICO
UPPER COLORADO
LOWER COLORADO
UPPER RIO GRANDE
LOWER RIO GRANDE
GLEN CANYON NAT'L REC AREA
GRAND STAIRCASE-ESCALANTE NAT'L MON.
CANYON OF THE ACIENTS NAT'L MON.
MESA VERDE NAT'L PARK
UTE MOUNTAIN UTE TRIBE
SOUTHERN UTE INDIAN TRIBE
JICARILLA APACHE NATION
CANYON DE CHELLEY NAT'L MON.
CHACO CULTURE NAT'L HIST. PARK
WUPATKI NAT'L MON.
PETRIFIED FOREST NAT'L PARK
EL MALPAIS NAT'L MON.
JEMEZ PUEBLO
SANTA DOMINGO PUEBLO
LAGUNA PUEBLO
ACOMA PUEBLO
ISLETA PUEBLO
PUEBLO OF ZUNI
RAMAH NAVAJO
Monticello
Blanding
Bluff
Lake Powell
Page
Kayenta
Tuba City
Second Mesa
Chinle
Ganado
Ft. Defiance
Window Rock
Gallup
Shiprock
Farmington
Cortez
Durango
Pagosa Springs
South Fork
Monte Vista
Dulce
Navajo Reservoir
Cuba
Espanola
Crownpoint
Grants
Zuni
Flagstaff
Winslow
St. Johns
Albuquerque
San Juan
Chinle Wash
Dolores
Mancos
La Plata
Animas
Piedra
Navajo
Rio Grande
Rio Chama
Little Colorado
191
95
491
145
550
160
149
17
163
64
84
371
264
89
602
53
40
180
25
NAVAJO-GALLUP PROJECT AREA
RIVER BASINS
NATIONAL PARKS AND MONUMENTS
INDIAN RESERVATIONS
0 12.5 25 50 Miles
N

ACRONYMS AND ABBREVIATIONS

A

AFY	acre-feet per year

B

BIA	Bureau of Indian Affairs

C

cfs	cubic feet per second
CRSP	Colorado River Storage Project

D

DBP	disinfection byproduct

E

EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act

G

gpcd	gallons per capita per day

H

HVAC	heating, ventilation, and air conditioning`

I

IHS	Indian Health Service

K

kW	kilowatt

L

LCP	local control panel

M

M&I	municipal and industrial
MCL	maximum contaminant level
MGD	million gallons per day
mg/L	milligrams per liter
MHI	median household income

N

NEPA	National Environmental Policy Act
NIIP	Navajo Indian Irrigation Project
NTU	Nestler Turbidity Units
NTUA	Navajo Tribal Utility Authority

O

O&M	operation and maintenance
OM&R	operation, maintenance, and replacement

P

PNM	Public Service Company of New Mexico
ppm	parts per million
PR/DEIS	planning report/draft environmental impact statement
Principles and Guidelines	*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*
proposed project	Navajo-Gallup Water Supply Project

R

Reclamation	Bureau of Reclamation
ROW	rights-of-way

S

SDWA	Safe Drinking Water Act
Secretary	Secretary of the Interior
Service	U.S. Fish and Wildlife Service
SJRPNM	San Juan River Public Service Company of New Mexico
SWTR	Surface Water Treatment Rule

T

TDS	total dissolved solids
TOC	total organic carbon
TSC	Technical Service Center

U

UV	ultraviolet

Executive Summary

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EXECUTIVE SUMMARY

INTRODUCTION

The Bureau of Reclamation (Reclamation) has developed this planning report and draft environmental impact statement (PR/DEIS) pursuant to Public Law 92-199 and the general authority to conduct water resources planning under the Reclamation Act of 1902 and all acts amendatory thereof and supplementary thereto. This document was undertaken to provide a discussion on (1) various ways to provide a municipal and industrial (M&I) water supply to the Navajo Nation, city of Gallup, and the Jicarilla Apache Nation and (2) the associated potential environmental impacts and costs of such an endeavor, should it be undertaken. Reclamation, however, does not have the current substantive or budgetary authorization that is required to construct, operate, and maintain any proposed facilities discussed in this PR/DEIS. It will take an act of Congress to provide such authority. In addition, Reclamation takes no position on whether such a project should be authorized. The indication of a preferred alternative is solely to meet the requirements of the National Environmental Policy Act (NEPA) and is not an indication that a particular alternative should be pursued since, as noted earlier, there is no project authorization that would allow Reclamation to commence this project.

Finally, we are aware that the Navajo Nation and the State of New Mexico have reached an agreement concerning the Navajo Nation's water rights in the San Juan River Basin in New Mexico and that a part of the proposed settlement is the construction, operation, and maintenance of the Navajo-Gallup Water Supply Project (proposed project). We wish to be clear that neither Reclamation, the Department of the Interior, nor the Administration has taken a position on the San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement executed between the Navajo Nation and the State of

New Mexico and that nothing herein is any indication of any position regarding the overall settlement. The cost analysis contained in this PR/DEIS is based on an appraisal level of analysis. The cost estimate of the preferred alternative identified in this report reflects prices as of January 2007 and is known as Reclamation's April 2007 construction cost estimate.

Reclamation historically supports projects for construction after a feasibility report is completed, which includes a feasibility-level cost estimate. This appraisal-level cost estimate does not meet that requirement. Additional analysis, detail, and updates of the appraisal-level cost estimates presented in this draft report are needed before project construction authorization can be supported. Failure to complete this additional effort may result in reliance on a cost estimate for the project that is not sufficient to characterize the expected project cost. The appraisal-level design must be upgraded to feasibility level before Reclamation would begin construction. The cost of, and time for, completing this additional work would be substantial.

PURPOSE AND NEED

The proposed project is to provide a long-term (year 2040) supply, treatment, and transmission of M&I water to the Navajo Nation, the Jicarilla Apache Nation, and the city of Gallup, New Mexico.

A long-term sustainable water supply is needed for the area to support current and future populations. The proposed project would be designed to serve a future population of approximately 250,000 people by the year 2040. Existing groundwater supplies are dwindling, have limited capacity, and are of poor quality. More than 40 percent of Navajo households rely on water hauling to meet daily water needs. The city of Gallup's groundwater levels have dropped approximately 200 feet over the past 10 years, and the supply is not expected to meet current water demands within the decade. The Jicarilla Apache people are currently not able to live and work outside the Town of Dulce on the reservation because of a lack of water supply.

THE NAVAJO-GALLUP WATER SUPPLY PROJECT

The proposed project would convey a reliable M&I water supply to the eastern section of the Navajo Nation, the southwestern part of the Jicarilla Apache Nation, and the city of Gallup via diversions from the San Juan River in northern New Mexico. The Navajo Nation, city of Gallup, and the Jicarilla Apache Nation are part of the project Steering Committee that assisted in preparation of portions of this document.

Navajo Nation communities and the city of Gallup rely on a rapidly depleting groundwater supply that is inadequate to meet present needs and anticipated growth. Other water sources are needed to meet current and future M&I demands of more than 43 Navajo chapters, including the communities of Fort Defiance and Window Rock in Arizona, the city of Gallup, and the Teepee Junction area of the Jicarilla Apache Nation.

The proposed project would deplete approximately 35,893 acre–feet of water annually from the San Juan River (Navajo Nation – 27,193 acre-feet, Jicarilla Apache Nation – 1,200 acre-feet, city of Gallup – 7,500 acre-feet). Based on the expected populations in the year 2040, the proposed project would serve approximately 203,000 people in 43 chapters in the Navajo Nation, 1,300 people in the Jicarilla Apache Nation, and approximately 47,000 people in the city of Gallup.

PLANNING PROCESS

Project planning has been intermittent over the past 40 years. Drawing from past analysis and projecting water needs and environmental conditions into the next 40 years has provided the basis for the planning work described in this report.

A project Steering Committee included representatives from the Navajo and Jicarilla Apache Nations, city of Gallup, State of New Mexico, Bureau of Indian Affairs (BIA), Indian Health Service (IHS), Navajo Tribal Utility Authority (NTUA), Northwest New Mexico Council of Governments, and Reclamation. The Steering Committee was formed in the early 1990s to guide the direction of this proposed project, provide technical analysis, support public involvement, provide political background, and conduct overall project coordination. Reclamation has provided planning, engineering, and environmental expertise to this committee.

Funding for project planning has mostly been through annual congressional write-in funds and cost sharing by the Navajo and Jicarilla Apache Nations and the city of Gallup. The level of analysis—appraisal verses feasibility level work—has been tailored to stay within the funds available.

To expedite planning and environmental steps, it was decided that this document would be a combined PR/DEIS. This document complies with the *Economic Principles and Guidelines for Water and Related Land Resources Implementation Studies* (*Principles and Guidelines*) and NEPA.

The NEPA process began with publishing a Notice of Intent in the *Federal Register* on March 27, 2000. Scoping meetings were held at five locations in April and May 2000: Crownpoint, Gallup, Shiprock, and Farmington, New Mexico and Saint Michaels, Arizona. The meetings were moderately attended, with a range of 15 to 50 people each. The most widespread comments indicated that there is a great need for a reliable M&I water supply throughout the proposed project area, that existing groundwater is in limited supply, and that the water is usually of poor quality.

The Navajo and Jicarilla Apache Nations and the city of Gallup provided their current and projected populations and associated M&I water needs to year 2040. An estimated water use rate of 160 gallons per day per person was used for the proposed project design, as requested by the Navajo and Jicarilla Apache Nations.[1] It was assumed that available groundwater would continue to be used and that project water would provide the remaining need.

The Steering Committee identified possible alternatives to meet current and future water needs. It was determined in all past studies, as well as in this study, that the San Juan River was the only sustainable source of water. Therefore, all the viable alternatives involved treating river water for use throughout the proposed project area.

Water conservation is currently well established in the proposed project area, and although additional conservation would reduce water use, it would not be enough to provide for future water needs. It is assumed that water conservation would continue with all project alternatives considered. Six physically different, viable alternatives were identified to bring San Juan River water to the proposed project area. All of the alternatives would provide the same quantity of treated water to the same delivery locations. The variables included where the water would be diverted and the location of the alternatives' facilities. Maximizing the use of existing facilities and information were important factors in the design of the alternatives. All of the alternatives use Navajo Reservoir and Navajo Indian Irrigation Project (NIIP) facilities to some extent and have the same Gallup Regional System supplying water to the city of Gallup and surrounding Navajo chapters.

Four of the alternatives obtain all of the water from Navajo Reservoir and the NIIP facilities:

- NIIP Moncisco Alternative
- NIIP Coury Lateral Alternative
- NIIP Cutter Alternative
- NIIP Amarillo Alternative

[1] The city of Gallup uses 160 gallons per capita per day (gpcd) for current and future demand projections. The Navajo Tribal Utility Authority's current average water use rate is 100 gpcd.

The other two alternatives have a San Juan River diversion in addition to the diversion from the NIIP:

- San Juan River Public Service Company of New Mexico (SJRPNM) Alternative
- San River Infiltration Alternative

Table S-1 shows the major features of each alternative.

Table ES-1.—General summary of components

Component	NIIP Moncisco Alternative	NIIP Coury Lateral Alternative	NIIP Cutter Alternative	NIIP Amarillo Alternative	SJRPNM Alternative	San Juan River Infiltration Alternative
River intake					1	
Infiltration wells						26 (year 2040)
River pumping plant					1	
Treatment plants	1	1	1	2	2	2
Forebay tanks	12	8	11	17	19	20
Pumping plants	12	8	11	17	20	20
Regulating tanks	5	5	5	6	5	5
Community storage tanks	20	20	20	20	20	20
Feet of pipeline	1,361,954	1,389,378	1,466,248	1,286,082	1,237,792	1,189,145
Miles of pipeline	258	263	278	244	234	225
Gallup Regional System						
Pumping plants	4	4	4	4	4	4
Community storage tanks	5	5	5	5	5	5
Feet of pipeline	171,923	171,923	171,923	171,923	171,923	171,923
Miles of pipeline	32.6	32.6	32.6	32.6	32.6	32.6

ALTERNATIVE SCREENING PROCESS

The six viable alternatives were compared using nine factors derived from the four accounts described in the *Principles and Guidelines*. The SJRPNM Alternative surfaced as the highest-ranked (best) alternative considering all of the factors. When considering only environmental factors, the SJRPNM Alternative again ranked the highest (least environmentally impacting). When considering only capital and annual operation, maintenance, and replacement (OM&R) costs as measured by present worth, the SJRPNM Alternative was least costly assuming Colorado River Storage Project (CRSP) power rates. When locally available power rates from the NTUA were used, the NIIP Amarillo Alternative was the least costly.

A detailed analysis of environmental impacts associated with the SJRPNM and NIIP Amarillo Alternatives and the No Action Alternative was completed in the environmental impact statement portion of this document. This analysis concluded that the SJRPNM Alternative is the least environmentally impacting alternative in most resource factors.

The SJRPNM Alternative has been identified as the preferred alternative considering all the factors and resources evaluated.

PREFERRED ALTERNATIVE

The SJRPNM Alternative would divert water from the San Juan River downstream of Fruitland, New Mexico, just above the existing Public Service Company of New Mexico (PNM) diversion structure, treat the water to drinking water standards, and then deliver it along Highway N36 and south to Navajo chapters along U.S. Highway 491. Water would be provided to Window Rock, Arizona, and Crownpoint, New Mexico, through sublaterals. Water delivery would continue to the Navajo Nation capital of Window Rock, Arizona, and to the city of Gallup, New Mexico. Another diversion would originate at Cutter Reservoir, an existing regulating reservoir on the NIIP, and would convey water to the eastern portion of the Navajo and Jicarilla Apache Nations.

The construction cost of this alternative is estimated to be $864,400,000 (Reclamation, April 2007 cost estimate, table S-2).

The annual OM&R costs for the preferred alternative are projected as shown in table S-3.

The appraisal-level design and cost estimate was done by Reclamation’s Technical Service Center. The design and cost estimate was peer reviewed by an independent engineering consulting firm, Boyle Engineering. Revisions were made to the estimate based on the review, and the contingency factor was increased. This estimate represents what this project could be constructed for at a January 2007 price level. This assumes that no unknown factors were encountered or changes made.

Table ES-2.—Preferred alternative cost estimate

Feature	Reclamation April 2007[1] cost estimate ($)
Pipelines	202,546,620
Pumping plants	28,355,000
Water treatment plants	53,673,055
Tanks and air chambers	85,575,000
Transmission lines	26,677,200
Turnout structure	1,707,380
Gallup Regional System	25,754,500
Subtotal	424,288,755
Mobilization (5%)	21,000,000
Unlisted items (10%)	44,711,245
Subtotal	490,000,0000
Contingencies (22.5%)	110,000,000
Subtotal (field costs)	600,000,000
Noncontract costs (27%)	162,000,000
Subtotal	762,000,000
New Mexico taxes on field costs (estimated at 6%)	36,000,000
Navajo Nation taxes on field costs, excluding Gallup Regional System field cost of $30 million (estimated at 3%)	16,900,000
Subtotal	814,900,000
Land, relocation, and damage[2]	9,000,000
Cultural resource mitigation	34,500,000
Environmental mitigation	6,000,000
Total project cost	864,400,000

[1] The cost analysis contained in this PR/DEIS is based on an appraisal level of analysis. This estimate is based on prices obtained in January 2007.

[2] The estimate includes rights-of-way (ROW) costs for the San Juan Treatment Plant only. Should it be determined that ROW for the rest of the features needs to be included in the project costs, an additional $30–60 million should be added.

Table ES-3.—Yearly OM&R costs ($) (SJRPNM Alternative)

Item	San Juan Lateral	Cutter Lateral	Gallup Regional System
NTUA power costs (relift pumping plant)	4,962,000	597,000	82,000
CRSP power costs (relift pumping plant)	1,841,000	221,000	31,000
NTUA power costs (booster pumping plant)	215,000	35,000	
CRSP power costs (booster pumping plant)	80,000	13,000	—
Relift pumping plant OM&R	3,170,000	1,245,000	723,000
Booster pumping plant OM&R	78,000	12,000	
Canal OM&R	—	35,000	—
NTUA power cost water treatment plant	511,000	63,000	—
CRSP power cost water treatment plant	187,000	22,000	—
Water treatment OM&R	2,605,000	$1,064,000	—
NTUA water treatment, miscellaneous 10%	312,000	$113,000	
CRSP water treatment, miscellaneous 10%	279,000	$109,000	
Power transmission OM&R	350,000	Included in San Juan Lateral	
Pipeline OM&R	801,000	187,000	57,000
Total NTUA	13,004,000	3,351,000	862,000
Total CRSP	9,391,000	2,908,000	811,000

Notes: (1) CRSP rate is 10.43 mils per kilowatthour and demand charge of $4.43 per kilowatt per month.
(2) CRSP total project power cost is $2,395,000.
(3) NTUA rate is 20 mils per kilowatthour and demand charge of $16.50 per kilowatt per month.
(4) NTUA total project power cost is $6,465,000.
(5) Cost reflects April 2007 project cost estimate with January 2007 price level.

WATER SUPPLY

Water for the Navajo Nation's use in New Mexico would be supplied from the State of New Mexico's Upper Basin apportionment, and water for the Navajo Nation use in Arizona would be supplied from the consumptive use apportionments made to the State of Arizona by compact or decree. Navajo Nation uses by the proposed project in both

States must be serviced through long-term water supply contracts between the Secretary of the Interior (Secretary) and the Navajo Nation. The Secretary would make the water available for contract deliveries under existing New Mexico permits that the Secretary holds.

Jicarilla Apache Nation water would come from Navajo Reservoir as part of the water obtained through the Jicarilla Apache Nation Water Right Settlement. The Jicarilla Apache Nation has an existing water supply contract for this water. It is anticipated that the city of Gallup would contract through the Jicarilla Apache Nation and/or Navajo Nation for its water supply. A long-term water supply subcontract among the Jicarilla Apache Nation and/or Navajo Nation, the city of Gallup, and Reclamation would be needed to finalize this arrangement.

ECONOMIC AND FINANCIAL ANALYSIS

The economic analysis compares project benefits measured by willingness to pay and cost of alternative source of water to project cost. The benefit to cost ratio is 1.25, which represents a beneficial use of national resources. The financial analysis addresses the cost of project water delivered to the users. The levelized cost of project water to the user is estimated to be $7.57 per thousand gallons. This compares with $5.50 per thousand gallons for the Lewis and Clark Project and $8.30 per thousand gallons for the Rocky Boy's/North Central Montana Regional System, both of which are authorized Federal rural water projects.

The analysis presented in this report is based on the identified preferred alternative. This alternative could change through the legislative and NEPA processes, and the method of economic and financial analysis could also change. Nonetheless, it is appropriate to provide the included analysis in order to inform the decisionmakers and the public of how costs could be allocated under Reclamation law and policy.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Positive impacts would occur from implementing the preferred alternative. The average flow in the San Juan River would be increased by approximately 5 cubic feet per second between Navajo Dam and the SJRPNM diversion. This increase would provide additional dilution for water quality improvement and would improve the habitat for fish (including the tail water trout fishery). Indian Trust Assets could be put to use by providing the Navajo and Jicarilla Apache Nations a water supply system. The socioeconomic resources would be improved by providing up to 650 jobs during construction and boosting the income to the region. An M&I water supply would help boost the overall economic growth to the region.

Negative impacts associated with construction of such a large project are unavoidable. They consist of a permanent loss of 43 acres of vegetation and associated wildlife habitat, including 1.1 acres of permanent loss of wetlands. There would be potential entrainment losses at the PNM diversion for flannel mouth sucker and speckled dace larva. Forty-three acres of private and Navajo Nation lands would be converted to project use by the alternative. Six families who currently live on the private land would be relocated. There would be a temporary impact to grazing on Navajo Nation lands during construction.

Special status species would be impacted due to the potential entrainment losses at the SJRPNM diversion for Colorado pikeminnow, razorback sucker, and bluehead sucker. Potential negative impacts would occur to the bald eagle and Southwestern willow flycatcher along the San Juan River. There are also potential negative impacts to the beautiful gilia and Mesa Verde cactus along the pipeline alignment.

Cultural resources could be potentially adversely impacted since there are an estimated 104 cultural resource sites within the area of potential effects. Approximately 90 sites could require treatment.

Mitigation measures addressing these potential impacts have been developed and are included in the preferred alternative design and cost estimate.

CONSULTATION AND COORDINATION

Reclamation, as the lead agency responsible for preparation of this PR/DEIS, used an interdisciplinary team to prepare the document in addition to representatives from the Navajo and Jicarilla Apache Nations and city of Gallup staff and consultants. In addition, the BIA, IHS, NTUA, State of New Mexico, and the Northwest New Mexico Council of Governments participated with the interdisciplinary team in preparing this document.

Consultation under the Endangered Species Act (ESA) is ongoing. Reclamation and the U.S. Fish and Wildlife Service (Service) have consulted, both formally and informally, regarding potential impacts to special status species as a result of potential development and operation of the preferred alternative.

A biological assessment was developed by Reclamation, and the Service issued a draft biological opinion under the ESA. In the draft biological opinion, the Service concluded that the proposed project, as described in the biological assessment and in this PR/DEIS, may affect, and is likely to adversely affect, the Colorado pikeminnow, razorback sucker, and Mesa Verde cactus. The draft biological opinion indicates that the final opinion would contain an incidental take permit for Colorado pikeminnow and razorback sucker larvae that may become entrained as a result of the diversion from the San Juan River. Mesa Verde cactus may be directly taken during the construction of project features. The Service concurred that the proposed project may affect, but is not likely to adversely affect, the Southwestern willow flycatcher and bald eagle.

The draft biological opinion incorporates a Navajo Nation depletion guarantee, which limits new depletion associated with the project to 5,271 acre-feet at full development (see chapter VI and volume II, appendix C). The opinion concludes that the 5,271 acre-feet of new depletions associated with the proposed project would not adversely impact the Colorado pikeminnow or razorback sucker. However, because larval fish may be lost due to the project diversions, the fish would be adversely affected. The opinion identifies the San Juan River Basin Recovery Implementation Program as the reasonable and prudent measure to reduce incidental take of Colorado pikeminnow and razorback sucker and identifies conservation recommendations to reduce the direct take of Mesa Verde cactus. The opinion also states that if re-initiation is required, the Service will follow the procedures regarding re-initiation of consultation pursuant to the "Principles for Conducting Endangered Species Act Section 7 Consultations on Water Development and Water Management Activities Affecting Endangered Fish Species in the San Juan River Basin." Results of any additional consultation will be included in the final biological opinion and will be incorporated into the planning report and final environmental impact statement.

A Planning Aid Memorandum and draft Fish and Wildlife Coordination Act report have also been completed by the Service and the recommendations included, where appropriate, in the preferred alternative plan.

ATTACHMENT F

Preferred Alternative

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Tables

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Attachment F

PREFERRED ALTERNATIVE

OVERVIEW

This attachment presents details of the preferred alternative, the San Juan River Public Service of New Mexico (SJRPNM) Alternative. The description of the preferred alternative includes the system's configuration and associated considerations and features, including:

- Water supply and demand
- Physical description
- Water quality and treatment
- Land requirements, damages, and rights-of-way (ROW)
- Cultural resource issues
- Environmental mitigation
- Navajo-Gallup Water Supply Project (proposed project) construction, ownership, and operation, maintenance, and replacement (OM&R) costs
- Economic analysis
- Financial analysis

Figure F-1 is a map of the proposed project area showing project area landmarks and the SJRPNM Alternative facilities. The SJRPNM Alternative would divert water from the San Juan River downstream of Fruitland, New Mexico, just above the existing Public Service Company of New Mexico (PNM) diversion structure, treat the water, and then deliver it along Highway N36 and south to Navajo chapters along U.S. Highway 491 (shown in figure F-2). Water delivery would continue to the Navajo Nation Capital at Window Rock, Arizona, and to the city of Gallup, New Mexico. Another diversion

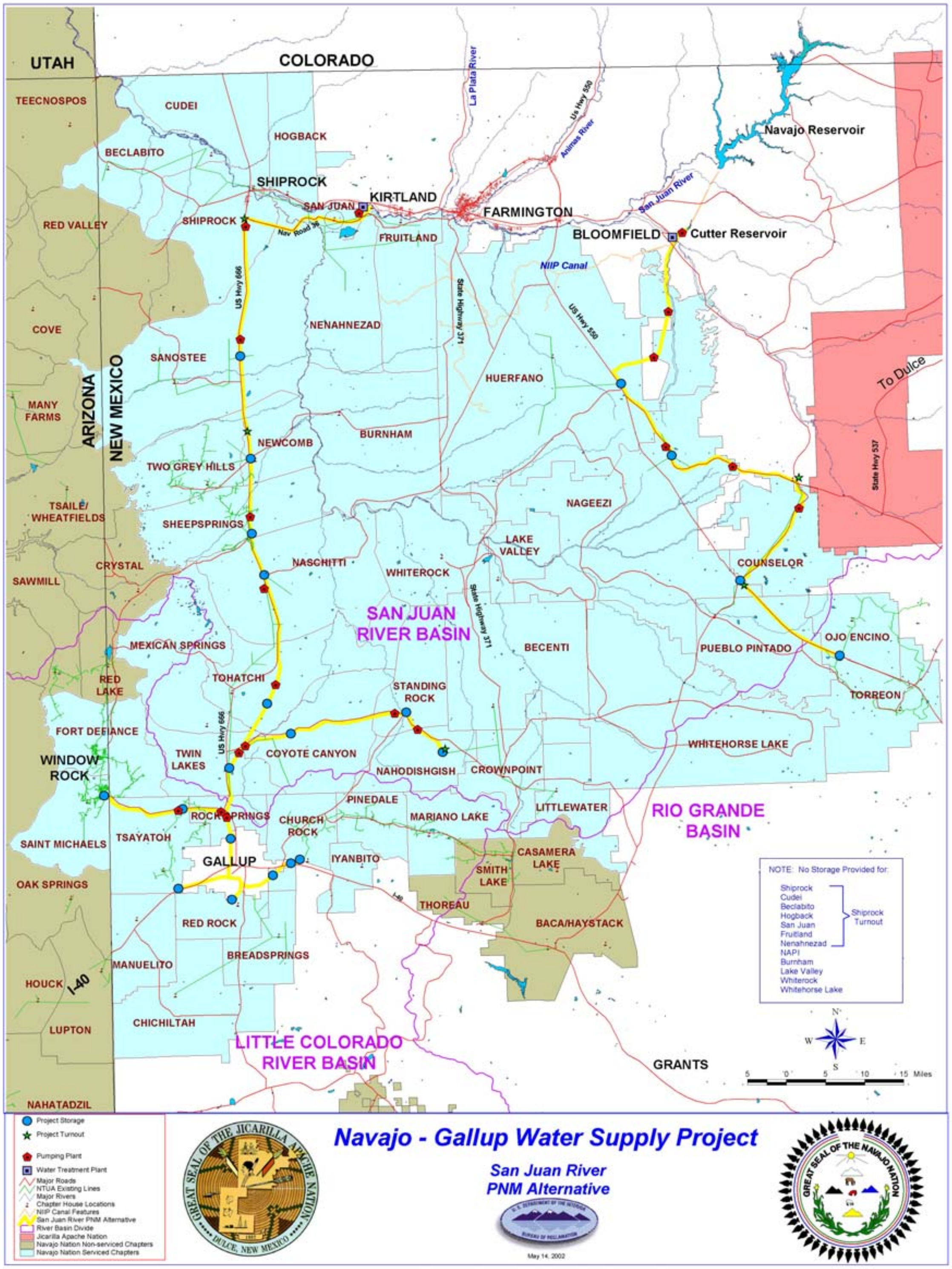

Figure F-1.—SJRPNM Alternative (preferred alternative).

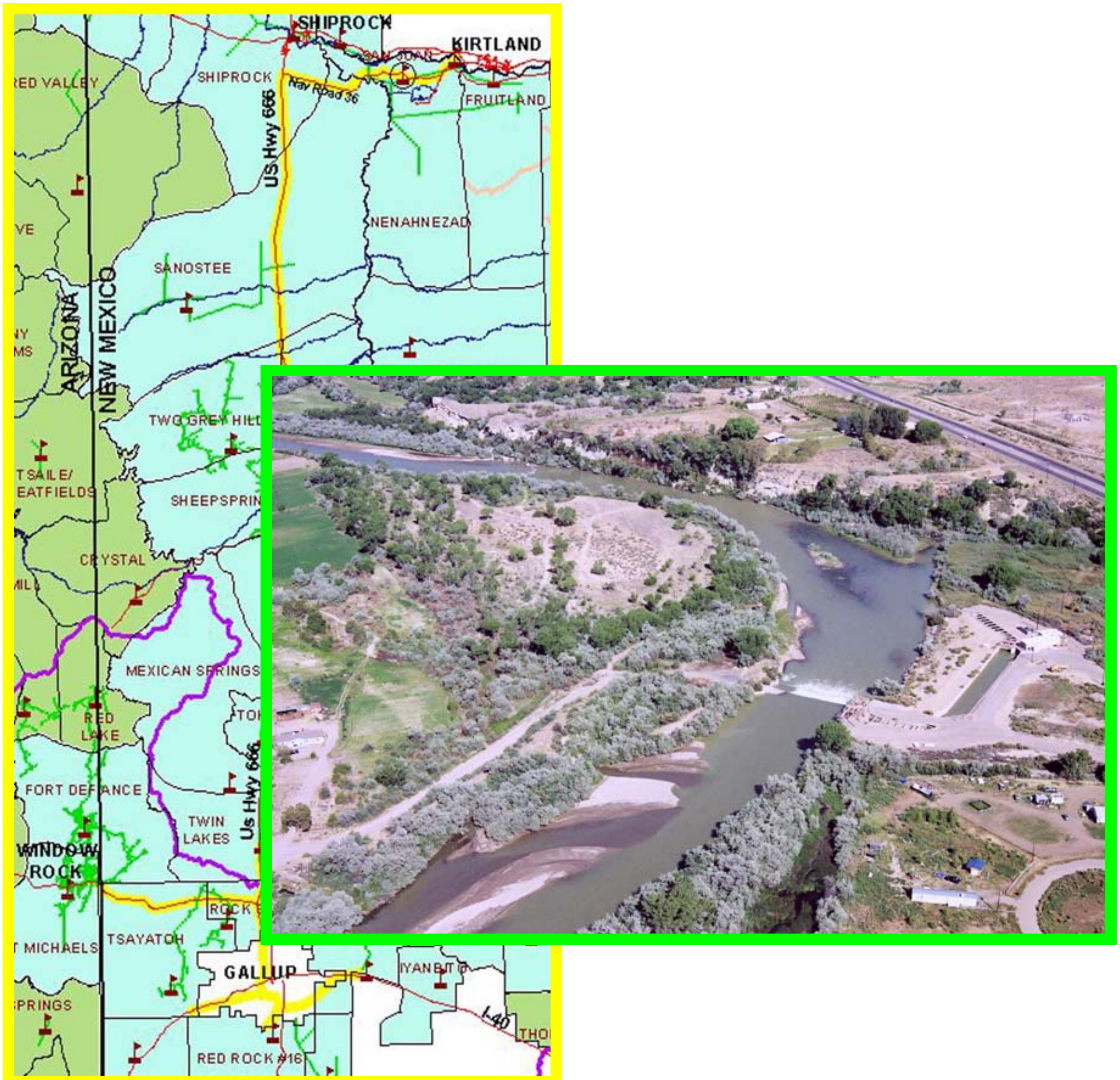

Figure F-2.—PNM diversion dam (project diversion point along the San Juan River).

would occur from Cutter Reservoir (figure F-3), an existing regulating reservoir on the Navajo Indian Irrigation Project (NIIP), conveying water to the eastern portion of the Navajo and the Jicarilla Apache Nations. The water would be provided to Window Rock, Arizona, and Crownpoint, New Mexico, through sublaterals. While basic design components were described in chapter IV, other components specific to the preferred alternative are described in this attachment.

TOTAL PROJECT WATER SUPPLY AND DEMAND

The proposed project is designed to divert a total of 37,764 acre-feet per year (AFY) from the San Juan River with a resulting depletion of 35,893 acre-feet to the San Juan River Basin, based on 2040 projected population with a demand rate of 160 gallons per capita per day (gpcd). The Cutter diversion would require 4,645 AFY with no return flow to the San Juan River. The PNM diversion would take the remaining 33,119 AFY of diversion, with an average return flow of 1,871 AFY. (The planned diversion and depletion by location is shown in table F-1).

It is assumed that the only return flow from the proposed project to the San Juan River would enter the river at the Shiprock waste water treatment plant. There may be some water delivery to users with individual septic systems in the Shiprock area, but the delivery is expected to be a small percentage of the total. All other deliveries would have similar losses, but the resulting return flow would be lost to evaporation or to recharging local groundwater aquifers. For water balance purposes, no return flow to the San Juan River from these other locations is expected or accounted for. Return flow to the Rio Grande or Little Colorado Rivers is highly unlikely, even though there would be discharge to the groundwater in these areas. Local groundwater storage space, together with local pumping, would limit the potential for surface discharge. Even if surface discharge does occur, the distance to the Rio Grande or Little Colorado Rivers is so great that it is unlikely that return flows would reach these rivers.

Deliveries typically vary depending on changes in demand, and the largest demand is in the summer months. The Shiprock water delivery pattern for March 1992 through February 1993, shown in table F-2, was used to determine average monthly deliveries, and return flows were assumed to follow the same distribution. The system would be designed to handle a 7-day peak demand for pumping plants and pipelines and is computed as 1.3 times the peak average monthly demand. Daily and diurnal demand peaking would be handled by the proposed project storage tanks.

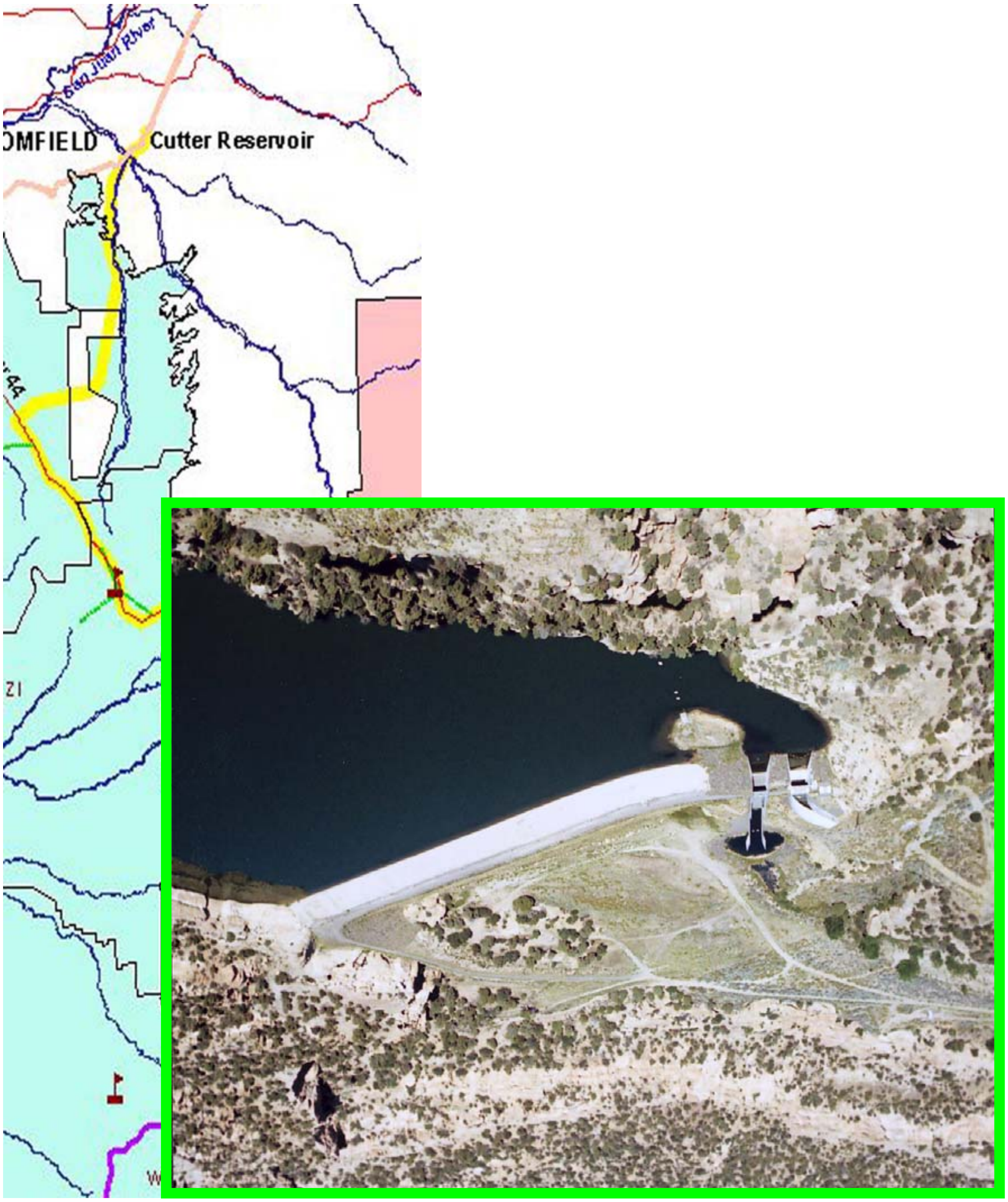

Figure F-3.—Cutter Dam and Reservoir.

Table F-1.—Project forecast 2040 demand and design capacity by service area

Location	San Juan River diversion (AFY)	San Juan River depletion (AFY)
City of Gallup, New Mexico	7,500	7,500
Jicarilla Apache Nation	1,200	1,200
Navajo Nation, New Mexico		
Central area	834	834
Crownpoint	2,473	2,473
Gallup area	4,316	4,316
Huerfano	864	864
Rock Springs	2,118	2,118
Route 491	5,366	5,366
Torreon	2,240	2,240
San Juan River	3,742	1,871
Navajo Agricultural Products Industry industrial uses	700	700
Navajo Nation, Arizona (Window Rock area)	6,411	6,411
Total Navajo Nation	29,064	27,193
Project total	37,764	35,893

Table F-2.—Monthly demand pattern for all deliveries

Month	Percent demand	Month	Percent demand
January	7	July	10
February	6	August	10
March	9	September	10
April	7	October	8
May	9	November	7
June	10	December	7

Navajo Nation

The proposed projected project water need for the Navajo Nation is a total diversion of 29,064 AFY. Of this, 6,411 AFY is for use in the Window Rock area of Arizona and 22,653 AFY is for use in the eastern portion of the reservation in New Mexico. The 22,653 AFY of water would come from Navajo Reservoir (3,445 AFY) through the Cutter diversion and from the San Juan River at the existing PNM diversion dam (19,208 AFY).

Water for the proposed project's New Mexico part of the Navajo Nation (22,653 AFY) would be supplied from New Mexico State Engineer File Nos. 2849 and 3215 held by the Secretary of the Interior (Secretary). This would be administered through a long-term water supply contract between the Bureau of Reclamation (Reclamation) and the Navajo Nation.

Consumptive uses by the Navajo Nation under the proposed project within Arizona in and near Window Rock must be supplied from the apportionments or allocations of water made to the State of Arizona by compact or decree. The *Colorado River System Consumptive Uses and Losses Report*, 1996–2000 (Reclamation, February 2004), estimates that current consumptive uses within the Upper Basin in Arizona amount to about 38,100 AFY. Thus, there appears to be adequate unused apportionment within the 50,000 AFY of Upper Basin consumptive use apportioned to the State of Arizona by article III(a) of the Upper Colorado River Basin Compact to source the Arizona portion of the proposed project. Use of Arizona's Upper Basin apportionment in the Lower Basin in Arizona for the Navajo Nation's project uses in the Window Rock area would be consistent with the provisions of section 303(d) of the Colorado River Basin Project Act and the June 2003 Resolution of the Upper Colorado River Commission consenting to New Mexico's use of its Upper Basin apportionment in the Lower Basin in New Mexico for project uses in Gallup and surrounding areas. The Arizona Water Settlements Act (S 437 – 108th Congress, January 20, 2004, §104, Allocation of the Central Arizona Project) provides that the Secretary is to retain 6,411 acre-feet of water from the Central Arizona Project for a future water rights settlement agreement. The State of Arizona and the Navajo Nation are in the process of determining which State water would be identified and accounted for to supply project demands. A diversion permit from the State of New Mexico would be required to divert water in New Mexico. Permits and/or contracts for using the Arizona water would be required and would be dependent on which source of water is used to supply the proposed project demand.

Jicarilla Apache Nation

The projected project water need for the Jicarilla Apache Nation is a total diversion of 1,200 AFY. All of this water would come from Navajo Reservoir to be supplied from

New Mexico State Engineer File No. 2849. This is part of the water obtained by the Jicarilla Apache Nation through the Jicarilla Apache Nation Apache Tribe Water Right Settlement Act, Public Law 102-441, October 23, 1992. This water would be made available through the existing Settlement Contract between the Jicarilla Apache Nation and the United States.

City of Gallup, New Mexico

The city of Gallup holds no water rights in the San Juan River and would be obtaining a long-term water supply contract for 7,500 AFY of water. The city has requested a water supply contract from Reclamation. As part of water right settlement and trust responsibilities, Reclamation asked the Jicarilla Apache Nation if it would be interested in providing this need with water it holds from its water rights settlement agreement. The Jicarilla Apache Nation was interested and is in the process of discussing terms and conditions of a long-term water contract with the city of Gallup (see attachment C). A long-term water supply subcontract between the city of Gallup and the Jicarilla Apache and/or the Navajo Nation and approved by the United States would consummate this arrangement.

Physical Description

The river intake would divert 33,118 AFY of water from the San Juan River from the water pool created by the existing PNM diversion dam. Water entering the intake would pass through a self-cleaning screen and then enter a sump where low-head pumps would lift the water into settling ponds for removal of suspended sediment. From the settling ponds, the water would enter a water treatment plant to be treated to meet safe drinking water standards. The treatment plant and pumping plant would occupy approximately 18 acres of land on the north side of the river just upstream from the existing PNM diversion dam.

The treated water would be pumped into the San Juan Lateral, a buried pipeline that crosses the San Juan River and ascends a mesa south of the river. Seven relift pumping stations would be constructed along the San Juan Lateral to keep the water flowing in the pipeline. The pipeline would extend south to Ya-ta-hey, New Mexico, and would connect to spur pipelines extending to Window Rock, Arizona; Gallup, New Mexico; and Crown Point, New Mexico. Navajo communities that have an existing water distribution system would have a storage tank and a method to increase (by means of a pumping plant) the pressure for proper distribution. In the city of Gallup, one new pumping plant would be constructed, three pumping plants upgraded, five new storage tanks constructed, and 32 miles of pipeline upgraded. The upgraded Gallup Regional System would be connected to five Navajo Nation water distribution systems on the outskirts of the city.

The Cutter Lateral would be constructed to carry water from Cutter Reservoir (an existing feature of the NIIP) to the eastern portion of the Navajo and Jicarilla Apache Nations. A water treatment plant would be constructed at the base of Cutter Reservoir to deliver treated water to the relift pumps and pipeline that make up Cutter Lateral. Existing Navajo Nation water distribution systems would be connected to the pipeline, and a tee with a blind flange would be provided for a future connection by the Jicarilla Apache Nation. Primary project features and their purposes are shown in table F-3.

Table F-3.—Primary project features and their purposes

Component	Purpose	Total project number
River intakes	Draw water from the San Juan River	1
River pump plants	Pump San Juan River water to treatment plant	1
Treatment plants	Treat water from San Juan River and the NIIP	2
Forebay tanks	Provide water for operation of relift pumping plants	19
Pumping plants	Force water through pipelines	24
Regulating tanks	Moderate fluctuations in system pressures	5
Community storage tanks	Provide for fluctuations in the water users' demands	25
Pipelines	Transmit treated water to point of distribution	266.4 miles

A typical relift pumping plant has a forebay tank, pumps and motors within an enclosed building, an air chamber, and re-chlorination equipment. The forebay tank provides an adequate supply of water to minimize the number of times the pumps cycle on and off. The air chamber provides protection of the pumping plant and pipeline when the pumps are started and stopped. Re-chlorination equipment provides the required chlorine residual in the treated water. The turnout pumping plants have the same components as the relift pumping plants except that a storage tank replaces the forebay tank. Figure F-4 shows a schematic of the proposed project's order of operation.

San Juan Lateral Water Treatment and Pumping Plant

The San Juan Lateral water treatment and pumping plant would include seven ultrafiltration units, seven ultraviolet (UV) disinfection units, a 797,000-gallon water tank, two waste water ponds, two sediment drying beds, mixing and flocculation tanks, chemical storage buildings, an operation and maintenance (O&M) building, a four-unit

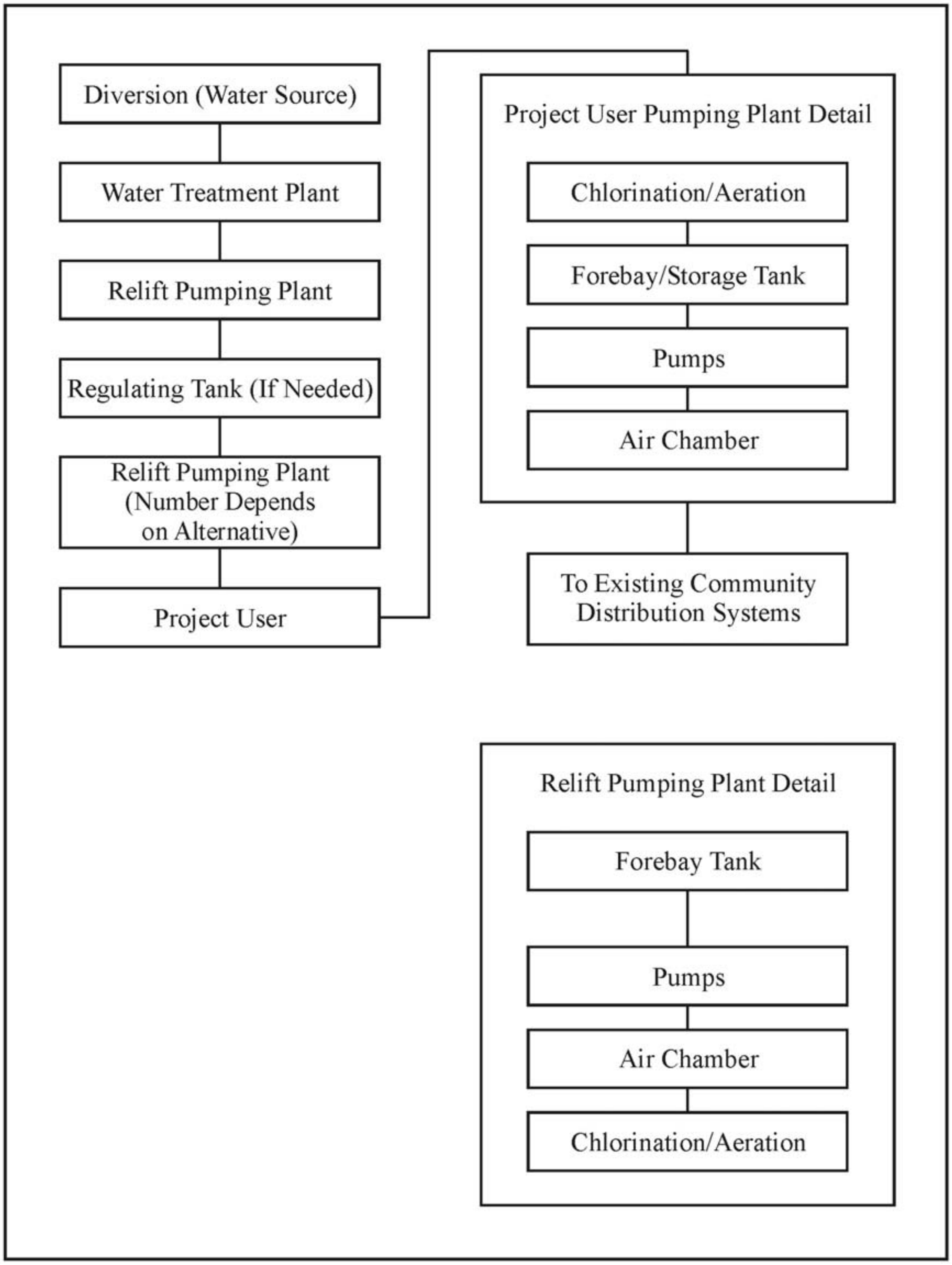

Figure F-4.—Typical schematic for the proposed project.

pumping station, and electrical control equipment. The capacity of the treatment plant would be approximately 38.25 million gallons per day (MGD) of water (59.19 cubic feet per second [cfs]).

The San Juan Lateral pumping plant would pump treated water into approximately 145 miles of buried 12- to 48-inch-diameter pipeline. From the pumping plant, the pipeline would cross the San Juan River upstream of the treatment plant and PNM diversion dam and ascend a mesa south of the river. From the mesa, the pipeline would extend west along the ROW of Navajo Highway 64 to U.S. 491. At U.S. 491, the pipeline would extend south along the highway ROW to Ya-ta-hey, New Mexico. At Ya-ta-hey, the pipeline would connect to spur waterlines extending to Window Rock and the city of Gallup. In the city of Gallup, one new pumping plant would be constructed, and three existing pumping plants, five storage tanks, and 32 miles of pipeline would be upgraded.

Seven booster pumping stations would be constructed along the San Juan Lateral. Each booster pumping station would occupy approximately 1 acre of land and would consist of a water tank, pumping plant, air chamber, chlorination building, and an electrical control structure. The San Juan Lateral would also include the construction of 17 water storage tanks, 3 water regulating tanks, junctions to the existing water supply systems, and a turnout to the NIIP and Navajo Nation chapters that do not have existing water supply systems.

The San Juan Lateral would serve the Shiprock, Burnham, Sanostee, Two Grey Hills, Newcomb, Sheep Springs, Naschitti, Tohatchi, Twin Lakes, and Mexican Springs Chapters. The Crown Point Lateral, which follows Navajo Route 9, would serve the Coyote Canyon, Standing Rock, Nahodishgish, Crown Point, Little Water, Becenti, Lake Valley, and White Rock Chapters. The Window Rock Lateral following Navajo Route 3 would serve the Rock Springs, Tsayatoh, St. Michaels, and Fort Defiance Chapters. The Gallup Junction Lateral would serve the city of Gallup and the Red Rock, Bread Springs, Chichillah, Manuelito, Church Rock, Iyanbito, Pinedale, and Mariano Lake Chapters. The proposed project would also include the construction of a new overhead electrical transmission line that parallels the San Juan Lateral pipeline and would provide power to the booster pumping stations.

The SJRPNM Alternative would also include construction of the Cutter Lateral pipeline. The Cutter Lateral would serve the Huerfano, Nageezi, Counselor, Pueblo Pintado, Ojo Encino, Toreon, and Whitehorse Chapters in the eastern portion of the proposed project area in New Mexico as well as the Jicarilla Apache Nation. The Cutter Lateral would originate at Cutter Reservoir and provide up to 4,645 AFY of water to the eastern service area. This lateral would include a water treatment and pumping plant that occupies approximately 3 to 4 acres of land. The Cutter Lateral water treatment and pumping plant would be smaller than the San Juan Lateral plant, but would contain much of the same equipment. The plant would include three ultrafiltration units, three UV disinfection units, a 112,000-gallon subsurface pumping plant forebay, two waste water ponds, mixing and flocculation tanks, chemical storage buildings, an O&M building, a four-unit pumping station, and electrical control equipment. The capacity of the Cutter Lateral treatment plant would be approximately 5.39 MGD (8.34 cfs).

