



Chapter IV

ALTERNATIVES

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INTRODUCTION

The first part of this chapter of the Navajo-Gallup Water Supply Project (proposed project) planning report and final environmental impact statement describes the eight alternatives that were considered for meeting the water demand needs presented in preceding chapters. The eight alternatives fall into three categories: no action, nonstructural, and structural. A No Action Alternative is included and an environmentally preferred alternative is identified, as required by the National Environmental Policy Act (NEPA) of 1969, for comparison with all action alternatives. A nonstructural Water Conservation Alternative (includes water reuse) and six structural alternatives are also described.

The second part of this chapter explains the methods used to screen out some of the eight alternatives that did not meet the proposed project purpose and need. Overall, the plan formulation evaluation process included the following steps, some of which were discussed in detail in the preceding chapters of this document:

- Identifying existing and projected problems and needs
- Evaluating resource capabilities
- Formulating alternative plans to solve problems and meet needs with available resources

- Analyzing the alternative plans to determine the advantages and disadvantages of each
- Selecting the preferred alternative from among viable alternatives

The plan selection process (also referred to as screening) included two categories of screening criteria under the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (Principles and Guidelines)*.¹ The first category involved four tests of viability. The second category included nine factors covering the four accounts (national economic development [NED], environmental quality [EQ], regional economic development [RED], and other social effects [OSE]). Under the four tests of viability, the Water Conservation and No Action Alternatives and the six 2020 design capacity alternatives did not meet initial screening criteria.²

Only the six structural alternatives at the larger year 2040 capacity adequately met the proposed project purpose and need. Of the six alternatives, through the screening process, two were found to have the lowest cost as measured by their present worth. These two action alternatives and the No Action Alternative were then evaluated using the NEPA process, as described in chapter V. A preferred alternative, the San Juan River Public Service Company of New Mexico (SJRPNM) Alternative (year 2040) was identified as ranking the highest among the nine factors (four accounts) and was the least environmentally impacting.

For the planning report requirements of this document, alternative plans for meeting the identified needs in the proposed project area had to meet a number of general criteria and standards, including those that encompass water quality, hazardous material concerns, endangered species preservation, and others.

PLAN FORMULATION PROCESS

The formulation of alternatives began with an evaluation of existing needs and solutions:

- Because of continued over-drafting of the groundwater table and limited surface water resources in the area, planning for the proposed project has been limited to surface water supplies from the San Juan River.

¹ A guide component in the formulation and subsequent evaluation of alternatives is the *Principles and Guidelines*, Water Resources Council, March 10, 1983.

² Another six structural year 2020 capacity alternatives were included early in the planning process for comparison purposes, but they were not retained for further analysis because by the time of project completion, their capacity would have been exceeded.

- Nonstructural alternatives—water conservation, water reuse, conjunctive use of groundwater, and aquifer storage—could not replace the proposed project. Rates of water use are already very low, and reuse is likely to be implemented with or without the proposed project to further reduce reliance on groundwater. Conjunctive use is planned to be an adjunct to project operation in the future.
- Plan formulation was influenced by public scoping meetings, informal public contacts, coordination with other entities, and interagency consultations. Specifically, the Bureau of Reclamation (Reclamation) worked closely with the Navajo and Jicarilla Apache Nations and the city of Gallup throughout the planning process.
- A project steering committee to guide the proposed project’s development has been in existence since the early 1990s. It is made up of representatives from the Navajo and Jicarilla Apache Nations, city of Gallup, State of New Mexico, Northwest New Mexico Council of Governments, Navajo Tribal Utility Authority (NTUA), Indian Health Service, Bureau of Indian Affairs, and Reclamation. The committee provided guidance throughout the planning process through technical experts representing the entities. The plan formulation process for this project spans nearly 30 years and is described in detail in volume II, appendix A.
- The laws and mandates listed at the end of chapter I were taken into account, as well as agency guidelines and procedures.

THE NO ACTION ALTERNATIVE

As required by NEPA, a No Action Alternative was formulated to provide the basis against which impacts of the action alternatives could be evaluated (chapter V). The No Action Alternative projects reasonably foreseeable future conditions without implementation of the proposed plan. Under the No Action Alternative, it is assumed that the action alternatives’ municipal and industrial (M&I) water supplies and delivery systems would not be constructed on the eastern side of the Navajo Nation, for the city of Gallup, or for the southwestern area of the Jicarilla Apache Nation.

The No Action Alternative assumes that water development in the San Juan River (Basin) would continue for projects with completed Endangered Species Act (ESA) section 7 compliance. It is also assumed that Navajo Dam and Reservoir will be operated to implement ESA-related Flow Recommendations to assist in conserving endangered fish in the San Juan River and to enable Basin water development (for more detail, see chapter I, “Other Projects and Actions in the San Juan River Basin,” and chapter V, “Connected, Cumulative, and Related Actions”).