The Cutter Lateral pumping plant would pump treated water into approximately 89 miles of buried 10- to 24-inch-diameter pipeline. The Cutter Lateral would include the construction of five 1-acre booster pumping stations, three community water storage tanks, and two water regulating tanks. Similar to that of the San Juan Lateral, an overhead electrical transmission line would be constructed along the Cutter Lateral to power the booster pumping stations. A substation would also be constructed to provide power from an existing PNM transmission line to the newly constructed transmission line.

Cutter Dam and Reservoir

The Cutter Lateral would serve communities in the eastern portion of the Navajo and Jicarilla Apache Nations by delivering water from Cutter Reservoir via the outlet works (see figure F-3). Water in Cutter Reservoir comes from Navajo Reservoir through an existing intake structure and a series of tunnels and siphons that would be operated throughout the year under the proposed project. The Cutter water treatment plant would deliver treated water to a pumping plant, which would then pump the water into Cutter Lateral for transmission to the various communities.

Service to Municipal Subareas

The 2040 population of the Navajo communities (1990 population with 2.48 percent annual growth rate) was used with an average daily water demand of 160 gpcd to determine the average daily demand. Surface diversion required for the proposed project was the average demand minus the available groundwater sources in each of the subareas. Supporting information can be found in volume II, appendix A. Peak daily demand was computed by multiplying the surface diversion for the proposed project by a 1.3 peaking factor. The peaking factor was derived from a 7-day average in mid-July. Navajo Nation communities that have an existing water distribution system would have a storage tank and a method to increase (by means of a turnout pumping plant) the pressure for proper distribution. Delivery locations in the transmission line that do not have an existing water distribution system would be provided with a tee and a blind flange for future use. The proposed project would connect to approximately 31 existing Navajo Nation municipal systems and would provide a pressure of 70 pounds per square inch at those locations. The storage capacity for each of the municipal systems was based on the individual service area 5-day demand for the year 2020 for those communities with existing water distribution systems.

The city of Gallup and Jicarilla Apache Nation surface diversion requirements are 7,500 and 1,200 AFY, respectively, for all years in the proposed project. An independent analysis (volume II, appendix B) conducted by the city of Gallup identifies the system requirements for the city and the surrounding Navajo communities served by the Gallup Regional System. No storage is provided for the Jicarilla Apache Nation.

WATER TREATMENT CONSIDERATIONS

Water Quality

Water from the Navajo Indian Irrigation Project

The water source for the Cutter Reservoir diversion is Navajo Reservoir. The water quality parameters, shown in table F-4, indicate that the only treatment requirements are filtration and disinfection as required under the Surface Water Treatment Rule (SWTR), which is part of the Safe Drinking Water Act (SDWA). Further sampling and analysis would be required before final design and construction to verify that the data presented in table F-4 are correct, especially during low- and high-precipitation years.

Table F-4.—Water quality (NIIP source water)

Parameter	Average[1]	Design range	Secondary maximum contaminant level (MCL)[2]
Electrical conductivity (umhos/cm)	195	205-187	
pH	7.72	7.75 – 7.71	
Temperature (degrees Fahrenheit)	46.7	49.1 – 45.3	
Turbidity (NTU)[3]	2.6	3.16 – 1.47	
Total suspended solids (mg/L)[4]	1.15	1.3 – 1	
Total dissolved solids (mg/L)	154	181 – 140	500
Sulfates, SO_4 (mg/L)	32.5	38.2 – 2.29	250
Total organic carbon (mg/L)	4.47	8 – 2.29	
Chlorides (mg/L)	1.6	1.9 – 1.2	250

[1] Data from three samples collected from the Cutter diversion April 2000 to June 2000.
[2] Secondary standards for MCLs are established by the Environmental Protection Agency for control of aesthetic qualities relating to public acceptance and include contaminants that may affect taste, color, odor, and appearance.
[3] Nestler Turbidity Units.
[4] Milligrams per liter.

San Juan River Diversion

The San Juan River, upstream of the PNM diversion, would provide water to the SJRPNM water treatment plant. Table F-5 provides water quality parameters. As shown, the water quality meets all primary standards established by the Environmental Protection Agency (EPA) for the parameters shown, resulting in the need for filtration and disinfection to meet the requirements of the SWTR. Several samples exceeded the total dissolved solids (TDS) and sulfates secondary standards. Sulfates and TDS are constituents that cannot be substantially reduced by the proposed ultrafiltration system. Further investigation is required to confirm the reduction of water quality due to the increase of TDS and sulfates associated with storm water runoff flows at the SJRPNM diversion points. Since this water cannot be treated by the proposed system, the following operation scenarios are suggested during major runoff events:

Table F-5.—Water quality (San Juan alternatives)

	PNM historic[1]		Design[2]	
Parameters	Average	Range	Range	Secondary maximum contaminant level (MCL)[3]
EC (umhos/cm)	538	1,102 – 276	632 – 214	
pH	8.1	8.7 – 7.7	8.7 – 7.6.	
Temperature (degrees Fahrenheit)	53	71 – 32.2	75 – 33	
Turbidity (NTU)[4]	166	1055 – 8	200 – 5.4[5]	
Total suspended solids (mg/L)[6]	876.6	1080 – 21	262 – 21	
TDS (mg/L)	362	772 – 145	1000 – 24	500[7]
SO_4 (mg/L)	140	322 – 65	200 – 38	250
TOC (mg/L)	5.7	10.5 – 2.9	4.76 – 2.89	
Chloride (mg/L)	14	23 – 6	26.6 – 2.91	250
T. hardness (mg/L)	163	232 – 84	232 – 84	

[1] Data for PNM is based on 34 samples collected at the diversion point between February 2003 through July 1, 2005.
[2] Design value for total suspended solids incorporates the reduction of turbidity and suspended solids by the pre-treatment settling pond.
[3] Secondary standards for MCLs are established by EPA for control of aesthetic qualities relating to public acceptance and include contaminants that may affect taste, color, odor, and appearance.
[4] Nestler Turbidity Units.
[5] All source water with a turbidity of over 200 NTU will need to be pre-treated by diversion through the settling ponds.
[6] Milligrams per liter.
[7] State of New Mexico secondary MCL for TDS is 1,000 mg/L.

Water hauling is necessary for a quality water supply
in parts of the Navajo Nation.

- Significant dilution may be provided in the SJRPNM settling ponds to reduce TDS and sulfate concentrations to below maximum contaminant level (MCL) limits.

- Storage capacity in the settling ponds, waste water polishing ponds, and treated water distribution system may be adequate to temporarily stop diverting water from the San Juan River to the treatment plant during large storm events. Once the concentrations of TDS at the diversion intakes are below 500 parts per million (ppm) TDS and 250 ppm sulfate, diversion of San Juan River water can resume.

Water Treatment

The water source for the SJRPNM Alternative is surface water from the NIIP and the San Juan River. The treatment systems used to provide drinking water to the consumers must comply with the SWTR.[1] The filtration and disinfection requirements under this rule protect consumers against the potential adverse effects of exposure to Giardia lamblia, Cryptosporidium, viruses, Legionella, and heterotrophic bacteria by requiring the inactivation of 99.9 percent (3 log) for Giardia cysts and 99.99 percent (4 log) for viruses.

The inactivation of potential pathogens, as required by the SWTR, is accomplished by the use of EPA-approved technologies for filtration and disinfection methods. Newly adopted regulations to address the risk of disinfection byproducts (DBPs) include the Disinfectants - Disinfection Byproducts Rule and the Interim Enhanced Surface Water Treatment Rule, which requires continual monitoring of filtered water turbidity and routine DBP levels in the distribution system.

The relatively high concentrations of total organic carbons (TOC) in samples from the NIIP and San Juan River water sources, as shown in tables F-4 and F-5, in combination with the long detention times required to convey the treated water to some of the delivery points, indicate a potential for the production of DBPs that may exceed current and future regulatory limits at the treated water service points or within the domestic water storage and distributions systems used to distribute the water to consumers. In order to determine the expected reduction in TOC concentrations by the proposed treatment system and the potential of DBPs production over time, bench-scale distribution simulation studies using chloramine and free chlorine disinfection should be done. If bench scale analysis indicates that the DBP limits are exceeded, additional treatment systems to remove the DBPs before consumption may be required in some locations.

Description of the Proposed Water Treatment System

The proposed water treatment system consists of enhanced coagulation, ultrafiltration, and ultraviolet disinfection to provide multiple treatment barriers for removal of organic molecules, Giardia, Cryptosporidium, and viruses. The use of chloramines to provide a disinfection residual during the conveyance of treated water from the treatment plant to the service areas will not only provide treated water that is not conducive to the formation of disinfection byproducts, but will also provide an additional disinfection barrier. Figure F-5 illustrates the proposal. Before final design and construction, a

[1] The SWTR was published in the *Federal Register* on June 29, 1989, and is promulgated by EPA as a National Primary Drinking Water Regulation for public water systems using surface water sources or groundwater under the direct influence of surface water.

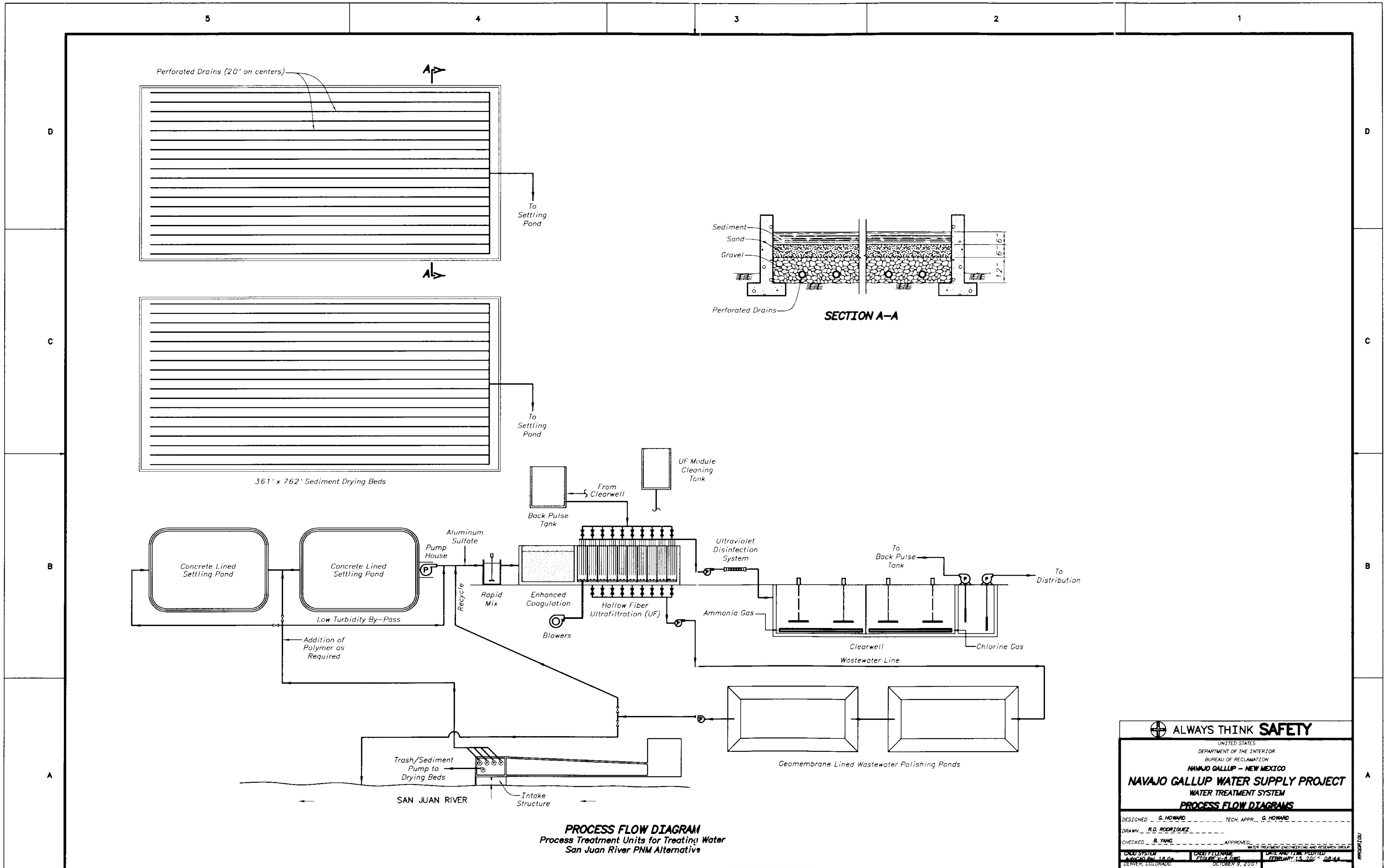
Perforated Drains (20' on centers)
A
To Settling Pond
To Settling Pond
361' x 762' Sediment Drying Beds
Sediment
Sand
Gravel
Perforated Drains
6"
6"
12"
SECTION A–A
Back Pulse Tank
From Clearwell
UF Module Cleaning Tank
Concrete Lined Settling Pond
Concrete Lined Settling Pond
Pump House
Aluminum Sulfate
Recycle
Rapid Mix
Enhanced Coagulation
Hollow Fiber Ultrafiltration (UF)
Blowers
Ultraviolet Disinfection System
To Back Pulse Tank
To Distribution
Ammonia Gas
Clearwell
Chlorine Gas
Wastewater Line
Low Turbidity By–Pass
Addition of Polymer as Required
Geomembrane Lined Wastewater Polishing Ponds
Trash/Sediment Pump to Drying Beds
SAN JUAN RIVER
Intake Structure
PROCESS FLOW DIAGRAM
Process Treatment Units for Treating Water
San Juan River PNM Alternative
ALWAYS THINK SAFETY
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
NAVAJO GALLUP – NEW MEXICO
NAVAJO GALLUP WATER SUPPLY PROJECT
WATER TREATMENT SYSTEM
PROCESS FLOW DIAGRAMS
DESIGNED G. HOWARD
TECH. APPR. G. HOWARD
DRAWN R.D. RODRIGUEZ
CHECKED B. YANG
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH GROUP
DENVER, COLORADO
OCTOBER 9, 2001
RRODRIGU

Figure F-5

comprehensive pilot-scale operation of each process will be required to verify the effectiveness and operation of each unit process and resultant water quality.

Water Treatment Plants.—The proposed water treatment plants primarily include buildings that would house most of the water treatment features already described. Figure F-5 displays the water treatment plant structures (all plant structures, except intakes, must be located above the 100-year flood plain).

Main Treatment Building – The main treatment building would be approximately 24,500 square feet with a second floor mezzanine that would be approximately 22 feet wide and 122 feet long. The proposed building would be a pre-engineered, pre-fabricated structure with metal siding and suitable insulation and ventilation to meet the building code requirements of the State of New Mexico and all other applicable code requirements. The building would house the 10-foot-tall flocculation basins, 10-foot-tall concrete tanks containing the ultrafiltration modules for each train, UV units, vacuum pumps, and internal piping. The second floor mezzanine would contain the control room for the filters and UV units, air blowers used for module cleaning, and the motor control center. The chlorine storage room and ammonia storage room would be included in the main building, but would have outside entrances and separate heating, ventilation, and air conditioning (HVAC) systems to eliminate the risk to the operators if leakage occurred in any of the cylinders. The building is designed to house the treatment system required to meet 2040 demands.

The chlorine and ammonia storage room would house the 1-ton containers of each gas along with the chlorinators and ammoniators, which would meter the gases into the clear well for mixing. Trunnions are provided in the storage room to provide for the storage of full containers to meet a 2-month demand along with spare trunnions for storage of an equal amount of empty or full containers.

NIIP Cutter Diversion Treatment Plant – The Cutter diversion water treatment plant is a scaled-down version of the main treatment plant, with a building area of approximately 4,600 square feet. Like the larger plant, the flocculation basins would be located inside the building to protect the water from windblown sand and freezing temperatures. Due to its reduced size, all treatment components for the Cutter treatment plant would be located on a single floor.

Regional O&M Buildings – The preferred alternative (SJRPNM) includes a 2,500-square-foot regional O&M building located within the treatment plant compound. Buildings would be on a slab on grade with 15-foot eave heights. The facility would be used for spare equipment/parts storage and for maintenance areas relating to the treatment, conveyance, and pumping of water for the proposed project.

Clear Well – The below-grade clear well would provide a detention time of 30 minutes and would include injection manifolds, baffles, and mixers to properly mix ammonia and chlorine with treated water. After chloramination, the treated water would be pumped by the service pumping station into the distribution system.

Waste Water Storage/Treatment Ponds – Water generated during the routine cleaning of the filters would flow into one of two passive treatment ponds. In these ponds, fine suspended solids filtered by the hollow fiber system would be settled out and removed from the site. After passive treatment, the water could be conveyed back into the treatment plant, discharged back into the source, or discharged to surface waters. The useful life of a pond is estimated to be between 10 to 15 years before settled sediment would need to be removed and conveyed to the sediment drying beds. Each pond would be lined with a 45-mil-thick geomembrane system to reduce the impact on regional groundwater.

Sediment Drying Beds – With the construction of a new diversion upstream from the existing PNM diversion dam, all sediment removed by the intake structure and settling ponds would have to be retained and ultimately disposed of off-site. The determination of the frequency of pond cleaning, volume of sediment, volume of dried sediment, size of required sediment drying beds, and resulting O&M costs in this report was based on one water quality sample taken during one storm event. This event occurred on August 23, 2000, and analyses indicated a turbidity reading over 23,000 Nestler Turbidity Units (NTU) units and a suspended solids loading of over 15,000 milligrams per liter (mg/L). The drying bed size and costs should be taken as preliminary because additional sampling and analyses would be required prior to design and construction. Using this data point, the lead pond would need to be dredged of sediment after every 10 days of storm runoff, and two sediment drying beds with a surface area of approximately 6 acres each would be required. When the sediment in the 10-foot-deep lead pond became 2 feet deep, approximately 130,000 cubic feet of sediment would need to be removed and placed on one of the drying beds. The excavated sediment would be applied at an approximate depth of 6 inches on the surface of each bed.[2] The system would remove water from the sediment by drainage and evaporation, reducing the water content by approximately 50 percent with a dried sediment depth of 2.5 to 3 inches. Once dried, the sludge would be removed from the top of each bed and transported to a nearby abandoned open pit coal mine for final disposal. O&M costs associated with excavation and transport of sediment collected from the settling ponds are based on two cleaning cycles per year.

Sediment Removal Ponds – The settling basins considered in this alternative are required to reduce turbidity of the San Juan River water before treatment. Most of the

[2] Beds consist of perforated polyvinyl chloride pipes located in a gravel under-drain system. Sand would lie on top of the gravel.

sediment contained in the source water would be removed by the intake and the proposed settling ponds. Each pond is designed with a 3-hour detention time, providing optimum conditions for the reduction of turbidity to acceptable limits before treatment by the enhanced coagulation and ultrafiltration systems. Settling tests using San Juan River water (collected during a high turbidity of 4,266 NTU) have verified that a two-pond system with each pond to provide a detention time of 3 hours would be sufficient to reduce turbidity to acceptable limits before treatment. The settling basins would have minimal effects on the quality of the water, with the exception of some dilution of high TDS and sulfate concentrations occurring during high runoff conditions. To reduce the impact of the ponds on regional groundwater through infiltration, and to avoid the need to replace the liner after each sediment removal event, each pond would be lined with 6 inches of reinforced concrete. The settling pond(s), sized to meet the hydraulic requirements for the demand year 2040, are based on a 6-hour detention time and have the following specifications:

- Influent flow rate of 38.25 MGD
- A required volume of 9,653,000 gallons in settling pond(s)
- A surface area of 1.72 acres with a 10-foot depth and 1:1 side slopes

Source water from the NIIP would not require settling basins because the water would have already passed through a large surface impoundment that acts like a settling basin.

Enhanced Coagulation – In waters that have variable annual turbidity or moderate-to-high TOC concentrations, ultrafiltration systems typically include an enhanced coagulation step prior to filtration to coagulate small suspended materials in the water and to increase the filtration efficiency. This process increases the removal of organic matter before disinfection to meet the requirements of the Stage 1 and Stage 2 DPB Rule. This pre-treatment process uses aluminum sulfate or other coagulants in such a manner that the type and dosage can only be determined by laboratory and field tests (assuming aluminum sulfate would be the coagulant of choice and the required concentration would be 30 mg/L).

Hollow Fiber Ultrafiltration Treatment System – Previous studies have evaluated the potential for using conventional, diatomaceous earth and microfiltration/ultrafiltration for the treatment of surface waters associated with this project. A discussion of these studies is included in volume II, appendix A, section 8.5. Based on this analysis, ultrafiltration using hollow fiber membranes along with enhanced coagulation is the proposed method for filtration because the system is (1) able to treat water with varying turbidity, (2) able to meet current and future regulatory standards, and (3) easy to operate and maintain.

The hollow fiber ultrafiltration treatment system physically removes suspended particles greater than 0.1 micron in diameter by having a nominal and absolute pore size of 0.035 and 0.1 micron, respectively. Particles found in surface water that exceed this size range are easily filtered. These particles include Giardia (5–15 microns in size), Cryptosporidium (4–6 microns in size), large viruses, and large organic molecules. The continuous hollow fiber ultrafiltration system manufactured by US Filter (CMF-S) or Zenon (ZeeWeed) are bundles or cassettes of tubular membranes that filter water through microscopic holes. Designed for large-scale systems, the pre-engineered cassettes are submerged into open-top concrete or steel tanks.

Ultraviolet Disinfection Units – Disinfection after ultrafiltration would be accomplished by state-of-the-art flow-through UV disinfection units that are located on the filtered water discharge line from each ultrafiltration treatment train. Each unit would consist of a stainless steel chamber containing eight UV lamps, an automatic cleaning system, a UV monitoring system, and a control cabinet. Each unit would provide a minimum UV dose of 40 microjewels per square centimeter to the filtered water before being routed to the clear well.

The proposed UV units would add an additional 3 log (99.9 percent) reduction of Giardia and Cryptosporidium and an additional 4 log (99.99 percent) reduction in viruses to the water following the ultrafiltration process. Based on this information, the unit processes of ultrafiltration and UV disinfection would provide a reduction of 9 log for Giardia and Cryptosporidium and 6 log for viruses. This reduction would far exceed the SDWA requirements.

Chloramination – The mixing of filtered and disinfected water with ammonia gas followed by chlorine gas in the clear well would provide a chloramine residual prior to being pumped by the service water pumping plant into the treated water mains leading to the service areas. This form of residual is being used to reduce the development of DBPs that would be generated by extended contact times in the conveyance and storage facilities if a free chlorine residual were used. Other benefits of a chloramine residual include prevention of taste and odor problems and the fact that the chloramine residual would last longer in the treated water transmission line and storage system, thus eliminating the number of re-chloramination stations (Reclamation, 2002).

Other Treatment Components.—

Chloramine Booster Stations – Each pumping plant would contain a chloramine booster station that would monitor the chloramine residual of the incoming water and automatically add, as required, additional chlorine to maintain the 0.5 ppm residual to the water being pumped by the plant. The capital and O&M costs of these re-chloramination systems are included as part of the unlisted items in the water treatment cost estimate.

Water Blending – Blending of good water quality produced by the proposed surface water treatment plants with low quality groundwater presently used by the city of Gallup and many of the Navajo Nation communities may increase turbidity in the mixed water.

Increased turbidity, a secondary MCL, in the blended water would decrease the aesthetic quality of the water. In order to predict and compensate for any reactions, a detailed water quality analysis for each well system is required. These data would then be used in the "Rothberg, Tamburnini & Windsor Model for Corrosion Control and Process Chemistry" or a similar model to predict turbidity formation. If the modeling determines chemical addition(s) are required to eliminate the formation of turbidity, followup laboratory verification is required. In order to provide funding for modeling and potential chemical injection systems, a 10-percent unlisted additive is included in the capital cost for each treatment system and each demand. To account for potential O&M costs of these systems, a 10-percent miscellaneous additive is provided.

Disinfection Byproduct Treatment – Included in the unlisted percentage in the capital cost for each alternative is funding for the installation of aeration systems and re-chlorination systems at each service point to remove DBPs that may be created during conveyance.

Pilot Plant Operation – Prior to final design of the selected alternative, a pilot study using the proposed treatment system would be required to optimize each treatment process and collect design data. The pilot plant should operate 24 hours a day over a minimum of 12 consecutive months to determine treatment requirements with changing water conditions. A line item providing a sum of $200,000 to fund the pilot study is included in the capital cost. The study would provide or determine:

- The most efficient chemical to use for coagulation
- Chemical injection rates based on changing water quality
- Backwash requirements and membrane cleaning requirements
- Waste water quality and production rates
- The potential for DBP formation during conveyance
- Operation requirements
- The ability of the treatment system to meet current and future regulatory standards
- Data to update capital and O&M costs
- Training for future operators on the full-scale treatment system

Operation.—The overall operational system would monitor the demands in the treated water distribution system and activate/deactivate the treatment system to maintain required water levels or pressures in the treated water storage tanks. When in operation, the water treatment system master control panel would control the local control panels (LCP) for each treatment process. During automatic operation, the water treatment master control system monitors all LCPs and provides inputs for adjustments for optimal treatment efficiency. Operators would be required to monitor operations 24 hours a day, along with routine duties such as calibrations of turbidity meters, chemical injection equipment, residual monitors, inventory control, and monthly reports. This control system would be integrated into the overall project control system.

Plant Operators.—Plant operation for all treatment plants and all demands would require a total staff of six personnel (four operators, one maintenance person, and one supervisor). The staff would ensure that at least one operator was at the plant during operation with suitable maintenance and supervisory support.

Chemicals.—Chemicals required include those for routine cleaning of the hollow fiber membranes, aluminum sulfate to flocculate the small suspended particles in the source water, and chlorine and ammonia gas to form a chloramine residual to keep the water disinfected during its transport from the treatment plants to service.

Power.—The annual cost for power to operate each plant would include power to operate vacuum pumps, air compressors, UV disinfection units, low-head lift pumps, lights, and HVAC units and a percentage increase for other loads required for operation of a large water treatment facility. For the Cutter diversion, a low lift pump would divert water from the waste water polishing ponds to the plant influent for recycling. Three low-head lift stations would be required for the SJRPNM component—one to transfer water from the river diversion to the settling ponds, one to transfer water from the settling ponds to the water treatment plant, and one to recycle water from the waste water ponds to the water treatment plant. To provide uninterrupted treated water, the New Mexico Environmental Department requires backup generators to be provided for all potable water treatment plants. These generators need to be rated to meet the power requirements during the average daily flow or 70 percent of the design flow.

Replacement of Equipment.—Annualized equipment replacement costs include annual replacement of UV light bulbs, the replacement of all hollow fiber cassettes every 10 years, and the replacement of mechanical equipment every 15 years. Details on the annualized cost of each are provided in volume II, appendix B.

Dredging and Disposing of Sediment.—When the settling and waste water polishing ponds contain a maximum of 2 to 3 feet of sediment, a dragline would be used to remove the sediment in the SJRPNM settling pond and each of the waste water polishing ponds. The sediment would be dried on the sand drying beds and, when dry, would be transported off-site for disposal. The estimated frequency for dredging and disposing of sediment is every 10 days of storm runoff for the SJRPNM lead settling pond and every 15 years for the waste water polishing pond.

PROJECT LAND, RIGHTS-OF-WAY, RELOCATIONS, AND DAMAGES

The proposed pipeline corridor needs a 60-foot-wide permanent ROW and a 150-foot temporary ROW (the total length of the pipeline is approximately 262 miles). Of this corridor, 8 percent is allotted Navajo Land, and 57 percent is Navajo Reservation Fee and Trust Land. The remainder is divided among a number of State, Federal, and private ownerships. The distribution of the land status is shown in table F-6. Existing utility ROW will be used where possible.

Table F-6.—Land status of the Navajo-Gallup water supply pipeline

Land status	San Juan River Alternative (miles)
Main Navajo Reservation	126
Checkerboard area	
Bureau of Land Management	39
Indian allotment	22
Navajo Fee land	11
Navajo Trust land	12
Private	36
State	13
Other	4
Total	262

The Navajo Nation Department of Natural Resources recommended that project parameters assume that the ROW within the Navajo Nation would be donated with no direct cost. Damages and necessary relocations associated with facility construction would be a project cost. It is also assumed that there would be no direct project costs for ROW on Federal and State land. The Navajo Nation requires that an appraisal of the proposed ROW be conducted. This evaluation is based on the beneficial use of the land and the value of the product in the pipeline. The fair market value of the corridor through the allotted land is between $240,000 and $480,000, and the fair market value of the corridor through Tribal Trust Land is between $14.1 and $23.5 million.

Pipeline construction.

As described in the Code of Federal Regulations 25 Part 169 – Rights-Of-Way Over Indian Lands, the Bureau of Indian Affairs (BIA) has a multi-step process for establishing ROWs across Trust Land (information on the specific procedures is available from BIA). Depending on the number of Indian land allotments crossed by the proposed project corridor, the ROW procedures may be complicated. The land affected must be appraised, the individual allotment owners must be contacted and informed, and consents for the proposed project must be obtained. This process could take 18 months or longer. The cost of this process is included in the non-contract costs associated with the proposed project.

Depending on the specific pipeline location, approximately 36 miles of the alignment could be on private land. It is assumed that there would be no direct project cost for obtaining this ROW.

The water treatment plant at the San Juan River diversion is to be located on private land. A 20-acre piece of land would be required. Six families will be re-located and their houses and land purchased at fair market value.

Cultural Resources

Although the SJRPNM Alternative is decidedly less impacting to cultural resources than the NIIP alternatives, significant impacts would result from the proposed project. An analysis predicts that approximately104 historic properties would exist in the Area of Potential Effects of the preferred alternative. Of the 104 properties, it is anticipated that approximately 83 of them would require some level of mitigative treatment—either archeological testing or full data recovery. The contract costs for performing such work (as estimated in December 2002) are estimated at $5.7 million. Other cultural resource costs include ethnographic investigations; identification and evaluation of in-use areas; non-contract (administrative) costs; consultation with Navajo Nation chapters and State, Tribal, and Federal entities; Native American Graves and Repatriation Act repatriation; unanticipated contingencies; and museum curation of cultural materials. Therefore, the total cost of a cultural resources program is estimated to be a maximum of 4% of the total project cost, $34.5 million (based on January 2007 prices). Other projects in the region, the Dolores and Animas LaPlata Projects, have needed this level of cultural resource program funding.

Environmental Mitigation

The construction of the proposed project diversion, treatment plant, pumping plant, and pipeline within the San Juan River Valley would impact approximately 25 acres of riparian and wetland area. Assuming a 3:1 mitigation ratio, 75 acres of similar adjacent land would be purchased or a permanent ROW obtained. This land's riparian and wetland characteristics would be enhanced through land management (i.e., fencing, grading, weed control, and planting vegetation).

Construction of the proposed project pumping plants and storage tanks along the pipeline would impact approximately 50 acres. It is anticipated that an equal number of adjacent lands would be improved through range enhancement (i.e., fencing, seeding, and constructing wildlife watering stations). Construction of the Cutter Lateral treatment plant and pumping plant would impact approximately 10 acres. It is anticipated that an equal number of adjacent lands would be improved through seeding, fertilizing, and mulching. Pipeline construction would impact an area up to 300 feet wide along the pipeline alignment. It is anticipated that this area would be re-seeded, fertilized, and mulched to restore the vegetation. This re-seeding would occur as sections of the pipeline are constructed.

CAPITAL AND OM&R

Project Construction, Ownership, and OM&R

Project facilities would be constructed through Reclamation. Ownership of all of the proposed project facilities would remain with Reclamation until a point in the future when the Navajo Nation and the city of Gallup would be capable, by mutual agreement, of taking over ownership. Until facilities are transferred from Reclamation, project OM&R would be the responsibility of Reclamation through contract to the Navajo Tribal Utility Authority (NTUA) and the city of Gallup. The costs of OM&R would be paid by the NTUA and the city. This arrangement would be detailed in an agreement among the entities. It is anticipated that the entire project's ownership and OM&R responsibility would be transferred to the Navajo Nation and the city of Gallup. The Jicarilla Apache Nation would pay its share of the project's OM&R costs and be party to all agreements pertaining to this proposed project's ownership and OM&R.

The appraisal design and construction cost estimate was provided by Reclamation's Denver Technical Service Center (TSC). This information was documented in the *Appraisal Level Designs and Cost Estimates Report*, April 2002 (volume II, appendix B). A peer review of the designs and cost estimates was performed by Boyle Engineering Corporation in February 2004. Based on results from this review and using current unit costs of materials, the TSC revised the proposed project construction cost estimate in April 2007. A summary of this April 2007 cost estimate is shown in table F-7 (based on January 2007 dollars).

Reclamation historically supports projects for construction after a feasibility report is completed, which includes a feasibility-level cost estimate. This appraisal-level cost estimate does not meet that requirement. Additional analysis, detail, and updates of the appraisal-level cost estimates presented in this draft report are needed before project construction authorization can be supported. Failure to complete this additional effort may result in reliance on a cost estimate for the proposed project that is not sufficient to characterize the expected cost. The appraisal-level design must be upgraded to feasibility level before Reclamation would begin construction. The cost of, and time for, completing this additional work would be substantial.

OM&R costs include electrical power, chemicals for water treatment, repair and replacement of components of the facilities, and personnel required to operate the system. Power costs were calculated using the January 2007 costs from the local power provider, NTUA, and the Colorado River Storage Project (CRSP). This analysis also included estimating the cost using power from the CRSP, and the economic analysis used NTUA and CRSP power rates for comparison purposes. Table F-8 details the OM&R costs.

Table F-7.—Preferred alternative cost estimate

Feature	Reclamation April 2007 cost estimate ($)
Pipelines	202,546,620
Pumping plants	28,355,000
Water treatment plants	53,673,055
Tanks and air chambers	85,575,000
Transmission lines	26,677,200
Turnout structure	1,707,380
Gallup Regional System	25,754,500
Subtotal	424,288,755
Mobilization (5%)	21,000,000
Unlisted items (10%)	44,711,245
Subtotal	490,000,000
Contingencies (22.5%)	110,000,000
Subtotal (field costs)	600,000,000
Noncontract costs (27%)	162,000,000
Subtotal	762,000,000
New Mexico taxes on field costs (estimated at 6%)	36,000,000
Navajo Nation taxes on field costs, excluding Gallup Regional System field cost of $30 million (estimated at 3%)	16,900,000
Subtotal	814,900,000
Land, relocation, and damage[1]	9,000,000
Cultural resource mitigation	34,500,000
Environmental mitigation	6,000,000
Total project cost	864,400,000

[1] The estimate includes ROW costs for the San Juan treatment plant only. Should it be determined that ROW for the rest of the features needs to be included in the project costs, an additional $30–60 million should be added.

Table F-8.—Yearly OM&R costs ($) (SJRPNM Alternative)

Item	San Juan Lateral	Cutter Lateral	Gallup Regional System
NTUA power costs (relift pumping plant)	4,962,000	597,000	82,000
CRSP power costs (relift pumping plant)	1,841,000	221,000	31,000
NTUA power costs (booster pumping plant)	215,000	35,000	
CRSP power costs (booster pumping plant)	80,000	13,000	—
Relift pumping plant OM&R	3,170,000	1,245,000	723,000
Booster pumping plant OM&R	78,000	12,000	
Canal OM&R	—	35,000	—
NTUA power cost water treatment plant	511,000	63,000	—
CRSP power cost water treatment plant	187,000	22,000	—
Water treatment OM&R	2,605,000	1,064,000	—
NTUA water treatment, miscellaneous 10%	312,000	113,000	
CRSP water treatment, miscellaneous 10%	279,000	109,000	
Power transmission OM&R	350,000	Included in San Juan Lateral	
Pipeline OM&R	801,000	187,000	57,000
Total NTUA	13,004,000	3,351,000	862,000
Total CRSP	9,391,000	2,908,000	811,000
Relift pumping plant power consumption (kilowatts [kW])	16,219	2,026	305
Booster pumping plant power consumption (kilowatts)	784	128	
Water Treatment Plant power consumption (kilowatts)	1,588	224	
Total kW	18,592	2,379	305

Notes: (1) CRSP rate is10.43 mils/kilowatthour and demand charge of $4.43 per kW/month.
(2) CRSP total project power cost is $2,395,000.
(3) NTUA rate is 20 mils/kilowatthour and demand charge of $16.50 per kW/month.
(4) NTUA total project power cost is $6,465,000.
(5) Cost reflects April 2007 project cost estimate with January 2007 price level.

Construction and Associated Costs

Interest During Construction

A project construction schedule was developed to support the economic analysis and help the proposed project beneficiaries plan future water supplies. The first objective of the schedule was to provide water to people in the shortest time period to get the earliest possible benefit from the proposed project. Consideration was given to constructing Cutter Lateral first to give the operators some years of experience operating a smaller scale facility before operating the very similar but larger facilities of the San Juan Lateral.

The Cutter Lateral would be constructed first. The San Juan Lateral from Twin Lakes to Window Rock and the Gallup Regional System would be next. This section of lateral would draw groundwater from the Twin Lakes area until surface water would be available from the San Juan River. The San Juan Lateral from the San Juan River to Twin Lakes and to Crownpoint would be the last segment constructed.

A construction schedule was developed based on the assumed limitation of $60 million in appropriations annually until project completion. The schedule shown in table F-9 shows the assumed yearly expenditures by feature from project construction start to finish. The schedule was used to estimate interest accrued on potentially borrowed money during construction and to estimate when people would receive water—the start of project benefits.

Cost Allocation

The purpose of cost allocation is to assign shares of the overall project costs to the various participants. The proposed project would provide municipal water supplies to three participating groups—the Navajo Nation, the city of Gallup, and the Jicarilla Apache Nation. The overriding philosophy in allocating project costs is that the three participants are equal partners in the proposed project.

Costs are separated into capital, fixed OM&R, and variable OM&R costs. Each of these cost categories is further divided into specific project reaches and then allocated to the participating parties. The analysis assumes that construction would begin in 2011, with a construction budget of approximately $60 million per year, and full project completion by January 1, 2027. The details of the cost allocation are documented in volume II, appendix D.

In allocating costs, specific project components were separated out by those that would be dedicated for the exclusive use by any single participant; the cost of those ***dedicated components*** was assigned to the beneficiary participant. These dedicated components typically include water storage tanks and pressurization pumps at most of the major delivery points. The bulk of the proposed project cost, however, is for components that would benefit more than one participant. These joint costs were allocated among the project participants to derive each participant's share of the total costs.

Joint costs were allocated according to the following principles:

- ***Capital costs were allocated according to each participant's share of design capacity***. The idea is that the size and cost of the facilities depend on each participant's desired capacity and not on average use or use in any particular period.

- ***Fixed OM&R costs were also allocated according to each participant's share of design capacity***. Here again, the fixed OM&R costs (staff size, dredging, equipment replacement, and pump maintenance) are primarily a function of the design capacity, not of flows in any particular period.

- ***Variable OM&R costs were allocated according to each participant's share of annual water deliveries***. The variable OM&R costs consist mainly of energy and water treatment chemical costs. These costs vary according to the water flows in any period, so the method used to allocate these costs assigns cost shares in each year according to the projected use in that year.

The proposed project envisions water deliveries at many locations along two main laterals. Every delivery changes the relative shares of the water flow that continues along the pipeline beyond the delivery point. Because, as described above, the relative share of design capacity and projected flow serve as the basis for the cost allocation, the cost allocations change after every delivery point. Therefore, each pipeline branch has been separated into specific ***reaches*** that are defined as the intervals between each two succeeding delivery points. The diversion structure and water treatment plant on each branch is also treated as a separate segment or reach. Each participant's share of design capacity on each reach was computed in order to serve as the basis for allocating capital and fixed OM&R costs.

Gallup Regional System Costs

The design work and cost estimates for the Gallup Regional System were first prepared by DePauli Engineering (DePauli Engineering and Surveying Company, 2002). Reclamation used the DePauli design but re-estimated much of the cost. Some of the Gallup Regional System components were included in Reclamation's cost estimates for the overall system (e.g., Navajo Nation chapter water storage tanks), but most components were listed separately as Gallup-specific. The components included with the other Reclamation elements were treated as part of the overall system cost allocation. The remaining items (all joint facilities) were allocated by their cost to participants based on their respective shares of design capacity. The OM&R costs were estimated as

Table F-9.—Construction schedule (cost in $ millions)
($60 million/year schedule)

	Year																
Construction phase	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Total**
Navajo-Gallup Water Supply Project	2.35	4.29	22.32	11.91													40.86
Cutter Lateral	5.99	7.53	4.27	16.20	16.14	21.72	21.70	17.19	7.41								118.14
Twin Lakes/ Window Rock	0.78	0.21				19.94	30.76	2.23									53.92
Cutter Power	0.72	0.73	0.73		3.00	3.27	6.60	9.59									24.63
San Juan Power		0.78	1.57					6.00	18.26	0.00							26.61
Gallup Regional System	0.40	4.37	20.33	26.66	28.09												79.85
San Juan Lateral		8.47	3.63		7.78	15.07	0.94			33.18	32.74	53.00	60.00	54.31	57.03	34.91	361.04
San Juan Pumping Plant		3.51	1.16					8.16	16.00		8.48	7.00		5.69	2.97		52.97
San Juan Water Treatment Plant	5.33	2.48						16.85	18.33	26.83	18.78						88.59
Cutter Water Treatment Plant	1.11	0.46	6.00	5.23	4.99												17.79
Total allocated spending	16.67	32.82	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	34.91	864.40
Percent distribution	1.93%	3.80%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	4.04%	100.00%
Overall spending	16.68	32.84	60.04	60.04	60.04	60.04	60.04	60.04	60.04	60.04	60.04	60.04	60.04	60.04	60.04	34.94	865.00
Interest during construction to January 1 of year 14	18.20	32.65	54.12	48.81	43.75	38.93	34.33	29.94	25.76	21.77	17.97	14.34	10.88	7.59	4.44	0.84	404.34

Note: The construction schedule assumes that annual appropriations will be indexed to keep in step with construction cost trends.

a lump sum (one each for the CRSP and NTUA energy rates). This overall annual OM&R cost was allocated to the participants based on their respective shares of design capacity.

The city of Gallup's cost of purchasing 7,500 AFY of water that would be conveyed by the proposed project is included. At this point, the city of Gallup has not reached an agreement with any water supplier, so the cost estimates may change. For purposes of this analysis, the price per acre-foot of water was estimated at $110, beginning when the city takes water in 2027. No financial cost for the water to be delivered to the Navajo and Jicarilla Apache Nation communities was included, although there may be some non-financial consideration between those two participants.

Cost of Water

In the absence of a water right settlement that establishes different terms, it is assumed that the Navajo Nation would pay for municipal and industrial water from Navajo Reservoir. These payments were estimated by Reclamation to have a present value of $108.45 per acre-foot. The Jicarilla Apache Nation presently has rights to water they intend to use in the proposed project. It is assumed that there would be no cost for their water, as described in their Navajo Reservoir water supply contract.

The city of Gallup, however, will have to pay for obtaining water from a water right holder. The present value of a tentative purchase arrangement is $20 million. Table F-10 shows how this cost translates to the levelized rate needed to cover the projected payments for water.

Table F-10.—Levelized water cost per thousand gallons (2007$)

	Navajo Nation	City of Gallup	Jicarilla Apache Nation	Project total
Present value of water costs	3,300,617	32,605,398	0	35,906,016
Annual amortization of water costs	177,317	1,751,636	0	1,928,953
Annual equivalent water deliveries (1,000 gallons)	9,889,759	2,443,890	560,120	12,893,770
Levelized cost per thousand gallons	0.02	0.72	0.00	0.15

Cost Allocation

Table F-11 summarizes the above analysis. The table addresses the capital, annual OM&R, and present value of OM&R costs for a scenario that assumes a construction budget of $60 million per year. The table combines total construction costs, including taxes for the Reclamation-designed system and for the Gallup Regional System. Allocated costs were added for environmental mitigation, cultural resources, and land acquisition, then interest during construction was added. The present value of the annual fixed plus variable OM&R costs (discounted at 4.875 percent) was calculated and estimated under both the CRSP and NTUA energy rates. All financial costs are expressed as of the beginning of the year 2027, the year in which the proposed project would be completed. Interest during construction and interest on pre-project completion water purchase fees are compiled up to January 1, 2027, and post-completion OM&R and post-completion water purchase fees are discounted to January 1, 2027. Next, the total present value of all costs, including capital, fixed OM&R, and variable OM&R costs, is shown. Table F-11 allocates these costs to each of the participants. All costs are based on January 2007 price levels.

Figures F-6 and F-7 illustrate the components of overall cost. Figure F-6 shows how total project costs are split among capital cost, interest during construction, the present value of future OM&R costs, and the present value of water cost. Figure F-7 shows how total project costs are allocated to the three project participants. Figures F-8, F-9, and F-10 show how the cost allocated to each project participant is composed of capital, interest during construction, OM&R, and water costs. Figure F-11 shows what the levelized cost per thousand gallons would be to each project participant, assuming full self-funding.

ECONOMIC BENEFIT/COST ANALYSIS

This economic analysis section is distinct from a financial analysis because an economic analysis is concerned with the generation and use of societal resources instead of the financial analyses' focus on tracing cash receipts and expenditures. Because Reclamation is overseeing the planning of the proposed project and its participants are seeking monetary support from the Federal Government, the resources of concern are those of the United States as a whole. The principal differences between this economic analysis and a financial analysis are:

- Inclusion of non-cash project costs that would affect third parties (diminished power generation and increased salinity effects)

Table F-11.—Present value of total costs (2007)

Total capital costs by user				
	Navajo	**City of Gallup**	**Jicarilla Apache Nation**	**Total**
Allocated construction costs – main system	$620,700,000	$115,800,000	$30,400,000	$766,900,000
Allocated capital costs – Gallup Regional	18,600,000	29,900,000	0	48,500,000
Allocated environmental mitigation cost	4,700,000	1,100,000	200,000	6,000,000
Allocated cultural resources cost	27,100,000	6,200,000	1,300,000	34,600,000
Allocated ROW cost	7,100,000	1,600,000	300,000	9,000,000
Total project capital cost before interest	678,200,000	154,600,000	32,200,000	865,000,000
Allocated interest during construction	317,000,000	72,300,000	15,100,000	404,300,000
Total project capital cost	995,200,000	226,900,000	47,300,000	1,269,400,000
Rounded values	995,000,000	227,000,000	47,000,000	1,269,000,000

Annual OM&R costs by user (at design capacity)				
CRSP rates	**Navajo**	**City of Gallup**	**Jicarilla Apache Nation**	**Total**
Allocated OM&R costs – main system	$9,542,654	$2,075,238	$743,636	$12,361,528
Allocated OM&R costs – Gallup Regional	311,000	500,000	0	811,000
Annual cost of water	177,317	1,751,636	0	1,928,953
Total allocated OM&R costs	10,030,971	4,326,874	743,636	15,101,481
Rounded values	10,000,000	4,300,000	700,000	15,100,000
NTUA rates				
Allocated OM&R costs – main system	12,594,137	2,977,044	846,194	16,417,375
Allocated OM&R costs – Gallup Regional	330,000	532,000	0	862,000
Annual cost of water	171,317	1,751,636	0	1,928,953
Total allocated OM&R costs	13,101,454	5,260,681	846,194	19,208,328
Rounded values	13,100,000	5,300,000	800,000	19,200,000

Table F-11.—Present value of total costs (2007) (continued)

Present value of total OM&R costs by user				
CRSP rates	**Navajo**	**City of Gallup**	**Jicarilla Apache Nation**	**Total**
Allocated OM&R costs–- main system	$210,482,000	$40,512,000	$20,843,000	$271,837,000
Allocated OM&R costs – Gallup Regional	5,781,000	9,315,000	0	15,096,000
Cost of water	3,300,617	32,605,398	0	35,906,016
Total allocated OM&R costs	219,563,617	82,432,398	20,843,000	322,839,016
Rounded values	220,000,000	82,000,000	21,000,000	323,000,000
NTUA rates				
Allocated OM&R costs – main system	267,447,000	58,117,000	23,717,000	349,281,000
Allocated OM&R costs – Gallup Regional	6,145,000	9,901,000	0	16,046,000
Cost of water	3,300,617	32,605,398	0	35,906,016
Total allocated OM&R costs	276,892,617	100,623,398	23,717,000	401,233,016
Rounded values	277,000,000	101,000,000	24,000,000	401,000,000
Present value of total capital and OM&R costs by user				
CRSP Rates	**Navajo**	**City of Gallup**	**Jicarilla Apache Nation**	**Total**
Capital	$995,000,000	$227,000,000	$47,000,000	$1,269,000,000
OM&R (including cost of water)	220,000,000	82,000,000	21,000,000	323,000,000
Total all costs	1,215,000,000	309,000,000	68,000,000	1,592,000,000
NTUA rates				
Capital	995,000,000	227,000,000	47,000,000	1,269,000,000
OM&R	277,000,000	101,000,000	24,000,000	401,000,000
Total all costs	1,272,000,000	328,000,000	71,000,000	1,670,000,000

Note: Present value of OM&R costs include fixed and variable OM&R costs incurred for partial water delivery before project completion.

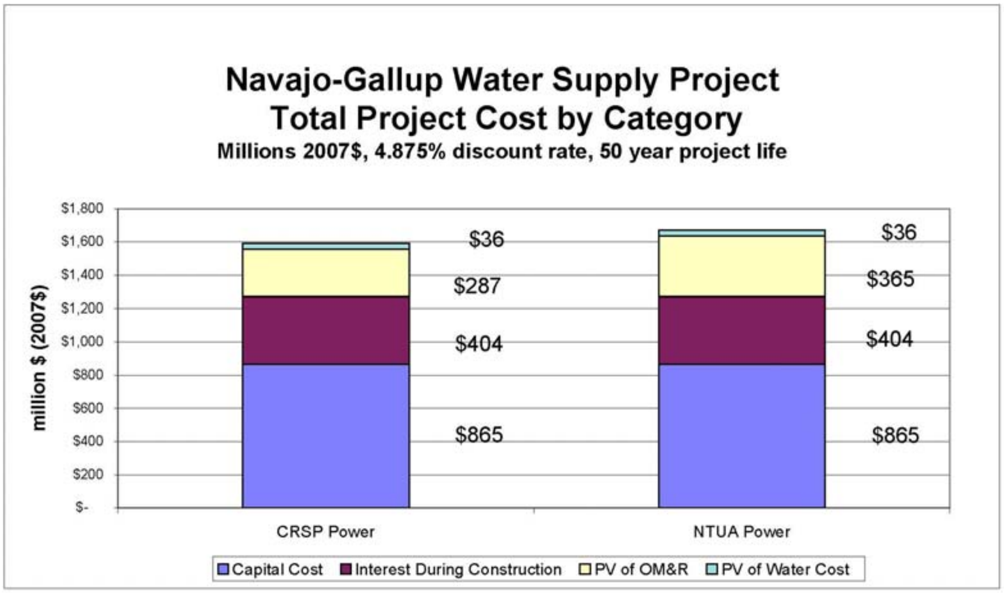

Figure F-6.—Total project cost by category.

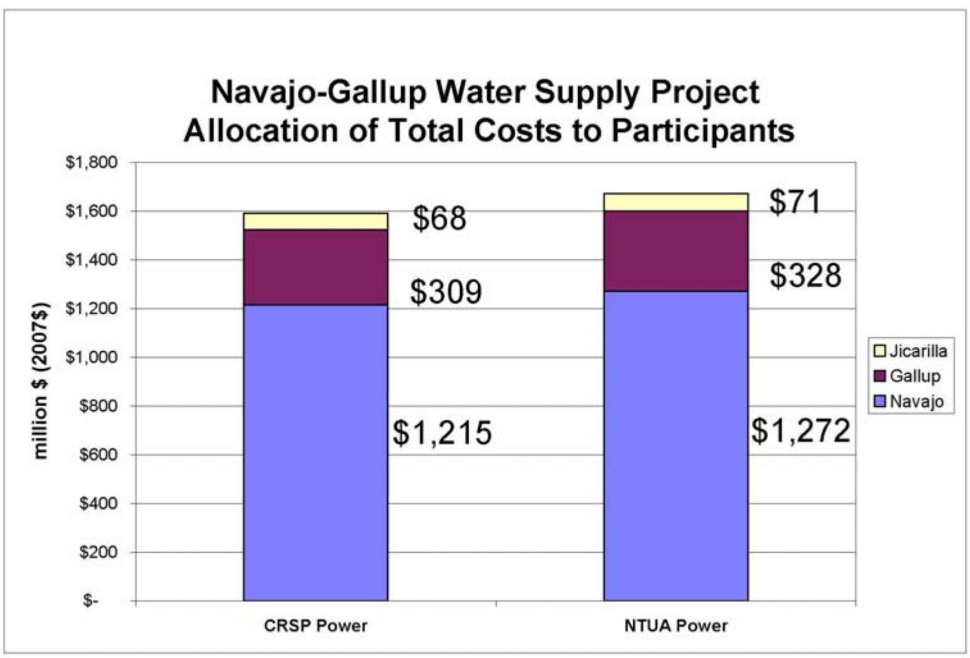

Figure F-7.—Allocation of total costs to participants.

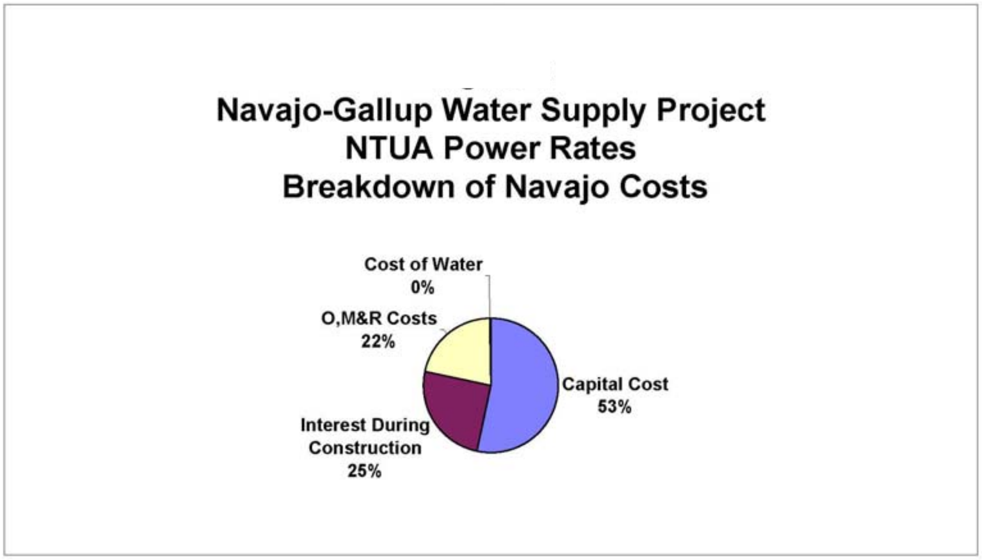

Figure F-8.—NTUA power rates (breakdown of Navajo costs).

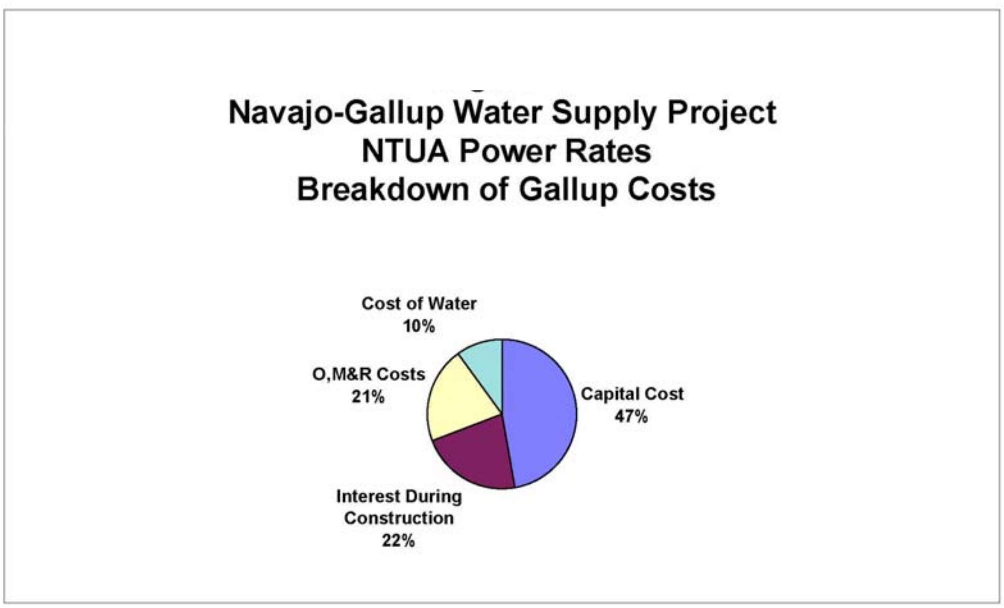

Figure F-9.—NTUA power rates (breakdown of Gallup costs).

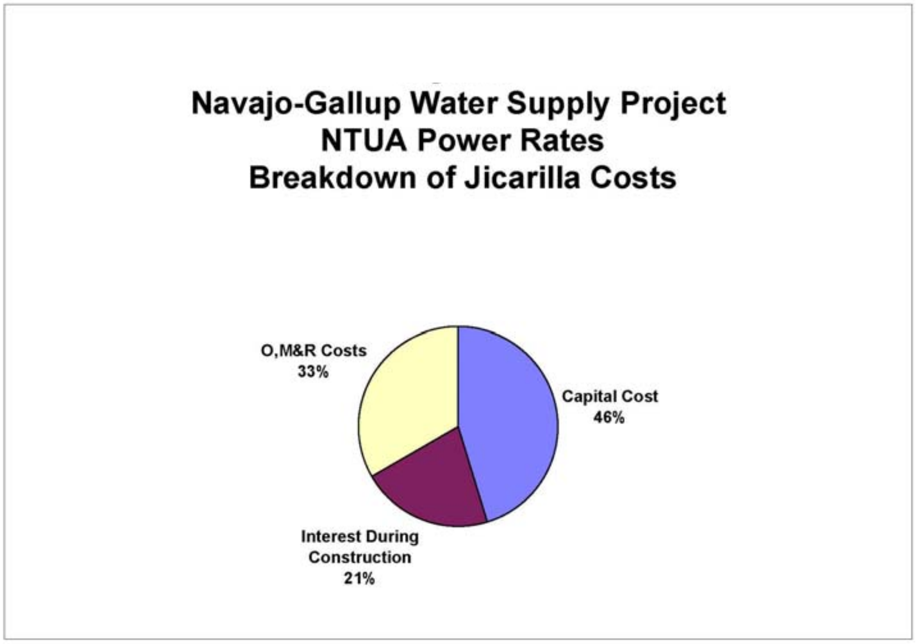

Figure F-10.—NTUA power rates (breakdown of Jicarilla costs).

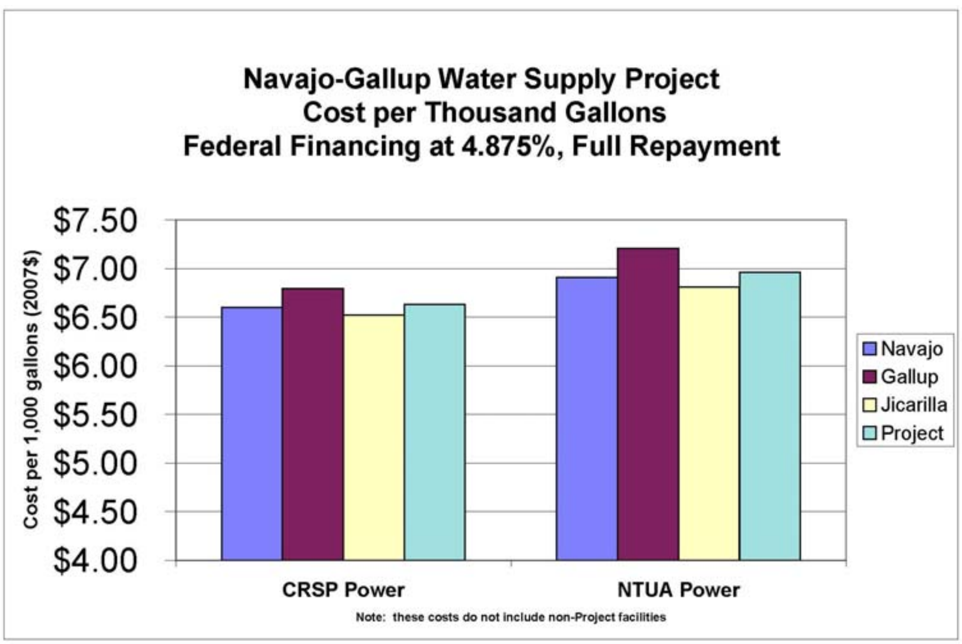

Figure F-11.—Cost per thousand gallons
(Federal financing at 4.875%, full repayment).

- Exclusion of project cash costs that do not represent use of scarce national resources (use of otherwise unemployed people for construction workforce)

- Exclusion of project transfer payments that do not represent use of scarce national resources (taxes paid on construction spending)

The proposed project would principally benefit people in the northwest corner of New Mexico by providing water to which they otherwise would not have access or could only have access at a relatively higher cost. The measure of the benefits to the city of Gallup and to the Navajo Nation members who would be supplied by the proposed project is the willingness of these beneficiaries to pay for project water. The city of Gallup's willingness to pay was estimated from data on the current use of water by people in communities throughout the Mountain States. The Navajo people's willingness to pay was estimated from data on their spending for piped water service when available and on spending to haul water when no service is available.

Benefits to the Jicarilla Apache Nation were estimated from the cost of the next least expensive alternative source of water for the area of the reservation to be served by the proposed project. The Indian Health Service identifies the availability of a community water supply as critical for maintaining the health of Indian people. This report roughly estimates the indirect health benefits to Navajo people that would accrue from the provision of a clean water supply.

The completion of the water supply project would also provide infrastructure that is a necessary prerequisite to economic development and poverty relief on the reservations. While it is uncertain how much economic development would be encouraged by the proposed project, it is clear that the lack of a reliable water supply presently poses a significant constraint to most types of economic development. Table F-12 summarizes the economic costs and benefits associated with the proposed project. The details of this analysis are presented in volume II, appendix D.

Ability to Pay

Ability to pay in a water supply context refers to the affordability of a water system. A common measure of ability to pay for water services is utility payments as a percent of median household income (EPA Prioritizing Drinking Water Needs, 1999). The EPA, for example, uses 2.5 percent of median household income (MHI) to determine whether water treatment options to comply with clean water standards are affordable and should be required.

Table F-12.—Summary of project economic benefits and costs
(million 2007$, 4.875% discount rate)

	Direct	Direct plus other
Benefits		
Gallup willingness to pay	361	361
Navajo willingness to pay	1,448	1,448
Jicarilla avoided cost	57	57
Construction employment	231	231
Indirect and induced employment	0	111
Health benefits	0	435
Reverse outmigration	0	+
Economic development	0	+
Total benefits	2,137	2,683
Costs		
Project construction	1,192	1,192
Distribution system construction	48	48
OM&R	368	368
Gallup water cost	33	33
Navajo water cost	24	24
Power generating cost	19	19
Salinity increase cost	20	20
Total costs	1,704	1,704
Benefit/cost ratio	1.25	1.57

Note: The benefit/cost ratio greater than 1.0 indicates that the anticipated project benefits are greater than cost and, thus, that the proposed project represents a beneficial use of national resources.

Legislation proposed in the 109th Congress allows the Secretary to determine the Federal share of construction costs based on an analysis of per capita income, MHI, poverty rate, ability to raise revenues, the strength of the balance sheet, and the existing cost of water, all relative to regional averages (109S 897, Section 106(f) (2)); however, the bill does not specify any threshold for these measures.

Given this lack of a basis for determining affordability, it may be useful to show the average percentage of MHI that the project participants would pay for water under various assumptions about the respective participant's share of capital cost. These percentages are determined by dividing the estimated annual household cost of project water to the MHI shown in table F-13.

Table F-13.—Median household income

	Navajo Nation	City of Gallup	Jicarilla Apache Nation
1999 median household income (1999$)	20,005	34,868	26,750
2005 median household income (2005$)	23,807	41,247	30,620

Source: 1999 MHI from U.S. Census Bureau, "2000 Census of Population and Housing" indexed to 2005$ with U.S. Bureau of Labor Statistics, "Consumer Price Index," annual growth rates from U.S. Census Bureau, "1990 Census of Housing" and "2000 Census of Population and Housing," Dornbusch and Associates.

The affordability percentages for different levels of participant capital cost repayment are shown by adjusting the capital portion of the levelized cost. Figure F-12 shows these affordability percentages for capital repayment ratio scenarios ranging from 0 percent repayment to 100 percent. Finally, figure F-12 also compares these affordability percentages to the benchmark 2.5 percent of MHI. These benchmarks are based on EPA judgments of the affordable portion of household income used to pay for a water supply.

Figure F-12 shows that all three project participants could pay project OM&R and a portion of the capital costs without exceeding the EPA threshold of 2.5 percent.

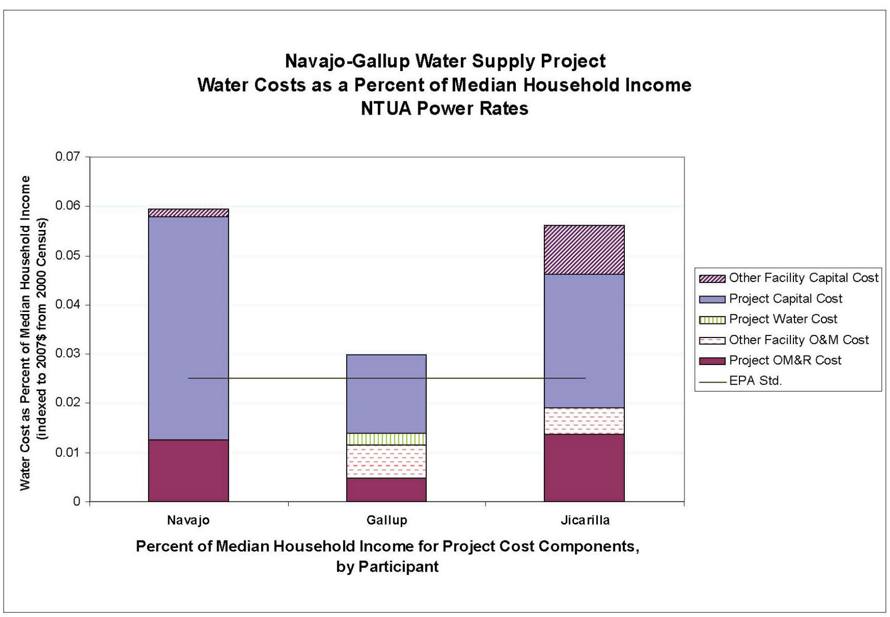

Figure F-12.—Water costs as a percent of median household income (NTUA power rates).

APPENDIX D

Part I Allocation of Capital and OM&R Costs Among Project Participants (San Juan River - PNM Alternative)

Part II Economic Benefit/Cost Analysis

Part III Financial and Repayment Analysis

Part IV Social Impacts from the Navajo-Gallup Water Supply Project

APPENDIX D

Part I

Allocation of Capital and OM&R Costs Among Project Participants

NAVAJO - GALLUP WATER SUPPLY PROJECT

ALLOCATION OF CAPITAL AND OM&R COSTS

AMONG PROJECT PARTICIPANTS

SAN JUAN RIVER - PNM ALTERNATIVE

James P. Merchant
Dornbusch Associates
Berkeley, CA
October 3, 2007

Executive Summary

This report is intended to describe the procedure used to allocate capital and operation, maintenance and replacement (O,M&R) costs for the preferred alignment and capacity scenario being considered for the Navajo-Gallup Water Supply Project (NGWSP). The report first explains the principles used for allocation, and then applies the principles to the 2040 version of the San Juan River PNM alternative. Costs are separated into capital costs, fixed O,M&R costs and variable O,M&R costs. Each of these cost categories is further divided into specific project reaches and then allocated to the participating parties. The allocation for the Gallup Regional System is included in the summary table but is developed separately in the detailed tables. The report assumes that construction would begin in 2011, with a construction budget of approximately $60 million per year (2007$). Full project completion would be January 1, 2027.

Allocation Principles

The purpose of cost allocation is to assign shares of the overall project costs to the various participants. This project will provide municipal water supplies to three groups of participants -- the Navajo Nation, the City of Gallup and the Jicarilla Apache Nation. The overriding philosophy in allocating project costs is that the three participants are equal partners in the project. Alternative allocation approaches NOT adopted include (1) assigning the same cost per gallon to all project participants regardless of their location (a "postage stamp" approach), or (2) assuming that one participant was primary and that the other two should pay only the additional costs incurred due to their participation (a "marginal cost" approach).

In allocating costs we first separated specific project components that will be dedicated for the exclusive use by any single participant, and we assigned the cost of those ***dedicated components*** to the beneficiary participant. These dedicated components typically include water storage tanks and pressurization pumps at most of the major delivery points. The bulk of the project cost, however, is for components that will benefit more than one participant. These ***joint costs*** were allocated among the project participants to derive each participant's share of the total costs.

Joint costs were allocated according to the following principles:

- ***Capital costs were allocated according to each participant's share of design capacity***. The idea is that the size and cost of the facilities depend upon each participant's desired capacity and not on average use or use in any particular period.
- ***Fixed O,M&R costs were also allocated according to each participant's share of design capacity***. Here again, the fixed O,M&R costs (staff size, dredging, equipment replacement, pump maintenance) are primarily a function of the design capacity, not of flows in any particular period.
- ***Variable O,M&R costs were allocated according to each participant's share of annual water deliveries***. The variable O,M&R costs consist mainly of

energy and water treatment chemical costs. These costs vary according to the water flows in any period, so the method used to allocate these costs assigns cost shares in each year according to the projected use in that year.

The project envisions water deliveries at many locations along (in this alignment alternative) two main branches. Every delivery to one party changes the relative shares of the water flow that continues along the pipeline beyond the delivery point. Because, as described above, the relative share of design capacity and projected flow serve as the basis for the cost allocation, the cost allocation changes after every delivery point. Therefore, we have separated each pipeline branch into specific ***reaches*** that are defined as the intervals between each two succeeding delivery points. The diversion structure and water treatment plant on each branch is also treated as a separate segment or reach. We computed each participant's share of design capacity on each reach in order to serve as the basis for allocating capital and fixed O,M&R costs (Table A1).

Capital Costs

All of the capital construction costs were assigned to specific reaches and then split into dedicated costs and joint costs. Specific types of costs were allocated as follows: Pumping plant costs were itemized by the Bureau of Reclamation and we assigned each cost to its specific reach (Table B4). We assigned pipeline costs to each reach by accumulating the linear feet of each pipeline diameter and head class designed for each reach, then multiplying the accumulated length of each pipeline diameter and head class by its respective cost per foot (Table B5). Electric and communication facilities were distributed to the reaches per the design, while transmission lines were allocated according to the miles of new transmission line required for each reach (Table B6). Diversion structures, river pumping plants and water treatment plant costs were assigned to the initial reach of each branch (Table B7).

The various components of joint capital costs were added together for each reach and then allocated to the participants using the design capacities (Table B3). We then added the allocated joint capital costs to the dedicated capital costs for each party in each reach (Table B2).

Finally, we added unlisted items (10% of listed items), mobilization costs (5% of listed plus unlisted items) and contingency costs (22.5% of listed items, unlisted items and mobilization costs) to derive the total construction cost, or field cost, for each participant. We then added non-contract cost (27% of field costs) to determine total construction cost before taxes, and then added taxes (9% of total construction cost for most costs and 6% of the construction cost for the Gallup Regional System) to arrive at total construction cost with taxes. Table B1 shows this total as allocated to each participant.

Fixed OM&R Costs

The fixed O,M&R costs (we use "O,M&R" as shorthand for operation, maintenance and replacement) are comprised of the annual components that do not vary substantially with differences in flows through the system. These costs include staff costs, dredging, equipment maintenance and annualized cost for equipment replacement. Allocation of fixed O,M&R costs was done analogously to the allocation of capital costs: the costs were assigned to the different reaches and then the O,M&R cost for each reach was apportioned among the participants according to their respective share of design capacity. About one-half of the fixed O,M&R cost was associated with the water treatment plants, so those costs were assigned entirely to the first reach of each branch, which contained the treatment plants. The remainder of the fixed O,M&R costs were pumping plant maintenance costs, and these costs were assigned to the reaches containing the pumping plants. Table D2 shows the fixed O,M&R costs for each reach, and allocates the costs to the participants.

Variable O,M&R Costs

The variable O,M&R costs are those annual operating costs that vary significantly with changes in system flows. These costs are primarily comprised of energy and water treatment chemical costs. Because these costs by definition change with changes in system flows we projected system flows over the 50-year life of the project (Table D3). The projected annual flows are based on the following assumptions:

- peak flows will be proportional to total water flows
- peak flows for Gallup and for the Jicarilla Apache Tribe would remain constant over the life of the project.
- peak flows for the Navajos would reach design capacity in the year designated in the Scenario: 2040.
- peak flows for the Navajos would remain constant following the year in which peak flows first reached design capacity
- peak flows for the Navajos would increase at a growth rate of 2.48% per year up to the year in which design capacity was first reached.

The Bureau of Reclamation provided energy and chemical costs associated with build-out project flows. We assumed that these costs would remain constant per unit of flow and then calculated the energy and chemical costs associated with each year's total flow. These total costs were allocated among the participants based on each year's respective shares of total flow. We performed these calculations for two different energy rate structures: Colorado River Storage Project (CRSP) rates (Table D6) and Navajo Tribal Utility Authority (NTUA) rates (Table D7). The applicable energy rates are shown as footnotes in Tables D6 and D7. Deliveries from Navajo Dam are subject to an estimated $1.00 per acre-foot O&M charge by the Bureau of Reclamation. This cost is included as a variable O,M&R cost in Tables D6 and D7.

Gallup Regional System Costs

The design work and cost estimates for the Gallup Regional System were first prepared by DePauli Engineering. The Bureau of Reclamation used the DePauli design but re-estimated much of the cost. Some of the Gallup System components were included in the Bureau's cost estimate worksheets for the overall system (eg. Navajo Chapter water storage tanks), but most components were listed separately on a Gallup-specific worksheet. We treated the components included with the other Bureau elements as part of the overall system cost allocation. We allocated the remaining items (all joint facilities) by allocating their cost to participants based on their respective shares of design capacity (Table C1).

O,M&R costs were estimated by the Bureau as a lump sum (one each for the CRSP and NTUA energy rates). We allocated this overall annual O,M&R cost to the participants based on their respective shares of design capacity (Table C2).

Water Costs

Table C3 estimates the City of Gallup's cost of purchasing 7,500 acre-feet per year of water that would be conveyed by the project. At this point Gallup has not reached an agreement with any water supplier, so the cost estimates included in these tables may change. We used the terms of a possible agreement with the Jicarilla Apache Nation as the basis for our cost estimates, but they have not yet been agreed to.

In the absence of a water rights settlement that establishes different terms the Navajo Nation would pay for water from Navajo Reservoir used for non-agricultural purposes. These payments were estimated by the Bureau of Reclamation to have a present value of $108.45 per acre-foot. We amortized that present value over the Navajo water deliveries using the CRSP interest rate of 2.875%. This cost is shown in Table D8.

We did not include any financial cost for the water to be delivered to the Jicarilla Apache Nation, pursuant to the terms of the Jicarilla Apache Tribe Water Rights Settlement Act (P.L. 102-441, section 8(d)(1)).

Overall Summation

Table 1 summarizes the above analysis. The table addresses the capital, annual O,M&R and present value of O,M&R costs for a scenario that assumes a construction budget of $60 million per year in 2007$. The table combines total construction cost including taxes for the Bureau-designed system and for the Gallup Regional System, developed separately in Tables B1 and C1. We added costs for environmental mitigation, cultural resources and right-of-way acquisition that were allocated in Table B8. We then added interest during construction that was calculated in Table B9. We calculated the present value of the annual fixed plus variable O,M&R costs (discounted at 4.875%), estimated under both the CRSP and NTUA energy rates. All financial costs are expressed as of the beginning of the year in which the project is completed: 2027. Interest during construction and interest on pre-project completion water purchase fees are compiled up to January 1, 2027, and post-completion O,M&R and post-completion water purchase fees are discounted to January 1, 2027. We then show the total present value of all costs, including capital, fixed O,M&R and variable O,M&R costs. Table 1 allocates these costs to each of the participants. All costs are based on January, 2007, price levels.

Figures 1 and 2 illustrate the components of overall cost. Figure 1 shows how total project costs are split among capital cost, interest during construction, the present value of future OM&R costs and the present value of water cost. Figure 2 shows how total project costs are allocation to the three project participants. Figures 3, 4 and 5 show how the cost allocated to each project participant are composed of capital, interest during construction, OM&R and water costs. Finally, Figure 6 shows what the levelized cost per thousand gallons (in 2007$) would be to each project participant, assuming full self-funding.

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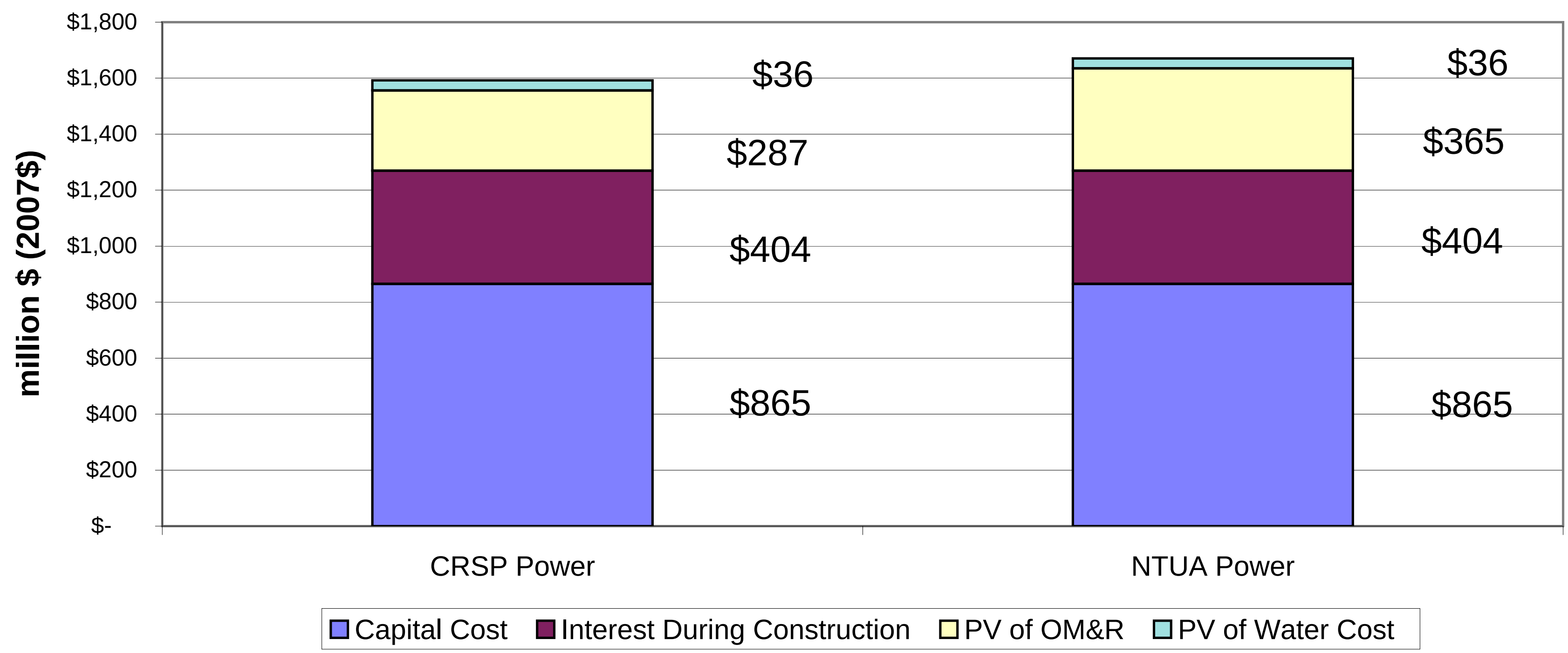
Navajo-Gallup Water Supply Project
Total Project Cost by Category

Millions 2007$, 4.875% discount rate, 50 year project life



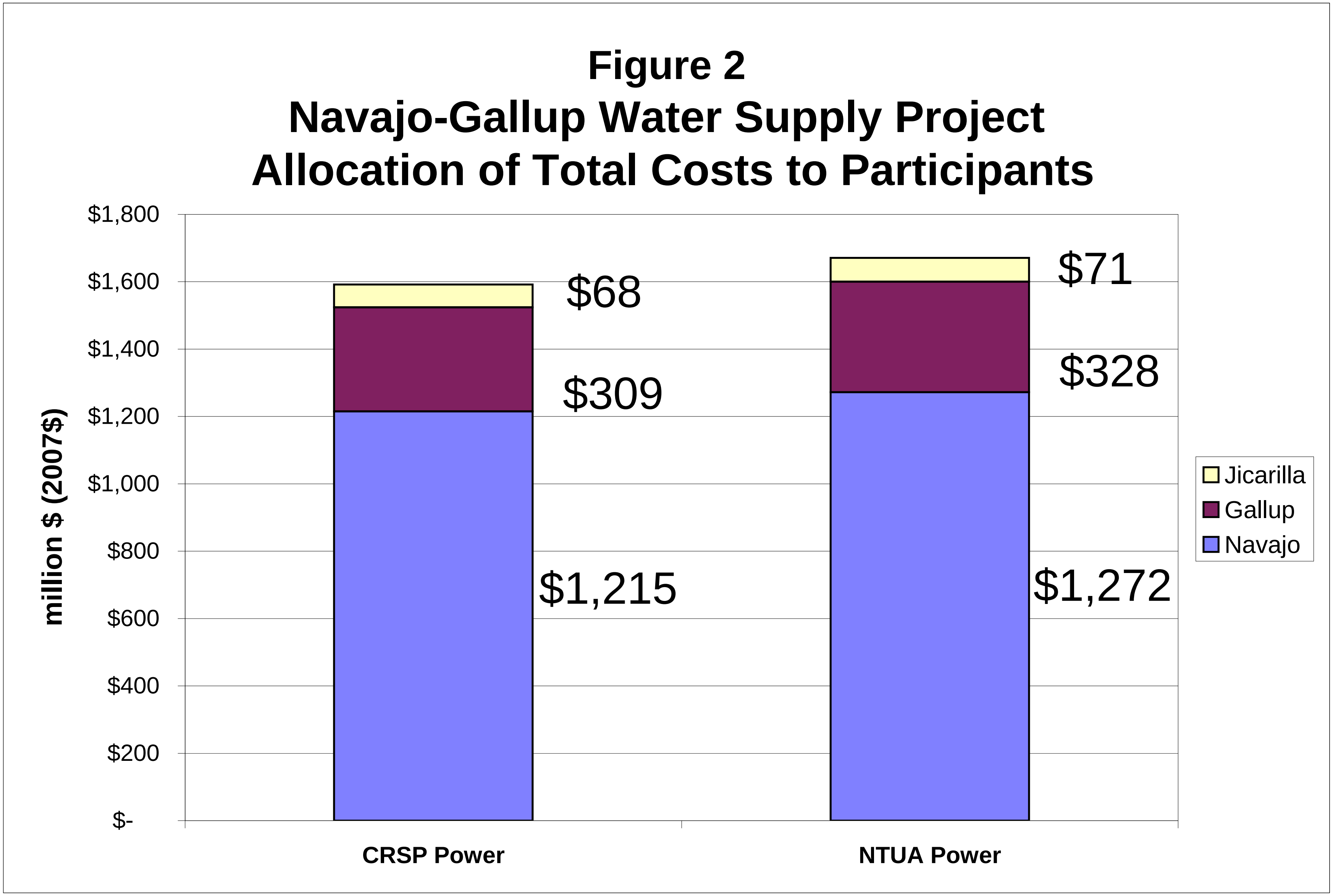


Figure 2
Navajo-Gallup Water Supply Project
Allocation of Total Costs to Participants
million $ (2007$)
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$-
$68
$309
$1,215
$71
$328
$1,272
CRSP Power
NTUA Power
Jicarilla
Gallup
Navajo

Figure 4
Navajo-Gallup Water Supply Project
NTUA Power Rates
Breakdown of Gallup Costs

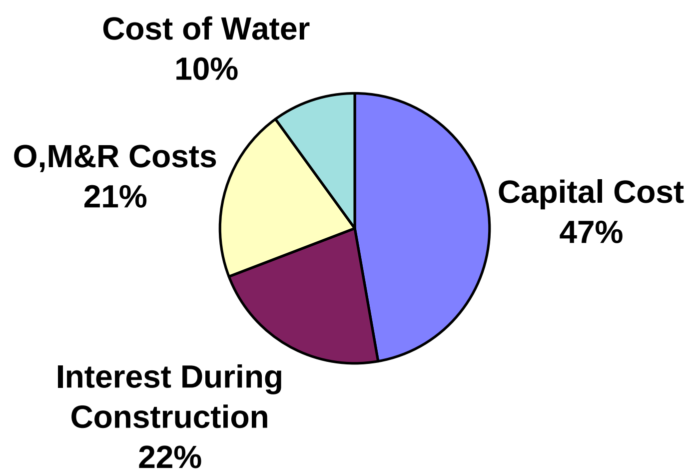
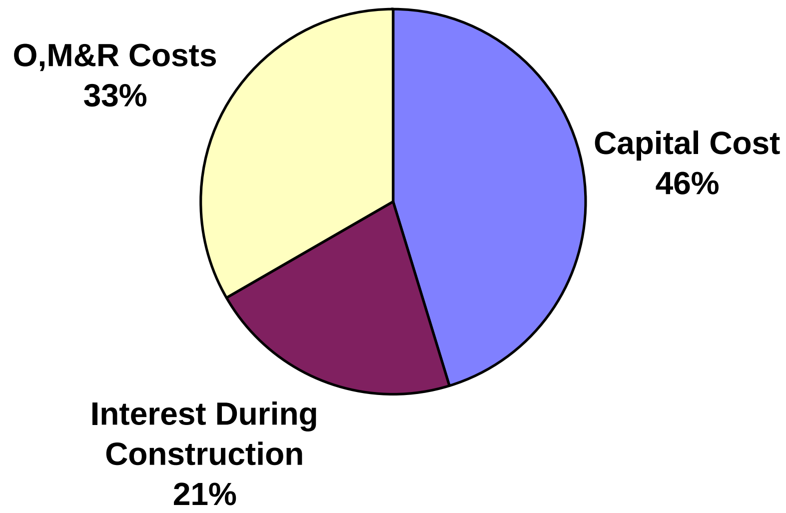


Figure 5
Navajo-Gallup Water Supply Project
NTUA Power Rates
Breakdown of Jicarilla Costs



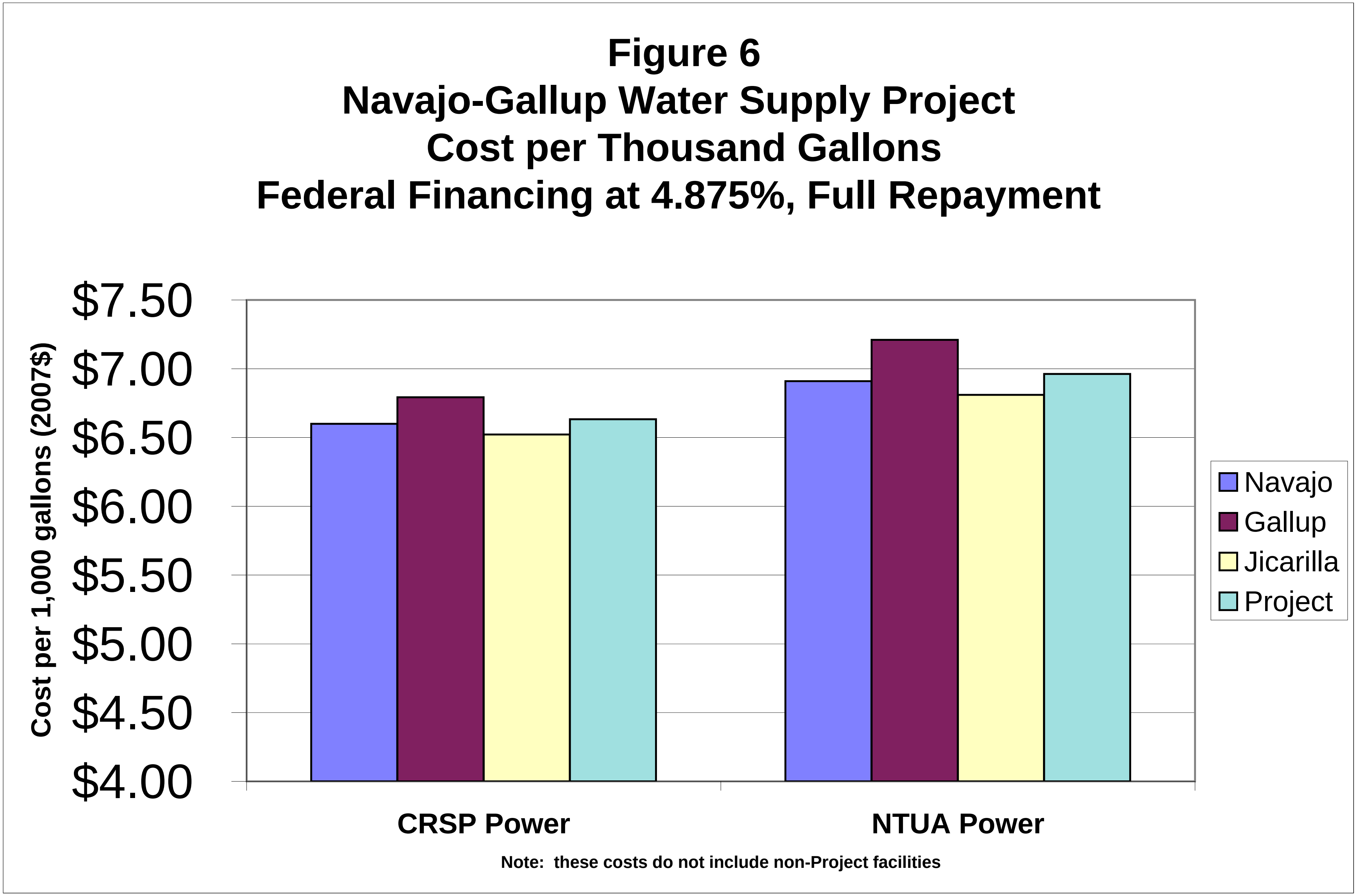


Figure 6
Navajo-Gallup Water Supply Project
Cost per Thousand Gallons
Federal Financing at 4.875%, Full Repayment
Cost per 1,000 gallons (2007$)
$7.50
$7.00
$6.50
$6.00
$5.50
$5.00
$4.50
$4.00
CRSP Power
NTUA Power
Navajo
Gallup
Jicarilla
Project
Note: these costs do not include non-Project facilities

Table 1
Navajo - Gallup Water Supply Project 2040
San Juan PNM Alternative - $60 million/year Construction Schedule
Present Value of Total Costs (2007$)
4.875% Discount Rate, 50 Year Project Life

Total Capital Costs By User	Navajo	Gallup	Jicarilla	Total
Allocated Construction Costs - Main System	$620,700,000	$115,800,000	$30,400,000	$766,900,000
Allocated Capital Costs - Gallup Regional	$18,600,000	$29,900,000	$0	$48,500,000
Allocated Environmental Mitigation Cost	$4,700,000	$1,100,000	$200,000	$6,000,000
Allocated Cultural Resources Cost	$27,100,000	$6,200,000	$1,300,000	$34,600,000
Allocated Right-of-Way Cost	$7,100,000	$1,600,000	$300,000	$9,000,000
Total Project Capital Cost before Interest	$678,200,000	$154,600,000	$32,200,000	$865,000,000
Allocated Interest During Construction	$317,000,000	$72,300,000	$15,100,000	$404,300,000
Total Project Capital Cost	$995,200,000	$226,900,000	$47,300,000	$1,269,400,000
Rounded Values	$995,000,000	$227,000,000	$47,000,000	$1,269,000,000

Annual O,M&R Costs By User (at Design Capacity)

CRSP Rates	Navajo	Gallup	Jicarilla	Total
Allocated O,M&R Costs - Main System	$9,542,654	$2,075,238	$743,636	$12,361,528
Allocated O,M&R Costs - Gallup Regional	$311,000	$500,000	$0	$811,000
Annual Cost of Water	$177,317	$1,751,636	$0	$1,928,953
Total Allocated O,M&R Costs	$10,030,971	$4,326,874	$743,636	$15,101,481
Rounded Values	$10,000,000	$4,300,000	$700,000	$15,100,000

NTUA Rates	Navajo	Gallup	Jicarilla	Total
Allocated O,M&R Costs - Main System	$12,594,137	$2,977,044	$846,194	$16,417,375
Allocated O,M&R Costs - Gallup Regional	$330,000	$532,000	$0	$862,000
Annual Cost of Water	$177,317	$1,751,636	$0	$1,928,953
Total Allocated O,M&R Costs	$13,101,454	$5,260,681	$846,194	$19,208,328
Rounded Values	$13,100,000	$5,300,000	$800,000	$19,200,000

Present Value of Total O,M&R Costs By User

CRSP Rates	Navajo	Gallup	Jicarilla	Total
Allocated O,M&R Costs - Main System	$210,482,000	$40,512,000	$20,843,000	$271,837,000
Allocated O,M&R Costs - Gallup Regional	$5,781,000	$9,315,000	$0	$15,096,000
Cost of Water	$3,300,617	$32,605,398	$0	$35,906,016
Total Allocated O,M&R Costs	$219,563,617	$82,432,398	$20,843,000	$322,839,016
Rounded Values	$220,000,000	$82,000,000	$21,000,000	$323,000,000

NTUA Rates	Navajo	Gallup	Jicarilla	Total
Allocated O,M&R Costs - Main System	$267,447,000	$58,117,000	$23,717,000	$349,281,000
Allocated O,M&R Costs - Gallup Regional	$6,145,000	$9,901,000	$0	$16,046,000
Cost of Water	$3,300,617	$32,605,398	$0	$35,906,016
Total Allocated O,M&R Costs	$276,892,617	$100,623,398	$23,717,000	$401,233,016
Rounded Values	$277,000,000	$101,000,000	$24,000,000	$401,000,000

Note: Present value of O,M&R costs include fixed and variable O,M&R costs incurred for partial water delivery before project completion

Present Value of Total Capital and O,M&R Costs By User

CRSP Rates				
Capital	$995,000,000	$227,000,000	$47,000,000	$1,269,000,000
O,M&R (including cost of water)	$220,000,000	$82,000,000	$21,000,000	$323,000,000
Total All Costs	**$1,215,000,000**	**$309,000,000**	**$68,000,000**	**$1,592,000,000**

NTUA Rates				
Capital	$995,000,000	$227,000,000	$47,000,000	$1,269,000,000
O,M&R	$277,000,000	$101,000,000	$24,000,000	$401,000,000
Total All Costs	**$1,272,000,000**	**$328,000,000**	**$71,000,000**	**$1,670,000,000**

Table A1
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Flow Capacities to Participants by Reach

San Juan Branch Number	Start	End	Pumping Plants	Peak Flow in Reach cfs	Peak Deliveries in Reach cfs	Navajo cfs	Gallup cfs	Jicarilla cfs	Navajo %	Gallup %	Jicarilla %
						Allocation of Peak Flows By Reach					
1	San Juan River	Water Treatment Plant (WTP)	River	59.18	0.00	45.71	13.47	0.00	0.7724	0.2276	0.0000
2	WTP	NAPI turnout	01	59.18	0.97	45.71	13.47	0.00	0.7724	0.2276	0.0000
3	NAPI	Shiprock Junction		58.21	6.72	44.74	13.47	0.00	0.7686	0.2314	0.0000
4	Shiprock J.	Sanostee turnout	02, 03	51.49	2.00	38.02	13.47	0.00	0.7384	0.2616	0.0000
5	Sanostee	Burnham Junction		49.49	0.27	36.02	13.47	0.00	0.7278	0.2722	0.0000
6	Burnham J.	Newcomb turnout		49.22	1.52	35.75	13.47	0.00	0.7263	0.2737	0.0000
7	Newcomb	Sheepsprings turnout	04	47.70	0.70	34.23	13.47	0.00	0.7176	0.2824	0.0000
8	Sheepsprings	Naschitti turnout	05	47.00	1.54	33.53	13.47	0.00	0.7134	0.2866	0.0000
9	Naschitti	Tohatchi turnout	06	45.46	1.99	31.99	13.47	0.00	0.7037	0.2963	0.0000
10	Tohatchi	Coyote Canyon Junction		43.47	5.06	30.00	13.47	0.00	0.6901	0.3099	0.0000
11	Coyote Canyon J.	Twin Lakes turnout	07	38.41	1.88	24.94	13.47	0.00	0.6493	0.3507	0.0000
12	Twin Lakes	Ya-ta-hey Junction	08	36.53	14.70	23.06	13.47	0.00	0.6313	0.3687	0.0000
13	Ya-ta-hey J.	Gallup Junction		21.83	13.47	8.36	13.47	0.00	0.3830	0.6170	0.0000
14	Gallup J.	Navajo Chapters		8.36	8.36	8.36	0.00	0.00	1.0000	0.0000	0.0000
					59.18						
10.1	Coyote Canyon J.	Coyote Canyon turnout	11	5.06	1.25	5.06	0.00	0.00	1.0000	0.0000	0.0000
10.2	Coyote Canyon	Standing Rock turnout	12	3.81	0.13	3.81	0.00	0.00	1.0000	0.0000	0.0000
10.3	Standing Rock	Dalton Pass turnout	13	3.68	3.68	3.68	0.00	0.00	1.0000	0.0000	0.0000
					5.06						
12.1	Ya-ta-hey J.	Rock Springs turnout	09	14.70	3.19	14.70	0.00	0.00	1.0000	0.0000	0.0000
12.2	Rock Springs	Window Rock turnout	10	11.51	11.51	11.51	0.00	0.00	1.0000	0.0000	0.0000
					14.70						

Cutter Branch Number	Start	End	Pumping Plants	Peak Flow in Reach cfs	Peak Deliveries in Reach cfs	Navajo cfs	Gallup cfs	Jicarilla cfs	Navajo %	Gallup %	Jicarilla %
						Allocation of Peak Flows By Reach					
21	NIIP Canal	WTP	Reservoir	8.34	0.00	6.19	0.00	2.15	0.7422	0.0000	0.2578
22	WTP	Huerfano turnout	01, 02, 03	8.34	0.50	6.19	0.00	2.15	0.7422	0.0000	0.2578
23	Huerfano	Nageezi turnout	04	7.84	1.05	5.69	0.00	2.15	0.7258	0.0000	0.2742
24	Nageezi	Jicarilla turnout	05	6.79	2.15	4.64	0.00	2.15	0.6834	0.0000	0.3166
25	Jicarilla	Counselor turnout	06	4.64	2.63	4.64	0.00	0.00	1.0000	0.0000	0.0000
26	Counselor	Torreon turnout		2.01	2.01	2.01	0.00	0.00	1.0000	0.0000	0.0000
					8.34						

Table B1
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Total Capital Costs - Main System
Jan-07 $

		Navajo	Gallup	Jicarilla	Total
Allocated Capital Costs		$322,589,765	$60,174,615	$15,785,594	$398,549,974
Mobilization @	5%	$16,129,488	$3,008,731	$789,280	$19,927,499
Subtotal		$338,719,253	$63,183,346	$16,574,874	$418,477,473
Unlisted Items @	10%	$33,871,925	$6,318,335	$1,657,487	$41,847,747
Subtotal		$372,591,178	$69,501,681	$18,232,361	$460,325,220
Contingencies @	22.5%	$83,833,015	$15,637,878	$4,102,281	$103,573,175
Total Field Costs		$456,424,193	$85,139,559	$22,334,642	$563,898,395
Non-Contract Costs @	27%	$123,234,532	$22,987,681	$6,030,353	$152,252,567
Total Construction Costs		$579,658,725	$108,127,240	$28,364,996	$716,150,961
Taxes on Field Cost @	9%	$41,078,177	$7,662,560	$2,010,118	$50,750,856
Total with Taxes		$620,736,903	$115,789,800	$30,375,114	$766,901,817
Rounded Total		$620,700,000	$115,800,000	$30,400,000	$766,900,000

Note: The costs in this table exclude the cost for the Gallup Regional System, which are shown in Table C1. The costs also exclude the environmental mitigation, cultural resourcs, right-of-way acquisition and interest during construction costs, which are shown in Table 1.