The No Action Alternative would not limit the Upper Basin States' right to develop and use their compact apportionment. Apportionment planned for use in the proposed project may be available for other projects within the Basin. However, by failing to implement the Navajo Settlement Agreement and forcing the Nation to reinitiate its claims, local water users could potentially be adversely affected. Public Law 111-11 provides nullification of a settlement if the proposed project is not completed by December 31, 2024. Public Law 111-11 also includes deadlines for other components of the settlement. Failure to implement the settlement would continue the uncertainty of water rights within the Basin.

Under the No Action Alternative, the benefits of the proposed project would probably not be realized. Water shortages would be expected to intensify, reaching 1 million gallons per day (MGD) in the city of Gallup during peak periods as early as 2010 and continuing to worsen, with comparable shortages elsewhere in the proposed project area.

Water conservation and water reuse would not make up the shortfall, and new groundwater sources would not provide a full supply. The groundwater table would be further depleted. The economic development represented by the Navajo Agricultural Products Industry and the potential infrastructure in the Jicarilla Apache and Navajo Nations would be adversely affected by the absence of an adequate and reliable water supply. This deficiency would, in turn, contribute to continuing high poverty rates, high unemployment, and increasing outmigration from reservation lands.

NONSTRUCTURAL ALTERNATIVES

These alternatives approached the proposed project purpose by reducing the need for water through water conservation and water reuse.

Water Conservation

Water conservation is accomplished through public education, economic incentives, and regulatory tools. The city of Gallup currently has a water use ranging from 150 to 164 gallons per capita per day (gpcd), one of the lowest water use rates of communities in the Southwest. It has instituted a public education program and a tiered water rate structure to deter excessive water use. This approach to water use must continue into the future with or without this project for the city to have adequate water in the future. While conservation measures may help meet short-term needs, conservation is not a viable solution to meet long-term needs, and water conservation will not address the problem of declining water quality (increased salinity).

Throughout the proposed project area of the Navajo Nation, water use is approximately 110 gpcd where piped water is available and 10 to 20 gpcd where water is hauled. These are extremely low water use rates that would be difficult to reduce. The Jicarilla Apache

Nation plans to develop the area around Teepee Junction from a crossroads to a permanent residential and commercial area. Because there is currently no appreciable water use there, water conservation is not applicable. As a nonstructural alternative, water conservation did not meet the proposed project purpose and need and is considered incomplete and ineffective.

Water Reuse

Although current Safe Drinking Water Act regulations limit water reuse applications, water reuse can significantly increase a community's usable water supply. Under certain circumstances, reclaimed water can be used on outdoor landscaping and athletic facilities. The city of Gallup has implemented several innovative water reuse projects to irrigate its golf course and athletic fields. On the Navajo Nation, irrigated landscaping is very limited and most waste water ends up in individual septic systems or evaporation ponds. The Navajo Nation and Reclamation have contracted with Westlands Resources to investigate water reuse opportunities, and appraisal-level studies have been conducted in Tuba City and Ganado. The National Park Service has received a grant from the Arizona Water Protection Fund to use NTUA effluent in Ganado for a riparian restoration project.

Out of necessity, within the next couple of decades, water reuse systems will become commonplace. At the current time, there are no direct municipal effluent-to-drinking water systems in use in Arizona or New Mexico. The city of Gallup is considering treating its waste water for direct reuse. Assuming 60 to 70 percent of the waste water can be reused, this is only a short-term (10- to 15-year) relief from needing a perpetual long-term water supply. This does not meet the proposed project's intended goals and is therefore not a complete alternative. It is assumed that waste water reuse will continue to be part of the city of Gallup's long-term water management methods with or without the proposed project.

STRUCTURAL ALTERNATIVES

Introduction

Six structural alternatives were identified at two design capacities (2020 and 2040), which were analyzed in greater detail in volume II, appendix B. The proposed project's purpose is to meet the 2040 water demand, but 2020 design capacities were considered for comparison purposes. The six alternatives are:

- Navajo Indian Irrigation Project (NIIP) Moncisco
- NIIP Coury Lateral (also referred to as NIIP Coury)
- NIIP Cutter Lateral (also referred to as NIIP Cutter)

- NIIP Amarillo
- SJRPNM
- San Juan River Infiltration

All of the alternatives have one or more surface water diversion points. The four NIIP alternatives would divert water entirely from the NIIP system originating at Navajo Reservoir. The differences among the NIIP alternatives center on the points at which the water would be diverted before entering the proposed project pipeline system. For the two San Juan River alternatives, one of the options for diverting water from the San Juan River would be to construct a new turnout structure just upstream from the existing Public Service Company of New Mexico (PNM) diversion structure. Another San Juan River alternative diversion option includes a proposed Infiltration Gallery System (IGS) that would obtain water from the San Juan River downstream from the Hogback (see figure IV-6) and upstream of its confluence with the Chaco River. This diversion option would tie into the previously proposed alignment for the SJRPNM Alternative at the most feasible point.