Table B2
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Total Capital Costs by Participant
Jan-07 $

		Joint Costs							*Dedicated Costs*			*Total Costs*		
San Juan Branch		Total	Allocation Ratios			Allocated Joint Costs								
Reach	End	Joint Costs	Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla
1	Water Treatment Plant (WTP)	$48,074,490	0.7724	0.2276	-	$37,132,223	$10,942,267	$0	$0	$0	$0	$37,132,223	$10,942,267	$0
2	NAPI turnout	$6,759,977	0.7724	0.2276	-	$5,221,334	$1,538,643	$0	$0	$0	$0	$5,221,334	$1,538,643	$0
3	Shiprock Junction	$25,518,556	0.7686	0.2314	-	$19,613,472	$5,905,084	$0	$0	$0	$0	$19,613,472	$5,905,084	$0
4	Sanostee turnout	$33,451,997	0.7384	0.2616	-	$24,700,814	$8,751,183	$0	$3,560,000	$0	$0	$28,260,814	$8,751,183	$0
5	Burnham Junction	$14,001,664	0.7278	0.2722	-	$10,190,744	$3,810,920	$0	$0	$0	$0	$10,190,744	$3,810,920	$0
6	Newcomb turnout	$6,952,463	0.7263	0.2737	-	$5,049,788	$1,902,675	$0	$2,840,000	$0	$0	$7,889,788	$1,902,675	$0
7	Sheepsprings turnout	$17,525,961	0.7176	0.2824	-	$12,576,806	$4,949,155	$0	$1,610,000	$0	$0	$14,186,806	$4,949,155	$0
8	Naschitti turnout	$12,813,913	0.7134	0.2866	-	$9,141,500	$3,672,413	$0	$3,140,000	$0	$0	$12,281,500	$3,672,413	$0
9	Tohatchi turnout	$26,981,230	0.7037	0.2963	-	$18,986,572	$7,994,658	$0	$3,560,000	$0	$0	$22,546,572	$7,994,658	$0
10	Coyote Canyon Junction	$7,849,753	0.6901	0.3099	-	$5,417,359	$2,432,394	$0	$0	$0	$0	$5,417,359	$2,432,394	$0
11	Twin Lakes turnout	$7,044,603	0.6493	0.3507	-	$4,574,132	$2,470,471	$0	$3,360,000	$0	$0	$7,934,132	$2,470,471	$0
12	Ya-ta-hey Junction	$9,510,653	0.6313	0.3687	-	$6,003,713	$3,506,939	$0	$0	$0	$0	$6,003,713	$3,506,939	$0
13	Gallup Junction	$3,723,923	0.3830	0.6170	-	$1,426,111	$2,297,812	$0	$0	$0	$0	$1,426,111	$2,297,812	$0
14	Navajo Chapters	$450,000	1.0000	-	-	$450,000	$0	$0	$15,360,000	$0	$0	$15,810,000	$0	$0
										$0	$0			
10.1	Coyote Canyon turnout	$5,209,982	1.0000	-	-	$5,209,982	$0	$0	$2,830,000	$0	$0	$8,039,982	$0	$0
10.2	Standing Rock turnout	$9,896,322	1.0000	-	-	$9,896,322	$0	$0	$685,000	$0	$0	$10,581,322	$0	$0
10.3	Dalton Pass turnout	$3,286,818	1.0000	-	-	$3,286,818	$0	$0	$5,020,000	$0	$0	$8,306,818	$0	$0
										$0	$0			
12.1	Rock Springs turnout	$6,245,235	1.0000	-	-	$6,245,235	$0	$0	$5,000,000	$0	$0	$11,245,235	$0	$0
12.2	Window Rock turnout	$10,584,015	1.0000	-	-	$10,584,015	$0	$0	$17,340,000	$0	$0	$27,924,015	$0	$0
Cutter Branch														
Reach	End													
21	WTP	$9,350,145	0.7422	-	0.2578	$6,939,736	$0	$2,410,409	$0	$0	$0	$6,939,736	$0	$2,410,409
22	Huerfano turnout	$28,101,842	0.7422	-	0.2578	$20,857,363	$0	$7,244,480	$1,350,000	$0	$0	$22,207,363	$0	$7,244,480
23	Nageezi turnout	$7,740,850	0.7258	-	0.2742	$5,618,040	$0	$2,122,810	$2,130,000	$0	$0	$7,748,040	$0	$2,122,810
24	Jicarilla turnout	$12,657,494	0.6834	-	0.3166	$8,649,598	$0	$4,007,896	$0	$0	$0	$8,649,598	$0	$4,007,896
25	Counselor turnout	$6,661,780	1.0000	-	-	$6,661,780	$0	$0	$3,580,000	$0	$0	$10,241,780	$0	$0
26	Torreon turnout	$3,231,307	1.0000	-	-	$3,231,307	$0	$0	$3,560,000	$0	$0	$6,791,307	$0	$0
	Total	$323,624,974				$247,664,765	$60,174,615	$15,785,594	$74,925,000	$0	$0	$322,589,765	$60,174,615	$15,785,594

Grand Total	$398,549,974

This table allocates the capital costs shown in Table B3 using the allocation percentages developed in Table A1.

Table B3
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Total Capital Costs by Reach
Jan-07 $

Reach	End	Joint Costs: Diversion Str. & Water Treatment	Joint Costs: Pipeline	Joint Costs: Tanks & Pumping Plants	Joint Costs: Transm. Lines	Joint Costs: Total	Dedicated Costs: Navajo	Dedicated Costs: Gallup	Dedicated Costs: Jicarilla
San Juan Branch									
1	Water Treatment Plant (WTP)	$46,363,890	$0	$1,200,000	$510,600	$48,074,490	$0	$0	$0
2	NAPI turnout	$0	$2,447,977	$4,135,000	$177,000	$6,759,977	$0	$0	$0
3	Shiprock Junction	$0	$25,138,556	$380,000	$0	$25,518,556	$0	$0	$0
4	Sanostee turnout	$0	$26,737,997	$6,270,000	$444,000	$33,451,997	$3,560,000	$0	$0
5	Burnham Junction	$0	$14,001,664	$0	$0	$14,001,664	$0	$0	$0
6	Newcomb turnout	$0	$5,284,637	$0	$1,667,826	$6,952,463	$2,840,000	$0	$0
7	Sheepsprings turnout	$0	$13,710,604	$2,635,000	$1,180,357	$17,525,961	$1,610,000	$0	$0
8	Naschitti turnout	$0	$7,431,902	$2,335,000	$3,047,011	$12,813,913	$3,140,000	$0	$0
9	Tohatchi turnout	$0	$22,672,956	$3,035,000	$1,273,273	$26,981,230	$3,560,000	$0	$0
10	Coyote Canyon Junction	$0	$7,369,175	$0	$480,578	$7,849,753	$0	$0	$0
11	Twin Lakes turnout	$0	$3,282,094	$2,535,000	$1,227,509	$7,044,603	$3,360,000	$0	$0
12	Ya-ta-hey Junction	$0	$6,498,653	$2,835,000	$177,000	$9,510,653	$0	$0	$0
13	Gallup Junction	$0	$3,283,923	$350,000	$90,000	$3,723,923	$0	$0	$0
14	Navajo Chapters	$0	$0	$0	$450,000	$450,000	$15,360,000	$0	$0
10.1	Coyote Canyon turnout	$0	$4,047,982	$895,000	$267,000	$5,209,982	$2,830,000	$0	$0
10.2	Standing Rock turnout	$0	$8,444,322	$1,185,000	$267,000	$9,896,322	$685,000	$0	$0
10.3	Dalton Pass turnout	$0	$2,074,818	$945,000	$267,000	$3,286,818	$5,020,000	$0	$0
12.1	Rock Springs turnout	$0	$4,613,235	$1,365,000	$267,000	$6,245,235	$5,000,000	$0	$0
12.2	Window Rock turnout	$0	$7,494,698	$1,495,000	$1,594,316	$10,584,015	$17,340,000	$0	$0
Cutter Branch									
Reach	End								
21	WTP	$9,016,545	$0	$0	$333,600	$9,350,145	$0	$0	$0
22	Huerfano turnout	$0	$15,865,627	$3,615,000	$8,621,215	$28,101,842	$1,350,000	$0	$0
23	Nageezi turnout	$0	$6,408,850	$1,065,000	$267,000	$7,740,850	$2,130,000	$0	$0
24	Jicarilla turnout	$0	$8,012,636	$1,445,000	$3,199,858	$12,657,494	$0	$0	$0
25	Counselor turnout	$0	$4,598,723	$1,285,000	$778,057	$6,661,780	$3,580,000	$0	$0
26	Torreon turnout	$0	$3,141,307	$0	$90,000	$3,231,307	$3,560,000	$0	$0
	Total	$55,380,435	$202,562,339	$39,005,000	$26,677,200	$323,624,974	$74,925,000	$0	$0

This table summarizes Joint and Dedicated Costs detailed in Tables B4, B5, B6 and B7.

Table B4
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Pumping Plant and Tank Costs by Reach
Jan-07 $

					Joint Costs					*Dedicated Costs*								
San Juan Branch		No.	No.	No.	Pipeline Pumping	Forebay	Air	Water Regualting		Storage Tanks			Service Area Pumping Plants			Total		
Reach	End	WTP	Turnouts	Pump P.	Plants	Tanks	Chambers	Tanks	Total	Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla
1	Water Treatment Plant (WTP)	1	0	0	$1,200,000	$0	$0		$1,200,000							$0	$0	$0
2	NAPI turnout	0	0	1	$3,500,000	$260,000	$375,000		$4,135,000							$0	$0	$0
3	Shiprock Junction	0	0	0		$0	$0	$380,000	$380,000							$0	$0	$0
4	Sanostee turnout	0	1	2	$5,000,000	$520,000	$750,000		$6,270,000	$3,400,000			$160,000			$3,560,000	$0	$0
5	Burnham Junction	0	0	0		$0	$0		$0							$0	$0	$0
6	Newcomb turnout	0	1	0		$0	$0		$0	$2,700,000			$140,000			$2,840,000	$0	$0
7	Sheepsprings turnout	0	1	1	$2,000,000	$260,000	$375,000		$2,635,000	$1,500,000			$110,000			$1,610,000	$0	$0
8	Naschitti turnout	0	1	1	$1,700,000	$260,000	$375,000		$2,335,000	$3,000,000			$140,000			$3,140,000	$0	$0
9	Tohatchi turnout	0	1	1	$2,400,000	$260,000	$375,000		$3,035,000	$3,400,000			$160,000			$3,560,000	$0	$0
10	Coyote Canyon Junction	0	0	0		$0	$0		$0							$0	$0	$0
11	Twin Lakes turnout	0	1	1	$1,900,000	$260,000	$375,000		$2,535,000	$3,200,000			$160,000			$3,360,000	$0	$0
12	Ya-ta-hey Junction	0	0	1	$2,200,000	$260,000	$375,000		$2,835,000							$0	$0	$0
13	Gallup Junction	0	1	0	$0	$0	$0	$350,000	$350,000							$0	$0	$0
14	Navajo Chapters	0	5	0		$0	$0		$0	$14,600,000			$760,000			$15,360,000	$0	$0
10.1	Coyote Canyon turnout	0	1	1	$260,000	$260,000	$375,000		$895,000	$2,700,000			$130,000			$2,830,000	$0	$0
10.2	Standing Rock turnout	0	1	1	$270,000	$260,000	$375,000	$280,000	$1,185,000	$600,000			$85,000			$685,000	$0	$0
10.3	Dalton Pass turnout	0	1	1	$310,000	$260,000	$375,000		$945,000	$4,800,000			$220,000			$5,020,000	$0	$0
12.1	Rock Springs turnout	0	1	1	$730,000	$260,000	$375,000		$1,365,000	$4,800,000			$200,000			$5,000,000	$0	$0
12.2	Window Rock turnout	0	1	1	$570,000	$260,000	$375,000	$290,000	$1,495,000	$16,900,000			$440,000			$17,340,000	$0	$0
Cutter Branch																		
Reach	End																	
21	WTP	1	0	0		$0	$0		$0							$0	$0	$0
22	Huerfano turnout	0	1	3	$1,710,000	$780,000	$1,125,000		$3,615,000	$1,250,000			$100,000			$1,350,000	$0	$0
23	Nageezi turnout	0	1	1	$430,000	$260,000	$375,000		$1,065,000	$2,000,000			$130,000			$2,130,000	$0	$0
24	Jicarilla turnout	0	0	1	$530,000	$260,000	$375,000	$280,000	$1,445,000							$0	$0	$0
25	Counselor turnout	0	1	1	$370,000	$260,000	$375,000	$280,000	$1,285,000	$3,400,000			$180,000			$3,580,000	$0	$0
26	Torreon turnout	0	1	0	$0	$0	$0		$0	$3,400,000			$160,000			$3,560,000	$0	$0
	Total	2	21	19	$25,080,000	$4,940,000	$7,125,000	$1,860,000	$39,005,000	$71,650,000	$0	$0	$3,275,000	$0	$0	$74,925,000	$0	$0

Cost per Unit
Forebay Tanks $260,000
Air Chambers $375,000

Table B5
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Pipeline Costs by Reach
Jan-07 $

					Joint Costs					
San Juan Branch		Total Excavation	Soil Cement Embedment	Backfill	Total Excavation	Soil Cement Embedment	Backfill	Butterfly Valves	Pipeline	
Reach	End	cubic yards	cubic yards	cubic yards	$	$	$	$	$	Total
1	Water Treatment Plant (WTP)				$0	$0	$0	$0	$0	$0
2	NAPI turnout	22,720	4,385	13,991	$119,094	$394,631	$90,943	$78,000	$1,765,309	$2,447,977
3	Shiprock Junction	258,690	49,923	159,300	$1,356,005	$4,493,038	$1,035,452	$702,000	$17,552,060	$25,138,556
4	Sanostee turnout	267,961	51,713	165,008	$1,404,602	$4,654,140	$1,072,554	$741,000	$18,865,700	$26,737,997
5	Burnham Junction	145,024	27,987	89,305	$760,189	$2,518,873	$580,479	$390,000	$9,752,123	$14,001,664
6	Newcomb turnout	54,217	10,463	33,387	$284,196	$941,663	$217,016	$156,000	$3,685,762	$5,284,637
7	Sheepsprings turnout	135,808	26,168	85,199	$711,881	$2,355,144	$553,792	$390,000	$9,699,788	$13,710,604
8	Naschitti turnout	70,620	15,148	42,763	$370,177	$1,363,299	$277,961	$234,000	$5,186,465	$7,431,902
9	Tohatchi turnout	241,956	45,020	154,240	$1,268,289	$4,051,767	$1,002,562	$630,000	$15,720,338	$22,672,956
10	Coyote Canyon Junction	80,687	15,480	51,629	$422,946	$1,393,169	$335,591	$189,000	$5,028,469	$7,369,175
11	Twin Lakes turnout	35,803	6,815	23,397	$187,673	$613,378	$152,078	$81,000	$2,247,965	$3,282,094
12	Ya-ta-hey Junction	71,559	13,621	46,762	$375,099	$1,225,853	$303,956	$162,000	$4,431,745	$6,498,653
13	Gallup Junction	37,248	6,904	25,973	$195,247	$621,327	$168,827	$56,000	$2,242,521	$3,283,923
14	Navajo Chapters				$0	$0	$0	$0	$0	$0
10.1	Coyote Canyon turnout	52,013	9,309	37,829	$272,643	$837,823	$245,888	$63,000	$2,628,629	$4,047,982
10.2	Standing Rock turnout	108,432	19,695	80,284	$568,381	$1,772,527	$521,848	$144,000	$5,437,566	$8,444,322
10.3	Dalton Pass turnout	28,983	4,295	22,932	$151,924	$386,518	$149,060	$32,000	$1,355,316	$2,074,818
12.1	Rock Springs turnout	53,238	9,868	37,124	$279,064	$888,133	$241,305	$84,000	$3,120,733	$4,613,235
12.2	Window Rock turnout	95,688	17,455	68,047	$501,579	$1,570,954	$442,305	$138,000	$4,841,860	$7,494,698
		1,760,647	334,247	1,137,172	$9,228,988	$30,082,239	$7,391,617	$4,270,000	$113,562,350	$164,535,195
Cutter Branch										
Reach	End									
21	WTP				$0	$0	$0	$0	$0	$0
22	Huerfano turnout	192,709	34,512	137,970	$835,554	$3,106,064	$896,806	$236,000	$10,791,204	$15,865,627
23	Nageezi turnout	88,749	15,884	63,162	$384,801	$1,429,576	$410,552	$108,000	$4,075,921	$6,408,850
24	Jicarilla turnout	110,898	18,269	80,964	$480,835	$1,644,179	$526,268	$169,000	$5,192,354	$8,012,636
25	Counselor turnout	66,894	9,912	51,239	$290,041	$892,105	$333,052	$72,000	$3,011,525	$4,598,723
26	Torreon turnout	55,295	7,754	44,158	$239,750	$697,829	$287,029	$68,000	$1,848,699	$3,141,307
	Total	2,275,192	420,578	1,514,665	$11,459,968	$37,851,993	$9,845,324	$4,923,000	$138,482,053	$202,562,339

Cost per Unit

Rock Excavation, per cy	$16.00	Average Excavtn cost/cy PMN	$5.24	Average Excavtn cost/cy Cutter	$4.34
Common Excavation, per cy	$4.00	Total Excavation, cy PNM	1,760,647	Total Excavation, cy Cutter	514,545
Backfill, per cy	$6.50	Rock Excavation, cy PNM	182,200	Rock Excavation, cy Cutter	14,400
Embedment, soil cement, per cy	$90.00	Rock/Total, ratio PNM	0.1035	Rock/Total, ratio Cutter	0.0280

Table B6
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Transmission Line Costs by Reach
Jan-07 $

						Joint Costs							
San Juan Branch		No.	No.	No.	Miles		Elect.						
Reach	End	WTP	Turnouts	Pump P.	Trans Ln	Trans. Ln	Equip	SCADA	Comm.	Security	Pwr Tap	Other	Total
1	Water Treatment Plant (WTP)	1	0	1		$0	$264,000	$18,000	$64,800	$19,800	$144,000		$510,600
2	NAPI turnout	0	0	1		$0	$84,000	$7,200	$28,800	$9,000	$48,000		$177,000
3	Shiprock Junction	0	0	0		$0	$0	$0	$0	$0	$0		$0
4	Sanostee turnout	0	1	2		$0	$192,000	$21,600	$86,400	$24,000	$120,000		$444,000
5	Burnham Junction	0	0	0		$0	$0	$0	$0	$0	$0		$0
6	Newcomb turnout	0	1	0	10.11	$1,577,826	$24,000	$7,200	$28,800	$6,000	$24,000		$1,667,826
7	Sheepsprings turnout	0	1	1	5.85	$913,357	$108,000	$14,400	$57,600	$15,000	$72,000		$1,180,357
8	Naschitti turnout	0	1	1	17.82	$2,780,011	$108,000	$14,400	$57,600	$15,000	$72,000		$3,047,011
9	Tohatchi turnout	0	1	1	6.45	$1,006,273	$108,000	$14,400	$57,600	$15,000	$72,000		$1,273,273
10	Coyote Canyon Junction	0	0	0	3.08	$480,578	$0	$0	$0	$0	$0		$480,578
11	Twin Lakes turnout	0	1	1	6.16	$960,509	$108,000	$14,400	$57,600	$15,000	$72,000		$1,227,509
12	Ya-ta-hey Junction	0	0	1		$0	$84,000	$7,200	$28,800	$9,000	$48,000		$177,000
13	Gallup Junction	0	1	0		$0	$24,000	$7,200	$28,800	$6,000	$24,000		$90,000
14	Navajo Chapters	0	5	0		$0	$120,000	$36,000	$144,000	$30,000	$120,000		$450,000
10.1	Coyote Canyon turnout	0	1	1		$0	$108,000	$14,400	$57,600	$15,000	$72,000		$267,000
10.2	Standing Rock turnout	0	1	1		$0	$108,000	$14,400	$57,600	$15,000	$72,000		$267,000
10.3	Dalton Pass turnout	0	1	1		$0	$108,000	$14,400	$57,600	$15,000	$72,000		$267,000
12.1	Rock Springs turnout	0	1	1		$0	$108,000	$14,400	$57,600	$15,000	$72,000		$267,000
12.2	Window Rock turnout	0	1	1	5.82	$907,316	$108,000	$14,400	$57,600	$15,000	$72,000	$420,000	$1,594,316
Cutter Branch													
Reach	End												
21	WTP	1	0	0		$0	$180,000	$10,800	$36,000	$10,800	$96,000		$333,600
22	Huerfano turnout	0	1	3	42.05	$6,560,215	$276,000	$28,800	$115,200	$33,000	$168,000	$1,440,000	$8,621,215
23	Nageezi turnout	0	1	1		$0	$108,000	$14,400	$57,600	$15,000	$72,000		$267,000
24	Jicarilla turnout	0	0	1	19.38	$3,022,858	$84,000	$7,200	$28,800	$9,000	$48,000		$3,199,858
25	Counselor turnout	0	1	1	3.28	$511,057	$108,000	$14,400	$57,600	$15,000	$72,000		$778,057
26	Torreon turnout	0	1	0	0.00	$0	$24,000	$7,200	$28,800	$6,000	$24,000		$90,000
	Total	2	21	20	120.00	$18,720,000	$2,544,000	$316,800	$1,252,800	$327,600	$1,656,000	$1,860,000	$26,677,200

Cost per unit			
Transimission line per mile	$130,000	Comm. equipment per WTP	$30,000
Electrical equipment per pumping plant	$70,000	Security system per pp	$7,500
Electrical equipment per WTP	$150,000	Security system per turnout	$5,000
Electrical equipment per turnout	$20,000	Security system per WTP	$9,000
SCADA equipment per pp and turnout	$6,000	Substation near Huerfano	$1,200,000
SCADA equipment per WTP	$9,000	Power tap poles per pp	$40,000
SCADA system for Ft. Defiance	$350,000	Power tap poles per turnout	$20,000
Comm. equipment per pp and turnout	$24,000	Power tap poles per WTP	$80,000
		Prime contractor OH & P allowance	120%

Table B7
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Dam, Diversion Structure, Wells and Water Treatment Costs by Reach
Jan-07 $

		Joint Costs				
San Juan Branch						
Reach	End	Dams	Diversion Structures	Wells	Water Treatment Plants	Total
1	Water Treatment Plant (WTP)		$1,707,380		$44,656,510	$46,363,890
2	NAPI turnout					$0
3	Shiprock Junction					$0
4	Sanostee turnout					$0
5	Burnham Junction					$0
6	Newcomb turnout					$0
7	Sheepsprings turnout					$0
8	Naschitti turnout					$0
9	Tohatchi turnout					$0
10	Coyote Canyon Junction					$0
11	Twin Lakes turnout					$0
12	Ya-ta-hey Junction					$0
13	Gallup Junction					$0
14	Navajo Chapters					$0
10.1	Coyote Canyon turnout					$0
10.2	Standing Rock turnout					$0
10.3	Dalton Pass turnout					$0
12.1	Rock Springs turnout					$0
12.2	Window Rock turnout					$0
Cutter Branch						
Reach	End					
21	WTP				$9,016,545	$9,016,545
22	Huerfano turnout					$0
23	Nageezi turnout					$0
24	Jicarilla turnout					$0
25	Counselor turnout					$0
26	Torreon turnout					$0
	Total	$0	$1,707,380	$0	$53,673,055	$55,380,435

Table B8
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2020
Allocation of Environmental Mitiagation, Cultural Resources and Right-of-Way Costs
Jan-07 $

	Main Navajo-Gallup Pipeline Project				Gallup Regional Water Supply System				
	Navajo	Gallup	Jicarilla	Total	Navajo	Gallup	Jicarilla	Total	Total
Total Field Costs	$456,400,000	$85,100,000	$22,300,000	$563,900,000	$14,000,000	$22,500,000	$0	$36,500,000	$600,400,000
% Distribution of Field Costs	76.02%	14.17%	3.71%	93.92%	2.33%	3.75%	0.00%	6.08%	100.00%
Environmental Mitigation Costs	$4,560,959	$850,433	$222,851	$5,635,243	$139,907	$224,850	$0	$364,757	$6,000,000
Cultural Resources Costs	$26,301,532	$4,904,164	$1,285,110	$32,496,569	$806,795	$1,296,636	$0	$2,103,431	$34,600,000
Right-of-Way Costs	$6,841,439	$1,275,650	$334,277	$8,452,865	$209,860	$337,275	$0	$547,135	$9,000,000
Total	$37,703,931	$7,030,247	$1,842,239	$46,584,677	$1,156,562	$1,858,761	$0	$3,015,323	$49,600,000
Total (rounded)	$37,700,000	$7,030,000	$1,840,000	$46,580,000	$1,160,000	$1,860,000	$0	$3,020,000	$49,600,000

Notes: Environmental mitigation costs estimated at $6,000,000 (Jan. 07 $) and allocated between systems and among users by share of field costs.
Cultural resources costs estimated at 4% of total project cost and allocated between systems and among users by share of field costs.
Right-of-way costs consist of land purchased from private parties for the water treatment plants, cost of relocating Navajo families who live in the pipeline route, and administration costs, totalling $9,000,000 (Jan. 07 $). These costs are allocated between systems and among users by share of field costs. It is assumed that both the Navajo Nation and the City of Gallup will contribute any other land needed for their respective systems.
Environmental mitigation costs, cultural resource costs and right-of-way costs include allowances for contingencies, non-contract costs and taxes.

Table B9
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Interest During Construction
4.875% Discount Rate
Jan-07 $

Scenario 1 - $60 million/year Schedule	CONSTRUCTION SCHEDULE Costs in millions *Year*																
Construction phase	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
NGWSP Project	$2.35	$4.29	22.316	$11.91													$40.86
Cutter Lateral	$5.99	$7.53	$4.27	$16.20	$16.14	$21.72	$21.70	$17.19	$7.41								$118.14
Twin Lakes/ Window Rock	$0.78	$0.21				$19.94	$30.76	$2.23									$53.92
Cutter Power	$0.72	$0.73	$0.73		$3.00	$3.27	$6.60	$9.59									$24.63
San Juan Power		$0.78	$1.57					$6.00	$18.26	$0.00							$26.61
Gallup Regional System	$0.40	$4.37	$20.33	$26.66	$28.09												$79.85
San Juan Lateral		$8.47	$3.63		$7.78	$15.07	$0.94			$33.18	$32.74	$53.00	$60.00	$54.31	$57.03	$34.91	$361.04
San Juan Pumping Plant		$3.51	$1.16					$8.16	$16.00		$8.48	$7.00		$5.69	2.971		$52.97
San Juan Water Treatment Plant	$5.33	$2.48						$16.85	$18.33	$26.83	$18.78						$88.59
Cutter Water Treatment Plant	$1.11	$0.46	$6.00	$5.23	$4.99												$17.79
TOTAL Allocated Spending	$16.67	$32.82	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$34.91	$864.40
Percent Distribution	1.93%	3.80%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	6.94%	4.04%	100.00%
Overall Spending	$16.68	$32.84	$60.04	$60.04	$60.04	$60.04	$60.04	$60.04	$60.04	$60.04	$60.04	$60.04	$60.04	$60.04	$60.04	$34.94	$865.00
Interest During Construction to January 1 of year 14	$18.20	$32.65	$54.12	$48.81	$43.75	$38.93	$34.33	$29.94	$25.76	$21.77	$17.97	$14.34	$10.88	$7.59	$4.44	$0.84	$404.34

Note: The construction schedule assumes that annual appropriations will be indexed to keep in step with construction cost trends.

Table C1
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Gallup Regional System Capital Costs
Jan-07 $

Category	Total Cost	Joint Cost	Allocation Factors		Allocated Joint Costs		Total Costs	
			Gallup	Navajo	Gallup	Navajo	Gallup	Navajo
Excavation, common	$542,400	$542,400	0.6170	0.3830	$334,683	$207,717	$334,683	$207,717
Excavation, rock	$384,000	$384,000	0.6170	0.3830	$236,944	$147,056	$236,944	$147,056
Backfill	$797,550	$797,550	0.6170	0.3830	$492,121	$305,429	$492,121	$305,429
Soil Cement Embedment	$2,097,000	$2,097,000	0.6170	0.3830	$1,293,934	$803,066	$1,293,934	$803,066
Pipeline	$7,658,550	$7,658,550	0.6170	0.3830	$4,725,638	$2,932,912	$4,725,638	$2,932,912
Crossings and borings	$1,100,000	$1,100,000	0.6170	0.3830	$678,745	$421,255	$678,745	$421,255
Water Storage Tanks	$10,900,000	$10,900,000	0.6170	0.3830	$6,725,744	$4,174,256	$6,725,744	$4,174,256
Pumping Plants	$1,100,000	$1,100,000	0.6170	0.3830	$678,745	$421,255	$678,745	$421,255
Valve & Metering Sta.	$800,000	$800,000	0.6170	0.3830	$493,633	$306,367	$493,633	$306,367
Surge Control	$375,000	$375,000	0.6170	0.3830	$231,390	$143,610	$231,390	$143,610
Subtotal	$25,754,500	$25,754,500			$15,891,577	$9,862,923	$15,891,577	$9,862,923
Mobilization @5%	$1,287,725						$794,579	$493,146
Subtotal	$27,042,225						$16,686,155	$10,356,070
Unlisted @10%	$2,704,223						$1,668,616	$1,035,607
Subtotal	$29,746,448						$18,354,771	$11,391,677
Contingency @22.5%	$6,692,951						$4,129,823	$2,563,127
Total Field Cost	$36,439,398						$22,484,594	$13,954,804
Non-Contract Costs @27%	$9,838,638						$6,070,840	$3,767,797
Total Construction Costs	$46,278,036						$28,555,435	$17,722,601
Taxes @6% of Field Cost	$2,186,364						$1,349,076	$837,288
Total with Taxes	$48,464,400						$29,904,510	$18,559,889
Rounded Total	$48,500,000						$29,900,000	$18,600,000

Note: The costs in this table include only the cost for the Gallup Regional System. The costs for the main water supply pipeline are shown in Table B1. The costs also exclude the environmental mitigation, cultural resourcs, right-of-way acquisition and interest during construction costs, which are shown in Table 1.

Table C2
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Gallup Regional System O,M & R Costs
Jan-07 $

Present Value @ 4.875%

	Annual Cost	Allocation Factors Gallup	Allocation Factors Navajo		Allocated Annual Cost Gallup	Allocated Annual Cost Navajo		Allocated Present Value Cost Gallup	Allocated Present Value Cost Navajo	Allocated Present Value Cost Total
CRSP Rates	$811,000	0.6170	0.3830		$500,420	$310,580		$9,314,944	$5,781,213	$15,096,157
				rounded	$500,000	$311,000	rounded	$9,315,000	$5,781,000	$15,096,000
NTUA Rate	$862,000	0.6170	0.3830		$531,889	$330,111		$9,900,718	$6,144,766	$16,045,484
				rounded	$532,000	$330,000	rounded	$9,901,000	$6,145,000	$16,045,000

Table C3 - Scenario 1 $60 million/yr Construction Schedule
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Cost of Water to City of Gallup
Jan-07 $

Event	Year	Cost to Gallup $/af	PV @ 4.875%
	2006	$0	$0
	2007	$42	$110
	2008	$45	$110
	2009	$47	$110
	2010	$49	$110
Construction Begins	2011	$51	$110
	2012	$54	$110
	2013	$56	$110
	2014	$59	$110
	2015	$62	$110
	2016	$65	$110
	2017	$68	$110
	2018	$72	$110
	2019	$75	$110
	2020	$79	$110
	2021	$83	$110
	2022	$87	$110
	2023	$91	$110
	2024	$95	$110
	2025	$100	$110
	2026	$105	$110
Project Completion	2027	$110	$110
Full Gallup Water Use	2028	$110	$105
	2029	$110	$100
	2030	$110	$95
	2031	$110	$91
	2032	$110	$87
	2033	$110	$83
	2034	$110	$79
	2035	$110	$75
	2036	$110	$72
	2037	$110	$68
	2038	$110	$65
	2039	$110	$62
	2040	$110	$59
	2041	$110	$56
	2042	$110	$54
	2043	$110	$51
	2044	$110	$49
	2045	$110	$47
	2046	$110	$45
	2047	$110	$42
	2048	$110	$40
	2049	$110	$39
	2050	$110	$37
	2051	$110	$35
	2052	$110	$33
	2053	$110	$32
	2054	$110	$30
	2055	$110	$29
	2056	$110	$28
	2057	$110	$26
	2058	$110	$25
	2059	$110	$24
	2060	$110	$23
	2061	$110	$22
	2062	$110	$21
	2063	$110	$20
	2064	$110	$19
	2065	$110	$18
	2066	$110	$17
	2067	$110	$16
	2068	$110	$16
	2069	$110	$15
	2070	$110	$14
	2071	$110	$14
	2072	$110	$13
	2073	$110	$12
	2074	$110	$12
	2075	$110	$11
	2076	$110	$11
	2077	$0	$0
	2078	$0	$0
	2079	$0	$0
	2080	$0	$0
		Total PV per acre-foot	$4,347
		Total PV for 7500 af	$32,605,398
Present Values as of	2027		

Note: The City of Gallup has not yet reached an agreement with the Jicarilla Apache Nation on the terms of a long-term water lease. For purposes of this report we have assumed that the price will be $110 per acre-foot (in 2007$), beginning when the City begins taking water in the year 2027. We also assume that prior to that time the City will pay an annual option fee equivalent in present value to the price for water in 2027. The City and the Jicarilla Nation may agree on terms very different from these.

Table D1- Scenario 1 - $60 million/year Construction Schedule
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Summary of Annual O,M&R Charges by User
Project Completion In 2027
Jan-07 $

CRSP Power Rate													
	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Navajo	Fixed	$0	$0	$638,599	$638,599	$638,599	$638,599	$2,674,341	$2,674,341	$2,674,341	$2,674,341	$2,674,341	$2,674,341
	Variable	$0	$0	$35,447	$35,251	$35,049	$34,843	$225,397	$229,890	$234,494	$239,212	$244,047	$249,002
	Total	$0	$0	$674,046	$673,850	$673,648	$673,442	$2,899,738	$2,904,231	$2,908,835	$2,913,553	$2,918,388	$2,923,343
Gallup	Fixed	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Variable	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jicarilla	Fixed	$0	$0	$0	$0	$0	$0	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852
	Variable	$0	$0	$0	$0	$0	$0	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784
	Total	$0	$0	$0	$0	$0	$0	$743,636	$743,636	$743,636	$743,636	$743,636	$743,636
Total	Fixed	$0	$0	$638,599	$638,599	$638,599	$638,599	$3,319,193	$3,319,193	$3,319,193	$3,319,193	$3,319,193	$3,319,193
	Variable	$0	$0	$35,447	$35,251	$35,049	$34,843	$324,181	$328,674	$333,278	$337,996	$342,831	$347,786
	Total	$0	$0	$674,046	$673,850	$673,648	$673,442	$3,643,374	$3,647,867	$3,652,471	$3,657,189	$3,662,024	$3,666,979
	Rounded	$0	$0	$674,000	$674,000	$674,000	$673,000	$3,643,000	$3,648,000	$3,652,000	$3,657,000	$3,662,000	$3,667,000
NTUA Power Rate													
	Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Navajo	Fixed	$0	$0	$638,599	$638,599	$638,599	$638,599	$2,674,341	$2,674,341	$2,674,341	$2,674,341	$2,674,341	$2,674,341
	Variable	$0	$0	$95,540	$95,011	$94,469	$93,914	$493,021	$502,290	$511,789	$521,524	$531,501	$541,725
	Total	$0	$0	$734,139	$733,610	$733,068	$732,513	$3,167,362	$3,176,631	$3,186,131	$3,195,866	$3,205,842	$3,216,066
Gallup	Fixed	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Variable	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Jicarilla	Fixed	$0	$0	$0	$0	$0	$0	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852
	Variable	$0	$0	$0	$0	$0	$0	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342
	Total	$0	$0	$0	$0	$0	$0	$846,194	$846,194	$846,194	$846,194	$846,194	$846,194
Total	Fixed	$0	$0	$638,599	$638,599	$638,599	$638,599	$3,319,193	$3,319,193	$3,319,193	$3,319,193	$3,319,193	$3,319,193
	Variable	$0	$0	$95,540	$95,011	$94,469	$93,914	$694,362	$703,632	$713,131	$722,866	$732,842	$743,066
	Total	$0	$0	$734,139	$733,610	$733,068	$732,513	$4,013,556	$4,022,825	$4,032,325	$4,042,060	$4,052,036	$4,062,260
	Rounded	$0	$0	$734,000	$734,000	$733,000	$733,000	$4,014,000	$4,023,000	$4,032,000	$4,042,000	$4,052,000	$4,062,000

Table D1- Scenario 1 - $60 million/year Construction Schedule
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Summary of Annual O,M&R Charges by User
Project Completion In 2027
page 2

2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060	2065-76
$2,674,341	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483
$254,080	$1,989,609	$2,038,781	$2,089,172	$2,140,813	$2,418,875	$2,733,171	$2,733,171	$2,733,171	$2,733,171	$2,733,171	$2,733,171
$2,928,421	$8,799,092	$8,848,264	$8,898,655	$8,950,296	$9,228,358	$9,542,654	$9,542,654	$9,542,654	$9,542,654	$9,542,654	$9,542,654
$0	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776
$0	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462
$0	$2,075,238	$2,075,238	$2,075,238	$2,075,238	$2,075,238	$2,075,238	$2,075,238	$2,075,238	$2,075,238	$2,075,238	$2,075,238
$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852
$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784
$743,636	$743,636	$743,636	$743,636	$743,636	$743,636	$743,636	$743,636	$743,636	$743,636	$743,636	$743,636
$3,319,193	$8,755,111	$8,755,111	$8,755,111	$8,755,111	$8,755,111	$8,755,111	$8,755,111	$8,755,111	$8,755,111	$8,755,111	$8,755,111
$352,864	$2,862,855	$2,912,027	$2,962,418	$3,014,059	$3,292,121	$3,606,417	$3,606,417	$3,606,417	$3,606,417	$3,606,417	$3,606,417
$3,672,057	$11,617,966	$11,667,138	$11,717,529	$11,769,170	$12,047,232	$12,361,528	$12,361,528	$12,361,528	$12,361,528	$12,361,528	$12,361,528
$3,672,000	$11,618,000	$11,667,000	$11,718,000	$11,769,000	$12,047,000	$12,362,000	$12,362,000	$12,362,000	$12,362,000	$12,362,000	$12,362,000

2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060	2065-76
$2,674,341	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483	$6,809,483
$552,202	$4,212,017	$4,316,016	$4,422,594	$4,531,814	$5,119,918	$5,784,654	$5,784,654	$5,784,654	$5,784,654	$5,784,654	$5,784,654
$3,226,543	$11,021,500	$11,125,499	$11,232,077	$11,341,298	$11,929,401	$12,594,137	$12,594,137	$12,594,137	$12,594,137	$12,594,137	$12,594,137
$0	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776	$1,300,776
$0	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268
$0	$2,977,044	$2,977,044	$2,977,044	$2,977,044	$2,977,044	$2,977,044	$2,977,044	$2,977,044	$2,977,044	$2,977,044	$2,977,044
$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852	$644,852
$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342
$846,194	$846,194	$846,194	$846,194	$846,194	$846,194	$846,194	$846,194	$846,194	$846,194	$846,194	$846,194
$3,319,193	$8,755,112	$8,755,112	$8,755,112	$8,755,112	$8,755,112	$8,755,112	$8,755,112	$8,755,112	$8,755,112	$8,755,112	$8,755,112
$753,544	$6,089,627	$6,193,626	$6,300,203	$6,409,424	$6,997,528	$7,662,264	$7,662,264	$7,662,264	$7,662,264	$7,662,264	$7,662,264
$4,072,737	$14,844,739	$14,948,737	$15,055,315	$15,164,536	$15,752,639	$16,417,375	$16,417,375	$16,417,375	$16,417,375	$16,417,375	$16,417,375
$4,073,000	$14,845,000	$14,949,000	$15,055,000	$15,165,000	$15,753,000	$16,417,000	$16,417,000	$16,417,000	$16,417,000	$16,417,000	$16,417,000

Table D2 - 2040
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Fixed O,M&R Costs by User
Jan-07 $

		Joint Costs										
		Pumping Plants		**Pipelines**	**Elec.Trans. Line**	**NIIP Canal**	**Water Treatment Plant Fixed O,M&R**				
San Juan Branch											
Reach	End	Pumping Plants	Annual Maintenance	Annual Maintenance	Annual Maintenance	Annual Maintenance	Operators	Equipment Replacement	Dredging	Misc. @ 10%	Total WTP
1	Water Treatment Plant (WTP)	River	$153,101	$0	$6,699		$845,000	$605,000	$212,000	$166,200	$1,828,200
2	NAPI turnout	01	$302,893	$12,240	$2,322						
3	Shiprock Junction		$0	$125,693	$0						
4	Sanostee turnout	02, 03	$532,344	$133,690	$5,825						
5	Burnham Junction		$0	$70,008	$0						
6	Newcomb turnout		$0	$26,423	$21,882						
7	Sheepsprings turnout	04	$248,187	$68,553	$15,486						
8	Naschitti turnout	05	$232,852	$37,160	$39,976						
9	Tohatchi turnout	06	$270,720	$113,365	$16,705						
10	Coyote Canyon Junction		$0	$36,846	$6,305						
11	Twin Lakes turnout	07	$255,331	$16,410	$16,105						
12	Ya-ta-hey Junction	08	$269,788	$32,493	$2,322						
13	Gallup Junction		$0	$16,420	$1,181						
14	Navajo Chapters		$0	$0	$5,904						
					$0						
10.1	Coyote Canyon turnout	11	$141,952	$20,240	$3,503						
10.2	Standing Rock turnout	12	$173,953	$42,222	$3,503						
10.3	Dalton Pass turnout	13	$188,735	$10,374	$3,503						
					$0						
12.1	Rock Springs turnout	09	$206,164	$23,066	$3,503						
12.2	Window Rock turnout	10	$193,980	$37,473	$20,917						
Cutter Branch											
Reach	End										
21	WTP	Reservoir	$0	$0	$4,377	$35,000	$845,000	$85,000	$1,000	$93,100	$1,024,100
22	Huerfano turnout	01, 02, 03	$637,697	$79,328	$113,109						
23	Nageezi turnout	04	$192,144	$32,044	$3,503						
24	Jicarilla turnout	05	$215,611	$40,063	$41,982						
25	Counselor turnout	06	$199,548	$22,994	$10,208						
26	Torreon turnout		$0	$15,707	$1,181						
		Total	$4,415,000	$1,012,812	$350,000	$35,000	$1,690,000	$690,000	$213,000	$259,300	$2,852,300

Annual pipeline OM&R estimated at 0.5% of capital cost
Pumping plant maintenance estimated at $3,170,000 for San Juan Branch, & $1,245,000 for Cutter Branch, per Bob Brown, BOR, 9/27/07
Annual electric transmission line OM&R estimated at $350,000

Table D2 - 2040, page 2
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Fixed O,M&R Costs by User

Allocated Joint Costs							*Dedicated Costs*			Total Annual Fixed OM&R Costs		
							Service Area Pumping Plants			**Dedicated Costs Plus**		
Total	Allocation Ratios			Allocated Joint Costs			Annual Maintenance			**Allocated Joint Costs**		
Joint Costs	Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla
$1,988,000	0.7724	0.2276	-	$1,535,510	$452,490	$0				$1,535,510	$452,490	$0
$317,455	0.7724	0.2276	-	$245,199	$72,256	$0				$245,199	$72,256	$0
$125,693	0.7686	0.2314	-	$96,607	$29,086	$0				$96,607	$29,086	$0
$671,859	0.7384	0.2616	-	$496,098	$175,761	$0	$3,774			$499,872	$175,761	$0
$70,008	0.7278	0.2722	-	$50,954	$19,055	$0				$50,954	$19,055	$0
$48,305	0.7263	0.2737	-	$35,085	$13,220	$0	$3,774			$38,859	$13,220	$0
$332,226	0.7176	0.2824	-	$238,409	$93,817	$0	$3,774			$242,183	$93,817	$0
$309,988	0.7134	0.2866	-	$221,147	$88,841	$0	$3,774			$224,921	$88,841	$0
$400,790	0.7037	0.2963	-	$282,034	$118,756	$0	$3,774			$285,808	$118,756	$0
$43,151	0.6901	0.3099	-	$29,780	$13,371	$0				$29,780	$13,371	$0
$287,846	0.6493	0.3507	-	$186,902	$100,945	$0	$3,774			$190,676	$100,945	$0
$304,603	0.6313	0.3687	-	$192,284	$112,319	$0				$192,284	$112,319	$0
$17,600	0.3830	0.6170	-	$6,740	$10,860	$0				$6,740	$10,860	$0
$5,904	1.0000	-	-	$5,904	$0	$0	$18,871			$24,775	$0	$0
$165,695	1.0000	-	-	$165,695	$0	$0	$3,774			$169,469	$0	$0
$219,678	1.0000	-	-	$219,678	$0	$0	$3,774			$223,452	$0	$0
$202,612	1.0000	-	-	$202,612	$0	$0	$3,774			$206,386	$0	$0
$232,733	1.0000	-	-	$232,733	$0	$0	$3,774			$236,507	$0	$0
$252,371	1.0000	-	-	$252,371	$0	$0	$21,387			$273,758	$0	$0
$1,063,477	0.7422	-	0.2578	$789,319	$0	$274,158				$789,319	$0	$274,158
$830,134	0.7422	-	0.2578	$616,130	$0	$214,003	$3,000			$619,130	$0	$214,003
$227,692	0.7258	-	0.2742	$165,251	$0	$62,441	$3,000			$168,251	$0	$62,441
$297,656	0.6834	-	0.3166	$203,405	$0	$94,250				$203,405	$0	$94,250
$232,749	1.0000	-	-	$232,749	$0	$0	$3,000			$235,749	$0	$0
$16,887	1.0000	-	-	$16,887	$0	$0	$3,000			$19,887	$0	$0
$8,665,112				$6,719,483	$1,300,776	$644,852	$90,000			$6,809,483	$1,300,776	$644,852

Booster station pumping plant maintenance estimated at $78,000 for San Juan Lateral, & $12,000 for Cutter Lateral,per Bob Brown, BOR, 9/

Table D2 - 2040, page 3
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Fixed O,M&R Costs by User

Total Annual Fixed OM&R Costs Cutter Lateral Only Scenario			**Total Annual Fixed OM&R Costs Gallup Chapters Scenario**		
Navajo	Gallup	Jicarilla	Navajo	Gallup	Jicarilla
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$291,621	$0	$0
$0	$0	$0	$304,603	$0	$0
$0	$0	$0	$17,600	$0	$0
$0	$0	$0	$24,775	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0
$789,319	$0	$274,158	$0	$0	$0
$619,130	$0	$214,003	$0	$0	$0
$168,251	$0	$62,441	$0	$0	$0
$203,405	$0	$94,250	$0	$0	$0
$235,749	$0	$0	$0	$0	$0
$19,887	$0	$0	$0	$0	$0
$2,035,742	$0	$644,852	$638,599	$0	$0

'27/07

Table D3 - 2040
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Projection of Peak Flows by Reach, Annually 2014-2030 and then by 5-Year Period, 2035 - 2076

		Design Capacity by Reach	Design Peak Deliveries by Reach	Total Deliveries (peak flows)																						
San Juan Branch				2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
Number	End	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs
1	Water Treatment Plant (WTP)	59.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	NAPI turnout	59.18	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.72	0.74	0.76	0.86	0.97	0.97	0.97	0.97	0.97
3	Shiprock Junction	58.21	6.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.89	5.01	5.13	5.26	5.95	6.72	6.72	6.72	6.72	6.72
4	Sanostee turnout	51.49	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.45	1.49	1.53	1.57	1.77	2.00	2.00	2.00	2.00	2.00
5	Burnham Junction	49.49	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.21	0.21	0.24	0.27	0.27	0.27	0.27	0.27
6	Newcomb turnout	49.22	1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11	1.13	1.16	1.19	1.34	1.52	1.52	1.52	1.52	1.52
7	Sheepsprings turnout	47.70	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.52	0.53	0.55	0.62	0.70	0.70	0.70	0.70	0.70
8	Naschitti turnout	47.00	1.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12	1.15	1.18	1.21	1.36	1.54	1.54	1.54	1.54	1.54
9	Tohatchi turnout	45.46	1.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.45	1.48	1.52	1.56	1.76	1.99	1.99	1.99	1.99	1.99
10	Coyote Canyon Junction	43.47	5.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.68	3.77	3.86	3.96	4.48	5.06	5.06	5.06	5.06	5.06
11	Twin Lakes turnout	38.41	1.88	0.00	0.00	1.04	1.07	1.10	1.12	1.15	1.18	1.21	1.24	1.27	1.30	1.33	1.37	1.40	1.44	1.47	1.66	1.88	1.88	1.88	1.88	1.88
12	Ya-ta-hey Junction	36.53	14.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.69	10.96	11.23	11.51	13.01	14.70	14.70	14.70	14.70	14.70
13	Gallup Junction	21.83	13.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47	13.47	13.47	13.47	13.47	13.47	13.47	13.47
14	Navajo Chapters	8.36	8.36	0.00	0.00	2.55	2.52	2.49	2.47	2.44	2.41	2.38	2.35	2.32	2.29	2.26	6.08	6.23	6.39	6.54	7.40	8.36	8.36	8.36	8.36	8.36
			59.18	0.00	0.00	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	46.71	47.54	48.38	49.25	53.91	59.18	59.18	59.18	59.18	59.18
10.1	Coyote Canyon turnout	5.06	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.93	0.95	0.98	1.11	1.25	1.25	1.25	1.25	1.25
10.2	Standing Rock turnout	3.81	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.10	0.10	0.10	0.12	0.13	0.13	0.13	0.13	0.13
10.3	Dalton Pass turnout	3.68	3.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.68	2.74	2.81	2.88	3.26	3.68	3.68	3.68	3.68	3.68
			5.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.68	3.77	3.86	3.96	4.48	5.06	5.06	5.06	5.06	5.06
12.1	Rock Springs turnout	14.70	3.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.32	2.38	2.44	2.50	2.82	3.19	3.19	3.19	3.19	3.19
12.2	Window Rock turnout	11.51	11.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.37	8.58	8.79	9.01	10.18	11.51	11.51	11.51	11.51	11.51
			14.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.69	10.96	11.23	11.51	13.01	14.70	14.70	14.70	14.70	14.70
Cutter Branch				2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
21	WTP	8.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	Huerfano turnout	8.34	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.31	0.32	0.33	0.34	0.35	0.35	0.36	0.37	0.38	0.39	0.44	0.50	0.50	0.50	0.50	0.50
23	Nageezi turnout	7.84	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.66	0.68	0.69	0.71	0.73	0.75	0.76	0.78	0.80	0.82	0.93	1.05	1.05	1.05	1.05	1.05
24	Jicarilla turnout	6.79	2.15	0.00	0.00	0.00	0.00	0.00	0.00	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
25	Counselor turnout	4.64	2.63	0.00	0.00	0.00	0.00	0.00	0.00	1.61	1.65	1.69	1.73	1.78	1.82	1.87	1.91	1.96	2.01	2.06	2.33	2.63	2.63	2.63	2.63	2.63
26	Torreon turnout	2.01	2.01	0.00	0.00	0.00	0.00	0.00	0.00	1.23	1.26	1.29	1.33	1.36	1.39	1.43	1.46	1.50	1.54	1.57	1.78	2.01	2.01	2.01	2.01	2.01
			8.34	0.00	0.00	0.00	0.00	0.00	0.00	5.94	6.04	6.13	6.23	6.33	6.44	6.54	6.65	6.76	6.88	7.00	7.63	8.34	8.34	8.34	8.34	8.34

Note: Peak flows = average flows times 1.3 peaking factor

Table D4, page 1
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Projection of Peak Flows in Each Reach Allocated to Each Party, Annually 2014-2030
and then by 5-Year Period, 2035 - 2076

	Navajo																						
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
Reach	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.24	34.07	34.91	35.78	40.44	45.71	45.71	45.71	45.71	45.71
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.24	34.07	34.91	35.78	40.44	45.71	45.71	45.71	45.71	45.71
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.54	33.34	34.17	35.02	39.58	44.74	44.74	44.74	44.74	44.74
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.65	28.34	29.04	29.76	33.64	38.02	38.02	38.02	38.02	38.02
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.20	26.85	27.51	28.19	31.87	36.02	36.02	36.02	36.02	36.02
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.00	26.64	27.31	27.98	31.63	35.75	35.75	35.75	35.75	35.75
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.89	25.51	26.14	26.79	30.28	34.23	34.23	34.23	34.23	34.23
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.39	24.99	25.61	26.24	29.66	33.53	33.53	33.53	33.53	33.53
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.27	23.84	24.43	25.04	28.30	31.99	31.99	31.99	31.99	31.99
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.82	22.36	22.91	23.48	26.54	30.00	30.00	30.00	30.00	30.00
11	0.00	0.00	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	18.14	18.59	19.05	19.52	22.06	24.94	24.94	24.94	24.94	24.94
12	0.00	0.00	2.55	2.52	2.49	2.47	2.44	2.41	2.38	2.35	2.32	2.29	2.26	16.77	17.19	17.61	18.05	20.40	23.06	23.06	23.06	23.06	23.06
13	0.00	0.00	2.55	2.52	2.49	2.47	2.44	2.41	2.38	2.35	2.32	2.29	2.26	6.08	6.23	6.39	6.54	7.40	8.36	8.36	8.36	8.36	8.36
14	0.00	0.00	2.55	2.52	2.49	2.47	2.44	2.41	2.38	2.35	2.32	2.29	2.26	6.08	6.23	6.39	6.54	7.40	8.36	8.36	8.36	8.36	8.36
10.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.68	3.77	3.86	3.96	4.48	5.06	5.06	5.06	5.06	5.06
10.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.77	2.84	2.91	2.98	3.37	3.81	3.81	3.81	3.81	3.81
10.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.68	2.74	2.81	2.88	3.26	3.68	3.68	3.68	3.68	3.68
12.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.69	10.96	11.23	11.51	13.01	14.70	14.70	14.70	14.70	14.70
12.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.37	8.58	8.79	9.01	10.18	11.51	11.51	11.51	11.51	11.51

	Navajo																						
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
21	0.00	0.00	0.00	0.00	0.00	0.00	3.79	3.89	3.98	4.08	4.18	4.29	4.39	4.50	4.61	4.73	4.85	5.48	6.19	6.19	6.19	6.19	6.19
22	0.00	0.00	0.00	0.00	0.00	0.00	3.79	3.89	3.98	4.08	4.18	4.29	4.39	4.50	4.61	4.73	4.85	5.48	6.19	6.19	6.19	6.19	6.19
23	0.00	0.00	0.00	0.00	0.00	0.00	3.49	3.57	3.66	3.75	3.84	3.94	4.04	4.14	4.24	4.35	4.45	5.03	5.69	5.69	5.69	5.69	5.69
24	0.00	0.00	0.00	0.00	0.00	0.00	2.84	2.91	2.99	3.06	3.14	3.21	3.29	3.37	3.46	3.54	3.63	4.11	4.64	4.64	4.64	4.64	4.64
25	0.00	0.00	0.00	0.00	0.00	0.00	2.84	2.91	2.99	3.06	3.14	3.21	3.29	3.37	3.46	3.54	3.63	4.11	4.64	4.64	4.64	4.64	4.64
26	0.00	0.00	0.00	0.00	0.00	0.00	1.23	1.26	1.29	1.33	1.36	1.39	1.43	1.46	1.50	1.54	1.57	1.78	2.01	2.01	2.01	2.01	2.01

Table D4, page 2
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Projection of Peak Flows in Each Reach Allocated to Each Party, Annually 2014-2030
and then by 5-Year Period, 2035 - 2076

Jicarilla	**Gallup**															
All yrs.	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029-76
cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.47	13.47	13.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Gallup	**Jicarilla**															
All yrs.	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029-76
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D5, page 1
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Projection of Flows by Reach
Projection of Peak Flows in Each Reach Allocated to Each Party, Annually 2014-2030
and then by 5-Year Period, 2035 - 2076

												Navajo											
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
Reach	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.16%	71.66%	72.16%	72.65%	75.01%	77.24%	77.24%	77.24%	77.24%	77.24%
2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.16%	71.66%	72.16%	72.65%	75.01%	77.24%	77.24%	77.24%	77.24%	77.24%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	70.72%	71.23%	71.73%	72.22%	74.61%	76.86%	76.86%	76.86%	76.86%	76.86%
4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	67.24%	67.78%	68.31%	68.84%	71.41%	73.84%	73.84%	73.84%	73.84%	73.84%
5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	66.04%	66.59%	67.13%	67.67%	70.29%	72.78%	72.78%	72.78%	72.78%	72.78%
6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	65.87%	66.42%	66.97%	67.50%	70.13%	72.63%	72.63%	72.63%	72.63%	72.63%
7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	64.89%	65.45%	66.00%	66.54%	69.21%	71.76%	71.76%	71.76%	71.76%	71.76%
8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	64.42%	64.98%	65.53%	66.08%	68.77%	71.34%	71.34%	71.34%	71.34%	71.34%
9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	63.33%	63.90%	64.46%	65.02%	67.75%	70.37%	70.37%	70.37%	70.37%	70.37%
10	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	61.83%	62.40%	62.98%	63.55%	66.33%	69.01%	69.01%	69.01%	69.01%	69.01%
11	0.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	57.38%	57.98%	58.58%	59.17%	62.09%	64.93%	64.93%	64.93%	64.93%	64.93%
12	0.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	55.46%	56.06%	56.66%	57.26%	60.23%	63.13%	63.13%	63.13%	63.13%	63.13%
13	0.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	31.10%	31.63%	32.16%	32.70%	35.45%	38.30%	38.30%	38.30%	38.30%	38.30%
14	0.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
10.1	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
10.2	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
10.3	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
12.1	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
12.2	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

	Navajo																						
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
21	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	63.82%	64.38%	64.94%	65.50%	66.05%	66.60%	67.14%	67.68%	68.21%	68.74%	69.26%	71.81%	74.22%	74.22%	74.22%	74.22%	74.22%
22	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	63.82%	64.38%	64.94%	65.50%	66.05%	66.60%	67.14%	67.68%	68.21%	68.74%	69.26%	71.81%	74.22%	74.22%	74.22%	74.22%	74.22%
23	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	61.85%	62.43%	63.00%	63.57%	64.14%	64.70%	65.26%	65.81%	66.36%	66.90%	67.44%	70.07%	72.58%	72.58%	72.58%	72.58%	72.58%
24	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	56.94%	57.54%	58.13%	58.73%	59.32%	59.91%	60.50%	61.08%	61.66%	62.24%	62.81%	65.63%	68.34%	68.34%	68.34%	68.34%	68.34%
25	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
26	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table D5, page 2
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Projection of Flows by Reach
Percentage of Peak Flows in Each Reach Allocated to Each Party, Annually 2014-2030
and then by 5-Year Period, 2035 - 2076

Gallup																							Jicarilla
2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76	All Years
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	28.84%	28.34%	27.84%	27.35%	24.99%	22.76%	22.76%	22.76%	22.76%	22.76%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	28.84%	28.34%	27.84%	27.35%	24.99%	22.76%	22.76%	22.76%	22.76%	22.76%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	29.28%	28.77%	28.27%	27.78%	25.39%	23.14%	23.14%	23.14%	23.14%	23.14%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	32.76%	32.22%	31.69%	31.16%	28.59%	26.16%	26.16%	26.16%	26.16%	26.16%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.96%	33.41%	32.87%	32.33%	29.71%	27.22%	27.22%	27.22%	27.22%	27.22%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	34.13%	33.58%	33.03%	32.50%	29.87%	27.37%	27.37%	27.37%	27.37%	27.37%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	35.11%	34.55%	34.00%	33.46%	30.79%	28.24%	28.24%	28.24%	28.24%	28.24%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	35.58%	35.02%	34.47%	33.92%	31.23%	28.66%	28.66%	28.66%	28.66%	28.66%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	36.67%	36.10%	35.54%	34.98%	32.25%	29.63%	29.63%	29.63%	29.63%	29.63%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	38.17%	37.60%	37.02%	36.45%	33.67%	30.99%	30.99%	30.99%	30.99%	30.99%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	42.62%	42.02%	41.42%	40.83%	37.91%	35.07%	35.07%	35.07%	35.07%	35.07%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	44.54%	43.94%	43.34%	42.74%	39.77%	36.87%	36.87%	36.87%	36.87%	36.87%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	68.90%	68.37%	67.84%	67.30%	64.55%	61.70%	61.70%	61.70%	61.70%	61.70%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Jicarilla																							Gallup
2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76	All Years
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	36.18%	35.62%	35.06%	34.50%	33.95%	33.40%	32.86%	32.32%	31.79%	31.26%	30.74%	28.19%	25.78%	25.78%	25.78%	25.78%	25.78%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	36.18%	35.62%	35.06%	34.50%	33.95%	33.40%	32.86%	32.32%	31.79%	31.26%	30.74%	28.19%	25.78%	25.78%	25.78%	25.78%	25.78%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	38.15%	37.57%	37.00%	36.43%	35.86%	35.30%	34.74%	34.19%	33.64%	33.10%	32.56%	29.93%	27.42%	27.42%	27.42%	27.42%	27.42%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	43.06%	42.46%	41.87%	41.27%	40.68%	40.09%	39.50%	38.92%	38.34%	37.76%	37.19%	34.37%	31.66%	31.66%	31.66%	31.66%	31.66%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table D6, page 1
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Variable O,M&R Costs by User
CRSP Power Rates
Jan-07 $

San Juan Branch		Dedicated Variable OM&R Costs at Design Capacity (all Navajo)	Joint Variable O,M&R at Design Capacity					
Reach	End	Booster Pump Energy	Pump Plant Energy	WTP Energy	WTP Chemicals	WTP Misc.	Sub Total	Navajo Dam OM&R
1	Water Treatment Plant (WTP)		$34,799	$187,000	$943,000	$113,000	$1,277,799	$32,955
2	NAPI turnout		$341,805				$341,805	
3	Shiprock Junction						$0	
4	Sanostee turnout	$4,234	$445,412				$445,412	
5	Burnham Junction						$0	
6	Newcomb turnout	$3,218					$0	
7	Sheepsprings turnout	$1,482	$165,176				$165,176	
8	Naschitti turnout	$3,281	$132,658				$132,658	
9	Tohatchi turnout	$4,213	$217,416				$217,416	
10	Coyote Canyon Junction						$0	
11	Twin Lakes turnout	$3,980	$168,642				$168,642	
12	Ya-ta-hey Junction		$199,530				$199,530	
13	Gallup Junction						$0	
14	Navajo Chapters	$17,696					$0	
10.1	Coyote Canyon turnout	$2,625	$11,108				$11,108	
10.2	Standing Rock turnout	$296	$13,840				$13,840	
10.3	Dalton Pass turnout	$7,790	$18,369				$18,369	
12.1	Rock Springs turnout	$6,753	$53,821				$53,821	
12.2	Window Rock turnout	$24,365	$38,353				$38,353	
	subtotal	$79,933					$3,083,929	$32,955
Cutter Branch								
21	WTP			$22,000	$133,000	$15,500	$170,500	$4,644
22	Huerfano turnout	$1,058	$128,815				$128,815	
23	Nageezi turnout	$2,223	$28,378				$28,378	
24	Jicarilla turnout		$39,927				$39,927	
25	Counselor turnout	$5,546	$24,253				$24,253	
26	Torreon turnout	$4,255					$0	
		$93,015	$2,062,302	$209,000	$1,076,000	$128,500	$3,475,802	$37,599

Projected Peak Flows as a Percentage of Design Flow by Year

Reach	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
10	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
11	0.00%	0.00%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%
12	0.00%	0.00%	6.97%	6.90%	6.83%	6.76%	6.68%	6.60%	6.52%	6.44%	6.35%	6.27%	6.18%
13	0.00%	0.00%	11.67%	11.55%	11.43%	11.30%	11.18%	11.05%	10.91%	10.77%	10.63%	10.49%	10.34%
14	0.00%	0.00%	30.47%	30.16%	29.84%	29.52%	29.18%	28.84%	28.49%	28.13%	27.77%	27.39%	27.00%
10.1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
10.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
10.3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
12.1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
12.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
21	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.25%	72.38%	73.53%	74.72%	75.93%	77.18%	78.45%
22	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.25%	72.38%	73.53%	74.72%	75.93%	77.18%	78.45%
23	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.89%	72.99%	74.12%	75.28%	76.47%	77.68%	78.93%
24	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	73.53%	74.57%	75.63%	76.72%	77.84%	78.99%	80.16%
25	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	61.27%	62.79%	64.34%	65.94%	67.57%	69.25%	70.97%
26	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	61.27%	62.79%	64.34%	65.94%	67.57%	69.25%	70.97%

Reach	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-70
1	78.93%	80.33%	81.75%	83.22%	91.10%	100.00%	100.00%	100.00%	100.00%	100.00%
2	78.93%	80.33%	81.75%	83.22%	91.10%	100.00%	100.00%	100.00%	100.00%	100.00%
3	79.04%	80.42%	81.84%	83.30%	91.14%	100.00%	100.00%	100.00%	100.00%	100.00%
4	79.86%	81.19%	82.56%	83.96%	91.49%	100.00%	100.00%	100.00%	100.00%	100.00%
5	80.15%	81.46%	82.81%	84.19%	91.61%	100.00%	100.00%	100.00%	100.00%	100.00%
6	80.19%	81.50%	82.84%	84.22%	91.63%	100.00%	100.00%	100.00%	100.00%	100.00%
7	80.43%	81.72%	83.05%	84.41%	91.73%	100.00%	100.00%	100.00%	100.00%	100.00%
8	80.54%	81.83%	83.15%	84.50%	91.78%	100.00%	100.00%	100.00%	100.00%	100.00%
9	80.81%	82.08%	83.38%	84.71%	91.89%	100.00%	100.00%	100.00%	100.00%	100.00%
10	81.18%	82.42%	83.70%	85.01%	92.04%	100.00%	100.00%	100.00%	100.00%	100.00%
11	82.29%	83.46%	84.66%	85.89%	92.51%	100.00%	100.00%	100.00%	100.00%	100.00%
12	82.78%	83.92%	85.09%	86.28%	92.72%	100.00%	100.00%	100.00%	100.00%	100.00%
13	89.56%	90.25%	90.95%	91.68%	95.59%	100.00%	100.00%	100.00%	100.00%	100.00%
14	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
10.1	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
10.2	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
10.3	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
12.1	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
12.2	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
21	79.76%	81.10%	82.47%	83.87%	91.44%	100.00%	100.00%	100.00%	100.00%	100.00%
22	79.76%	81.10%	82.47%	83.87%	91.44%	100.00%	100.00%	100.00%	100.00%	100.00%
23	80.21%	81.51%	82.86%	84.23%	91.63%	100.00%	100.00%	100.00%	100.00%	100.00%
24	81.36%	82.59%	83.86%	85.15%	92.12%	100.00%	100.00%	100.00%	100.00%	100.00%
25	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
26	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%

CRSP rates used in this table are $.01043 per KWH plus $53.16 per year per KW.
Navajo Dam OM&R estimated at $1.00 per acre-foot; Gallup's share assumed included in payments to Jicarilla Apache Nation; therefore Jicarilla assumed to pay both Jicarilla and Gallup OM&R directly to dam operator.

Table D6, page 2
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Variable O,M&R Costs by User
CRSP Power Rates
Jan-07 $

	Navajo Share of Variable O,M&R Costs by Year																						
Reach	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$736,290	$754,550	$773,263	$792,440	$895,699	$1,012,412	$1,012,412	$1,012,412	$1,012,412	$1,012,412
2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$192,002	$196,764	$201,644	$206,644	$233,571	$264,007	$264,007	$264,007	$264,007	$264,007
3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$242,571	$248,559	$254,696	$260,985	$294,848	$333,124	$333,124	$333,124	$333,124	$333,124
5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,581	$2,623	$2,666	$2,710	$2,949	$3,218	$3,218	$3,218	$3,218	$3,218
7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$87,396	$89,553	$91,763	$94,029	$106,227	$120,014	$120,014	$120,014	$120,014	$120,014
8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$71,470	$73,219	$75,012	$76,849	$86,740	$97,920	$97,920	$97,920	$97,920	$97,920
9	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$114,672	$117,485	$120,367	$123,322	$139,228	$157,208	$157,208	$157,208	$157,208	$157,208
10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
11	$0	$0	$16,141	$16,141	$16,141	$16,141	$16,141	$16,141	$16,141	$16,141	$16,141	$16,141	$16,141	$82,911	$84,933	$87,004	$89,128	$100,559	$113,481	$113,481	$113,481	$113,481	$113,481
12	$0	$0	$13,914	$13,772	$13,627	$13,479	$13,326	$13,170	$13,010	$12,847	$12,679	$12,507	$12,330	$91,603	$93,875	$96,203	$98,589	$111,435	$125,956	$125,956	$125,956	$125,956	$125,956
13	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	$0	$0	$5,392	$5,337	$5,281	$5,223	$5,164	$5,104	$5,042	$4,978	$4,913	$4,847	$4,778	$12,870	$13,189	$13,516	$13,851	$15,656	$17,696	$17,696	$17,696	$17,696	$17,696
10.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$9,988	$10,235	$10,489	$10,749	$12,150	$13,733	$13,733	$13,733	$13,733	$13,733
10.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10,281	$10,536	$10,797	$11,065	$12,506	$14,136	$14,136	$14,136	$14,136	$14,136
10.3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$19,024	$19,496	$19,980	$20,475	$23,143	$26,159	$26,159	$26,159	$26,159	$26,159
12.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$44,053	$45,146	$46,265	$47,413	$53,591	$60,574	$60,574	$60,574	$60,574	$60,574
12.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$45,612	$46,744	$47,903	$49,091	$55,488	$62,718	$62,718	$62,718	$62,718	$62,718
21	$0	$0	$0	$0	$0	$0	$79,641	$81,616	$83,640	$85,715	$87,840	$90,019	$92,251	$94,539	$96,884	$99,286	$101,749	$115,007	$129,993	$129,993	$129,993	$129,993	$129,993
22	$0	$0	$0	$0	$0	$0	$59,328	$60,793	$62,294	$63,832	$65,408	$67,024	$68,679	$70,375	$72,114	$73,896	$75,722	$85,553	$96,665	$96,665	$96,665	$96,665	$96,665
23	$0	$0	$0	$0	$0	$0	$14,216	$14,554	$14,899	$15,254	$15,617	$15,989	$16,371	$16,762	$17,162	$17,573	$17,993	$20,258	$22,819	$22,819	$22,819	$22,819	$22,819
24	$0	$0	$0	$0	$0	$0	$16,716	$17,131	$17,555	$17,991	$18,437	$18,894	$19,363	$19,843	$20,335	$20,839	$21,356	$24,139	$27,284	$27,284	$27,284	$27,284	$27,284
25	$0	$0	$0	$0	$0	$0	$18,257	$18,709	$19,173	$19,649	$20,136	$20,635	$21,147	$21,672	$22,209	$22,760	$23,324	$26,364	$29,799	$29,799	$29,799	$29,799	$29,799
26	$0	$0	$0	$0	$0	$0	$2,607	$2,672	$2,738	$2,806	$2,875	$2,947	$3,020	$3,095	$3,171	$3,250	$3,330	$3,764	$4,255	$4,255	$4,255	$4,255	$4,255
Total	$0	$0	$35,447	$35,251	$35,049	$34,843	$225,397	$229,890	$234,494	$239,212	$244,047	$249,002	$254,080	$1,989,609	$2,038,781	$2,089,172	$2,140,813	$2,418,875	$2,733,171	$2,733,171	$2,733,171	$2,733,171	$2,733,171

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Navajo - Gallup Water Supply Project
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Allocation of Annual Variable O,M&R Costs by User
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	Gallup Share of Variable O,M&R Costs by Year																						
Reach	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$298,342	$298,342	$298,342	$298,342	$298,342	$298,342	$298,342	$298,342	$298,342	$298,342
2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$77,798	$77,798	$77,798	$77,798	$77,798	$77,798	$77,798	$77,798	$77,798	$77,798
3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$116,522	$116,522	$116,522	$116,522	$116,522	$116,522	$116,522	$116,522	$116,522	$116,522
5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$46,644	$46,644	$46,644	$46,644	$46,644	$46,644	$46,644	$46,644	$46,644	$46,644
8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$38,019	$38,019	$38,019	$38,019	$38,019	$38,019	$38,019	$38,019	$38,019	$38,019
9	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$64,421	$64,421	$64,421	$64,421	$64,421	$64,421	$64,421	$64,421	$64,421	$64,421
10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
11	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$59,141	$59,141	$59,141	$59,141	$59,141	$59,141	$59,141	$59,141	$59,141	$59,141
12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$73,574	$73,574	$73,574	$73,574	$73,574	$73,574	$73,574	$73,574	$73,574	$73,574
13	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
21	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
22	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
23	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
24	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
25	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
26	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462	$774,462

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Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Variable O,M&R Costs by User
CRSP Power Rates
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	Jicarilla Share of Variable O,M&R Costs by Year																						
Reach	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
11	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
13	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
21	$0	$0	$0	$0	$0	$0	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151	$45,151
22	$0	$0	$0	$0	$0	$0	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208	$33,208
23	$0	$0	$0	$0	$0	$0	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782	$7,782
24	$0	$0	$0	$0	$0	$0	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643	$12,643
25	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
26	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total	$0	$0	$0	$0	$0	$0	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784	$98,784

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Navajo - Gallup Water Supply Project
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Allocation of Annual Variable O,M&R Costs by User
NTUA Power Rates
Jan-07 $

Reach	End	Dedicated Variable OM&R Costs at Design Capacity (all Navajo) Booster Pump Energy	Joint Variable O,M&R at Design Capacity: Pump Plant Energy	WTP Energy	WTP Chemicals	WTP Misc.	Sub Total	Navajo Dam OM&R
San Juan Branch								
1	Water Treatment Plant (WTP)		$93,794	$511,354	$943,000	$145,435	$1,693,583	$32,955
2	NAPI turnout		$921,270				$921,270	
3	Shiprock Junction						$0	
4	Sanostee turnout	$11,411	$1,200,523				$1,200,523	
5	Burnham Junction						$0	
6	Newcomb turnout	$8,673					$0	
7	Sheepsprings turnout	$3,994	$445,199				$445,199	
8	Naschitti turnout	$8,844	$357,554				$357,554	
9	Tohatchi turnout	$11,354	$586,004				$586,004	
10	Coyote Canyon Junction						$0	
11	Twin Lakes turnout	$10,727	$454,541				$454,541	
12	Ya-ta-hey Junction		$537,794				$537,794	
13	Gallup Junction						$0	
14	Navajo Chapters	$47,698					$0	
10.1	Coyote Canyon turnout	$7,075	$29,940				$29,940	
10.2	Standing Rock turnout	$799	$37,304				$37,304	
10.3	Dalton Pass turnout	$20,997	$49,511				$49,511	
12.1	Rock Springs turnout	$18,201	$145,064				$145,064	
12.2	Window Rock turnout	$65,672	$103,373				$103,373	
Cutter Branch								
21	WTP			$63,030	$133,000	$19,603	$215,633	$4,644
22	Huerfano turnout	$2,853	$347,195				$347,195	
23	Nageezi turnout	$5,991	$76,487				$76,487	
24	Jicarilla turnout		$107,615				$107,615	
25	Counselor turnout	$14,949	$65,368				$65,368	
26	Torreon turnout	$11,468					$0	
		$250,706	$5,558,536	$574,384	$1,076,000	$165,038	$7,373,958	$37,599

Projected Flow as a Percentage of Design Flow by Year

Reach	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
10	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
11	0.00%	0.00%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%	9.35%
12	0.00%	0.00%	6.97%	6.90%	6.83%	6.76%	6.68%	6.60%	6.52%	6.44%	6.35%	6.27%	6.18%
13	0.00%	0.00%	11.67%	11.55%	11.43%	11.30%	11.18%	11.05%	10.91%	10.77%	10.63%	10.49%	10.34%
14	0.00%	0.00%	30.47%	30.16%	29.84%	29.52%	29.18%	28.84%	28.49%	28.13%	27.77%	27.39%	27.00%
10.1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
10.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
10.3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
12.1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
12.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
21	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.25%	72.38%	73.53%	74.72%	75.93%	77.18%	78.45%
22	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.25%	72.38%	73.53%	74.72%	75.93%	77.18%	78.45%
23	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	71.89%	72.99%	74.12%	75.28%	76.47%	77.68%	78.93%
24	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	73.53%	74.57%	75.63%	76.72%	77.84%	78.99%	80.16%
25	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	61.27%	62.79%	64.34%	65.94%	67.57%	69.25%	70.97%
26	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	61.27%	62.79%	64.34%	65.94%	67.57%	69.25%	70.97%

Reach	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-70
1	78.93%	80.33%	81.75%	83.22%	91.10%	100.00%	100.00%	100.00%	100.00%	100.00%
2	78.93%	80.33%	81.75%	83.22%	91.10%	100.00%	100.00%	100.00%	100.00%	100.00%
3	79.04%	80.42%	81.84%	83.30%	91.14%	100.00%	100.00%	100.00%	100.00%	100.00%
4	79.86%	81.19%	82.56%	83.96%	91.49%	100.00%	100.00%	100.00%	100.00%	100.00%
5	80.15%	81.46%	82.81%	84.19%	91.61%	100.00%	100.00%	100.00%	100.00%	100.00%
6	80.19%	81.50%	82.84%	84.22%	91.63%	100.00%	100.00%	100.00%	100.00%	100.00%
7	80.43%	81.72%	83.05%	84.41%	91.73%	100.00%	100.00%	100.00%	100.00%	100.00%
8	80.54%	81.83%	83.15%	84.50%	91.78%	100.00%	100.00%	100.00%	100.00%	100.00%
9	80.81%	82.08%	83.38%	84.71%	91.89%	100.00%	100.00%	100.00%	100.00%	100.00%
10	81.18%	82.42%	83.70%	85.01%	92.04%	100.00%	100.00%	100.00%	100.00%	100.00%
11	82.29%	83.46%	84.66%	85.89%	92.51%	100.00%	100.00%	100.00%	100.00%	100.00%
12	82.78%	83.92%	85.09%	86.28%	92.72%	100.00%	100.00%	100.00%	100.00%	100.00%
13	89.56%	90.25%	90.95%	91.68%	95.59%	100.00%	100.00%	100.00%	100.00%	100.00%
14	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
10.1	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
10.2	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
10.3	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
12.1	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
12.2	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
21	79.76%	81.10%	82.47%	83.87%	91.44%	100.00%	100.00%	100.00%	100.00%	100.00%
22	79.76%	81.10%	82.47%	83.87%	91.44%	100.00%	100.00%	100.00%	100.00%	100.00%
23	80.21%	81.51%	82.86%	84.23%	91.63%	100.00%	100.00%	100.00%	100.00%	100.00%
24	81.36%	82.59%	83.86%	85.15%	92.12%	100.00%	100.00%	100.00%	100.00%	100.00%
25	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%
26	72.73%	74.53%	76.38%	78.27%	88.47%	100.00%	100.00%	100.00%	100.00%	100.00%

NTUA rates used in this table are $.0200 per KWH plus $198.00 per year per KW.
Navajo Dam OM&R estimated at $1.00 per acre-foot; Gallup's share assumed included in payments to Jicarilla Apache Nation; therefore Jicarilla assumed to pay both Jicarilla and Gallup OM&R directly to dam operator.

Table D7, page 2
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Variable O,M&R Costs by User
NTUA Power Rates
Jan-07 $

	Navajo Share of Variable O,M&R Costs by Year																						
Reach	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$969,849	$993,901	$1,018,550	$1,043,810	$1,179,823	$1,333,560	$1,333,560	$1,333,560	$1,333,560	$1,333,560
2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$517,505	$530,339	$543,492	$556,970	$629,546	$711,579	$711,579	$711,579	$711,579	$711,579
3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$653,803	$669,944	$686,484	$703,435	$794,707	$897,872	$897,872	$897,872	$897,872	$897,872
5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,955	$7,069	$7,185	$7,304	$7,947	$8,673	$8,673	$8,673	$8,673	$8,673
7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$235,558	$241,372	$247,330	$253,435	$286,312	$323,473	$323,473	$323,473	$323,473	$323,473
8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$192,634	$197,348	$202,180	$207,131	$233,791	$263,925	$263,925	$263,925	$263,925	$263,925
9	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$309,075	$316,657	$324,426	$332,389	$375,262	$423,722	$423,722	$423,722	$423,722	$423,722
10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
11	$0	$0	$43,506	$43,506	$43,506	$43,506	$43,506	$43,506	$43,506	$43,506	$43,506	$43,506	$43,506	$223,470	$228,919	$234,503	$240,225	$271,038	$305,865	$305,865	$305,865	$305,865	$305,865
12	$0	$0	$37,501	$37,120	$36,729	$36,329	$35,918	$35,498	$35,067	$34,625	$34,173	$33,709	$33,234	$246,898	$253,021	$259,296	$265,726	$300,352	$339,489	$339,489	$339,489	$339,489	$339,489
13	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	$0	$0	$14,534	$14,386	$14,234	$14,079	$13,920	$13,757	$13,590	$13,419	$13,244	$13,064	$12,880	$34,689	$35,549	$36,431	$37,334	$42,199	$47,698	$47,698	$47,698	$47,698	$47,698
10.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$26,920	$27,587	$28,271	$28,973	$32,748	$37,015	$37,015	$37,015	$37,015	$37,015
10.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$27,711	$28,398	$29,102	$29,824	$33,710	$38,103	$38,103	$38,103	$38,103	$38,103
10.3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$51,278	$52,550	$53,853	$55,188	$62,380	$70,508	$70,508	$70,508	$70,508	$70,508
12.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$118,737	$121,681	$124,699	$127,791	$144,443	$163,265	$163,265	$163,265	$163,265	$163,265
12.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$122,940	$125,989	$129,114	$132,316	$149,557	$169,045	$169,045	$169,045	$169,045	$169,045
21	$0	$0	$0	$0	$0	$0	$100,164	$102,648	$105,194	$107,803	$110,476	$113,216	$116,024	$118,901	$121,850	$124,872	$127,968	$144,643	$163,491	$163,491	$163,491	$163,491	$163,491
22	$0	$0	$0	$0	$0	$0	$159,909	$163,856	$167,902	$172,047	$176,296	$180,650	$185,112	$189,684	$194,370	$199,172	$204,093	$230,592	$260,543	$260,543	$260,543	$260,543	$260,543
23	$0	$0	$0	$0	$0	$0	$38,316	$39,226	$40,158	$41,113	$42,092	$43,095	$44,123	$45,177	$46,256	$47,363	$48,497	$54,602	$61,503	$61,503	$61,503	$61,503	$61,503
24	$0	$0	$0	$0	$0	$0	$45,055	$46,172	$47,317	$48,490	$49,693	$50,925	$52,188	$53,483	$54,809	$56,168	$57,561	$65,062	$73,540	$73,540	$73,540	$73,540	$73,540
25	$0	$0	$0	$0	$0	$0	$49,207	$50,427	$51,678	$52,959	$54,273	$55,619	$56,998	$58,412	$59,860	$61,345	$62,866	$71,058	$80,317	$80,317	$80,317	$80,317	$80,317
26	$0	$0	$0	$0	$0	$0	$7,026	$7,200	$7,379	$7,562	$7,749	$7,941	$8,138	$8,340	$8,547	$8,759	$8,976	$10,146	$11,468	$11,468	$11,468	$11,468	$11,468
Total	$0	$0	$95,540	$95,011	$94,469	$93,914	$493,021	$502,290	$511,789	$521,524	$531,501	$541,725	$552,202	$4,212,017	$4,316,016	$4,422,594	$4,531,814	$5,119,918	$5,784,654	$5,784,654	$5,784,654	$5,784,654	$5,784,654

Table D7, page 3
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Variable O,M&R Costs by User
NTUA Power Rates
Jan-07 $

	Gallup Share of Variable O,M&R Costs by Year																						
Reach	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$392,979	$392,979	$392,979	$392,979	$392,979	$392,979	$392,979	$392,979	$392,979	$392,979
2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$209,691	$209,691	$209,691	$209,691	$209,691	$209,691	$209,691	$209,691	$209,691	$209,691
3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$314,062	$314,062	$314,062	$314,062	$314,062	$314,062	$314,062	$314,062	$314,062	$314,062
5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$125,720	$125,720	$125,720	$125,720	$125,720	$125,720	$125,720	$125,720	$125,720	$125,720
8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$102,473	$102,473	$102,473	$102,473	$102,473	$102,473	$102,473	$102,473	$102,473	$102,473
9	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$173,636	$173,636	$173,636	$173,636	$173,636	$173,636	$173,636	$173,636	$173,636	$173,636
10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
11	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$159,403	$159,403	$159,403	$159,403	$159,403	$159,403	$159,403	$159,403	$159,403	$159,403
12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$198,305	$198,305	$198,305	$198,305	$198,305	$198,305	$198,305	$198,305	$198,305	$198,305
13	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
21	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
22	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
23	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
24	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
25	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
26	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268	$1,676,268

Table D7, page 4
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Allocation of Annual Variable O,M&R Costs by User
NTUA Power Rates
Jan-07 $

	Jicarilla Share of Variable O,M&R Costs by Year																						
Reach	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	2055	2060-76
1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
11	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
13	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10.3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12.1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12.2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
21	$0	$0	$0	$0	$0	$0	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786	$56,786
22	$0	$0	$0	$0	$0	$0	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505	$89,505
23	$0	$0	$0	$0	$0	$0	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975	$20,975
24	$0	$0	$0	$0	$0	$0	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075	$34,075
25	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
26	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total	$0	$0	$0	$0	$0	$0	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342	$201,342

Table D8 - 2040
Navajo - Gallup Water Supply Project
San Juan River PNM Alternative - 2040
Cost of Water to Navajo Nation
Discount rate = 2.875%

Year		peak cfs Main Lateral	Cutter Lateral	Total	Annual afy	Discounted Peak cfs	Annual afy	CRSP charge $4.12/af	Discounted to 2027
2014	1	-	-	-	-	-	-	$0	$0
2015	2	-	-	-	-	-	-	$0	$0
2016	3	3.59	-	3.59	2,000	4.91	2,732	$8,231	$11,242
2017	4	3.59	-	3.59	2,000	4.77	2,655	$8,231	$10,928
2018	5	3.59	-	3.59	2,000	4.64	2,581	$8,231	$10,623
2019	6	3.59	-	3.59	2,000	4.51	2,509	$8,231	$10,326
2020	7	3.59	3.70	7.29	4,061	8.89	4,952	$16,711	$20,379
2021	8	3.59	3.79	7.38	4,112	8.75	4,874	$16,922	$20,059
2022	9	3.59	3.89	7.48	4,164	8.62	4,798	$17,137	$19,747
2023	10	3.59	3.98	7.57	4,218	8.48	4,724	$17,358	$19,442
2024	11	3.59	4.08	7.67	4,273	8.35	4,652	$17,585	$19,145
2025	12	3.59	4.18	7.77	4,329	8.23	4,582	$17,816	$18,856
2026	13	3.59	4.29	7.88	4,387	8.10	4,513	$18,054	$18,573
2027	14	32.44	4.39	36.83	20,510	36.83	20,510	$84,407	$84,407
2028	15	33.24	4.50	37.74	21,018	36.69	20,431	$86,500	$84,083
2029	16	34.07	4.61	38.68	21,540	36.55	20,352	$88,645	$83,760
2030	17	34.91	4.73	39.64	22,074	36.41	20,274	$90,844	$83,438
2031	18	35.78	4.85	40.62	22,621	36.27	20,196	$93,097	$83,118
2032	19	36.67	4.97	41.63	23,182	36.13	20,119	$95,405	$82,799
2033	20	37.57	5.09	42.66	23,757	35.99	20,042	$97,771	$82,481
2034	21	38.51	5.21	43.72	24,346	35.85	19,965	$100,196	$82,164
2035	22	39.46	5.34	44.81	24,950	35.72	19,888	$102,681	$81,849
2036	23	40.44	5.48	45.92	25,569	35.58	19,812	$105,227	$81,534
2037	24	41.44	5.61	47.06	26,203	35.44	19,736	$107,837	$81,221
2038	25	42.47	5.75	48.22	26,853	35.31	19,660	$110,511	$80,909
2039	26	43.52	5.89	49.42	27,519	35.17	19,584	$113,252	$80,599
2040	27	45.71	6.19	51.90	28,900	35.90	19,993	$118,939	$82,280
2041	28	45.71	6.19	51.90	28,900	34.90	19,434	$118,939	$79,981
2042	29	45.71	6.19	51.90	28,900	33.92	18,891	$118,939	$77,746
2043	30	45.71	6.19	51.90	28,900	32.98	18,363	$118,939	$75,573
2044	31	45.71	6.19	51.90	28,900	32.06	17,850	$118,939	$73,461
2045	32	45.71	6.19	51.90	28,900	31.16	17,351	$118,939	$71,408
2046	33	45.71	6.19	51.90	28,900	30.29	16,866	$118,939	$69,412
2047	34	45.71	6.19	51.90	28,900	29.44	16,395	$118,939	$67,473
2048	35	45.71	6.19	51.90	28,900	28.62	15,937	$118,939	$65,587
2049	36	45.71	6.19	51.90	28,900	27.82	15,491	$118,939	$63,754
2050	37	45.71	6.19	51.90	28,900	27.04	15,058	$118,939	$61,972
2051	38	45.71	6.19	51.90	28,900	26.29	14,638	$118,939	$60,240
2052	39	45.71	6.19	51.90	28,900	25.55	14,228	$118,939	$58,557
2053	40	45.71	6.19	51.90	28,900	24.84	13,831	$118,939	$56,920
2054	41	45.71	6.19	51.90	28,900	24.14	13,444	$118,939	$55,330
2055	42	45.71	6.19	51.90	28,900	23.47	13,069	$118,939	$53,783
2056	43	45.71	6.19	51.90	28,900	22.81	12,703	$118,939	$52,280
2057	44	45.71	6.19	51.90	28,900	22.18	12,348	$118,939	$50,819
2058	45	45.71	6.19	51.90	28,900	21.56	12,003	$118,939	$49,399
2059	46	45.71	6.19	51.90	28,900	20.95	11,668	$118,939	$48,019
2060	47	45.71	6.19	51.90	28,900	20.37	11,342	$118,939	$46,677
2061	48	45.71	6.19	51.90	28,900	19.80	11,025	$118,939	$45,372
2062	49	45.71	6.19	51.90	28,900	19.25	10,717	$118,939	$44,104
2063	50	45.71	6.19	51.90	28,900	18.71	10,417	$118,939	$42,872
2064	51	45.71	6.19	51.90	28,900	18.18	10,126	$118,939	$41,674
2065	52	45.71	6.19	51.90	28,900	17.68	9,843	$118,939	$40,509
2066	53	45.71	6.19	51.90	28,900	17.18	9,568	$118,939	$39,377
2067	54	45.71	6.19	51.90	28,900	16.70	9,301	$118,939	$38,276
2068	55	45.71	6.19	51.90	28,900	16.24	9,041	$118,939	$37,207
2069	56	45.71	6.19	51.90	28,900	15.78	8,788	$118,939	$36,167
2070	57	45.71	6.19	51.90	28,900	15.34	8,542	$118,939	$35,156
2071	58	45.71	6.19	51.90	28,900	14.91	8,304	$118,939	$34,174
2072	59	45.71	6.19	51.90	28,900	14.50	8,072	$118,939	$33,219
2073	60	45.71	6.19	51.90	28,900	14.09	7,846	$118,939	$32,290
2074	61	45.71	6.19	51.90	28,900	13.70	7,627	$118,939	$31,388
2075	62	45.71	6.19	51.90	28,900	13.31	7,414	$118,939	$30,511
2076	63	45.71	6.19	51.90	28,900	12.94	7,206	$118,939	$29,658
2077	64	45.71	6.19	51.90	28,900	12.58	7,005	$118,939	$28,829
2078	65	45.71	6.19	51.90	28,900	12.23	6,809	$118,939	$28,024
2079	66	45.71	6.19	51.90	28,900	11.89	6,619	$118,939	$27,240
2080	67	45.71	6.19	51.90	28,900	11.55	6,434	$118,939	$26,479
2081	68	45.71	6.19	51.90	28,900	11.23	6,254	$118,939	$25,739
					Total	1,440.25	802,003	$6,426,324	$3,300,617
					Annual Equivalent	54.65	30,434		30,434
							Total PV per acre foot		$108.45

Note: Navajo annual equivalent is calculated for the purpose of determining the levelized cost per acre foot to amortize the present value capital costs over the 61 year period of water deliveries. CRSP charge for water has a present value of $108.45 per acre foot. This charge was amortized over 50 years
the CRSP interest rate of 2.875% to determine an annual charge of $4.12 per acre foot. This charge is then applied to all water delivered to the Navajos.

APPENDIX D

Part II
Economic Benefit/Cost Analysis

ECONOMIC BENEFIT/COST ANALYSIS
NAVAJO – GALLUP WATER SUPPLY PROJECT

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October 1, 2007

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A. Executive Summary

This report focuses on the economic benefits and costs associated with the proposed Navajo – Gallup Water Supply Project in northwestern New Mexico. The Project would be developed to deliver water for domestic, commercial, municipal and industrial use to the City of Gallup, to numerous Navajo Chapters and to an undeveloped section of the Jicarilla Apache Nation. Water is currently scarce in all of these areas, and the Project will ultimately deliver water to some individuals who presently drive many miles to haul water.

The economic analysis in this report is distinct from a financial analysis. While a financial analysis traces cash receipts and expenditure, the economic analysis is instead more concerned with the generation and use of societal resources. Because the U.S. Bureau of Reclamation is overseeing the planning of this Project, and because the Project participants are seeking monetary support from the Federal government, the society whose resources we are concerned about is the United States as a whole. The principal differences between this economic analysis and a financial analysis are (1) inclusion of non-cash Project costs that would affect third parties (diminished power generation and increased salinity effects), (2) exclusion of Project cash costs that do not represent use of scarce national resources (use of otherwise unemployed people for construction workforce), and (3) exclusion of Project transfer payments that do not represent use of scarce national resources (taxes paid on construction spending).

The Project will principally benefit people in the northwest corner of New Mexico by providing water to which they otherwise would not have access or could only have access at a relatively higher cost. The measure of the benefits to the City of Gallup and to the Navajo people who would be supplied by the Project is the willingness of these beneficiaries to pay for Project water. Gallup's willingness to pay was estimated from data on the current use of water by people in communities throughout the mountain states. The Navajo people's willingness to pay was estimated from data on their spending for piped water service when available and on spending to haul water when no service is available. Benefits to the Jicarilla Apache people were estimated from the cost of the next cheapest alternative source of water for the area of the Reservation to be served by the Project.

The Indian Health Service identifies the availability of a community water supply as critical for maintaining the health of Indian people. This report roughly estimates the indirect health benefits to Navajo people that would accrue from the provision of a clean water supply.

The completion of the water supply project will also provide infrastructure that is a necessary prerequisite to economic development and poverty relief on the Reservations. While it is uncertain how much economic development would be encouraged by the Project, it is clear that the lack of a reliable water supply presently poses a significant constraint to most types of economic development. Table ES-1 summarizes the economic costs and benefits associated with the Project.

Table ES-1

Summary of Navajo-Gallup Water Supply Project Economic Benefits and Costs

Millions 2007$, 4.875% Discount Rate, 50 year Project life

		Direct	Direct Plus Other
BENEFITS			
	Gallup Willingness to Pay	$361	$361
	Navajo Willingness to Pay	$1,488	$1,488
	Jicarilla Avoided Cost	$57	$57
	Construction Employment	$231	$231
	Indirect and Induced Employment	$0	$111
	Health Benefits	$0	$435
	Reverse Outmigration	$0	+
	Economic Development	$0	+
	Total Benefits	$2,137	$2,683
COSTS			
	Project Construction	$1,192	$1,192
	Distribution System Construction	$48	$48
	O,M&R	$368	$368
	Gallup Water Cost	$33	$33
	Navajo Water Cost	$24	$24
	Power Generating Cost	$19	$19
	Salinity Increase Cost	$20	$20
	Total Costs	$1,704	$1,704
BENEFIT/COST RATIO		**1.25**	**1.57**

The benefit/cost ratio greater than 1.0 indicates that the anticipated project benefits are greater than cost and thus, that the Project represents a beneficial use of national resources.

B. Analytical Framework

Dornbusch Associates was engaged by the Bureau of Reclamation et al. to evaluate the economic feasibility of the proposed Navajo-Gallup Water Supply Project (NGWSP). This report summarizes the Dornbusch analysis findings as well as the supporting data and technical methodologies. While a Cost Allocation Report, under separate cover, analyzes the distribution of the Project's estimated ***financial*** cost between the Project's stakeholders, this report focuses on the Project's overall ***economic*** benefits and costs and thus economic feasibility. The Project's economic benefits and costs are compared to a base case that is expected to occur if the Project is not built (a "with vs. without" comparison).

An economic as opposed to a financial analysis approach is used to evaluate projects by international and federal agencies because those agencies are concerned with using a country's resources most effectively. The economic analysis approach considers the value to the country's overall economy of the resources potentially used and produced by a project, so that the sponsoring agency can determine whether that project represents a good investment of the country's resources. In general, if a substantial source of financing for a project is to be national government funds then it is appropriate to conduct a national level economic analysis to determine whether the project contributes to the country's overall economic well-being. This economic approach is also recommended by the Water Resource Council's Principles and Guidelines [Water Resource Council, p. iv], which the Bureau of Reclamation is required to follow.

In contrast, a financial analysis focuses only on whether a project is or will be a profitable investment for a participant. If, for example, a city were able to obtain private financing to develop a water project the city would use a financial analysis to determine what the project would cost and how to pay for it. Depending on some of the factors discussed below, such as subsidies or the cost of money, financial and economic analyses may reach similar or diverse conclusions as to the feasibility of a project.

The approach in this report is to use an economic rather than a financial perspective to evaluate the potential benefits and costs from the proposed NGWSP. The primary source of funding for the NGWSP would most likely be the federal government; hence it is appropriate to assess the Project's feasibility from the perspective of the U.S. as a whole. The remainder of this section discusses the important differences between economic and financial analyses and explains several key aspects of the economic analysis methodology used to evaluate the proposed project.

The primary technical differences between an economic and a financial analysis relate to valuing commodity prices, investment subsidies, taxes, discount rates, labor and water. Each of these is explained as follows:

1. **Commodity prices**

In a financial analysis it would be appropriate to use whatever prices a project paid for materials and services or would receive for water sold. The actual prices (including any subsidies) would accurately reflect the cash flow from the perspective of the project participants. The objective of an economic analysis, however, is to price commodities at a level that indicates their value to the economy. Government subsidies are a type of transfer payment as they represent payments from the government without the government receiving any goods or services in return. Accordingly, in an economic analysis subsidies paid within the economy are removed from commodity prices. If a participating agency chooses to subsidize water sales, for example, an economic analysis would impute a price reflective of the water's value to the economy and disregard the subsidized price. In contrast, a financial analysis would use the subsidized price to reflect actual revenues realized by the direct participants from the sale of water.

2. **Investment costs**

Investment costs are treated in a similar fashion to commodity prices (as discussed above). In an economic analysis, even if a project's investment costs are subsidized by a federal program, the full costs of the resources used to build the project are counted. Costs for goods and services used to build a project are measured by their value in other uses that would be displaced by the project (opportunity cost). This concept is discussed in greater detail below, in the sections addressing labor and water costs.

3. Taxes

Most taxes are levied simply to raise general revenues and are not payments that are directly exchanged for something of value. Taxes levied to raise general revenues include, for example, income and sales taxes. Income tax payments go into a general fund and do not pay for specific goods or services that the taxpayer only receives if he pays taxes. Because taxes are not usually linked to an exchange of goods or services they are excluded from an economic analysis. Such general taxes can be thought of not as determining whether a project is feasible but as determining how the benefits from a project are split between the project participants and the government. These taxes are a type of transfer payment because they "transfer" resources from one entity (a taxpayer) to another (the government) without the direct exchange of goods or services.

A use tax is one of the few examples of a tax levied in exchange for goods or services. In the case of use taxes a government entity levies the tax as a fee for services rendered, such as payments for the use of a public facility like a park. In this case value is being received (enjoyment of a park) that is linked directly to the payment of the tax. In an economic analysis such a use tax payment would be recognized as a purchase of goods or services and would be counted as a cost or a benefit.

Both general taxes and use taxes are included in a financial analysis because both represent cash outflows that increase the cost of a project. Only the use tax would be included in an economic analysis, however, because the general tax is a transfer payment that does not represent a purchase of specific goods and services.

For the NGWSP analysis, we consider taxes on field costs to be a type of transfer payment and accordingly we exclude them from our estimates of the Project's economic cost.

4. Discount rate

A development project is considered to be economically feasible when its potential benefits are equal to or exceed its estimated costs. A problem in comparing a project's benefits with its costs is that those benefits and costs do not typically occur at the same point in time. Construction costs are incurred only during the development phase of a project, whereas replacement of equipment occurs periodically throughout a project's life, and operating costs and economic benefits occur annually throughout a project's life.

To relate the stream of benefits and costs to each other, it is necessary to recognize that money has a "time value". A dollar today has a greater value than a dollar in the future – a reality that is recognized in every loan transaction. To illustrate, if Party A loans $100 to Party B for ten years, Party A will require Party B to repay something more than $100 at the end of the ten year period. The additional amount that must be paid reflects the "time value" of the $100 loan. Or, looking at it another way, if someone is offered a choice between $100 today or $100 in ten years, he or she will certainly prefer receiving the $100 today, recognizing that the money can be invested and subsequently yield more than $100 at the end of the ten-year period.

For the purpose of discounting future benefits and costs for the NGWSP we have used the federal rate of 4.875% that is applicable during FY2007 to water resource projects [U.S. Bureau of Reclamation, 2006]. This federal rate is a constrained, lagged, nominal (includes inflation) rate computed annually from U.S. Treasury security yields. It reflects average yields on marketable securities with a term of 15 years or more, but is constrained from changing more than .25% per year. The rate is then rounded to the nearest one-eighth of one percent. Absent these constraints the 2007 rate would be 4.9351% [Ibid.]. For sensitivity analysis we have also evaluated the Project's economic feasibility applying a real (inflation removed) discount rate of 3%. This real rate is based on an average between inflation-free rates of return on long-term federal bonds and inflation-free returns that have been obtained historically by all taxpayers, including all industrial and commercial sectors, households, and institutions [Fraumeni, pp. 161-244].