In all of the alternatives, surface water would be treated to meet applicable drinking water standards for the proposed project area before entering the proposed project conveyance system. All of the proposed alternatives would include the same Gallup Regional System and be fully automated systems.

Basic Design Considerations

Water supply for the alternatives would originate directly from the San Juan River below Navajo Dam and/or from Navajo Reservoir through the NIIP facilities. Various river diversion points were considered, and the use of existing facilities to reduce impacts and costs was considered a priority in locating points to evaluate for diversion. The PNM diversion was considered the most logical to investigate because a fish passage exists at that point to help control impacts to fish and access to utilities and land for facilities is readily available at this point. Just downstream from the PNM diversion, prior investigation on an under-river drainage diversion had been done that led to evaluation of another diversion alternative. Consideration was also given to use of the existing NIIP facilities to transport project water, where possible, to capitalize on existing structures and reduce impacts and costs of new facilities.

Two facility sizes were evaluated based on providing a future water supply to 2020 and 2040. The year 2020 was selected as the minimum time horizon a future water supply should be considered, and 2040 demand was considered to be the most realistic projection of water need. The proposed project's purpose is to meet the 2040 water demand, and 2020 design capacities were shown for comparison purposes in the alternative comparison process but were not considered viable alternatives.

Conjunctive Use of Groundwater and Aquifer Storage

It is planned that groundwater would be used conjunctively with the proposed project water supply to enhance the overall water supply available to the city of Gallup and the Navajo Nation. Two approaches for conjunctive use have been considered: (1) utilizing wells during the summer when the water demand is at its peak and (2) using aquifer storage and recovery. These approaches are described in greater detail in the following sections.

Utilize Wells for Peak Summer Demand.—During the first few years of project operation, the proposed project would have adequate capacity to greatly reduce groundwater withdrawals. Eventually, however, the city of Gallup and NTUA would need to utilize their wells for short periods during the summer when the water demand is at its peak. By the year 2040, it is projected that the city's system will need to produce approximately 1,400 acre-feet of groundwater, primarily during the summer months. The aquifers will be able to recharge during the remainder of the year.

Although the city of Gallup's well fields may be able to supplement the total projected peak demands for a short period of time, it is unlikely that they will be able to replace the total projected summer demand. The estimated recharge to the source aquifers is very low, far less than current withdrawals. During the early life of the proposed project, it would greatly reduce or eliminate the city's dependence on groundwater; however, by the year 2040, groundwater would be needed to help meet the summer peak demands.

Aquifer Storage and Recovery.—According to a technical review of aquifer storage (Shomaker, Inc., 1991), it may be possible to store and recover project water. Eventually, it may also be economically possible to store and recover treated waste water. Conceptually, production wells in the Ya-ta-hey and Santa Fe Well Fields would be used as injection wells during periods when water was available in excess of the city of Gallup's demand. This water would then be available during periods when surface water was not available in adequate amounts. During the first years of the proposed project, the city might only be able to utilize approximately 4,500 acre-feet per year (AFY) out of the total project allocation of 7,500 acre-feet, and the difference might be available for recharge. Typically, the storage and recovery cycle is seasonal. With a seasonal cycle, the stored water does not have enough time to move far from the recovery well, and the groundwater head does not have enough time to dissipate to pre-storage levels before the water is recovered.

The source aquifers for the city of Gallup are confined, and they have very low hydraulic conductivities and storage coefficients (Shomaker, Inc., 1991). Because of the low

conductivity, groundwater movement is relatively slow. For these reasons, the injected water would stay within reach of a recovery well for a longer than typical period, and the rise in water levels would take a long time to dissipate. Therefore, a longer recovery period might be feasible. Injecting project water could restore part of the large decline in water levels in the wells and extend the life of the fields beyond the limits predicted by the city. The cost of storing this water would be partly offset by a reduction in the pumping lifts. Water levels are so deep that water may be injected successfully by gravity flow, requiring no pumping; aquifer storage is especially sensitive to the quality and chemical characteristics of the water (Shomaker, Inc., 1991). It is concluded that the concept is worth considering, but a complex analysis is needed before the feasibility of the concept can be determined.

All structural alternatives would rely on available groundwater in addition to the proposed project's surface water. Aquifer storage may help the city of Gallup and the Navajo Nation manage its water more efficiently if proven feasible.

Delivery Data

Delivery data for water demand in 2020 and 2040 were based on estimated population and demand for each of the six alternatives for each community each year. At the delivery points, the proposed project would connect to existing public water systems.