A financial analysis would use an actual market rate of interest, adjusted so to be consistent with the inflation assumption built into the benefit and cost projections for the project. For example, if the project benefits were projected in inflation-free (constant) dollars, then the interest rate should be net of the expected inflation rate.

5. Labor

In an economic analysis the cost of labor is determined based on its value as a productive resource. This means that in a national economic analysis the cost of labor for the subject project depends on how much it would contribute to the national economy if that labor was not used for the project being evaluated. This cost is measured by labor's opportunity cost, which is its value in its next best use. For that portion of the labor pool that would be otherwise fully employed in another project, the labor cost is its value as reflected in the full wage rate. However, for that portion of the labor pool that would be otherwise unemployed, and for whom no alternative employment opportunities would be available in the absence of the proposed development project, the opportunity cost of that labor is assumed to be zero. The implication of a zero opportunity cost in analyzing the proposed NGWSP is that in the absence of the project the workers would be unlikely to otherwise be employed in some type of work that added to the nation's supply of goods and services.

This method of using the opportunity cost to reflect the cost of labor in an economic analysis is standard practice among international development agencies such as the World Bank and the U.S. Agency for International Development. The Principles and Guidelines recommend using this method of labor valuation in assessing the costs of a project's construction phase but not its operational phase [Water Resource Council, section 2.11.2(b)].

A financial analysis would account for all wage costs that may be incurred by a project regardless of whether the workers would otherwise be employed or not.

6. Water

In a financial analysis the water used in a project would be valued at whatever dollar cost was paid for the use of water by the project participants. In an economic analysis the water is valued at its opportunity cost, or its value in its next best use. To the extent that project participants pay market prices for the water then the two approaches (financial and economic) should converge. If a participant already owns rights to water, however, then its financial cost would be zero while its economic cost would be the value in whatever other uses were precluded by the project.

C. Project Benefits

In an economic analysis the basis for estimating benefits from a water project is the *Willingness to Pay* for the "increase in value of goods and services attributable to the [project] water supply." [see Water Resource Council, section 2.2.2(a)]. In a municipal water use setting it is impractical to measure the increase in value for each use of water (bathing, toilet flushing, cooking, drinking washing, lawn and garden watering, etc.) Instead we try to estimate what users are willing to pay for the water itself, assuming they are best placed to know the value of water's various uses. This estimated willingness to pay is the amount of money that water users would be willing to pay for project water; it reflects the economic value of the water to the users and thereby to society as a whole. In performing an economic feasibility analysis of the NGWSP, we estimated this willingness to pay separately for the three project participants: the City of Gallup, the Navajo Nation and the Jicarilla Apache Nation.

1. City of Gallup Willingness to Pay

Willingness to pay is commonly estimated in one of two ways: deducing what people are willing to pay by analyzing their actual payment patterns (revealed preference) or by asking them what they would pay in a structured hypothetical situation (stated preference). We have used a revealed preference approach to estimate a water demand function for 79 mountain states mid-sized communities, including Gallup. Towards this end, we compiled data on each communities water use during 2000, price for water, median income levels, household size and average rainfall. From this data we estimated a generalized demand curve that relates these variables to the demand for water. This approach implicitly assumes that water use patterns are substantially similar among the communities in the database, except for those differences accounted for by the explanatory variables (see also the discussion of other variables in part C.1.e, below). Equation (1) shows the estimated relationships. The data and regression results are shown in Appendices A and B.

(1) $\ln GPCD = 2.913 + .372 * \ln HHY - 1.348 * \ln HHS - .554 * \ln P$

$(2.258)^{**} \quad (2.805)^{**} \quad (-5.680)^{**} \quad (-10.878)^{**}$

where GPCD = water use in gallons per capita per day

HHY = median household income

HHS = average household size

P = average price for water

Numbers in parentheses are t-statistics. All coefficients are different from zero at 90% (*) or 95% (**) level of confidence.

Adjusted $R^2 = .630$

Observations = 79

Degrees of freedom = 75

Converting the logarithmic equation (1) to an exponential equation form gives equation (2), which was used to estimate the demand for water in Gallup.

(2) $GPCD = 18.405 * HHY^{.372} * HHS^{-1.348} * P^{-.554}$

a. Household Income

Our expectation is that increasing income will lead to increasing water use, and the estimated exponent in equation (2) is consistent with that expectation. The exponent of the income term can be interpreted at the ***Income Elasticity*** of demand for water, that is, the amount by which the demand for water will increase given an increase in household income. The estimated income elasticity of .372 in equation (2) is similar to other income elasticities reported in the literature. Table 1 shows examples of reported income elasticities for water.

Table 1

Income Elasticities Reported in the Economics Literature

STUDY	INCOME ELASTICITY
Jones & Morris	0.40 to 0.55
Martin & Wilder	0.04 to 0.27
Nieswiadomy & Cobb	0.64
Nieswiadomy	0.28 to 0.44
Schneider & Whitlatch	0.207
Morgan	0.33 to 0.39

The income elasticity was used in the willingness to pay analysis to estimate how the demand for water in Gallup (willingness to pay for water) would increase in the future with increases in median household income. Median household income was assumed to continue growing at a real (adjusted for inflation) rate of slightly above 1.0% per year, which was the rate of growth in McKinley County personal income from 1969 to 1999 [US Census Bureau, 2004].

b. Household Size

Some researchers have observed that per capita water use is inversely related to household size [see eg. Brown]. This inverse relationship seems logical, as outdoor use in particular should not increase linearly with the number of people in a household. Our data analysis did find a strong inverse correlation between household size and per capita water use. The estimated exponent in equation (2) is negative 1.348, which is substantially larger than some other values reported in the literature. Nieswiadomy reports a household size water use elasticity of .69 for western cities, on a dependent variable defined as total household use. Converting the dependent variable in Niewswiadomy's estimate to per capita terms would reduce the exponent of the household size independent variable to negative .31. Jones and Morris report a household size elasticity of 0.17 (also on total household use), which converts to an elasticity estimate of negative .83 for per capita use.

This household size variable is used in the willingness to pay analysis to adjust per capita water demand in accordance with the expected future decrease in average Gallup household size. Gallup presently has an average household size of 2.85 persons per household, compared to the national average of 2.63 persons per household, and Gallup's average household size has been declining. For the analysis, we assumed that Gallup's household size would continue to decline at 0.005 persons per household per year until it converged with the 2000 national average, and then would remain at that level.

c. Price for Water

Economic theory suggests that, if all else is equal, people demand less of most goods and services the more expensive they are. Our data analysis showed a strong inverse correlation between per capita water use and the price for water. The estimate exponent of the water price term in equation (2) is negative 0.554. This estimate is generally consistent with other price elasticity results reported in the literature, examples of which are shown in Table 2.

Table 2

Price Elasticities Reported in the Economics Literature

STUDY	**PRICE ELASTICITY**
Jones & Morris	-0.34
Nieswiadomy	-0.22 to -0.60
Agthe & Billings	-0.595 to -0.624
Billings & Agthe	-0.267
Martin & Wilder	-0.49 to -0.70
Nieswiadomy & Cobb	-0.63
Schneider & Whitlatch	-0.63
Weber	-0.202
Nieswiadomy & Molina	-0.36 to -0.86
Hasson	-0.22 to -0.34
Young	-0.41 to -0.60
Foster & Beattie	-0.27 to -0.76
Brookshire et al. (summarizing other studies)	-0.11 to -1.59 (average -0.49)

The estimated price elasticity, income elasticity and household size elasticity of water consumption are used in the willingness to pay analysis to estimate the implicit price associated with various quantities of water use. These price estimates are necessary in order to calculate the total willingness to pay by Gallup residents for different quantities of water. These elasticity estimates are used in conjunction with the assumptions about future changes in income and household size levels, previously discussed. Table 3 shows for various future years the implicit price per thousand gallons for total average water use of 160 gpcd. This price represents the amount that average Gallup water users would be willing to pay for water, at the 160 gpcd level of average consumption. The price that we expect Gallup water users to be willing to pay for water increases over time as incomes rise and household size decreases.

Table 3

Estimated Willingness to Pay for Domestic Water (160 gpcd)

Price Per Thousand Gallons of Water, Gallup, New Mexico (2007$)

YEAR	PRICE PER THOUSAND GALLONS
2020	$2.44
2030	$2.65
2040	$2.88
2050	$3.08
2060	$3.16
2070	$3.27

d. Climate variables

Some researchers have found a significant relationship between per capita water use in an area and climatic variables for that area, such as rainfall or growing season temperatures. We compiled data on average annual rainfall and average annual growing degree hours[1] for each community in our data set. While we found plausible results from statistical analyses (linear regression) that included those variables the coefficients were not significant at reasonable levels (less that 80% likely different from zero and they did not add to the overall explanatory power of the overall equation. Accordingly, the linear regression

[1] "Growing degree hours" is a measure of the temperature above a certain threshold multiplied by the hours at that temperature, accumulated throughout the growing season. It is an indication of how vigorously plants will grow and is generally correlated with water use by plants.

equation used to estimate Gallup's willingness to pay for water does not include those variables.

e. Other Variables

Although our demand equation includes water price, household income, household size and rainfall variables, other factors may also influence per capita water use in different cities. Differences in water quality and reliability, for example, may affect per capita water use. We have no reason to suspect that these and other omitted variables significantly affect our results, and we expect that any bias from omitting these variables would be small. However, to the extent that an omitted water quality variable would be significant we have probably underestimated the project benefits because the project will provide very high quality water to its users.

f. Gallup Without-Project Condition

Gallup currently relies on groundwater pumping to supply water to its residents. The water levels have been falling by 7 to 29 feet per year over an extended period, and at some point the production capacity of the current well system is expected to diminish. For purposes of our analysis we have assumed that annual production capacity will peak at 5MGD (5600 afy) in the year 2010, and that the production capacity will decline linearly to 1439 afy by the year 2040 [Navajo Nation et al., "Technical Memorandum", Table 4.2]. The production capacity of 5600 afy exceeds the City's projected water needs of about 4500 afy in 2010, but the progressively increasing needs and diminishing capacity indicate that Gallup will need a supplemental water supply to meet demand by the year 2016. Gallup is currently investigating a water reuse facility to treat effluent as a source for this supplemental supply. For purpose of our analyses we have assumed that by 2012 Gallup will construct such a reuse facility that will supply one MGD (1,120 afy) to help meet forecasted water needs [Allgood]. Once the Project is operating, Gallup plans to shut down its wells and rely entirely on water from the Project and from the planned reuse facility.

Even following implementation of the assumed additional water reuse facility, due to population growth the City of Gallup cannot continue to supply its residents with their current level of average per capita water use (171 gpcd) beyond the year 2018. Absent the Project, therefore, Gallup would be faced with some combination of the following scenarios: (1) development of alternative water supply projects, (2) diminishing per capita water supply, and/or (3) curtailment of population growth. Gallup has not been able to identify any other water supply project that is as cost-effective as the Navajo Gallup Water Supply Project. Without new water supplies in addition to the assumed water reuse facility it is estimated that the available water per capita would fall to about 100 gpcd by the year 2030, and continue to decline thereafter. Thus without the Project, Gallup would have to make major changes in water use patterns, with consequential negative implications for the city's economic well-being. While the Willingness to Pay approach does address the amount of money that Gallup residents would be willing to spend for a supplemental water supply, the approach does not address the overall economic losses to the City that would occur if future water shortages caused residents and businesses to locate elsewhere.

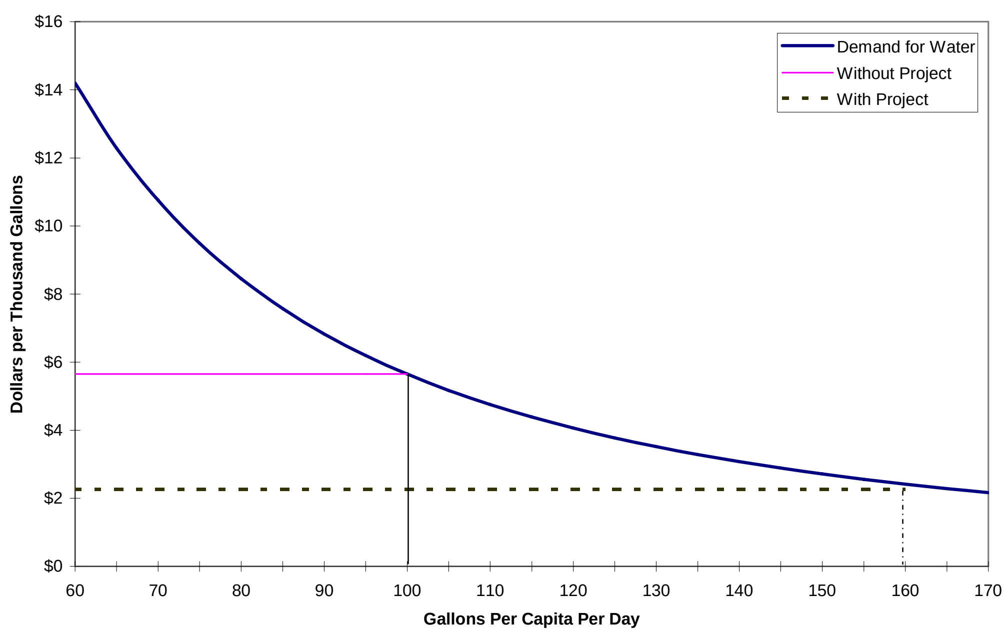
g. Gallup With-Project Condition

For purposes of the economic analysis we assume that the Project will be operational by January, 2027. We further assume that in the future, average Gallup water consumption per capita will decline slightly from today's 171 gpcd to 160 gpcd. Two factors should affect per capita water consumption in the future. First, water rates may be somewhat higher in the future in order to pay for a supplemental water supply, and higher rates should cause water use per capita to decline. Second, per capita water use may currently be somewhat elevated due to water use by non-Gallup residents who haul water from Gallup sources. When the Project is completed the need for water hauling should diminish.

h. Calculation of Project Benefits for Gallup

The potential economic benefits to Gallup from the Project can be measured by the area under the demand curve between (1) the projected use without the Project and (2) 160 gpcd. We measured this area for each year for the 50 year period beginning with planned Project completion in 2027. Each year's benefits are slightly different, due to decreasing household size and increasing population and income. Figure 1 shows Gallup's demand for water estimated for the year 2030 (curved line). The area below the demand curve and to the left of 160 gpcd shows the total willingness to pay (WTP) for 160 gpcd. However, the area below the demand curve and to the left of 100 gpcd indicates WTP for water that could be supplied by Gallup in 2030 even in the absence of the Project; and that area is not included in the benefit calculation. In addition to the benefits from supplemental water Gallup residents will benefit from the cost savings generated by replacing expensive deep wells with Project water. Gallup estimates that the city will save approximately $790,000 per year once the Project water supplies allow it to shut down deep wells [Munn]. Future benefits were discounted back to 2027, using the current (FY2007) federal discount rate of 4.875%. The discounted estimated annual benefits of the Project sum to a total present value of $361 million (2007$).

Figure 1
Demand for Water in 2030
Gallup, New Mexico



Note 1: The area under the demand curve was calculated by integrating equation (2) and solving for the area under the demand curve between the implicit price for projected water use without the project and the price at 160 gpcd water use with the project. This calculation is shown as equation (3).

$$(3)\ \text{Area} = 18.405\ *\ HHY^{..372}\ *\ HHS^{-1.348}\ *\ (P1^{(1-.554)} - P0^{(1-.554)}) / (1-.554),$$

where Area = area under demand curve between P1 and P0

HHY = household income

HHS = household size

P1 = price at 160 gpcd

P0 = price at base (without Project) per capita water use

Coefficients and exponents as estimated in equation (2)

The above calculation provides the area under the demand curve and to the right of the y-axis. Finally, to derive the economic benefits we adjust the above calculation to find the area below the demand curve but above the x-axis. This was done by subtracting the rectangle Q0 * (P1-P0) and adding the rectangle P1 * (Q1-Q0), where Q0 is the base (without Project) per capita water use and Q1 is the per capita water use with the Project.

2. Navajo Nation Willingness to Pay

Water use patterns on the Navajo Indian Reservation are substantially different from that in most off-Reservation communities, including Gallup. Most notably, about 40 percent of Navajo Reservation residents have no piped water supply so they must haul water to their homes. Water hauling is time consuming and expensive, with the result that those Navajos who do haul water tend to consume far less water per capita than those who have piped water. The circumstances of water hauling (price and per capita water use) are completely outside the range of data for any community surveyed as part of the Gallup analysis. Hence we concluded that it would be questionable to apply the price elasticity used for Gallup or that for any other community with a predominantly piped water supply to an assessment of Navajo willingness to pay for water. Instead, because of the importance of water hauling among the Navajo people we have estimated a Navajo-specific water demand function instead of using the demand curve developed for Gallup.

The Navajo water demand equation is based on fitting a log-log equation (similar to that used in the Gallup analysis) to the year 2005 water use and price data from Navajos who either (1) pay for water piped to their homes by the Navajo Tribal Utilities Authority (NTUA), or (2) purchase bulk water and haul it to their homes.[2] This estimated demand relationship is shown in equation (4).

(4) $\ln GPCD = -.1454 + -.8402 * \ln P$

where GPCD = water use in gallons per capita per day

P = price for water[3]

Converting the logarithmic equation (4) to an exponential equation form gives equation (5):

(5) $GPCD = .8646 * P^{-.8402}$

The price elasticity of negative .8402 estimated in equation (5) is somewhat higher than the average reported for communities having piped water supplies but is within the range of reported results (shown in Table 2).

Because the Navajo water use data did not include income for the water users we could not estimate a Navajo-specific income elasticity for water use. Since the Navajo household income is within the range of incomes in our community survey, we used the income elasticity from that survey for that Navajos. Essentially, we assumed that the Navajo would exhibit the same income response to water use (income elasticity) as we found in our sample of 79 mountain state communities in equation (2). We therefore added the income

[2] We recognize that piped and hauled water are dissimilar commodities. However, by including the cost of hauling to and storing at the household we attempted to define both as an "in-home water supply." There remains the possibility that even after accounting for the difference in cost, people's demand for hauled water would be less than that for piped water, due to the heightened awareness of resource scarcity. To the extent that this difference exists we may have underestimated the project benefits.

[3]The demand curve was estimated using 2005 prices. Once Willingness to Pay was determined from the demand curve we adjusted the valued to 2007$ using the CPI.

elasticity term to equation (5) and solved for an adjusted constant term, deriving equation (6) that was used to estimate Navajo benefits from water use.

(6) $GPCD = .021 * P^{-.840} * HHY^{.372}$

where HHY = median household income

a. NTUA Water Use

About 60 percent of Navajo Reservation households obtain piped water supplied by the NTUA. Average annual consumption is about 100 gpcd [Foley]. Average household size is 4.5 persons per household [U.S. Census Bureau], which translates to an average monthly household water consumption of 13,500 gallons (100 x 4.5 x 30 = 13,500). NTUA charges $2.20 per thousand gallons for the first 3,000 gallons per month and $3.35 per thousand gallons for additional use [Navajo Tribal Utility Authority]. NTUA also levies a monthly service charge of $5.50 for each hook-up. Given the average monthly household water use of 13,500 gallons the average monthly household water bill is $47.28 (3 x $2.20 + 10.5 x $3.35 + $5.50 = $47.28). Dividing the monthly bill by average monthly water use gives an average price of $3.502 per thousand gallons.

b. Water Hauling

About 40 percent of Navajo Reservation households do not have water piped to their homes [Navajo Department of Water Resources, 2000, p. ES-3]. These households instead haul water from NTUA distribution points, from wells, from vending machines, or from other water sources. Data from a recent survey indicates that Navajo households without a piped water supply haul an average of 5.4 gpcd [Ecosystem, 2003]. We used data for about 45 households from the same survey to estimate a delivered cost for hauled water. The delivered cost is necessary for the demand analysis so the cost for hauled water can be put in comparable terms to the cost for piped (delivered) water. We estimated four components of the delivered cost of hauled water: (1) purchase cost, (2) container cost, (3) transportation cost and (4) the opportunity cost of time.

Navajos hauling water pay a range of prices for water, from zero for water obtained from wells to as much a $0.25 per gallon for water purchased from vending machines. The survey average price paid for water in 2003 was $0.032 per gallon, or $32.00 per thousand gallons [Ibid.]. We used the Consumer Price Index (CPI) to convert this cost to a January, 2005 cost of $33.17 per thousand gallons.

The cost of sanitary containers used to haul water averaged $35.00 per household in 2003 [Ibid.]. Indexed by the CPI to 2005$ this cost is $36.27. We assume that the containers are replaced annually. Given water use of 5.4 gpcd and 4.5 persons per household, the 2005 container cost is $4.09 per thousand gallons ($36.27 per container per year / 5.4 gpcd x 4.5 persons per household x 365 days/year = $4.09 per thousand gallons).

The Ecosystem survey found that the average distance per hauling trip was 14 miles each way, for a 28 mile round trip [Ibid.]. We value the economic cost of transportation at the marginal cost for a light truck or van. This marginal cost includes both variable operating costs (gasoline, oil, tires, repairs, etc.), as well as additional vehicle depreciation associated with excess vehicle mileage. The variable operating costs are estimated to average $0.1755 per mile [Victoria Transport Policy Institute, indexed to 2005$ by CPI]. Additional depreciation was estimated to average $0.1085 per mile [Kelly Blue Book]. Total marginal cost per mile is thus estimated at $0.2840. The Ecosystem report adds 25% to average vehicle operating costs to allow for the use of more expensive than average vehicle maintenance and for extra costs due to rough roads. We have addressed the first issue by using data for light trucks instead of for automobiles. Our resulting costs per vehicle-mile may still be conservative because we have not made any allowance for extra costs due to rough roads. Given an average roundtrip mileage of 28 miles and average haulage of 173 gallons per load, transportation costs are estimated to be $45.97 per thousand gallons (28 miles per load x $0.2840 per mile / 173 gallons per load = $45.97 per thousand gallons).

Finally, we estimated the value of the time spent by Navajos who haul water. While in a financial analysis we would value their time only at whatever monetary compensation was sacrificed in order to haul water, in an economic analysis such as this it is important to consider the implicit value that people hauling water place on their time. [see, eg., Asian

Development Bank]. Economists recognize that people place a value on their time, even if they are unemployed. While employment status may affect the magnitude of the value that water haulers place on their time it does not affect the principle that people generally put some positive value on the time they spend doing chores. The value of time is recognized repeatedly as people make choices that trade off money against time. A good example is the premium people pay for convenience food over food needing preparation.

The value of time spent in transit is an issue that is commonly addressed in studies of recreational values. Many such studies simply assume that time spent traveling to a recreation site has some value relative to the wage rate, typically 25% to 50%, regardless of the employment status of those traveling [Cesario, Smith, Chia-Yu, Bhat, Bowder, Loomis]. Some recreational studies have attempted to calculate the value of time in transit in comparison to the wage rate [Bockstael (one to three times the wage rate), Feather (6% to 100% of the wage rate), Larson (48% to 79% of the wage rate), Shaikh (65% to 90% of the wage rate)]. A few studies have tried to estimate directly the value of time spent to haul water [World Bank (52% of wage rate), Whittington (100% or more of wage rate)]. For purposes of this economic analysis we have assumed that Navajo people value their time hauling water at 50 percent of the minimum wage rate. A Navajo survey cited in the Ecosystems report found that average hauling time was 52 minutes. Doubling that to allow for a round trip and rounding up to allow for filling and emptying time we assume that each load takes 2 hours. At one-half of the 2005 New Mexico minimum wage of $5.15 per hour and 173 gallons per load, the estimated opportunity cost per thousand gallons is $29.77 per thousand gallons ($5.15 per hour x one-half x 2 hours/load / 173 gallons/load = $29.77 per thousand gallons).

This approach implicitly assumes that the sole purpose of the trips is for water hauling. Unfortunately, the survey did not collect trip purpose information, so we assumed that water hauling was the primary purpose of each trip and that other trip purposes were incidental. Given the importance of water hauling and the relatively small window of time that each household may have to schedule trip when their water containers are nearing empty, this assumption may be generally reasonable.

The total economic cost for hauling water is the sum of the costs for purchasing water, purchasing containers, operating a vehicle and allowing for the opportunity cost of the time required. This sum is $113.00 per thousand gallons ($33.17 + $4.09 + $45.97 + $29.77 = $113.00)(2005$).

We also contacted two commercial water haulers who were prepared to deliver water to Navajo households. Including the cost of a 1,000 gallon cistern (amortized over 25 years) the delivered cost of water averaged about $133 (2005$) per thousand gallons, about 20% higher than the $113 per TG used in this analysis.

Note 2: The water use and cost per thousand gallons data for NTUA customers and for water haulers, described above, was used to estimate the a and b parameters in equation (4).

$Q = a * P^{b}$

NTUA customers: Q1 = 100, P1 = 3.502

Water haulers: Q2 = 5.4, P2 = 113.00

lnQ = ln(a) + b * lnP

NTUA customers: ln Q1 = 4.605, ln P1 = -5.654

Water haulers: ln Q2 = 1.686, ln P2 = -2.180

$$b = \frac{\ln Q1 - \ln Q2}{\ln P1 - \ln P2} = -0.8402$$

ln a = ln Q1 - b * ln P1 = -0.1454

c. Navajo Without-Project Condition

In the absence of the Project the Navajo Nation will continue to extend piped water service to a portion of its growing population, but for this analysis we assume that in the future the proportion of Navajos who haul water will remain at today's 40 percent. We also assume that without water from the Project and the economic growth facilitated by the Project that per capita water use among NTUA customers will remain at 100 gpcd into the foreseeable future.

d. Navajo With-Project Condition

The Project will deliver water to two different areas of the Navajo Reservation. The Cutter Lateral will convey water to a corridor of communities on the far eastern edge of the Navajo Reservation, eventually delivering water to the Jicarilla Apache Nation as well. We assume that this lateral will be operational by 2019.

A western lateral (San Juan Lateral) will convey water from the San Juan River directly south to Gallup, serving Navajo chapters along the way, with a branch that delivers water as far west as Window Rock and Fort Defiance. This analysis assumes that the section of this lateral that serves the Twin Lakes Chapter and is connected to the Chapters around Gallup will be completed by 2016. A well field will supply up to 2,000 afy to these chapters until the entire San Juan Lateral is completed in 2027.

For purposes of this economic analysis we assume that Project water will go first to NTUA customers to supplement their existing water supplies, and then to Navajos who would otherwise be hauling water. The reason is that the delivery infrastructure is already largely in place for NTUA customers but still needs to be constructed for water haulers. Because of the remote location for some water haulers we assume that 10 percent of today's Navajo population will continue to haul water despite implementation of the Project.

e. Calculation of Project Benefits for the Navajo Nation

The calculation of Project benefits accruing to the Navajo Nation is similar to that for the City of Gallup in that Willingness to Pay is measured by the area under a demand curve. We used the demand curve shown as equation (6) to estimate these benefits. We assume that household use for NTUA customers will increase from 100 gpcd to 130 gpcd, and that household water use for people who would otherwise haul water would increase from 5.4 gpcd to 130 gpcd. We further assume that an additional 22.5 gpcd will be used to support increased commercial activity and non-metered productive uses, such as community landscaping, construction and fire protection. A final 7.5 gpcd will go to other non-metered uses and losses. Benefits for NTUA customers were measured as the willingness to pay for supplemental water to increase per capita consumption from 100 gpcd to 130 gpcd. Benefits to commercial and other productive uses were assumed proportional to residential uses, so the final benefit is 152.5/130 times the residential-only benefit. No benefits were counted for system losses and any other non-productive uses. Per capita benefits were calculated for each year of the 50-year Project life, multiplied by the projected population in that year, and discounted using the current federal discount rate of 4.875% per year. Based on this calculation, the estimated present value of benefits of the Project to the Navajo Nation is $1,488 million (2007$).

Note 3: The area under the demand curve was calculated by integrating equation (6) and solving for the area under the demand curve between the implicit price for projected water use without the project and the price at 130 gpcd water use with the project. This calculation is shown as equation (7).

(7) $\text{Area} = .021 * \text{HHY}^{.372} * (\text{P1}^{(1-.846)} - \text{P0}^{(1-.846)}) / (1-.846)$,

where Area = area under demand curve between P1 and P0

HHY = household income

P1 = price at 130 gpcd

P0 = price at base (without Project) per capita water use

Coefficients and exponents as estimated in equation (6)

The above calculation provides the area under the demand curve and to the right of the y-axis. Finally, to derive the economic benefits we adjust the above calculation to find the area below the demand curve but above the x-axis. This was done by subtracting the rectangle Q0 * (P1-P0) and adding the rectangle P1 * (Q1-Q0). The calculations were done separately for water haulers and for NTUA customers because their respective base prices (P) and quantities of water use (Q) were different.

3. Jicarilla Apache Nation Willingness to Pay

The Jicarilla Apache Nation has long-term plans to develop the southwest area of their reservation, which is not presently populated. The Nation's development plans include housing and commercial projects, and are contingent on securing a reliable and high-quality water supply for the area [Jicarilla Apache Nation].

a. Basis for Estimating Benefits

The absence of a population base for which to estimate Willingness to Pay for the Navajo Gallup Water Supply Project makes it difficult to use a demand function to estimate benefits for the Jicarilla Apache Nation as was done for the City of Gallup and the Navajo Nation. Moreover, much of the anticipated Project benefit is expected to come from the commercial enterprises facilitated by the new water supply, rather than from household use. Under these circumstances, coupled with the articulated tribal policy to develop this area, we believe it is appropriate to estimate Project benefits by comparing the cost of the Project to the most likely alternative means of supplying water to the area. This method is a proxy for willingness to pay insofar as it reflects the amount the Apache Nation is willing to pay to secure a water supply, and is also consistent with the approach recommended by the Water Resource Council's Principles and Guidelines [Water Resource Council, section 2.2.2].

b. Jicarilla Without-Project Condition

As discussed above, The Jicarilla Apache Nation has adopted a policy of developing the southwest area of their reservation, and in case the Navajo Gallup Water Supply Project is not approved, they have investigated alternative means of conveying water to this area. We reviewed the associated project construction and operating cost estimates provided to the Nation [Frick (September) and Frick (October)], and adjusted those cost estimates to be comparable to the estimated costs for the NGWSP. These adjustments include (1) updating the costs to January, 2007 dollar terms, (2) making consistent assumptions regarding unlisted items (10% of listed items), contingencies (22.5% of listed plus unlisted items), engineering (27% of listed plus unlisted items plus contingencies), and cultural resource investigations (4.2% of listed plus unlisted items plus contingencies), and (3) adding interest during construction at the current federal rate for project analysis of 4.875%. Following these adjustments, we calculate that the average of the high and low cost estimates for the Jicarilla Nation's alternative water supply project is approximately $57 million (2007$).

c. Jicarilla With-Project Condition

The Jicarilla Apache Nation would be full partners in the Navajo Gallup Water Supply Project. They would receive 1,200 afy through the Cutter Lateral, which is assumed to be operational by 2020. The costs for the Jicarilla Apache Nation are included in the construction cost estimates discussed below.

d. Calculation of Project Benefits for Jicarilla Apache Nation

The Jicarilla Apache Nation would receive Project benefits of $57 million (2007$), measured by the cost of constructing and operating an alternative water supply project, discussed in section b, above.

4. Comparison of benefits per thousand gallons

Because Project benefits were estimated for the three participants using separate analytical techniques we believe it useful to compare the per unit benefits for the participants. Table 4 shows that the benefits are in fact reasonably similar. This table shows only direct benefits and does not include regional benefits such as unemployment relief or health care efficiency improvement.

Table 4

Comparison of Benefits per Thousand Gallons among Project Participants

	Navajo	Gallup	Jicarilla Apache
Present Value of Benefits	$1,488,000,000	$361,000,000	$57,000,000
Annualized Benefits	$79,939,000	$19,394,000	$3,062,000
Levelized Water Use (TG/yr)	9,890,000	2,444,000	560,000
Benefits / TG	$8.08	$7.94	$5.47

5. Unemployment Relief Benefits – Construction Employment

As discussed in section A.5, above, in an economic analysis the measured cost of employing labor is less than the wage rate if the labor would otherwise be unemployed. The Principles and Guidelines recognize this principle [Water Resource Council, section

2.11] and recommend applying a zero opportunity cost to construction phase labor that would otherwise be unemployed.

Unemployment is well above the national average in the Project area. Table 5 shows recent unemployment rates for the two counties and two Indian reservations in the Project area, as well as nationally. Most of the Project would be constructed on Navajo Reservation land to serve Navajo chapters, and we are assuming that a local hire rule encouraging Indian employment would be in effect. The very high unemployment rates on the Indian reservations clearly support the conclusion that much of the labor force used to construct the Project would come from the ranks of the otherwise unemployed.

Table 5

Unemployment Rates in United States and Vicinity of Navajo Gallup Water Supply Project

Year	United States	San Juan County, NM	McKinley County, NM	Navajo Reservation	Jicarilla Apache Reservation
1999	4.2%	7.5%	7.1%	34%	40%
2000	4.0%	5.8%	6.6%		
2001	4.7%	6.2%	6.2%	52%	33%
2002	5.8%	6.9%	6.2%		
2003	6.0%	7.6%	7.4%		
2004	5.5%	6.1%	7.6%		
2005	5.1%	5.5%	6.8%		
2006	4.8%	4.3%	5.6%		

Sources: National and county unemployment rates from U.S. Bureau of Labor Statistics, "Local Area Unemployment Statistics;" Reservation unemployment rates from U.S. Bureau of Indian Affairs, "American Indian Population and Labor Force Report," 1999 and 2001.

The Principles and Guidelines recommend that in an area of substantial and persistent unemployment and in the case of a local hire rule we assume for the economic analysis that 43% of skilled workers and 58% of unskilled workers be considered as otherwise unemployed during the construction phase of the Project [Water Resource Council, section 2.11.4]. We used an IMPLAN input-output model [IMPLAN, "Professional 2.0;"

IMPLAN, “County Data”]to estimate the average earnings of workers needed for the Project, and used Bureau of Reclamation data to split the total earnings estimate between earnings for skilled and unskilled workers [U.S. Bureau of Reclamation, 1988]. We estimated the earnings for each year of construction, and accumulated interest during construction until the year of completion (2027) using the federal discount rate of 4.875%. The estimated present value (as of 2027) of the construction earnings going to otherwise unemployed persons is $231 million (in 2007$).

6. Other Project Benefits

a. Unemployment Relief Benefits – Secondary Employment

The wages and salaries paid to area construction employees will in turn provide a substantial boost to the local economy, known as an “induced” impact. The Principles and Guidelines suggest that because of measurement and identification problems and because unemployment is regarded as a temporary phenonemon that a project analysis should only account for the benefits from employing construction labor and not the associated induced employment [Water Resource Council, section 2.11.2]. However, high unemployment levels have been persistent on both the Navajo and Jicarilla Apache reservations for generations, directly contrary to the “full employment economy” premise of the Principles and Guidelines [Water Resource Council, section 1.7.2(e)(3)]. We have therefore estimated the value of earnings going to otherwise unemployed people in the non-construction industries stimulated by local construction spending, particularly for labor. We used the same methodology as in estimating earnings of construction workers, except that we did not assume any local hiring preference and assume that only 30 percent of skilled workers and 47 percent of unskilled workers would be otherwise unemployed [Water Resources Council, p. 94]. The present value of wages in non-construction industries that will go to otherwise unemployed persons is estimated at $111 million (in 2007$)

b. Health Benefits

A primary rationale for the public policy of providing clean and reliable water to all people in the United States is the resulting health benefit. For example, Congress has found specifically for Indians that a “major national goal of the United States is to provide the quantity and quality of health services which will permit the health status of Indians to be raised to the highest possible level …” [25 USC 1601], and that “the provision of safe water supply systems and sanitary sewage and solid waste disposal systems is primarily a health consideration and function,” and that “it is in the interest of the United States, and it is the policy of the United States, that all Indian communities and Indian homes, new and existing, be provided with safe and adequate water supply systems… as soon as possible.” [25 USC 1632].

There is a clear connection between sanitation facilities (water & sewerage) and Indian health. The Indian Health Service considers the availability of essential sanitation facilities to be “critical to breaking the chain of waterborne communicable disease episodes… In addition, many other communicable diseases, including hepatitis A, shigella, and impetigo are associated with the limited hand washing and bathing practices often found in households lacking adequate water supplies. This is particularly true for families that haul water” [Indian Health Service, 2004]. The Indian Health Service reports that American Indian families living in homes with satisfactory environmental conditions required about one-fourth the medical services as those with unsatisfactory environmental conditions [Ibid.].

Benefits from an improved water supply will accrue both to consumers and providers of health care. The Navajo people will enjoy better health as a result of their access to a clean and reliable water supply. Their benefit should be reflected in their willingness to pay for water and is already addressed in that analysis. The Indian Health Service, which provides health care to the Navajos, will also experience a reduction in their cost of providing health care services as a result of the reduced case load from water-related illness. This efficiency improvement is the focus of the present section.

The Indian Health Service concludes that the average annual cost for medical care in the Shiprock-Gallup-Fort Defiance area that would be equivalent to the Federal Employees Health Plan is $3,415 per person in 2007$ [Indian Health Service, 2002, US BLS, 2007]. If even 10% of this cost could be saved by the provision of a clean piped water supply to those households who would otherwise haul water, that savings would amount to a present value of as much as $11,000 per person for those people connecting to the Project by 2016, or $5,400 per person for those connecting by 2030. The Navajo-Gallup Water Supply Project will ultimately provide water to over 100,000 people who would otherwise haul water, for an estimated total savings in medical expenses of over $435 million over the life of the Project (in 2007$).

c. Increase in Economic Activity

The entire project area and the Navajo Reservation in particular are characterized by persistent poverty and above national average unemployment rates [USDA; Table 4, supra]. Over 40 percent of Navajo families have income below the poverty level, compared with less than 10 percent nationwide [Navajo Division of Community Development, 2004, p. 22], and median income for Navajo households is less than one-half of the national average [Ibid.].

Provision of a clean, reliable water supply can serve to promote economic activity in the project area. International agencies recognize that not only is water an important factor of production in some industries (eg. cooling water in a power plant), but that investments in water infrastructure can also serve as a catalyst for more general development [Lenton, p. 129]. A recent study of foreign aid focused on short-term projects (eg. roads, irrigation systems, electricity generators and ports) concluded that every $1 invested in short-term aid returned a present value of $1.64 in increased output and income [Clemens]. Although the study objective was to estimate the effect from short-term aid the results also suggest “an important long-run positive impact on growth from long-term aid” (such as a water supply project)[Clemens, p. 41 and Table 5].

Two recent studies in the United States examined the extent to which development of water projects stimulated the regional economy. The first study investigated the effects of dams on local economic growth and development by analyzing the effects on county income, employment, population and earnings [Aleseyed]. Control group counties were paired with counties with new water projects. The study concluded that large dam reservoirs had a statistically significant positive effect on growth in the local areas, with the strongest positive effects from non-flood control projects, and weaker effects from regions without a large city [Aleseyed, pp. 17-18].

The second study focused on the extent to which water and sewer projects can save and/or create jobs, spur private investment, attract government funds and enlarge the property tax base [Bagi]. The study found that "[e]very dollar spent in constructing an average water/sewer project generated almost $15 of private investment, leveraged $2 of public funds, and added $14 to the local property tax base" [Bagi, p. 46]. In addition, the study found that many more permanent jobs were either saved or created by the project than the number of construction jobs needed to build the project [Bagi, p. 49].

It is difficult to forecast the extent to which the NGWSP will promote economic growth in the region. The evidence cited above, however, clearly indicates that we should expect a substantial regional economic stimulus from the project. The Anderson School of Management at University of New Mexico recently evaluated the economic impacts from the proposed San Juan River Settlement Agreement and related NGWSP [UNM]. Their report discusses state and level construction impacts, tax revenues, social benefits and the effect on the regional economy from improving the water supply. The report concludes that "improving the water infrastructure in economically depressed areas can be the catalyst for the development of small economic clusters such as those centered around manufacturing" [Ibid., p. 34]. The report also makes the important point that the NGWSP will increase the flexibility of water use in northern New Mexico [Ibid., pp. 38-9], thereby potentially increasing the economic efficiency of water use.

d. Curtailment of Navajo Outmigration

Finally, the Project may indirectly help reduce the outmigration of Navajo people. The improved economic climate facilitated by the Project will provide more employment opportunities for the minority and low-income populations. This increased employment opportunity, together with an improved water infrastructure, will make the area more attractive for young adults who might otherwise consider moving outside the area. This impact is discussed in the companion report "Social Impacts from the Navajo-Gallup Water Supply Project." [Merchant, 2007b]

D. Economic Costs

The Project's economic costs were estimated using the same principles as in estimating project benefits. The primary categories of Project costs include (1) Project construction costs, (2) distribution line construction costs, (3) operation, maintenance and replacement costs, (4) costs for water, (5) downstream effects on power generation, and (6) downstream effects on salinity.

1. Project Construction Cost

In a companion report we estimated the total financial Project costs and the respective shares of cost for each of the three Project participants [Merchant, 2007a]. The total project capital cost before interest during construction (IDC) is estimated at $865 million. Two adjustments of this number are necessary to derive the Project's economic cost. First, as explained in section A.3, above, the $53 million of taxes included in this total are transfer payments and should be excluded [Ibid.], leaving a net cost before taxes of $812 million.

The second adjustment necessary is to add IDC to reflect the cost to the economy of tying up resources used during construction of the Project and before the project begins to deliver water and to provide benefits. We assume that Project construction would begin in 2011, full Project operation would begin in 2027, and we compound IDC to the completion date at the rate of 4.875% per year. IDC based on a pre-tax construction cost of $812 million amounts to $380 million [Ibid., adjusted to remove IDC on taxes]. The total economic construction cost is thus estimated at $1,192 million. This IDC calculation and the associated 16-year construction schedule is assumed to be limited to constant dollar construction funding of $60 million per year (2007$). If the funding level were sufficient to sustain an 8-year construction schedule IDC would be about $185 million, less than one-half of the amount used in this report.

2. Distribution Line Construction Cost

The Project construction cost includes all costs necessary to build the main laterals that would convey water to each participant. It also includes the costs for water treatment, pumping plants and storage tanks. However, it does not include the cost for the distribution lines needed to deliver water to each connection. Because the benefits were estimated based on the assumption that nearly all residents would have a piped water supply, it is important that the costs include whatever additional facilities are needed to provide those connections. Each of the three participants begin with different circumstances.

a. City of Gallup

The Project capital cost estimates for the City of Gallup already includes a substantial portion of the distribution system necessary to deliver water within the City and to the neighboring Navajo Chapters. Additional costs incurred by the City to hook up new customers are normally passed on to the customers by means of a connection fee. These costs will therefore be covered by the water users and will not be charged to the Project.

b. Navajo Nation

Recall that the "Without-Project" condition described in section B.2.c, above, is that even in the absence of the Project the Navajo Nation will continue to extend piped water service to about 60% of a growing population. The Project will deliver supplemental water to these people. The Project will also deliver water to most of the remaining 40%, who are those who would otherwise be hauling water. We have included a cost allowance to provide distribution systems for the Navajos who would otherwise haul water. We estimated the number of connections added per year for the life of the Project and calculated an annual Project cost using a cost of $669 per connection [MSE-HKM, indexed for inflation]. These annual totals were discounted to 2027 using the federal discount rate of 4.875%. The total discounted cost amounts to $48 million (2007$).

c. Jicarilla Apache Nation

Although the Jicarilla Apache Nation will incur some cost for distribution lines they would incur the same cost if they were to develop an alternative water supply in lieu of the Navajo Gallup Water Supply Project. Because the benefits included in the economic analysis are based only on the cost savings of this Project compared to other projects, the added cost of distribution lines does not affect the difference and should therefore not be included as either a Project cost or the cost of any alternative projects.

3. Operation, Maintenance and Replacement Cost

The Project's annual operation, maintenance and replacement (O,M&R) costs were estimated for each year of the Project and discounted to the assumed initial year of full Project operation, 2027. These costs were estimated for both commercial (NTUA) power rates and Colorado River Storage Project rates. A financial analysis would use whichever rates were ultimately charged to the Project. However, an economic analysis from the perspective of the federal government would use the market rate regardless of whether the Project qualified for a concessionary rate since the market rate presumably reflects the value to the Nation of power. (see discussion in section A.1, above). We therefore used the NTUA rates to determine the economic cost of Project O,M&R. This cost is $368 million [Merchant, 2007a].

4. Cost of Water

An economic analysis should address the cost of the water dedicated to the Project. While a financial analysis would consider only the actual payments for water an economic analysis evaluates the opportunity cost of water even in the absence of financial payments (see discussion in section A.6, above). The relevant perspective for the opportunity cost is that of the water rights holder because the uses of water are limited to whatever opportunities are available to whoever owns the water. The analysis is different for all three Project participants.

a. City of Gallup

The City of Gallup does not presently hold the water rights for its intended Project use. The City is negotiating with the Jicarilla Apache Nation and presumably will reach an arms length agreement to appropriately compensate the Jicarilla for Gallup use of Jicarilla watter. This cost will reflect the market conditions for water and should offer a fair assessment of the opportunity cost of water for the Jicarillas. Pending completion of the negotiations we have assumed an annual price of $110 per acre foot during Project operation, plus an option fee to hold the water until the Project is completed, which together have a present value over the life of the Project of $33 million.

b. Navajo Nation

Absent a water rights settlement providing other terms, the Navajo Nation will pay an estimated $4.12 per acre-foot for their non-agricultural use of water from Navajo Reservoir. This cost represents a financial cost to the Navajos, but because it is based on historical investment costs and not a current use of resources it is not an economic cost. The relevant economic cost is the lowest-returning opportunity available to the Navajos that would be displaced by dedicating water to the Project. For the Navajos we assume that this opportunity is probably growing irrigated alfalfa. We used New Mexico Cooperative Extension Service crop budgets [Libbins] and New Mexico Agricultural Statistics [New Mexico Agricultural Statistics Service] to estimate the returns to water used in growing alfalfa. The expected annual average return is $178 per acre in 2007$. Assuming 4 afy are diverted to grow each acre of alfalfa the opportunity cost for each acre-foot is $45. The present value of the opportunity cost for the 28,900 afy of average Project water use is thus estimated at $26 million in 2007$.

c. Jicarilla Apache Nation

Although the Jicarilla Apache Nation will incur some opportunity cost for dedicating some of their water supply to the Project, the Jicarilla Nation would incur the same opportunity cost if they were to develop an alternative water supply besides the Navajo Gallup Water Supply Project. Because the benefits included in the economic analysis are based only on the cost savings of this Project compared to other projects, the added water opportunity cost does not affect the difference and should therefore not be included as either a Project cost or the cost of any alternative projects.

5. Other Project Costs

The Project will have some effect on downstream water users (externalities). These effects include a reduction in Colorado River power generation and increases in Colorado River salinity. Similar downstream effects would result from any depletion in the Upper Colorado River Basin. Because the Project water use will be within the scope of the water rights held (or leased) by Project participants, the participants can legitimately deplete water without regard to the impact on lower priority users. And since there is no mechanism for Lower Basin users (who would be most impacted by any increase in salinity) to compensate Upper Basin water rights holders for not using water, the Upper Basin water users have no financial opportunity cost that recognizes the impact of their water use on Lower Basin users. From a national perspective, however, we should recognize the broader effect of Upper Basin water rights holder exercising their water rights.

a. Loss in Electrical Power Revenues

Water diverted for the Project from the San Juan River will deplete Lake Powell inflow. This depletion could have a range of impacts on power generation at Glen Canyon Dam, depending on total flows into Lake Powell and on total water use in the Upper Basin. The Upper Basin is obligated to release a minimum amount of water from Lake Powell for the benefit of Lower Basin and Mexico users of the Colorado River. Diversions for the Navajo-Gallup Water Supply Project will not relieve the Upper Basin from this obligation, so at one extreme the total releases from Lake Powell may not change. On the other hand, until the Upper Basin uses its full water allocation and during periods of above-normal nature runoff in the Upper Basin, the Upper Basin may release more than its obligated minimum from Lake Powell. Under these circumstances the depletion from the Navajo-Gallup Water Supply Project will cause a reduction in power generation at Glen Canyon Dam. In order to determine the maximum impact of the Navajo-Gallup Project we have estimated the cost of diminished power generation under the second set of assumptions.

The estimated average flow of the Navajo-Gallup Water Supply Project will reach 51.94 cfs [Merchant]. A Bureau of Reclamation study reports that the power generation lost at Glen Canyon Dam amounts to .0408 MW/cfs [U.S. Bureau of Reclamation, 2000b], so the total capacity lost due to the Project would be 2.12 MW. At 8,760 hours per year the total electrical energy lost would be 18,563 MWh. We valued this lost energy at its estimated replacement cost of 55.68 mills per kwh (2007$) [Energy Information Administration, p. 78]. At the federal discount rate of 4.875% the present value of these lost power benefits over the 50 year Project life is estimated to be $19 million.

b. Downstream Salinity Effects

The Navajo-Gallup Water Supply Project will have two effects on downstream salinity. First, the Project depletions will diminish the flow of relatively high quality water into into Lake Powell, raising the average total dissolved solids (TDS) of Lake Powell inflows by an estimated approximately 0.7 mg/L. Second, the Project will produce some return flow that would enter Lake Powell. This return flow is higher in TDS than the average inflow and would raise the average TDS by an estimated about 0.8 mg/L [U.S. Bureau of Reclamation, 2004; Leach]. The total increase in TDS will thus be about 1.5 mg/L.

The cost of this 1.5 mg/L increase in salinity is the lesser of two factors. First, the Bureau of Reclamation has estimated that in 2000 the annual cost to Lower Basin water users for each 1.0 mg/L increase in salinity is about $2,500,000 [U.S. Bureau of Reclamation, 2000a]. Updating this cost to 2007$ [U.S. Bureau of Labor Statistics, CPI] and applying it to the 1.5 mg/L increase converts to an annual cost of $4,000,000. The second factor is the cost of mitigating the increase in salinity. The Bureau of Reclamation is actively soliciting proposals from Colorado Basin water users to reduce the salinity load of the Colorado River. The average cost of this program is less than one-quarter of the cost of tolerating increased salinity loads [[U.S. Bureau of Reclamation, 2003]. The annual cost to mitigate the salinity increase due to the Project would therefore be about $1,000,000. The present value of these mitigation costs over the 50 year Project life would be about $20 million (2007$) (again applying the federal discount rate of 4.875%).

E. Benefit – Cost Summary

Table 6 summarizes the estimated benefits and costs from the Navajo-Gallup Water Supply Project.

Table 6

Summary of Navajo-Gallup Water Supply Project Economic Benefits and Costs

(4.875% discount rate, 50 year project life)

Millions 2007$

BENEFITS	**Direct**	**Direct plus Other**
Gallup Willingness to Pay	361	361
Navajo Willingness to Pay	1,488	1,488
Jicarilla Avoided Cost	57	57
Construction Employment	231	231
Induced Employment	-	111
Health Benefits	-	435
Total Benefits	2,137	2,683
COSTS		
Project Construction	1,192	1,192
Distribution System Construction	48	48
O,M&R	368	368
Gallup Water Cost	33	33
Navajo Water Cost	24	24
Power Generating Cost	19	19
Salinity Increase Cost	20	20
Total Costs	1,704	1,704
BENEFIT/COST RATIO	**1.25**	**1.57+**

F. Discount Rate Sensitivity Analysis

Federal legislation requires an annual determination of a discount rate to be used by federal agencies in water resources planning. During fiscal year 2007 the federal rate is 4.875% [U.S.

Bureau of Reclamation, 2006]. This federal rate is a constrained, lagged, nominal (includes inflation) rate computed annually from U.S. Treasury security yields. The rate is constrained because it cannot move more than .25% per year regardless of how much market interest rates move between consecutive years. The rate is then rounded to the nearest one-eighth of one percent. Absent these constraints the 2007 rate would be 4.9351% [Ibid.].The rate is lagged because it reflects *average* yields on marketable securities with a term of 15 years or more, not just the most recent yields on securities. The rate is nominal because no effort has been made to subtract the expected inflation that is built into the rate (lenders always ask for a premium above a real or inflation-free interest rate to compensate them for the expected loss in purchasing power that is caused by future inflation).

This federal rate is not well suited to cost-benefit analysis because its use violates a fundamental economic principle, viz. consistent treatment of inflation in both the discount rate and the estimation of future benefits and costs. The federal rate is based on nominal (inflation-including) rates because it does not attempt to adjust market rates for the expected inflation that is implicitly built into the rates. On the other hand, the federal rate is not an accurate measure of current nominal rates, either, because the rate is both lagged and constrained, as explained above.

In keeping with the Principles and Guidelines [Water Resources Council, section 1.4.10] all of the future costs and benefits for the Navajo-Gallup Water Supply Project have been estimated in constant 2007 price levels. To maintain consistency these constant dollar prices should be discounted at a rate that also assumes constant price levels, and as explained above, the federal rate does not meet that condition.

The real (net of inflation) cost of long-term federal funds is in the range of 2.0% to 4.0% per year. The Office of Management and Budget, for example, concludes that the real rate on 10-year bonds is 2.8% and the real rate on 30-year bonds is 3.5% [OMB]. For the purpose of evaluating the sensitivity of the benefit cost analysis results to the level of the discount rate we have recomputed all costs and benefits using a real discount rate of 3%. The results of this analysis are shown in Table 7.

Table 7 shows that using a real discount rate of 3% significantly increases the Benefit/Cost ratio. The lower rate increases the importance of future events (predominantly benefits) relative to the near term events (predominantly costs), resulting in the increased ratio of benefits to costs.

Table 7

Summary of Navajo-Gallup Water Supply Project Benefits and Costs

(3% discount rate, 50 year project life, millions 2007$)

	Direct	Direct Plus Other
BENEFITS		
Gallup Willingness to Pay	$596	$596
Navajo Willingness to Pay	$2,137	$2,137
Jicarilla Avoided Cost	$58	$58
Construction Employment	$199	$199
Indirect and Induced Employment	$0	$95
Health Benefits	$0	$630
Total Benefits	$2,990	$3,715
COSTS		
Project Construction	$1,026	$1,026
Distribution System Construction	$53	$53
O,M&R	$486	$486
Gallup Water Cost	$38	$38
Navajo Water Cost	$34	$34
Power Generating Cost	$27	$27
Salinity Increase Cost	$27	$27
Total Costs	$1,691	$1,691
BENEFIT/COST RATIO	1.77	2.20

REFERENCES

Agthe, Donald E., and R. Bruce Billings, "Simultaneous Equation Demand Model for Block Rates," Water Resources Research, Vol. 22, No. 1, January, 1986.

Aleseyed, Mostafa, Terance Rephann, and Andrew Isserman, "The Local Economic Effects of Large Dam Reservoirs: U.S. Experience, 1975-95," Review of Urban and Regional Development Studies 10 (Autumn 1998): 91-108, http://www.equotient.net/papers/dams.pdf

Allgood, Lance, City of Gallup Water Department, personal communication, October 28, 2004.

Asian Development Bank, "Handbook for the Economic Analysis of Water Supply Projects," 1999, www.adb.org/documents/handbooks/water_supply_projects , accessed 9/24/04.

Bagi, Faqir S., "Economic Impact of Water/Sewer Facilities on Rural and Urban Communities," Rural America, Vol. 17, Issue 4, Winter, 2002.

Bhat, Gajanan, and John C. Bergstrom, "Integration of Geographical Information Systems Based Spatial Analysis in Recreation Demand Studies," Department of Agricultural and Applied Economics, University of Georgia, Faculty Series 96-26, January, 1997.

Billings, R. Bruce, and Donald E. Agthe, "Price Elasticities for Water: A Case of Increasing Block Rates," Land Economics, Vol. 56, No. 1, February, 1980.

Bockstael, Nancy E., Ivar E. Strand and W. Michael Hanemann, "Time and the Recreational Demand Model," American Journal of Agricultural Economics, Vol. 69, May, 1987.

Bowker, J.M., Donald B.K. English, and Jason A. Donovan, "Toward a Value for Guided Rafting on Southern Rivers," Journal of Agricultural and Applied Economics, Vol. 28, No. 2, December, 1996.

Brookshire, David S., H. Stuart Burness, M. Chermak, & Kate Krause, "Western Urban Water Demand," Natural Resources Journal, Vol. 42, No. 4, Fall, 2002.

Brown, Thomas C., "Projecting U.S. Freshwater Withdrawals," Journal of Water Resources Research, Vol. 36, No. 3, March, 2000.

Cesario, Frank J., "Value of Time in Recreation Benefit Studies," Land Economics, Vol. 52, No. 1, February, 1976.

Clemens, Michael, Steven Radelet, and Rikhil Bhavnani, "Counting Chickens When They Hatch: The Short Term Effect of Aid on Growth," Center for Global Development Working Paper Number 44, December 2, 2004.

Ecosystem Management, Inc., "Sanitary Assessment of Drinking Water Used By Navajo Residents Not Connected to Public Water Systems Report," prepared for Navajo Nation Surface and Groundwater Protection Department, Navajo Nation Environmental Protection Agency, Sept., 2003.

Feather, Peter, and W. Douglas Shaw, "Estimating the Cost of Leisure Time for Recreation Demand Models," prepared for the American Agricultural Economics Association Annual Meeting, August, 1998.

Federal Register, December 9, 2004, p. 71425.

Foley, Mike, Navajo Department of Water Resources, personal communication.

Foster, Henry S., and Bruce R. Beattie, "Urban Residential Demand for Water in the United States," Land Economics, Vol. 55, No. 1, February, 1979.

Fraumeni, Barbara et al., "The Role of Capital in U.S. Economic Growth, 1948-1979," in Ali Dogramaci, ed., Measurement Issues and Behavior of Productivity Variables, 1986.

Frick, David M., "Memorandum to Mike Hamman, Tribal Water Administrator, Jicarilla Apache Nation, Re: Cost Analysis – Navajo Gallup Water Supply Project," Ayres Associates, September 20, 2002.

Frick, David M., "Memorandum to Mike Hamman, Tribal Water Administrator, Jicarilla Apache Nation, Re: Follow-up Cost Analysis – Navajo Gallup Water Supply Project," Ayres Associates, October 7, 2002.

Hasson, David S., "Price Elasticity and Conservation Potential," in ASCE, Water Management in the 90's, 1993.

Jicarilla Apache Nation, "Resolution of the Legislative Council No. 2001-R-290-06," June 6, 2001.

IMPLAN, "County Data Sets for 2002: San Juan and McKinley counties, New Mexico."

IMPLAN, "Professional 2.0" software, Minnesota IMPLAN Group.

Indian Health Service, "The Sanitation Facilities Construction Program of the Indian Health Service, Public Law 86-121 Annual Report for 2003," 2004.

Indian Health Service, "2001 FEHP Disparity Index and IHCIF Calculations for Operating Units," May 9, 2002, www.ihs.gov/NonmedicalPrograms/LNF/, accessed 1/9/05.

Jones, C. Vaughan, and John R. Morris, "Instrumental Price Estimates and Residential Water Demand," Water Resources Research, Vol. 20, 1984.

Kelley Blue Book, Blue Book Private Party Report, 2000 Ford F150 Long Bed, www.kbb.com , accessed 11/8/04.

Larson, Douglas M., Sabina L. Shaikh, and David F. Layton, "Revealing Preferences for Leisure Time From Stated Preference Data," American Journal of Agricultural Economics, Vol. 86, No. 2, May, 2004.

Leach, Rege, U.S. Bureau of Reclamation, Personal Communication, 11/11/04.

Lenton, Roberto, Albert M. Wright, & Kristen Lewis, "Health, dignity, and development: what will it take?," UN Millennium Project, Task Force Report on Water and Sanitation, 2005, http://unmp.forumone.com/.

Loomis, John, and Joseph Cooper, "Comparison of Environmental Quality-Induced Demand Shifts Using Time-Series and Cross-Section Data," Western Journal of Agricultural Economics, Vol. 15, No. 1, July, 1990.

MSE-HKM, "Three Canyons Project, Cost of Improvements to Existing Systems," February, 2000.

Martin, Randolph C., and Ronald P. Wilder, "Residential Demand for Water and the Pricing of Municipal Water Services," Public Finance Quarterly, Vol. 20, No. 1, January, 1992.

Merchant, James P., "Navajo-Gallup Water Supply Project, Allocation of Capital and O,M&R Costs Among Project Participants, San Juan River – PNM Alternative," 2007a.

Merchant, James P., "Social Impacts from the Navajo-Gallup Water Supply Project," 2007b.

Morgan, W. Douglas, "Residential Water Demand: The Case from Micro Data," Water Resources Research, Vol. 9, No. 4, August, 1973.

Munn, Gary, Gallup Water Department, personal communication, December 16, 2004.

Navajo Nation Division of Community Development, "Chapter Images: 1996," Summer, 1997.

Navajo Nation Division of Community Development, "Chapter Images: 2004," April, 2004.

Navajo Nation Department of Water Resources, "Water Resource Development Strategy for the Navajo Nation," July 17, 2000.

Navajo Nation Department of Water Resources, City of Gallup, Northwest New Mexico Council of Governments, and U.S. Bureau of Reclamation, "Technical Memorandum, The Navajo-Gallup Water Supply Project," March 16, 2001.

Navajo Tribal Utility Authority, "Rate Schedule WR-01, Residential Water Service," April 1, 1993.

New Mexico Cooperative Extension Service, "Cost & Return Estimates (2005 Projected) San Juan County, 80 acre sprinkler," http://costsandreturns.nmsu.edu/ /2005Projected.htm, accessed 7/28/05.

New Mexico Agricultural Statistics Service, "New Mexico Agricultural Statistics, 2003," 2004.

Nieswiadomy, Michael L., "Estimating Urban Residential Water Demand: Effects of Price Structure, Conservation, and Education," Water Resources Research, Vol. 28, No. 3, March, 1992.

Nieswiadomy, Michael L., and Steven L. Cobb, "Impact of Pricing Structure Selectivity on Urban Water Demand," Contemporary Policy Issues, Vol. XI, July, 1993.

Nieswiadomy, Michael L., and David L. Molina, "Comparing Residential Water Demand Estimates under Decreasing and Increasing Block Rates Using Household Data," Land Economics, Vol. 65, No. 3, August, 1989.

Office of Management and Budget, Executive Office of the President, "OMB Circular No. A-94, Appendix C, Discount Rates for Cost-Effectiveness, Lease Purchases and Related Analyses," revised February, 2004, www.whitehouse.gove/omb/circulars/, accessed 1/9/05.

Schneider, Michael L., and E. Earl Whitlatch, "User-Specific Water Demand Elasticities," Journal of Water Resources Planning and Management, Vol. 117, No. 1, January/February, 1991.

Shaikh, Sabina L., "A Whale of a Good Time: Exploring Flexibility in the Recreational Demand Model," prepared for the American Agricultural Economics Association Annual Meeting, August, 1998.

Smith, V. Kerry, William H. Desvousges, and Matthew P. McGivney, "The Opportunity Cost of Travel Time in Recreational Demand Models," Land Economics, Vol. 59, No. 3, August, 1983.

U.S. Bureau of Indian Affairs, "American Indian Population and Labor Force Report," 1999.

U.S. Bureau of Indian Affairs, "American Indian Population and Labor Force Report," 2001.

U.S. Bureau of Labor Statistics, “Consumer Price Index,” http://data.bls.gov , accessed 7/16/07.

U.S. Bureau of Labor Statistics, “Current Population Survey, Employment Status of the Civilian Noninstitutional Population,” http://www.stats.bls.gov/cps, accessed 8/13/07.

U.S. Bureau of Labor Statistics, “Local Area Unemployment Statistics,” ftp://ftp.bls.gov/pub/special.requests/la/laucnty06 accessed 8/3/07.

U.S. Bureau of Reclamation, “Change in the Discount Rate for Water Resources Planning,” Federal Register, Volume 71, Number 246, p.77061, December 22, 2006.

U.S. Bureau of Reclamation, “Colorado River Basin Salinity Control Program,” www.usbr.gov/uc/progact/salinity , accessed on 11/11/04.

U.S. Bureau of Reclamation, “Colorado River Interim Surplus Criteria, Final Environmental Impact Statement, December, 2000 (2000a).

U.S. Bureau of Reclamation, “Construction Impact from each $1,000,000 of Appropriations,” 1988.

U.S. Bureau of Reclamation, “Draft EIS, Allocation of Water Supply and Long Term Contract Execution, Central Arizona Project,” June, 2000, Appendix J (2000b).

US Census Bureau, "American FactFinder, DP-1, Profile of General Demographic Characteristics: 2000, Navajo Nation Reservation and Off-Reservation Trust Land, AZ_NM_UT," http://factfinder.census.gov, accessed on 2/7/05

US Census Bureau, "American Indian and Alaska Native Population:2000, Table 5. American Indian and Alaska Native Population by Selected Tribal Grouping: 2000," February, 2002, www.census.gov/prod/2002pubs/c2kbr01-15.pdf, accessed on 2/7/05.

US Census Bureau, "American Indian Reservations and Trust Lands," www.census.gov/geo/ezstate/airpov.pdf, accessed on 2/7/05.

U.S. Census Bureau, “General Population and Housing Characteristics: 1990 Data Set: 1990 Summary Tape File 1 (STF 1),” http://factfinder.census.gov/ , accessed 7/12/01.

U.S. Census Bureau, “Profiles of General Demographic Characteristics, 2000 Census of Population and Housing, New Mexico,” May, 2001.

US Census Bureau, "Table 1. Top 25 American Indian Tribes for the United States: 1990 and 1980," August, 1995, www.census.gov/population/socdemo/race/indian/ailang1.txt, accessed on 2/7/05.

U.S. Department of Agriculture, “Final 2004 County Typology Codes,” August 26, 2004, www.ers.usda.gov/data/TypologyCodes/2004/all_final_codes.xls, accessed on February 7, 2005.

U.S. Department of the Interior, "Quality of Water, Colorado River Basin, Progress Report No. 21," January, 2003.

U.S. Energy Information Administration, "Annual Energy Outlook 2007 with Projections to 2030," February, 2007, www.eia.doe.gov/oiaf/aeo/index.html, accessed on July 16, 2007.

U.S. Water Resources Council, "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies," March 10, 1983.

University of New Mexico, Anderson School of Management, "Economic Impact and Opportunities Created by the Navajo-Gallup Water Supply Project (NGWSP) and Settlement Agreement," prepared by Craig White, Dante DiGregorio, Douglas Thomas and Steven Walsh, August, 2006.

Victoria Transportation Policy Institute, "Transportation Cost and Benefit Analysis," updated June, 2003, www.vtpi.org/tca/ , accessed 11/8/04.

Weber, Jack A., "Forecasting Demand and Measuring Price Elasticity," Journal AWWA, Vol. 81, May, 1989.

Whittington, Dale, Xinming Mu and Robert Roche, "The Value of Time Spent on Collecting Water: Some Estimates for Ukunda, Kenya," World Bank Infrastructure and Urban Development Department Report UNU 46, May, 1989.

World Bank, "Nepal, Rural Water Supply and Sanitation Project," Staff Appraisal Report, Report No. 15232-NEP, July 8, 1996.

Yeh, Chia-Yu, and Brent L. Sohngen, "Estimating Dynamic Recreational Demand by the Hedonic Travel Cost Method," presented at the American Agricultural Economics Association Annual Meetings, August, 2004.

Young, Robert A., "Price Elasticity of Demand for Municipal Water: A Case Study of Tucson, Arizona," Water Resources Research, Vol. 9, No. 4, August, 1973.

APPENDIX A
DATA USED TO ESTIMATE WATER DEMAND FUNCTION

City	State	GPCD	1999 HH Inc	HH size	Cost/ 1000 gal.	ln GPCD	ln HH Inc	ln HH size	ln Cost
Camp Verde	AZ	80	$31,868	2.57	$6.88	4.382	10.369	0.944	1.929
Flagstaff	AZ	122	$37,146	2.59	$3.07	4.804	10.523	0.952	1.122
Page	AZ	141	$46,935	3.26	$2.01	4.950	10.757	1.182	0.700
Payson, AZ	AZ	95	$33,638	2.25	$4.20	4.554	10.423	0.811	1.434
Prescott Valley	AZ	99	$34,341	2.53	$3.36	4.591	10.444	0.928	1.212
Show Low	AZ	126	$32,356	2.85	$6.35	4.836	10.385	1.047	1.848
Brighton	CO	137	$46,779	2.81	$3.09	4.918	10.753	1.033	1.127
Broomfield	CO	142	$63,903	2.82	$2.62	4.955	11.065	1.037	0.965
Brush	CO	282	$31,333	2.48	$2.59	5.641	10.352	0.908	0.950
Canon City	CO	347	$31,736	2.26	$1.97	5.850	10.365	0.815	0.677
Delta	CO	161	$27,415	2.27	$2.65	5.084	10.219	0.820	0.974
Durango	CO	225	$34,892	2.37	$1.51	5.416	10.460	0.863	0.414
Englewood	CO	192	$38,943	2.18	$1.69	5.257	10.570	0.779	0.523
Estes Park	CO	221	$43,262	2.27	$2.73	5.397	10.675	0.820	1.004
Federal Heights	CO	109	$33,750	2.72	$2.71	4.690	10.427	1.001	0.996
Fort Morgan	CO	313	$33,128	2.54	$1.52	5.746	10.408	0.932	0.417
Golden	CO	198	$49,115	2.22	$2.65	5.289	10.802	0.798	0.973
Grand Junction	CO	136	$33,152	2.15	$2.34	4.915	10.409	0.765	0.850
Gunnison	CO	167	$25,768	2.21	$1.40	5.119	10.157	0.793	0.334
La Junta	CO	289	$29,002	2.56	$0.87	5.668	10.275	0.940	-0.137
Lamar	CO	193	$28,660	2.58	$1.34	5.264	10.263	0.948	0.293
Louisville	CO	198	$69,945	2.65	$2.31	5.287	11.155	0.975	0.836
Montrose	CO	173	$33,750	2.29	$2.47	5.152	10.427	0.829	0.906
Northglenn	CO	123	$48,276	2.78	$2.52	4.813	10.785	1.022	0.924
Sterling	CO	207	$27,337	2.33	$1.10	5.335	10.216	0.846	0.097
Alamagordo	NM	185	$30,928	2.57	$1.63	5.220	10.339	0.944	0.488
Aztec	NM	98	$33,110	2.69	$2.76	4.583	10.408	0.990	1.014
Belen	NM	275	$26,754	2.79	$1.63	5.617	10.194	1.026	0.489
Bernalillo	NM	151	$30,864	3.06	$2.37	5.019	10.337	1.118	0.863
Carlsbad	NM	296	$30,658	2.51	$1.55	5.690	10.331	0.920	0.441
Clovis	NM	156	$28,878	2.57	$2.52	5.050	10.271	0.944	0.924
Deming	NM	195	$20,081	2.65	$0.55	5.273	9.908	0.975	-0.597
Farmington	NM	214	$37,663	2.81	$2.14	5.366	10.536	1.033	0.762
Gallup	NM	172	$34,868	2.85	$2.48	5.147	10.459	1.047	0.909
Hobbs	NM	72	$28,100	2.87	$1.43	4.272	10.244	1.054	0.357
Las Cruces	NM	135	$30,375	2.83	$1.71	4.904	10.321	1.040	0.537
Los Alamos	NM	197	$71,536	2.31	$4.22	5.283	11.178	0.837	1.439
Portales	NM	250	$24,658	2.51	$1.40	5.521	10.113	0.920	0.335
Rio Rancho	NM	184	$47,169	2.70	$2.42	5.215	10.761	0.993	0.883
Santa Fe	NM	166	$40,392	2.20	$3.91	5.112	10.606	0.788	1.364
Socorro	NM	110	$20,728	2.58	$3.42	4.700	9.939	0.948	1.230
Tucumcari	NM	123	$22,560	2.40	$2.65	4.808	10.024	0.875	0.976
Boulder City	NV	251	$50,523	2.41	$1.41	5.525	10.830	0.880	0.346
Elko	NV	700	$48,608	2.62	$0.30	6.551	10.792	0.963	-1.207
Fallon	NV	240	$35,935	2.40	$0.63	5.481	10.489	0.875	-0.468
Mesquite	NV	152	$40,392	3.16	$1.88	5.024	10.606	1.151	0.631
Alpine	UT	134	$72,880	4.51	$1.60	4.901	11.197	1.506	0.473
American Fork	UT	186	$51,955	3.74	$1.00	5.228	10.858	1.319	0.002

Brigham City	UT	203	$42,335	3.18	$0.91	5.315	10.653	1.157	-0.090
Centerville	UT	101	$64,818	3.83	$1.76	4.618	11.079	1.343	0.565
Clinton	UT	97	$53,909	3.91	$1.22	4.571	10.895	1.364	0.195
Grantsville	UT	167	$45,614	3.20	$1.83	5.115	10.728	1.163	0.605
Heber	UT	183	$45,394	2.96	$1.08	5.208	10.723	1.085	0.073
Holliday	UT	278	$66,468	2.91	$1.22	5.628	11.104	1.068	0.199
Midvale	UT	388	$40,130	2.56	$0.57	5.962	10.600	0.940	-0.562
Murray	UT	263	$45,569	2.66	$1.05	5.571	10.727	0.978	0.051
North Logan	UT	120	$49,154	3.90	$1.94	4.787	10.803	1.361	0.661
North Salt Lake	UT	219	$47,052	3.14	$1.23	5.391	10.759	1.144	0.209
Park City	UT	224	$65,800	2.50	$1.39	5.413	11.094	0.916	0.331
Pleasant Grove	UT	18	$52,036	3.83	$9.14	2.891	10.860	1.343	2.213
Price	UT	131	$31,687	2.85	$2.93	4.874	10.364	1.047	1.073
Riverdale	UT	326	$44,375	2.78	$0.36	5.788	10.700	1.022	-1.021
Riverton	UT	183	$63,980	4.14	$1.19	5.211	11.066	1.421	0.177
South Jordan	UT	216	$75,433	4.39	$1.31	5.376	11.231	1.479	0.270
Spanish Fork	UT	156	$48,705	3.39	$1.29	5.052	10.794	1.221	0.257
Springville	UT	223	$46,472	3.28	$0.96	5.408	10.747	1.188	-0.038
Sunset	UT	176	$41,726	2.95	$1.02	5.168	10.639	1.082	0.021
Tremonton	UT	196	$44,784	3.12	$1.24	5.276	10.710	1.138	0.214
Washington	UT	201	$35,341	3.29	$0.83	5.301	10.473	1.191	-0.182
Cody	WY	74	$34,450	2.38	$5.41	4.309	10.447	0.867	1.688
Douglas	WY	247	$36,944	2.66	$2.10	5.511	10.517	0.978	0.740
Evanston	WY	234	$42,019	2.99	$1.69	5.456	10.646	1.095	0.522
Lander	WY	121	$32,397	2.48	$3.06	4.798	10.386	0.908	1.117
Powell	WY	131	$27,364	2.41	$4.07	4.877	10.217	0.880	1.405
Rawlins	WY	419	$36,600	2.60	$0.34	6.037	10.508	0.956	-1.092
Riverton	WY	190	$31,531	2.58	$2.24	5.249	10.359	0.948	0.806
Rock Springs	WY	92	$42,584	2.66	$11.24	4.523	10.659	0.978	2.419
Sheridan	WY	177	$31,420	2.31	$1.94	5.175	10.355	0.837	0.664
Worland	WY	95	$31,447	2.63	$2.53	4.556	10.356	0.967	0.926

Sources:

Black & Veatch, “Arizona Water/Wastewater Rate Survey, 2000,” 2000.

Colorado Municipal League, “Water and Wastewate Utility Charges and Practices in Colorado,” 1997.

Dornbusch Associates, telephone interviews.

Utah Department of Environmental Quality, Division of Drinking Water, “1999 Survey of Community Drinking Water Systems,” 2000.

Wyoming Water Development Commission, “1998 Water System Survey Report,” 1998.

APPENDIX B - SUMMARY OUTPUT FROM REGRESSION

Regression Statistics	
Multiple R	0.8028
R Square	0.6445
Adjusted R Square	0.6303
Standard Error	0.2961
Observations	79

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	11.9214	3.9738	45.3229	0.0000
Residual	75	6.5758	0.0877		
Total	78	18.4972			

	Coefficients	*andard Err*	*t Stat*	*P-value*
Intercept	2.9126	1.2897	2.2583	0.0268
Household Income	0.3716	0.1325	2.8051	0.0064
Household Size	-1.3483	0.2374	-5.6802	0.0000
Cost of Water	-0.5538	0.0509	-10.8778	0.0000

APPENDIX D

Part III
Financial and Repayment Analysis

FINANCIAL AND REPAYMENT ANALYSIS
NAVAJO – GALLUP WATER SUPPLY PROJECT

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October 2, 2007

TABLE OF CONTENTS

I. Executive Summary

This report is one of a series of reports concerning economic issues pertaining to the Navajo Gallup Water Supply Project. While another report addresses the *economic* benefits and costs of the Project, this report deals with the Project's *financial* or cash costs. Specifically, the report discusses the capital costs, operation, maintenance and replacement costs, cost of water, and non-Project cash costs that each participant must pay to deliver water to their users. The costs are averaged over the projected water deliveries during the life of the Project to determine a levelized cost, or the constant cost (in 2007$) per thousand gallons that would repay all Project costs if charged on all Project deliveries. Table EX-1 shows this levelized cost for all participants.

Table EX-1
NAVAJO-GALLUP WATER SUPPLY PROJECT
SUMMARY OF LEVELIZED COST / THOUSAND GALLONS
Federal Financing at 4.875%, NTUA Rates for Energy, 2007$

	Navajo	Gallup	Jicarilla	Project Total
Total Levelized Cost	**$7.12**	**$9.32**	**$9.35**	**$7.57**

Several federal programs are available to assist in financing rural and small community water projects. The Department of Agriculture and Environmental Projection Agency both have programs that distribute annual appropriations to qualifying projects. Unfortunately, neither program appears to be a good fit for the Navajo Gallup Water Supply Project.

Although the Bureau of Reclamation has no program to distribute annual appropriations to projects it is designated by Congress to assist in planning, constructing and funding water projects that are specifically approved by legislation. We conducted a review of the capital costs of other projects that have either been approved by Congress or are in the planning stages. The Navajo Gallup Water Supply Project capital costs per person served and per acre-foot delivered are both at the lower end of the range represented by these other projects. When the available information on annual operation and maintenance costs are included, Navajo-Gallup Water Supply Project is still within the range of other western U.S. projects, but at the upper end.

Some agency funding programs assess the affordability of community Project costs, and often the programs will provide more assistance if the costs exceed some threshold of affordability. The most common measure of affordability is cost as a percent of median household income, and by that measure the operation, maintenance and water costs for all three Project participants would fall below the EPA threshold, but exceed that threshold once all Project capital costs are added.

II. Introduction

This report focuses on the ***financial*** costs of the Navajo Gallup Water Supply Project and how those costs might be paid. The report is a companion to three other reports that address different economic aspects of the Project: (1) "Navajo-Gallup Water Supply Project, Allocation of Capital and OM&R Costs Among Project Participants, San Juan River – PNM Alternative," (2) "Economic Benefit/Cost Analysis, Navajo-Gallup Water Supply Project," and (3) "Navajo-Gallup Water Supply Project, Socioeconomic Impacts."

The financial analysis estimates the cash cost of the Project and determines what the overall cost per thousand gallons would be for Project participants, under different financing scenarios. The financing alternatives considered include various assumptions about the degree to which the Project may be subsidized by the federal government.

III. Financial Analysis of Project Costs

A. Financial costs

In this report the term "financial analysis" refers to the compilation of Project cash costs assigned to the Project participants. The financial analysis differs from the economic analysis in the "Economic Benefit/Cost Analysis" report in two important respects. First, the financial analysis focuses on cash flow, excluding non-cash costs such as the opportunity cost of Project water used by the Navajo Nation and Jicarilla Apache Nation, and including cash costs that do not represent a use of economic resources, such as the projected Project-associated tax expenditures. Second, the financial analysis focuses on the projected costs incurred by the Project participants, excluding costs that may be borne by non-participants, such as the loss of downstream power generation capability. Please refer to Chapter B of the "Economic Benefit/Cost Analysis" report [Merchant, 2007b] for a more complete discussion of the differences between the financial and economic analysis frameworks.

B. Project financial costs

1. Capital costs

The Project's financial costs include both costs for (1) the main system of pipelines, treatment plants and storage tanks, and (2) the facilities build in and around Gallup to distribute Project water. The total cost for these facilities is expected to be $865 million (2007$). In addition, because most of the capital investment will be incurred before Project completion, interest during construction will add an additional $404 million (2007$) for which Project participants will also be responsible, assuming full repayment of Project costs. These costs include all construction, right-of-way acquisition, environmental mitigation, cultural resource investigations and taxes [Merchant, 2007a].

The estimated Project construction and interest costs are translated to a constant annual amount by amortizing those costs over the anticipated life of the Project using the current federal discount rate for water projects of 4.875% per year. Then the annual amortized amount is divided by the annual equivalent amount of water deliveries to determine the levelized rate per thousand gallons needed to repay those costs. In this report the term "levelized cost" refers to a constant rate per thousand gallons (in 2007$), which if applied to all water delivered would repay the capital, interest, OM&R, water and other utility costs over the life of the Project.[1] This rate is calculated by discounting the costs to be paid and all water to be delivered by the same discount rate (4.875% in this report), and dividing the first by the second. Table 1 shows how the levelized rate to repay capital costs is calculated.

Table 1
NAVAJO-GALLUP WATER SUPPLY PROJECT
LEVELIZED CAPITAL COST / THOUSAND GALLONS
50 year Project Life, Federal Financing at 4.875%, 2007$

	Navajo	Gallup	Jicarilla	Project Total
Present Value of Capital Costs	$995,000,000	$227,000,000	$47,000,000	$1,269,000,000
Annual Amortization of Capital Costs	$53,453,671	$12,194,958	$2,524,947	$68,173,576
Annual Equivalent Water Deliveries (1,000 gal.)	9,889,759	2,443,890	560,120	12,893,770
Levelized Cost/ Thousand Gallons	$5.40	$4.99	$4.51	$5.29

2. Operation, Maintenance and Replacement (OM&R) costs

Following its construction, the Project will incur both fixed and variable OM&R costs. The fixed costs include staff salaries, intake dredging, annual maintenance and equipment replacement. Variable costs include energy and chemical costs. The distinction is important because while the fixed costs are assumed constant (in 2007$) over time, the variable costs will increase in conjunction with increases in water use. We calculate the total present value of the Project's OM&R costs to be $365 million (2007$), using a 4.875% discount rate and energy rates provided by the Navajo Tribal Utility Authority.

Table 2 shows how this OM&R cost is allocated among project participants and calculates the levelized rate needed to pay this cost.

[1] Levelized cost is calculated by dividing the present value of costs by the levelized annual water delivery. The levelized annual water delivery is that constant annual delivery of water that over the 50 year project life has the same present value as the anticipated actual water deliveries (which may change over time and in some cases begin before the 50 year project period).

Table 2
NAVAJO-GALLUP WATER SUPPLY PROJECT
LEVELIZED O,M&R COST / THOUSAND GALLONS
NTUA Rates for Energy, 50 year Project Life, 4.875%, 2007$

	Navajo	Gallup	Jicarilla	Project Total
Present Value of O,M&R Costs	$273,592,000	$68,018,000	$23,717,000	$365,327,000
Annual Amortization of O,M&R Costs	$14,697,987	$3,654,082	$1,274,131	$19,626,200
Annual Equivalent Water Deliveries (1,000 gal.)	9,889,759	2,443,890	560,120	12,893,770
Levelized Cost/ Thousand Gallons	$1.49	$1.50	$2.27	$1.52

3. Cost of water

Both the Navajo Nation and the Jicarilla Apache Nation presently have rights to water they intend to use in the Project. The terms of the Jicarilla Water Rights Settlement Act exempt the Jicarillas from paying any cash cost for water from Navajo Reservoir, the source for Project water. In the absence of a similar settlement the Navajo Nation will pay a levelized cost to the Bureau of Reclamation estimated to be $4.12 per acre-foot. The City of Gallup will have to pay for obtaining water from a water rights owner. The present value of a tentative purchase arrangement is $33 million (2007$). Table 3 shows how this cost translates to the levelized rate needed to cover the projected payments for water.

Table 3
NAVAJO-GALLUP WATER SUPPLY PROJECT
LEVELIZED WATER COST / THOUSAND GALLONS
50 year Project Life, Federal Financing at 4.875%, 2007$

	Navajo	Gallup	Jicarilla	Project Total
Present Value of Water Costs	$3,300,617	$32,605,398	$0	$35,906,016
Annual Amortization of Water Costs	$177,317	$1,751,636	$0	$1,928,953
Annual Equivalent Water Deliveries (1,000 gal.)	9,889,759	2,443,890	560,120	12,893,770
Levelized Cost/ Thousand Gallons	$0.02	$0.72	$0.00	$0.15

4. Continuing utility costs

The Navajo Nation, the City of Gallup and the Jicarilla Apache Nation will all incur costs separate from the Project to build distribution systems and/or operate their water systems. These costs will presumably be paid by the customers of each utility, and the costs are therefore appropriate to include in future rate calculations. The Navajo costs include the amortized cost of constructing distribution lines to deliver the Project water to various Navajo Chapters. Gallup costs are those costs to operate the City system that will continue even after the Project is constructed. These Gallup costs do not include the cost of operating wells that will be shut down when the Project begins delivering water. The Jicarilla costs included here are those needed to construct and operate a distribution system serving the commercial and residential (not industrial) users of their water allocation. Table 4 summarized these other costs and calculates the levelized rate needed to pay them.

Table 4
NAVAJO-GALLUP WATER SUPPLY PROJECT
LEVELIZED OTHER COST / THOUSAND GALLONS
50 year Project Life, Federal Financing at 4.875%, 2007$

	Navajo	Gallup	Jicarilla	Project Total
Annual Amount of Other Costs - Capital	$2,041,000		$269,000	$2,310,000
Annual Amount of Other Costs - O&M		$5,183,284	$150,000	$5,333,284
Annual Equivalent Water Deliveries (1,000 gal.)	9,889,759	2,443,890	162,926	12,496,575
Levelized Cost/ TG - Capital	$0.21		$1.65	$0.18
Levelized Cost/ TG - O&M		$2.12	$0.92	$0.43

Note: Jicarilla other costs are for commercial and residential users only

5. Summary of levelized rate

Table 5 summarizes the various cost components for each participant and for the Project as a whole, and shows the levelized rate per thousand gallons needed to pay all the financial costs.

Table 5 NAVAJO-GALLUP WATER SUPPLY PROJECT SUMMARY OF LEVELIZED COST / THOUSAND GALLONS 50 year Project life, Federal Financing at 4.875% and NTUA Rates for Energy, 2007$				
	Navajo	**Gallup**	**Jicarilla**	**Project Total**
Capital Cost	$5.40	$4.99	$4.51	$5.29
OM&R Cost	$1.49	$1.50	$2.27	$1.52
Water Cost	$0.02	$0.72	$0.00	$0.15
Other Cost - Capital	$0.21	$0.00	$1.65	$0.18
Other Cost - O&M	$0.00	$2.12	$0.92	$0.43
Total Cost	**$7.12**	**$9.32**	**$9.35**	**$7.57**

IV. Federal and State Programs Available to Assist in Project Financing

Many water projects in the rural West have been funded through government programs, both federal and state. The eligibility criteria for Indian tribes generally differ from those for non-Indian projects, so the two cases will be discussed separately.

A. Non-Tribal Water Supply Projects

The United States Department of Agriculture (USDA), Environmental Protection Agency (EPA), and Bureau of Reclamation (BOR) are the primary federal agencies responsible for funding water supply projects in small towns and rural areas. While the BOR builds or supervises construction of water projects at the direction of Congress, USDA and EPA have programs that fund water project construction in communities that meet program criteria.

The USDA's Rural Utility Service (RUS) provides rural communities with loans and grants for water project construction. The RUS distributes funds in direct loans, guaranteed loans, and grants through the Water and Waste Disposal for Rural Communities program. Total program funding declined from the $2.1 billion in FY 2002 to about $1.5 billion in FY 2003, 2004 and 2005 [USDA, 2005]. Fiscal year 2007 funds are about $1.3 billion USDA, 2007]. These funds are allocated to each state using a formula that takes into account each state's share of national rural population, national rural population with incomes below the poverty level, and national nonmetropolitan unemployment [USDA, 1999]. In FY 2007 New Mexico was allocated $1,095,000 in funds for guaranteed loans, $13,440,000 in funds for direct loans and $4,550,000 in funds for grants [USDA, 2007]. USDA criteria for participation include economic feasibility, population limits, and need. Except in the case of grants awarded to low-income[2] communities, all USDA funds must be repaid [USDA, 1999, Section 1780.10(b)(2)].

The EPA's Drinking Water State Revolving Fund (DWSRF) provides states with capitalization grant funds for loans. These funds are loaned by states to public and non-profit water systems within their respective states. The DWSRF funding for FY 2006 was $823 million and is

[2] Grant funds cannot be used to pay any costs of a project when the median household income exceeds the non-metropolitan median household income of the State.

expected to be $827 million in FY 2007 [U.S. EPA, 2007a and 2007b]. New Mexico's share was $8,229,300 in FY 2006 and is tentatively $8,268,800 in FY 2007 [U.S. EPA, 2007a and 2007b]. New Mexico adds 20% of the federal contributions as matching funds, so the total available funding is slightly in excess of $10 million annually. Each state develops its own criteria for participation in the DWSRF program. The criteria for New Mexico are based on public health risk, environmental factors, affordability and capacity development factors [New Mexico Finance Authority, "Fund"]. With the exception of grants awarded based on need, all DWSRF funds must be repaid. Interest rates are applied in three tiers: (1) communities not qualifying as "disadvantaged"[3] pay 3% annual interest; (2) communities with median household income (MHI) less than 90% of State MHI and with an affordability ratio between 1.0% and 1.5% pay 0% interest, and (3) communities with MHI less than 90% of State MHI and an affordability ratio greater than 1.5% receive assistance in planning, design and engineering services, extension of loan repayment period, or forgiveness of principal sufficient to bring their affordability ratio down to 1.5%. New Mexico treats 1.5% as the maximum affordability ratio that a disadvantage community should bear [New Mexico Finance Authority, "Program"].

The BOR does not presently have a program for funding water projects. On the other hand, BOR is often delegated authority by Congress to construct or oversee projects, and the Rural Water Supply Act of 2006 authorizes $15 million per year for a program for BOR to assist rural communities in planning (but not constructing) water supply projects [U.S. Congress, 2006]. The Act requires the Secretary of the Interior to publish in the Federal Register criteria for determining eligibility of rural communities for assistance under the program [Ibid., section 103(c)], although the Secretary has not yet established any formal eligibility criteria. However, the Act does not amend Section 9 of the 1939 Reclamation Project Act requiring that projects authorized or built pursuant to Federal reclamation laws repay at least their annual operation and maintenance cost [U.S.Congress, 1939]. The Act allows up to 75% federal cost sharing of construction costs. This Act, however, does not establish any separate funding mechanism for water projects [U.S. Congress, 2006, section 106(e)(1)(A)(i)(II)(aa)]. – any recommended projects would still need Congressional authorization and appropriations.

The Non-Tribal assistance criteria for the USDA, EPA, and BOR are summarized in Table 7. The Table shows that the Navajo Gallup Water Supply Pipeline is not a good fit for any of the programs. The USDA's RUS program requires that a project serve only communities of fewer than 10,000 people, while Gallup alone has a population approximately double this size. BOR does not have an ongoing program to fund water projects, so Project participants would have to secure Congressional authorization to obtain BOR sponsorship – they cannot apply directly to the BOR. Most significantly, both the RUS program and the EPA's DWSRF program are inadequate in scale to use as principal funding sources for the Project. The Project's initial capital cost of $865 million far exceeds the recent program funds that have been made available for water projects in New Mexico.

[3] "Disadvantaged" is defined as having median household income less than 90% of the State average and having an affordability ratio of at least 1.0%, where the affordability ratio is calculated as the ratio of the cost of water service to the median household income.

Table 7

Federal Assistance Funding Criteria For Non-Tribal Water Supply Projects

Agency	**USDA**	**EPA**	**BOR**
Population	Population of town cannot exceed 10,000	At least 15% of state fund must be used yearly for projects serving no more than 10,000	Population of community or Indian tribe not more than 50,000
Project Type	Construction, enlargement, extension or improvement of water supplies	Drinking water infrastructure project that bring existing water systems in compliance with the Safe Drinking Water Act or address public health problems	Planning, evaluation and construction oversight of rural water supply projects
Applicant Type	Public entity; not-for-profit organization, or Indian tribe	Community water systems and publicly or privately owned or nonprofit community water systems	State, regional or local authority, including Indian tribes and public districts
Applicant Eligibility	Applicant must have legal authority and responsibility to undertake the project, operate and maintain the proposed facility, and meet the financial terms of the project.	Applicant must be able to repay the loan.	Eligibility criteria yet to be adopted
Cost Sharing Criteria	Project must be economically feasible with regard to repayment, 75% maximum federal cost share.	100% repayment with interest, although States can allow subsidized interest and/or principal forgiveness to disadvantaged communities.	Project must be economically feasible with regard to repayment, 75% maximum federal cost share, based on capability to pay. Locals must pay 100% OM&R.
Growth Considerations	Designed to meet the needs of present or projected population	Project cannot be intended primarily for growth, but may meet needs for reasonable growth over its life.	Project can address future water supply needs
State Requirements		States must prioritize projects on basis of health risk, clean water standards, and need.	
Recent annual funding in N.M	$12 million	$10 million (including State contribution)	NA
Service Area	National	National	17 Western States

Sources: General Accounting Office. Federal Assistance Criteria Related to the Fort Peck Reservation Rural Water Project, June 1998; U.S. Congress, 2006.

B. Tribal Water Supply Projects

USDA does not have special criteria for tribal water projects.

EPA and BOR criteria for funding tribal water supply projects differ significantly from criteria for non-tribal water supply projects. Whereas both the EPA and the BOR historically have expected full repayment for non-tribal projects, tribal projects are not expected to repay funds. The primary EPA program for funding tribal water supply projects is the DWSRF Tribal Set Aside. The BOR presently does not have a formal policy regarding funding or cost share. However, as with non-tribal projects, there has been an informal funding policy, which in the case of tribal water projects has been full federal funding. Legislation pending in the current Congress would allow the Secretary of the Interior to consider deferring all tribal construction costs if warranted based on an assessment of tribal capability to repay costs [109 S. 895].

Tribal assistance criteria for the USDA, EPA, and BOR are summarized in the Table 8, below. While both the Navajo Nation and Jicarilla Apache Nation would apparently qualify for both EPA and BOR funding, the EPA funds are inadequate to contribute substantially to the Navajo Gallup Project, and BOR funding is obtained only through specific Congressional authorization, as discussed in the next section.

Table 8

Federal Assistance Funding Criteria For Tribal Water Supply Projects

Agency	USDA	EPA	BOR
Special Tribal Criteria	None	1.5% Tribal set-aside	Repayment of construction costs may be deferred.
Project Type	Construction, enlargement, extension or improvement of water supplies	Drinking water infrastructure project that bring existing water systems in compliance with the Safe Drinking Water Act or address public health problems	Planning, evaluation and construction oversight of rural water supply projects
Applicant Type	Indian tribes are eligible	Indian tribes are eligible	Indian tribes are eligible
Applicant Eligibility	Applicant must have legal authority and responsibility to undertake the project, operate and maintain the proposed facility, and meet the financial terms of the project.	Applicant must be able to repay the loan.	Eligibility criteria yet to be adopted
Cost Sharing Criteria	Project must be economically feasible with regard to repayment, 75% maximum federal cost share.	100% federal funding	Up to 75% federal funding

Table 9 - Western Municipal Water Projects Funded by Congressional Authorization

	General		Demographics		Capital Cost (2007$)					OM&R Cost		Bill or Statute (a)	
Project	**State**	**Water Delivered (afy)**	**Pop Served**	**% Indian**	**per pers. served**	**per af**	**total (million $)**	**cost share split fed/non-fed**	**Interest During Construction**	**OM&R Cost share fed/non-fed**	**Preference Power authorized**	**introduced**	**enacted**
Lewis and Clark Rural Water System (b)	SD, MN, IA	25,763	200,000	0%	$2,279	$17,695	$456	80/20, with the exception of Sioux Falls, Sioux Falls - 50/50 split of incremental cost		0/100			PL106-246
Mid Dakota (c)	SD	4,481	32,000	4%	$5,321	$38,005	$170	$100 million federal funding of $147 million project, up to 85% grant	forgiven		yes		PL102-575 Title XIX
Mni Wiconi (d)	SD	14,563	50,000	75%	$9,286	$31,881	$464	non tribal - 80/20 tribal - 100			yes		PL103-434
Rocky Boy North Central Montana Water System (e)	MO	8,000	31,000	10%	$9,606	$37,222	$298	non tribal - 80/20 tribal - 100		all (core) 100/0 non-tribal 0/100 (non-core)	yes		PL106-163 PL107-331
WEB Rural Water Development Project (f)	SD	4,604	14,763	0%	$12,994	$41,670	$192	80/20					PL100-490
Animas La Plata (g)	CO, NM	57,100	70,190	2%	$8,015	$9,853	$563	non-tribal - 0/100 tribal - 100 feds pay 100% of design and env.		all 0/100			PL106-554
Southwest Pipeline Project (h)	ND	3,109	35,000	0%	$5,697	$64,129	$199	75/25				99 HR 1116 106 S 623	
Perkins County (i)	SD	460	2,500	0%	$12,933	$70,230	$32	75/25			yes		PL106-136
Fort Peck Reservation Rural Water System (j)	MO	6,000	28,000	36%	$8,122	$37,900	$227	non-tribal 76/24 tribal - 100		non-tribal 0/100 tribal 100/0	yes.		PL104-300 PL106-382
Fall River Water Users District Rural Water System (k)	SD	118	660	0%	$8,076	$45,061	$5	70/30			yes.		PL105-352
Jicarilla Apache Reservation Rural Water System (l)	NM			100%			$48 mil. (federal)	specific items allocated to feds and tribe					PL107-331

Notes:

(c) There is no Indian component in authorization, but Crow Creek reservation is inside service boundaries,
Maximum federal funding for project is a dollar amount ceiling, not a percentage. Maximum grant for federal share is 15%.

(f) WEB Water was unable to provide Population Served. Population Served calculated using number of hook-ups provided by WEB Water and number of persons per household provided by 1990 U.S. Census

(g) Population served has not been formally determined. Population numbers are estimated based on population of prospective service area and USBR informal estimates.
Tribal Population is based on number of Ute Indians.

Source:

(a) www.thomas.gov
(b) Pam Bonrud, Lewis and Clark Rural Water System
(c) Tribal Population from Department. Of Commerce, Economic Development Administration, all other information from Kurt Pheifle, Mid Dakota Rural Water District
(d) Mike Curly, Lyman Jones Rural Water System
(e) Tribal Population from Chippewa Creek Tribal Council, all other information from Anne-Marie Robinson, Bear Paw Development
(f) Laurie Swallow, WEB Water
(g) Pat Shumacher, USBR; Rege Leach, USBR
(h) Pinkie Evanscurry, Southwest Pipeline
(i) Dave Ryan, State of South Dakota Department of Environment and Natural Resources
(j) Clint Jacobs, Dry Prairie Rural Water Authority
(k) PL105-352
(l) PL107-331

Capital cost and population served updated from Federal Reserve Bank of Minneapolis, "Fedgazette," Sept., 2005, www.minneapolisfed.org/pub/fedgaz/05-09/table.cfm.
Capital cost indexed to Jan., 2007$ using Bureau of Reclamation Composite Construction Cost Index

Table 10 - Proposed Western Municipal Water Projects

	General		Demographics		Capital Cost (2007$)					OM&R Cost		Bill or Statute (a)	
Title	**State**	**Water Delivered (afy)**	**Pop Served**	**% Indian**	**per pers. served**	**per af**	**total (million $)**	**cost share split fed/non-fed**	**Interest During Construction**	**OM&R Cost share fed/non-fed**	**Preference Power authorized**	**introduced**	**enacted**
Lake Powell - St. George Pipeline (a)	UT	100,000	200,000	0%	$2,694	$5,389	$539						
Southern Delivery System (b)	CO	87,000	32,000	0%	$34,030	$12,517	$1,089						
Northern Integrated Supply Project ©	CO	35,700	50,000	0%	$8,519	$11,931	$426						
St. Mary Canal (d)	MT	2,509	14,000	NA	$9,238	$51,543	$129						
Southern Black Hills Water System (e)	SD	3,405	19,000	NA	$4,538	$25,320	$86						
South Central Regional Water System (f)	ND	2,420	13,500	NA	$5,908	$32,962	$80						
Fort Berthold Rural Water Supply System (g)	ND	3,307	9,866	100%	$13,039	$38,901	$129						
Eastern New Mexico Rural Water System (h)	NM	24,000	133,911	0%	$2,165	$12,080	$290	80/20		0/100		108 S. 2513	
Red River Valley Water Supply Project (i)	ND	NA	480,000 to 566,000	NA	$1,050 to $4,940	NA	$590 to $2,370					106 S. 623	PL106-541
Navajo Gallup Water Supply Project (j)	NM - AZ	37,600	209,794	80%	$4,123	$23,005	$865						

Notes:

(h) population served estimated from water deliveries based on 160 gpcd

(d)(e)(f) water use estimated from population based on 160 gpcd

Source:

(a) "Water Strategist," July/August, 2005

(b) Colorado Springs Utilities, "Southern Delivery System Fact Sheet," May, 2005.

(c) MWH Americas, Inc., "Northern Integrated Supply Project, Phase II Alternative Evaluation," Jan., 2004.

(d) Federal Reserve Bank of Minneapolis, "Fedgazette," Sept., 2005, www.minneapolisfed.org/pub/fedgaz/05-09/table.cfm.

(e) Federal Reserve Bank of Minneapolis, "Fedgazette," Sept., 2005, www.minneapolisfed.org/pub/fedgaz/05-09/table.cfm.

(f) Federal Reserve Bank of Minneapolis, "Fedgazette," Sept., 2005, www.minneapolisfed.org/pub/fedgaz/05-09/table.cfm.

(g) MSE-HKM, Inc., "Discussion of recent Large Scale Municipal, Rural and Industrial (MR&I) Water Projects," Dec. 8, 1999.

(h) 108 S. 2513

(i) Federal Reserve Bank of Minneapolis, "Fedgazette," Sept., 2005, www.minneapolisfed.org/pub/fedgaz/05-09/table.cfm.

(j) James P. Merchant, "Navajo-Gallup Water Supply Project, Allocation of Capital and O,M&R Costs Among Project Participants, San Juan River - PNM Alternative," Sept. 26, 2005.

Growth Considerations	Designed to meet the needs of present or projected population	Project cannot be intended primarily for growth, but may meet needs for reasonable growth over its life.	Project can address future water supply needs
Recent annual national funding	$16 million	$13 million	NA
Service Area	National	National	17 Western States

Sources: General Accounting Office. Federal Assistance Criteria Related to the Fort Peck Reservation Rural Water Project, June 1998; ; U.S. Congress, 2006..

C. Congressional Project Authorization

Projects that do not meet the criteria of established funding programs can seek Congressional authorization. Because the authorization is project-specific there are no formal guidelines on determining whether a project qualifies or the terms of funding once awarded. However, many of the recent Western rural water projects funded by Congress have some similar characteristics. Table 9 shows that the federal share of construction costs for non-Indian projects has typically ranged from 70 to 80 percent, while the federal share of construction costs for Indian projects has normally been 100 percent. While all non-Indian projects have been expected to pay 100 percent of OM&R costs, the Indian projects sometimes pay zero percent and sometimes pay 100 percent.

Table 10 shows how the Navajo-Gallup Water Supply Project compares to other water projects being proposed in the West. None of these projects has received Congressional approval for construction, so the terms of any approval are still pending. However, the table does show the relative size of the projects in terms of population served, water supply developed and cost. Figures 1 and 2 compare these proposed projects on a cost per person served and a cost per acre-foot of capacity basis.

Tables 9 and 10, and Figures 1 and 2, compare only the capital costs of various water projects. Operation and maintenance (O&M) costs are not readily available for most of these projects. Table 11 shows the total levelized cost per thousand gallons ($/TG) for some western projects for which O&M costs were available.

Table 11
Western Municipal Water Projects
Total Cost per Thousand Gallons (2007$)

Project	Capacity (afy)	Cost / TG
Albuquerque	97,000	$1.42
Lewis & Clark	25,760	$5.50
Navajo-Gallup Water Supply Project	37,550	$7.57
Rocky Boys/North Central Montana Regional Water System	8,802	$8.30
Santa Fe	8,730	$5.71

Sources: Stomp, Carpenter, HKM, Banner, Dornbusch Associates.

Figure 1
Western United States Water Projects
2007$ per Person Served

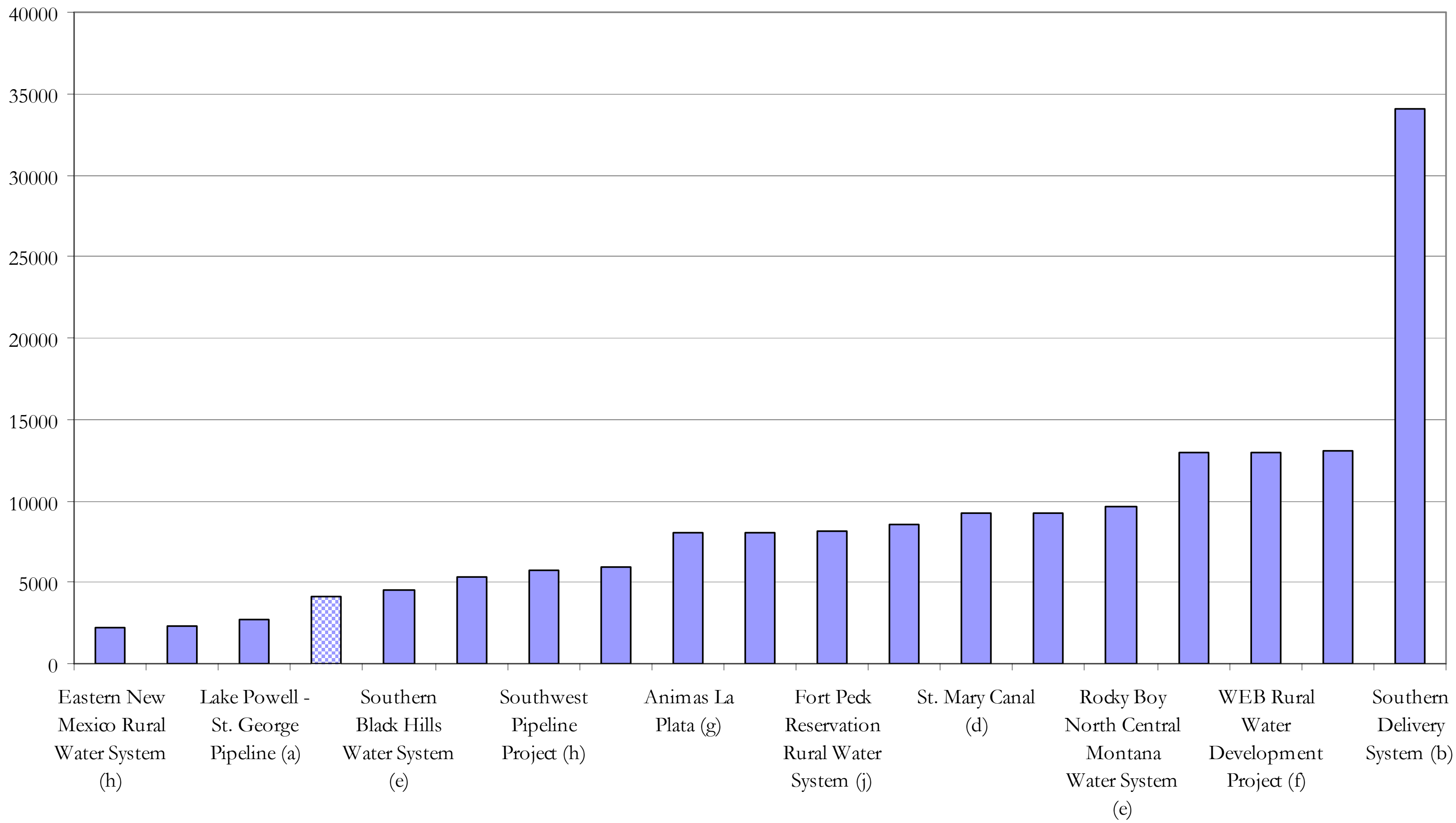
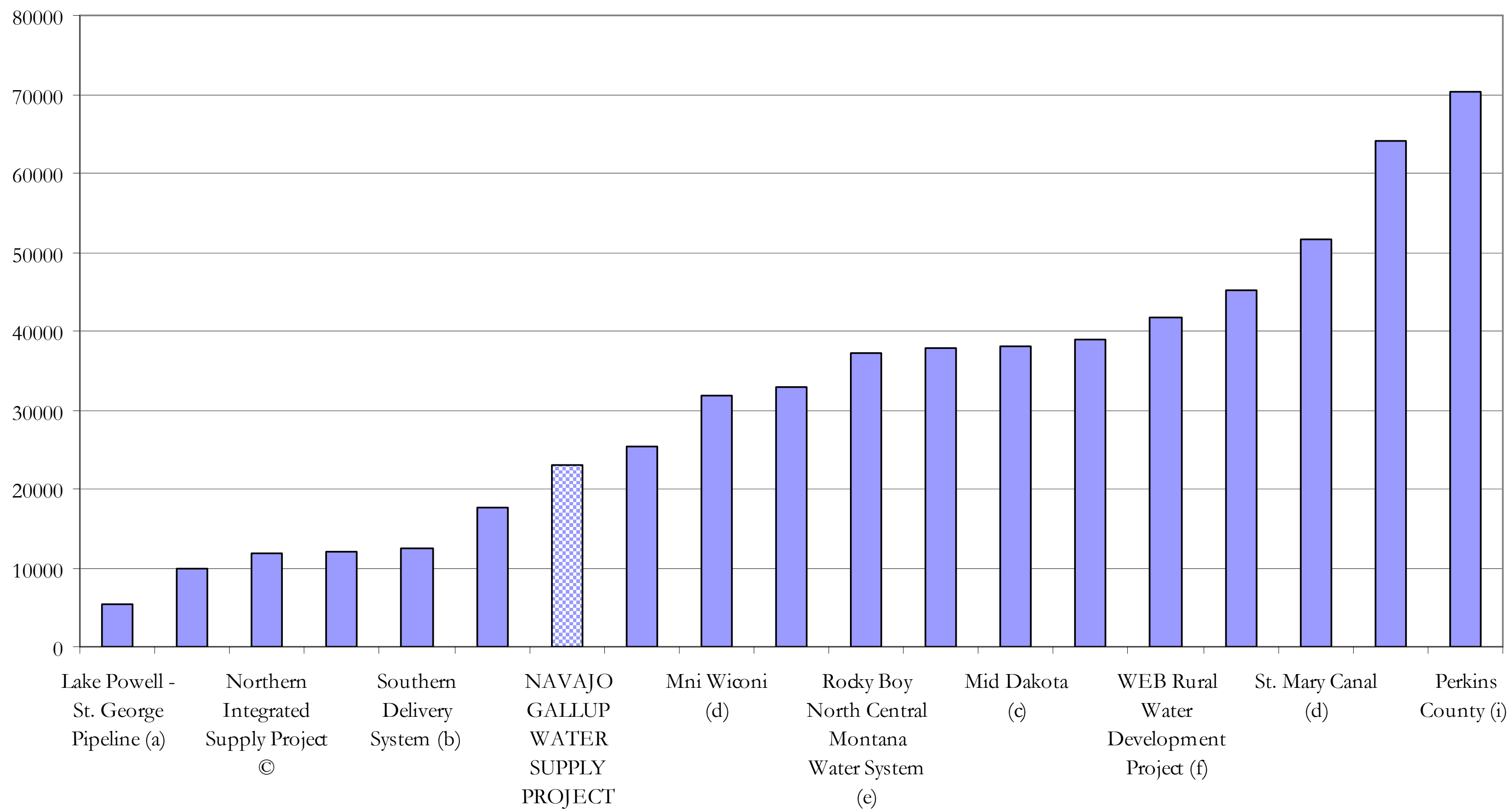


Figure 2
Western United States Water Projects
2007$ per Acre-Foot of Capacity



V. Ability to Pay

Some of the funding programs discussed above use "affordability ratios" [NMFA] or "capability to pay" measures [[U.S. Congress, 2007]. These concepts are commonly referred to as the ability of water users to pay for their water service, or in short, the "ability to pay" issue.

Ability to pay in a water supply context refers to the affordability of a water system. The Asian Development Bank, for example, explains "ability-to-pay" as "[t]he affordability or the ability of the users to pay for the water services, as expressed by the ratio of the monthly household water consumption expenditure to the monthly household income." [ADB, p. 362] This ability to pay concept is used by some programs as a threshold which once surpassed triggers additional assistance or as a limit on how much of project's costs a beneficiary should pay. Although it appears that the available funding programs are either inadequately funded or inappropriate for the Navajo Gallup Water Supply Project, it may be useful to review how the ability to pay is used by these programs and by other agencies. If the Project participants seek Congressional funding, for example, Congress may be interested in knowing the affordability of the Project costs.

The most common measure of ability to pay for water services is utility payments as a percent of median household income. [EPA, 1999(b), p. 93] EPA, for example, uses 2.5% of median household income (MHI) in determining whether water treatment options to comply with clean water standards are affordable and should be required. EPA selected 2.5% of median household income as an affordability threshold based on their analysis of consumer spending on discretionary goods (alcohol and tobacco = 1.5% of MHI), on other utilities (telephone = 1.9% of income, and energy and fuels = 3.3% of MHI), and on the cost of bottled water (about 2.1% of MHI). [EPA, 1998(b), p. 45]

Individual states are free to develop their own criteria for determining an affordability threshold in their drinking water programs. Some states use a ratio of water charges to MHI but set the affordability threshold at a lower level than the EPA's 2.5%. New York State, for example, sets their threshold at 1.0% to 1.5% depending on the level of income. Pennsylvania uses a sliding threshold of 1.0% to 2.0% of MHI depending on the socioeconomic condition of the community. The State of Washington uses an affordability range of 1.25% to 1.75%. [EPA, 1998(b), Appendix F] New Mexico designates 1.5% of MHI as the maximum amount that any disadvantaged community (MHI less than 90% of statewide average) should pay. [NM Finance Authority, "Program"]

The USDA Rural Utilities Service uses a different approach in determining the extent to which a project can qualify for federal funds under the Water and Waste Water Loan and Grant Program. Projects can qualify for 75% federal funding when the median household income is below the higher of the poverty line or 80% of the state nonmetropolitan median income, or 45% federal funding if the MHI is above 80% but below 100% of the statewide nonmetropolitan household income. [USDA, 1999]

The Rural Water Supply Act of 2006 directs the Secretary of Interior to determine the Federal share of construction costs based on an analysis of per capita income, median household income, poverty rate, ability to raise revenues, the strength of the balance sheet and the existing cost of water, all relative to regional averages. [U.S. Congress, 2006, Section 106(f)(2)] However, the Act does not specify any threshold for these measures.

The Asian Development Bank and the World Bank use a rule of thumb that water costs should not exceed 5% of household income. [See Churchill, p. 102; ADB, p. 58; IRC, p. 17 (3% to 5%)]. For example, in the China Rural Water Supply Project costs of 3.6% to 3.7% of household income are characterized as appearing to be "affordable." [World Bank, pp. 5-6] Similarly, in a Chilean water supply project subsidies are provided to limit the maximum household payments for water and sewer to 5% of monthly household income. [Kessides, p. 28]

The variety of MHI thresholds used to determine affordability, as well as the application of alternative approaches in defining affordability, highlight the fact that affordability is not an objective economic concept. Rather, affordability is a social or equity concept based on the premise that safe drinking water is a right that all citizens should enjoy, and that no one should have to pay more than some limited percentage of their income to obtain that water supply. This threshold percentage cannot be objectively determined but is based on a subjective judgment of fairness and equity. [See EPA, pp. 7 and 11; CBO, Appendix C; Churchill, p. 102; Bieder, p. 8]

Given this lack of an objective basis for determining affordability it may be useful to show the average percentage of MHI that the Project participants would pay for water. Table 12 shows the Project costs, by component, as a percent of MHI. These percentages are calculated by dividing the average monthly household costs for each component (from Table 6), by the MHI shown in Table 13.

Table 12
NAVAJO-GALLUP WATER SUPPLY PROJECT
TOTAL ANNUAL COST (FULL REPAYMENT) / MEDIAN HOUSEHOLD INCOME
50 year Project life, Federal Financing at 4.875% and NTUA Rates for Energy, 2007$

	Navajo	Gallup	Jicarilla
Project Capital Cost	4.5%	1.6%	2.7%
Project OM&R Cost	1.2%	0.5%	1.4%
Project Water Cost	0.0%	0.2%	0.0%
Other Facility Capital Cost	0.2%	0.0%	1.0%
Other Facility O&M Cost	0.0%	0.7%	0.6%
Total Cost	**6.0%**	**3.0%**	**5.6%**

Table 13 NAVAJO-GALLUP WATER SUPPLY PROJECT MEDIAN HOUSEHOLD INCOME			
	NAVAJO NATION	**CITY OF GALLUP**	**JICARILLA APACHE NATION**
1999 MEDIAN HOUSEHOLD INCOME (1999$)	**$20,005**	**$34,868**	**$26,750**
2007 MEDIAN HOUSEHOLD INCOME (2007$)	**$25,597**	**$44,261**	**$32,498**

Source: 1999 MHI from U.S. Census Bureau, "2000 Census of Population and Housing;" indexed to 2005$ with U.S. Bureau of Labor Statistics, "Consumer Price Index;" annual growth rates from U.S. Census Bureau, "1990 Census of Housing" and "2000 Census of Population and Housing;" Dornbusch Associates.

The affordability percentages for different Project cost components are shown in Figure 3. Figure 3 also compares these cost percentages to the EPA benchmark 2.5% of MHI. This benchmark is based on the EPA judgment of the affordable portion of household income used to pay for a water supply. Figure 3 shows that the O&M and water costs for all three Project participants are within the EPA threshold of 2.5%, but once full capital cost repayment is added the percentage income needed exceeds the EPA threshold for all three participants.

Other measures of Ability to Pay. Although water cost as a percent of median household income is a common way for programs to measure ability to pay, it is not the only way. Recent federal legislation, for example, requires the Secretary of the Interior to devise a measure of "capability to pay" by including factors such as per capita income, poverty rate, ability to raise tax revenues, strength of the community balance sheet and existing cost of water, in addition to median household income. While many of these additional measures should be highly correlated to median household income some may not be, and the resulting analysis could provide a more nuanced assessment of affordability, particularly in borderline cases.

Income Disparity. Regardless of how water costs compare to median household income in a community, by definition costs are a greater percentage of household income for one-half of the households and a lesser percentage of household income for the other one-half. This means that even if community-wide water costs are below some threshold of affordability, there may be many individual households within that community for which water costs exceed that threshold. This disparity can be addressed within a community by implementing a progressive rate structure such that a certain basic water supply is available at a relatively low rate and additional amounts of water are available at progressively higher rates. The *average* rate for water can remain the same, but low water users not only pay for less water but also a lower rate for that water, and higher water users not only pay for more water but also a higher rate. This type of price structure encourages water conservation while also addressing the income disparity issue.

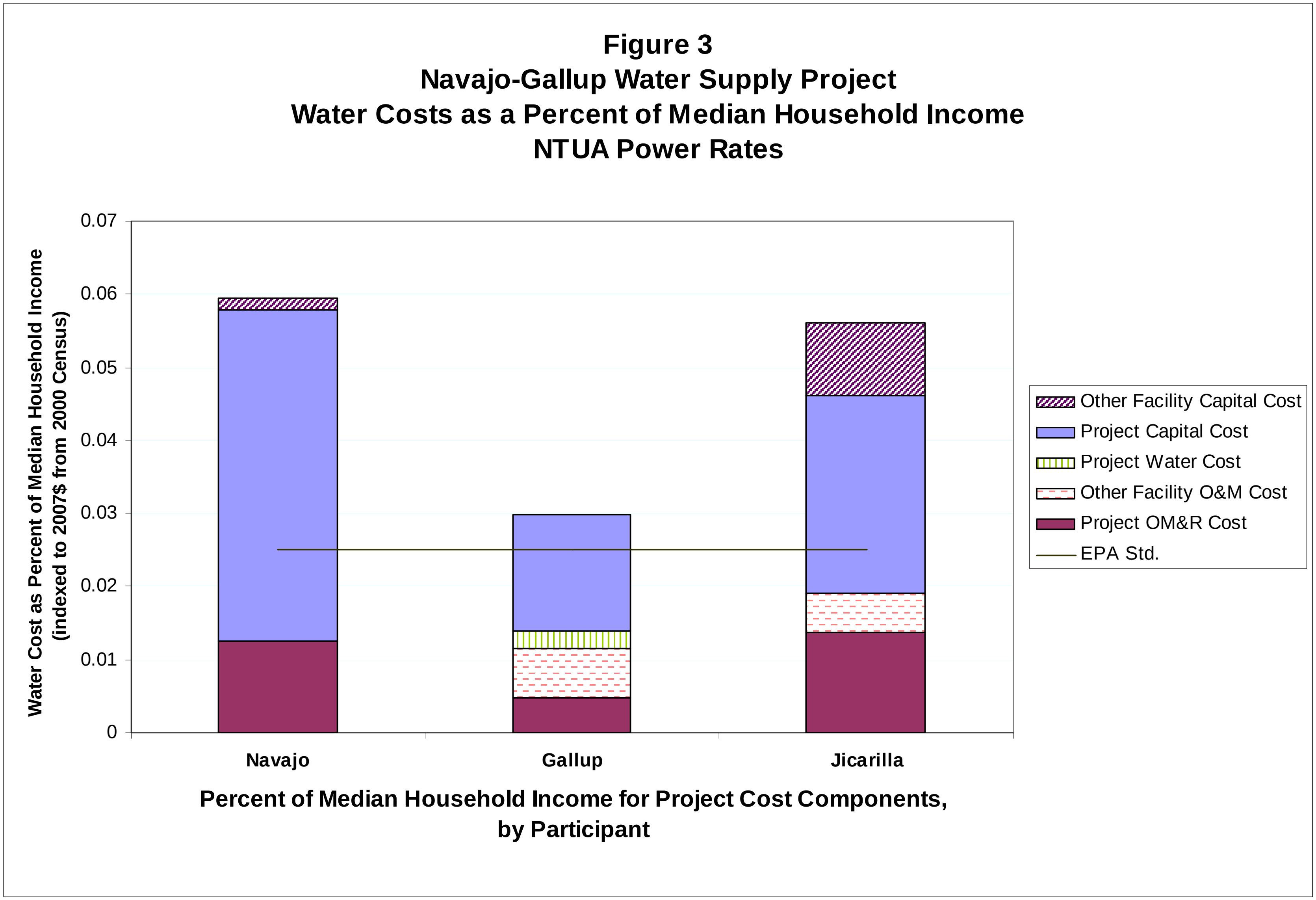


Figure 3
Navajo-Gallup Water Supply Project
Water Costs as a Percent of Median Household Income
NTUA Power Rates
Water Cost as Percent of Median Household Income
(indexed to 2007$ from 2000 Census)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Navajo
Gallup
Jicarilla
Other Facility Capital Cost
Project Capital Cost
Project Water Cost
Other Facility O&M Cost
Project OM&R Cost
EPA Std.
Percent of Median Household Income for Project Cost Components,
by Participant

References

Asian Development Bank, "Handbook for the Economic Analysis of Water Supply Projects," 1999.

Banner Associates, HDR Engineering, TRC Mariah Associates, "Lewis & Clark Water Supply Project, Final Engineering Report," May, 2002, accessed at www.lcrws.org/engineering.asp.

Beider, Perry C., "Future Investment in Drinking Water Infrastructure," CBO Testimony, April 11, 2002.

Carpenter, Rick, Project Manager, Santa Fe Buckman Direct Diversion Project, telephone interview March 23, 2006.

Churchill, Anthony A., "Rural Water Supply and Sanitation," World Bank Discussion Paper 18, September, 1987.

Congressional Budget Office, "Future Investment in Drinking Water and Wastewater Infrastructure," November, 2002.

Dinar, Ariel ed., "The Political Economy of Water Pricing Reforms," April, 2000.

HKM Engineering and HDR Engineering, "Rocky Boy's/North Central Montana Regional Water System Final Engineering Report," September, 2004.

Kessides, Christine, "World Bank Experience with the Provision of Infrastructure Services for the Urban Poor," World Bank Environmentally Sustainable Development Staff, January, 1997.

Merchant, James, "Allocation of Capital and OM&R Cost, Navajo-Gallup Water Supply Project," 2007a.

Merchant, James, "Economic Benefit/Cost Analysis, Navajo-Gallup Water Supply Project," 2007b.

New Mexico Finance Authority, "Drinking Water Revolving Loan Fund," n.d.

New Mexico Finance Authority, "Drinking Water Revolving Loan Program," n.d.

Rubin, Scott J., "Criteria to Assess Affordability Concerns in Conference Report for H.R. 2620," National Rural Water Association, January, 2002.

Stomp, John, Albuquerque Water Resources Manager, telephone interview, April 12, 2006.

US Census Bureau, "1990 Census of Housing, New Mexico," 1990 CH-2-33.

US Census Bureau, "2000 Census of Population and Housing," PHC-2-33, April, 2003.

US Congress, "Rural Water Supply Act of 2006," PL 109-451, 120 Stat. 3345, 2006.

US Congress, "Reclamation Project Act of 1939," August 4, 1939, 53 Stat. 1187, codified at 42USC485(c)(2).

USDA, "Rural Community Advancement Program Budget Summary," 2005, www.usda.gov/agency/obpa/Bidget-Summary/2004.07RD.htm.

USDA, Rural Utilities Service, "Regulations for Water and Wastewater Loan and Grant Program," 7 CFR 1780, revised 6-4-99, http://www.usda.gov/rus/water/regs.htm.

USDA, "Water and Environmental Programs, Fiscal Year 2007," 2007, www.usda.gov/rus/water/2007funding.htm.

US EPA, "Affordability Criteria for Small Drinking Water Systems: An EPA Science Advisory Board Report," EPA-SAB-EEAC-03-004, December, 2002.

US EPA, "Distribution of Drinking Water State Revolving Fund Appropriation for FY 2006," 2007a , www.epa.gov/safewater/dwsrf/allotments/funding_dwsrf_allotments-2006.html.

US EPA, "Drinking Water State Revolving Fund (DWSRF) Annual State Grant Allotment Fact Sheet, EPA 816-F-05-006, April, 2005, www.epa.gov/cgi-bin/epaprintonly.cgi.

US EPA, "Handbook for Capacity Development," EPA 816-R-99-012, July, 1999(b).

US EPA, "Information for States on Developing Affordability Criteria for Drinking Water," EPA 816-R-98-002, February, 1998(a).

US EPA, "Prioritizing Drinking Water Needs," EPA 816-R-99-001, January, 1999(a).

US EPA, "Tentative Distribution of Drinking Water State Revolving Fund Appropriation for FY 2007," 2007b, www.epa.gov/safewater/dwsrf/allotments/funding_dwsrf_allotments-2006.html.

US EPA, "Variance Technology Findings for Contaminants Regulated Before 1996," EPA 815-R-98-003, September, 1998(b).

US General Accounting Office, "Rural Development: USDA's Approach to Funding Water and Sewer Projects," GAO/RCED-95-258, September, 1995.

Water Resources Development Act of 1986 (as amended by PL106-170).

World Bank Water and Sanitation Program, "Willingness to Charge and Willingness to Pay," Field Note, August, 2002.

APPENDIX D

Part IV
Social Impacts from the Navajo-Gallup
Water Supply Project

SOCIAL IMPACTS FROM THE NAVAJO – GALLUP WATER SUPPLY PROJECT

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October 2, 2007

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A. EXECUTIVE SUMMARY

This report discusses the social impacts associated with the Navajo-Gallup Water Supply Project. The report addresses impacts on three groups of people, the Navajo Nation, the City of Gallup and the Jicarilla Apache Nation. The types of social impacts addressed include (1) Community cohesion, (2) Accessibility to water, (3) Public health, (4) Employment impacts, (5) Demand for local services, and (6) Environmental Justice issues.

The Project should have strong positive effects on the Accessibility to water and Public health categories, and positive effects on Employment and Environmental Justice categories. If Project jobs are filled predominantly by new arrivals to the area there may be a minor negative impact on the Demand for local services. Project employment may increase construction sector employment by somewhat more (166%) than the standard deviation in that sector, but total Project-related employment (including secondary employment) will not represent an unusual fluctuation in the area's year-to-year total employment. We did not identify any significant impact on Community Cohesion.

B. COMMUNITY COHESION

For purposes of this report "Community Cohesion" refers to interactions among people and groups within a community[1] and may be affected to the extent that a project interferes with those interactions or introduces stress into the social patterns within a community. A project could interfere with community interactions by physically displacing people, by creating physical or aesthetic barriers that disrupt established patterns, or by creating a divisive debate about the advisability of the project.

The Navajo-Gallup Water Supply Project will consist primarily of buried pipelines, community storage tanks and two water treatment plants. While the pipeline route will

[1] US Department of Transportation, 1996.

transit some privately held property, most of that route is in rural areas and no residences will be displaced. Undergrounding the pipeline should preclude any barrier effect from that project aspect. The storage tanks and treatment plants are tentatively sited outside any community and should also not create barriers to community interaction.

The Project has enjoyed very strong local support among all its constituents. The Northwest New Mexico Council of Governments in conjunction with the U.S. Bureau of Reclamation held public scoping meetings early in the Project design stage at which numerous people spoke about the Project's desirability. The meetings were held in St. Michaels, AZ, and Crownpoint, Farmington, Shiprock and Gallup, New Mexico[2]. Of the 36 speakers, 19 people specifically expressed support for the Project, 3 expressed qualified support, and 3 others supported the concept of an increased water supply but did not express an opinion on the Project. Of the 36 speakers only 2 did not support the Project in some way.

All three local government bodies also have expressed their support for the Project. The Resources Committee of the Navajo Nation Council adopted a resolution supporting the PNM alignment of the Project, and the Navajo President and Vice-President have repeatedly written letters expressing the Navajo Nation's support for the Project.[3] The City of Gallup … The Legislative Council of the Jicarilla Apache Nation has cited their significant development plans for the southeast portion of their Reservation and has formally endorsed the planning effort to participate in the Navajo-Gallup Water Supply Project.[4]

Finally, the Upper Colorado River Commission, representing the Upper Basin states of Colorado, New Mexico, Utah and Wyoming, also adopted a resolution supporting the Navajo-Gallup Water Supply Project.[5]

[2] Northwest New Mexico Council of Governments, 2000.
[3] Navajo Nation Council, Resources Committee.
[4] Jicarilla Apache Nation, 2001.
[5] Upper Colorado River Commission.

C. ACCESSIBILITY TO WATER

Accessibility to a clean, reliable water supply is considered so important that the United Nations Millennium Project cites water infrastructure as one of the key requirements to help people break out of the "poverty trap." [6] Providing a water supply is also cited as the basis for Congressional legislation in the United States. For example, the first Congressional finding in the 1996 Amendments to the Clean Water Act states that "safe drinking water is essential to the protection of public health." [7]

Some 40% of the Navajo people living in the Project service area presently have no access to piped water, and consequently haul water from sometimes distant sources.[8] Some of the water they do consume is from non-potable sources intended for stock watering and not compliant with EPA water quality standards.[9] The Project is planned to deliver a reliable supply of treated water to many of the Navajo homes that are presently without a piped water supply. Although Project plans assume that 10% of the Navajo homes presently without a piped water supply will not be served by the Project, the remainder will be.

In addition, many of the Navajo communities in the Project service area that presently do have a piped water supply rely on wells with a limited water supply. The Project will allow these communities to provide an adequate water supply to their future population and commercial needs.

The City of Gallup currently relies on groundwater pumping to supply water to its residents. The water level in Gallup wells has been falling by 7 to 29 feet per year over an extended period, and at some point the production capacity of the current well system is expected to diminish. Absent the Project, therefore, Gallup would be faced with some combination of the following scenarios: (1) development of alternative water supply

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[6] UN Millennium Project, 2005, p. 39.
[7] PL 104-182, 1996, Section 3.
[8] Navajo Nation Department of Water Resources, p. ES-3.
[9] Ecosystem Management, Inc., 2004.

projects, (2) diminishing per capita water supply, and/or (3) curtailment of population growth. Gallup has not been able to identify any other water supply project that is as cost-effective as the Navajo Gallup Water Supply Project. Without new water it is estimated that the available water per capita would fall to less than one-half of existing water use by the year 2033. Thus without the Project, Gallup would have to make major changes in water use patterns, with consequential negative implications for the city's economic well-being. Accordingly, one Project impact is to prevent the overall economic losses to the City that would occur if future water shortages caused residents and businesses to locate elsewhere.

The Jicarilla Apache Nation has established a policy of developing the southwest portion of its Reservation. In order to attract the housing and commercial enterprises to that area they must develop a reliable, sustainable water supply. The Nation has no adequate local water sources capable of providing such a water supply, so they have investigated various alternatives for importing water from non-local sources. Of the alternatives investigated the Navajo Gallup Water Supply Project offers the best combination of reliability and cost-effectiveness. The effect, then, of the Project would be to facilitate the Jicarilla Nation's plans to diversify their Reservation, both residentially and economically.

D. PUBLIC HEALTH

A primary rationale for the public policy of providing clean and reliable water to all people in the United States is the resulting health benefit. As noted in the "Accessibility to Water" section, above, the 1996 Amendments to the Clean Water Act explicitly link public health to safe drinking water.[10] In addition, Congress has found specifically for Indians that a "major national goal of the United States is to provide the quantity and quality of health services which will permit the health status of Indians to be raised to the highest possible level …,"[11] and that "the provision of safe water supply systems and sanitary sewage and solid waste disposal systems is primarily a health consideration and

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[10] PL 104-182, Section 3.
[11] 25 USC 1601

function," and that "it is in the interest of the United States, and it is the policy of the United States, that all Indian communities and Indian homes, new and existing, be provided with safe and adequate water supply systems… as soon as possible."[12]

There is a clear connection between sanitation facilities (water & sewerage) and Indian health. The Indian Health Service considers the availability of essential sanitation facilities to be "critical to breaking the chain of waterborne communicable disease episodes… In addition, many other communicable diseases, including hepatitis A, shigella, and impetigo are associated with the limited hand washing and bathing practices often found in households lacking adequate water supplies. This is particularly true for families that haul water."[13] The Indian Health Service reports that American Indian families living in homes with satisfactory environmental conditions required about one-fourth the medical services as those with unsatisfactory environmental conditions.[14]

The Navajo Gallup Water Supply Project will provide a safe water supply to many households who would otherwise not have it, particularly on the Navajo Reservation. As mentioned in the previous section, approximately 40% of Navajo households presently must haul water, sometimes from non-potable water sources. The Project is designed to deliver a safe, reliable water supply to most of these households, and this water supply should have a direct beneficial effect on the health of the people receiving it.

E. EMPLOYMENT IMPACTS

Project-induced change in employment opportunities could represent either a positive or negative social impact. To the extent that a project provides opportunities for employment in an area with high unemployment rates, the project can relieve social stress due to the lack of jobs. On the other hand, a project that attracts a large number of employees from outside the local area could create social tension. The degree to which

[12] 25 USC 1632
[13] Indian Health Service, 2004
[14] Ibid.

Project employment could attract a substantial influx of workers, stressing both community infrastructure and community cohesion, is addressed in the next section.

The Navajo-Gallup Water Supply Project will create jobs for both the construction and operation phases. The construction phase is expected to last some 16 years, and construction will occur in San Juan and McKinley counties in two main corridors: the western branch from the PNM diversion on the San Juan River to Gallup, with east and west branches; and the eastern branch from the Cutter diversion on the NAPI canal south to Torreon. The construction employment is estimated to average about 600 workers and peak at about 650 workers during the 3rd through 15th years of construction. The operational phase will employ about 28 full-time equivalent workers on a long term basis. The jobs for these workers will be located primarily at the water treatment plants and pumping plants, with crews monitoring and repairing the pipelines and electric transmission lines.

The San Juan – McKinley county area has experienced long-term unemployment problems, particularly among the Navajo and Jicarilla people. In recent years the overall unemployment rate in the area has exceeded the national rate by approximately 10% to 70%, while the unemployment rate among Navajo and Jicarilla people has been six to ten times the national rate. Table 1 shows the most recently available unemployment rates for the area.

Table 1

Unemployment Rates in United States and Vicinity of Navajo Gallup Water Supply Project

Year	United States	San Juan County, NM	McKinley County, NM	Navajo Reservation	Jicarilla Apache Reservation
1999	4.2%	7.5%	7.1%	34%	40%
2000	4.0%	5.8%	6.6%		
2001	4.7%	6.2%	6.2%	52%	33%
2002	5.8%	6.9%	6.2%		
2003	6.0%	7.6%	7.4%		
2004	5.5%	6.1%	7.6%		
2005	5.1%	5.5%	6.8%		
2006	4.6%	4.3%	5.6%		

Sources: National and county unemployment rates from U.S. Bureau of Labor Statistics, "Local Area Unemployment Statistics;" Reservation unemployment rates from U.S. Bureau of Indian Affairs, "American Indian Population and Labor Force Report," 1999 and 2001.

To the extent that the construction and operation jobs can be filled by currently unemployed local people, the Project should represent an important benefit to the local area's socioeconomic condition. The Water Resources Council's Principles and Guidelines conclude that in an area of substantial and persistent unemployment a local hire rule can increase the percent of jobs going to otherwise unemployed people from 30% to 43% in the case of skilled workers, and from 47% to 58% in the case of unskilled workers.[15] In either event the Project should result in a significant number of jobs for otherwise unemployed people.

F. DEMAND FOR LOCAL SERVICES

Although many Project workers may be hired from the local population base, some other workers may be attracted from outside the area. If the number of immigrants is sufficiently large, it may have negative effects on both community infrastructure and on community social fabric.

During the construction phase the Project will support two types of additional employment in the region. First, the Project will require several hundred construction workers to build the water treatment plants, pipeline, storage tanks, pumping plants and electrical transmission lines. Second, the income earned by Project construction workers will stimulate local spending on goods and services, adding more jobs primarily to the retail and service sectors. Table 2 shows an estimate of the jobs added in the construction sector and in all sectors (including construction) during each year of construction. The numbers of new construction and new total jobs were estimated using an IMPLAN input-output model that links a change in employment to an initial change in spending (in this case, Project construction spending).[16] Table 2 also shows an estimate of the baseline construction and overall employment that would exist in the absence of the Project.

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[15] U.S. Water Resources Council, p. 94.
[16] IMPLAN

Future overall employment was estimated by extending the 1999-2003 trend in overall employment into the future. Construction employment has been declining over the 1999-2003 period. For purposes of this analysis we assumed that the decline will halt and in the absence of the Project, future construction employment would stabilize at the 2003 level.

Table 2

Baseline and Project-Related Additional Employment

McKinley and San Juan Counties, New Mexico

Year	Baseline Construction Employment	Additional Project-Related Construction Employment	Baseline Total Employment	Additional Project-Related Total Employment
1999	5,124		62,261	
2000	4,554		62,097	
2001	4,477		64,377	
2002	4,142		65,441	
2003	4,187		66,000	
2004	4,187		67,282	
2005	4,187		68,364	
2006	4,187		69,446	
2007	4,187		70,528	
2008	4,187		71,611	
2009	4,187		72,693	
2010	4,187		73,775	
2011	4,187	181	74,857	346
2012	4,187	357	75,939	682
2013	4,187	653	77,022	1247
2014	4,187	653	78,104	1247
2015	4,187	653	79,186	1247
2016	4,187	653	80,268	1247
2017	4,187	653	81,350	1247
2018	4,187	653	82,433	1247
2019	4,187	653	83,515	1247
2020	4,187	653	84,597	1247
2021	4,187	653	85,679	1247
2022	4,187	653	86,761	1247
2023	4,187	653	87,844	1247
2024	4,187	653	88,926	1247
2025	4,187	653	90,008	1247
2026	4,187	380	91,090	725

Source: U.S. Bureau of Labor Statistics, "State and County Employment and Wages from the Quarterly Census of Employment and Wages;" IMPLAN; Dornbusch Associates.

Table 2 shows the future estimated baseline (without Project) employment and the Project-related increase in employment for the construction sector and for total employment. The significance of these increases is a remaining question. As the actual employment data for 1999-2003 in Table 2 show, employment can vary considerably from year to year. Using the data for 1999-2003 we calculate standard deviations for both construction and total employment. This measure indicates the expected variability in employment from year to year. So long as the annual employment numbers are "normally" distributed, we would expect the annual numbers to be within one standard deviation of the mean about two-thirds of the time. Table 3 shows the annual Project-related employment as a percent of one standard deviation.

Table 3

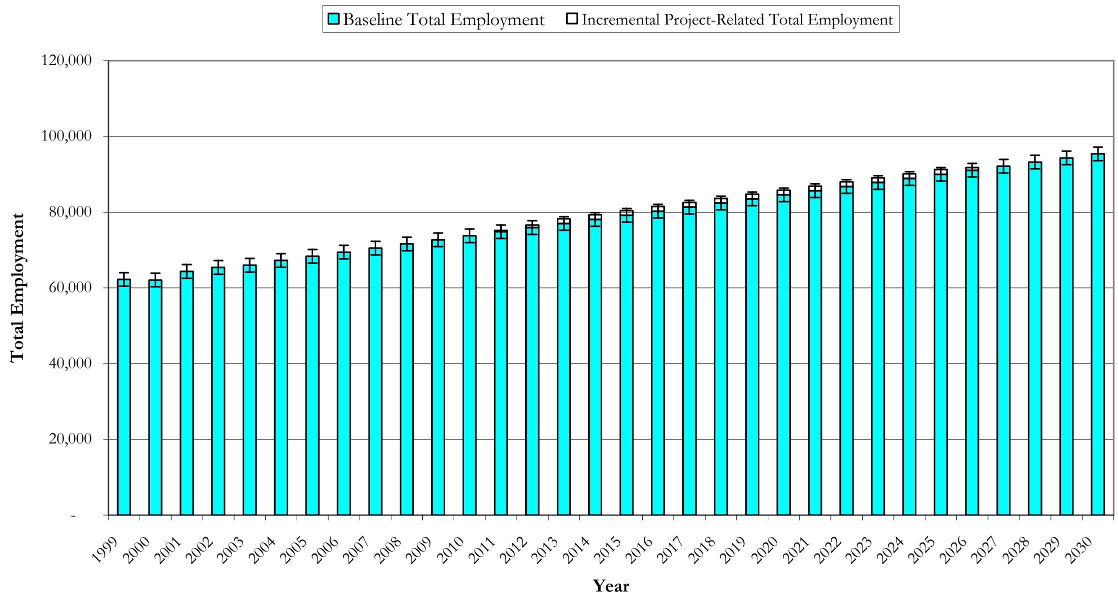
Project-Related Construction and Total Employment as a Percent of One Standard Deviation, McKinley and San Juan Counties, New Mexico

Year	Project-Related Construction Employment / Standard Deviation	Project-Related Total Employment / Standard Deviation
2011	46%	19%
2012	91%	38%
2013	166%	70%
2014	166%	70%
2015	166%	70%
2016	166%	70%
2017	166%	70%
2018	166%	70%
2019	166%	70%
2020	166%	70%
2021	166%	70%
2022	166%	70%
2023	166%	70%
2024	166%	70%
2025	166%	70%
2026	97%	40%

Table 3 shows that the Project-related total employment change is estimated to be within one standard deviation of the baseline employment. On the other hand, the Project-related construction employment is estimated to exceed one standard deviation from the baseline employment. If the distribution of annual construction employment follows a normal distribution, an increase the magnitude of Project-related construction employment would only be expected to occur in about one year in ten. However, the Project-related construction employment does not reach this peak level until the third year of construction; the biggest year-to-year change in Project-related construction employment is well within the one standard deviation benchmark. Figures 1 and 2 show graphically how the Project-related construction and total employment, respectively, compare to expected baseline employment during the construction phase. The error bars around the baseline employment numbers represent plus and minus one standard deviation from the mean number.

Figure 1
Project Construction Employment Impact
Navajo-Gallup Water Supply Project
San Juan and McKinley Counties, NM

Figure 2
Project-Related Total Employment Impact
Navajo-Gallup Water Supply Project
San Juan and McKinley Counties, NM



The changes shown in Table 3 represent a worst case possibility. To the extent that the construction industry and other sectors hire local people who were otherwise unemployed these jobs will be filled by people who will not add substantially to the demand for local services and infrastructure. For example, these local people may already have housing and their children may already attend local schools. As discussed in the previous section, the U.S. Water Resources Council suggests that in an area with persistent and substantial unemployment some 30% to 58% of the construction workforce will come from the pool of unemployed workers. The number depends partially on whether the jobs are skilled or unskilled and on the presence of a local hire rule.[17]

The Project operation will require operators and maintenance personnel. Based on the IMPLAN model we estimate that about 83 workers will be needed, of which about one-third will be directly working on the Project, one-third working for businesses that supply goods and services to the Project, and the remaining one-third working for businesses that provide goods and services to Project employees and employees of the businesses

[17] U.S. Water Resources Council, p. 94.

supplying the Project. Sixty-six employees represents about one-tenth of one percent of total area employment. This level of employment should not have more than a minor impact on the area's infrastructure and services.

G. ENVIRONMENTAL JUSTICE

The Environmental Justice issue is essentially one of discrimination against specific subpopulations. Executive Order 12898 directs that federal programs, policies and activities not have a disproportionately high and adverse human health and environmental effect on minority and low-income populations.[18]

Substantial populations in the Project area clearly qualify as minority and low-income. The 2000 Census of Population reports that 74.7% of the 74,798 people in McKinley County and 36.9% of the 113,801 people in San Juan County are American Indians.[19] The 2000 Census also shows that both the Navajo people ($21,830) and Jicarilla Apache people ($26,667) in New Mexico earn median incomes far below the New Mexico state average ($34,133).[20]

No major adverse impacts from the Project have been identified, and there is no indication that any adverse impacts would have a disproportionate effect on the minority and low-income populations.

Conversely, the beneficial effects from providing water to those who would otherwise have to haul water will accrue *primarily* to the minority and low-income populations. This access to water benefit and the related health improvements are discussed in earlier sections of this report. These important positive Project impacts will assist rather than harm the minority and low-income populations.

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[18] Presidential Executive Order 12898.
[19] US Census Bureau, Quick Facts McKinley County and US Census Bureau, Quick Facts San Juan County.
[20] US Census Bureau, Characteristics of American Indians.

In addition to the positive water accessibility and related health benefits to the minority and low-income populations, the Project will have an additional beneficial impact by increasing the attractiveness of the area for economic development. The Project will provide a water infrastructure essential for many businesses. The water provided by the Project will assist the City of Gallup in retaining existing businesses and attracting new ones, and will assist the Navajo Chapters and the Jicarilla Apache Nation in attracting businesses that would not otherwise be interested in investing in the area.

Finally, the Project may indirectly help reduce the outmigration of Navajo people. The improved economic climate facilitated by the Project will provide more employment opportunities for the minority and low-income populations. This increased employment opportunity, together with an improved water infrastructure, will make the area more attractive for young adults who might otherwise consider moving outside the area.

According to Census Bureau data the population of the Navajo Nation grew by 32.4% between 1990 and 2000, from 225,298 to 298,197 people [U.S. Census Bureau, 1995; U.S. Census Bureau, 2002]. In contrast, the number of Navajo people residing on the Navajo Reservation or Trust Lands increased only 21.6% [U.S. Census Bureau, "American Factfinder;" U.S. Census Bureau, "American Indian Reservations and Trust Lands"]. This disparity indicates that the number of Navajo people residing off-Reservation increased by 53.2%, or over 40,000 people.

The Navajo tribal statistician noted this trend of Navajo outmigration in the 1996 "Chapter Images" profile of Navajo communities [Navajo Division of Community Development, 1997, p. vii]. The statistician attributed the trend to "development stagnation" on the Reservation [Ibid.]. Another factor contributing to the outmigration, however, may be the low standard of living due to primitive water supply conditions. About 40% of Navajo families have no piped water supply and must haul water from a central source to their dwellings. As noted in the section discussing health benefits, above, water hauling is not only expensive and inconvenient but also contributes to health problems for families who haul water.

Section E, above, discussed the likelihood that the Navajo Gallup Water Supply Project would stimulate the regional economy. This increased economic activity should provide additional long-term employment opportunities for all people in the Project service area, including those on the Navajo Reservation. In addition, the provision of a piped water supply will raise the standard of living in the Project area, providing clean, reliable water at a price much less than the cost of water hauling. The increased opportunity for increased economic well-being, in addition to the convenience afforded by a reliable source of clean piped water, should substantially reduce the outmigration of Navajo people.

REFERENCES

Ecosystem Management, Inc., "Sanitary Assessment of Drinking Water Used By Navajo Residents Not Connected to Public Water Systems," January, 2004.

IMPLAN, "Professional 2.0" software, Minnesota IMPLAN Group.

Indian Health Service, "The Sanitation Facilities Construction Program of the Indian Health Service, Public Law 86-121 Annual Report for 2003," 2004.

Jicarilla Apache Nation, "Resolution of the Legislative Council No. 2001-R-290-06," June 6, 2001.

Navajo Nation Council, Resources Committee, "Resolution RCMA-16-02, Supporting the Selection of the San Juan River (PNM) Alternative as the Preferred Alternative for the Navajo-Gallup Water Supply Project," February 22, 2002.

Navajo Nation Department of Water Resources, "Water Resource Development Strategy for the Navajo Nation," July 17, 2000.

Navajo Nation Division of Community Development, "Chapter Images: 1996," Summer, 1997.

Northwest New Mexico Council of Governments and U.S. Bureau of Reclamation, "Transcripts from the Public Scoping Meetings on the Navajo-Gallup Water Supply Project," April 25, April 26, April 27, May 2 and May 3, 2000.

Presidential Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," February 11, 1994, http://www.hud.gov/offices/fheo/FHLaws/EXO12898.cfm.

Public Law 104-182, "Safe Drinking Water Act Amendments of 1996," 1996.

UN Millennium Project, "Investing in Development, A Practical Plan to Achieve the Millennium Development Goals," 2005, http://www.unmillenniumproject.org/reports/.

U.S. Bureau of Indian Affairs, "American Indian Population and Labor Force Report," 1999.

U.S. Bureau of Indian Affairs, "American Indian Population and Labor Force Report," 2001.

U.S. Bureau of Labor Statistics, "Local Area Unemployment Statistics," ftp://ftp.bls.gov/pub/special.requests/la/laucnty06.txt, accessed 8/13/07.

U.S. Bureau of Labor Statistics, "Employment Status of the Civilian Noninstitutional Population," http://www.stats.bls.gov/cps/cpsaatl.pdf, accessed 8/13/07

US Census Bureau, "American FactFinder, DP-1, Profile of General Demographic Characteristics: 2000, Navajo Nation Reservation and Off-Reservation Trust Land, AZ_NM_UT," http://factfinder.census.gov, accessed on 2/7/05

US Census Bureau, "American Indian and Alaska Native Population:2000, Table 5. American Indian and Alaska Native Population by Selected Tribal Grouping: 2000," February, 2002, www.census.gov/prod/2002pubs/c2kbr01-15.pdf, accessed on 2/7/05.

U.S. Census Bureau, "General Population and Housing Characteristics: 1990 Data Set: 1990 Summary Tape File 1 (STF 1)," http://factfinder.census.gov/ , accessed 7/12/01.

US Census Bureau, "Table 1. Top 25 American Indian Tribes for the United States: 1990 and 1980," August, 1995, www.census.gov/population/socdemo/race/indian/ailang1.txt, accessed on 2/7/05.

U.S. Census Bureau, "Characteristics of American Indians and Alaska Natives by Tribe and Language: 2000," PHC-5, 2003.

U.S. Census Bureau, "Quick Facts, McKinley County," http://quickfacts.census.gov/qfc/states/35/35031.html

U.S. Census Bureau, "Quick Facts, San Juan County," http://quickfacts.census.gov/qfc/states/35/35045.html

U.S. Code, Title 25, Chapter 18, "Indian Health Care," 2002.

U.S. Department of Transportation, "Community Impact Assessment: A Quick Reference for Transportation," FHWA-PD-96-036, 1996, www.ciatrans.net/CIA_Quick_Reference/.

U.S. Water Resources Council, "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies," 1983.

Upper Colorado River Commission, "Resolution Regarding the Use and Accounting of Upper Basin Water Supplied to the Lower Basin in New Mexico by the Proposed Navajo-Gallup Water Supply Project," June 19, 2003.