Based on 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. Peak daily demand was computed by multiplying the surface diversion for this project by a 1.3 peaking factor. The peaking factor was derived from a 7-day average in mid-July. The proposed project would connect to approximately 31 existing Navajo municipal systems and would provide a pressure of 70 pounds per square inch (psi) at those locations. The pressure requirement will vary with individual turnout. Storage capacity 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 conducted by the city of Gallup identifies the system requirements for the city and the surrounding Navajo communities served by the city's system. No storage is included for the Jicarilla Apache Nation.

Commonalities of the Structural Alternatives

The structural alternatives for this project have similar design considerations, but the components vary for each alternative. All of the structural alternatives would have one or more surface water diversion points. The two San Juan River alternatives would divert water from both the San Juan River and from Cutter Reservoir. Cutter Reservoir is an existing feature of the NIIP system, which receives water from Navajo Reservoir.

The four NIIP alternatives would divert water entirely from the NIIP system originating at Navajo Reservoir. The differences between the NIIP alternatives center on the points at which the water would be diverted before entering the proposed project pipeline system. The NIIP Moncisco Alternative would convey water through the NIIP system and would store water in the proposed Moncisco Reservoir. The NIIP Coury Lateral Alternative would require construction of a smaller storage facility near the existing Coury Lateral. The NIIP Cutter Alternative would divert water from Cutter Reservoir. The NIIP Amarillo Alternative would convey water through the NIIP system and would require construction of a storage facility near the end of the Amarillo Canal, but also would divert water from Cutter Reservoir. The NIIP Coury Lateral, NIIP Cutter, and NIIP Amarillo Alternatives would require modification to NIIP facilities for winter use.

In all of the structural alternatives, surface water would be treated to meet primary Safe Drinking Water Act standards before entering the proposed project conveyance system. Treatment plant designs are based on the quality of the water at the point of diversion. Treated water would then be conveyed in pipelines toward points of use. When necessary, relift pumping plants would be included to keep the water flowing in the pipeline. Navajo 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.

A typical relift pumping plant has a forebay tank, pumps and motors within an enclosed building, an air chamber, and rechlorination 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. Rechlorination equipment provides the required chlorine residual in the treated water.

The turnout pumping plants would have the same components as the relift pumping plants except that a storage tank would replace the forebay tank. Rechlorination equipment might not be necessary if chlorine residuals were adequate. A summary of the major components required for each of the alternatives is shown in table IV-1.

Table IV-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
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

Project facilities serving the Gallup area are collectively called the Gallup Regional System, and they are common to all alternatives. They consist of one new pumping plant, upgrades to three storage tanks, and 32 miles of pipeline, as shown in table IV-2. None of the alternatives' facilities physically connect with the Animas-La Plata Project's Navajo Nation Municipal Pipeline.

Table IV-2.—Gallup Regional System

Component	NIIP Moncisco Alternative	NIIP Coury Lateral Alternative	NIIP Cutter Alternative	NIIP Amarillo Alternative	SJRPNM Alternative	San Juan River Infiltration Alternative
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

Surface Water Diversions

NIIP Alternatives

Cutter Reservoir.—For the NIIP Cutter Alternative only, existing Cutter Reservoir would supply all of the water for the entire project, and there would be no diversion from the San Juan River.

Moncisco Dam and Reservoir.—Moncisco Dam and Reservoir would be constructed specifically for the proposed project. Water would be delivered to Moncisco Reservoir from the existing Burnham Lateral, part of the NIIP. The designs for Moncisco Dam would include a river outlet works with a tee for diverting water into the water treatment plant.

The Moncisco Water Treatment Plant would deliver treated water to a pumping plant, which would then pump water into the proposed Cutter and San Juan Laterals for transmission to the various communities.

Coury Lateral.—A canal turnout structure would be constructed near the beginning of Coury Lateral for the NIIP Coury Lateral Alternative. Water from the Coury Lateral would be diverted into a 4,500 acre-foot storage pond and, from that point, would be pumped into a treatment plant.

Amarillo Canal.—A canal turnout structure would be constructed near the end of the Amarillo Canal for the NIIP Amarillo Alternative. Water from the Amarillo Canal would be diverted into a 4,500 acre-foot storage pond and, from that point, would be pumped into a treatment plant.

San Juan River Alternatives

PNM Diversion Structure.—For the San Juan River alternatives, one of the options for diverting water from the San Juan River is to construct a new turnout structure just upstream from the existing PNM diversion structure, which is located about 1.5 miles northwest of Fruitland, New Mexico. The PNM diversion conveys water for a coal-fired steam electric plant.³ The use of the existing PNM facilities was evaluated, but because of the potential impact on PNM's water quality, it was determined that a study should

³ A report was prepared for Reclamation by Tetra-Tech Inc. In this report, Tetra-Tech developed a simple HECRAS model of the PNM diversion and settling channel describing the hydraulics and theoretical settling characteristics of sediment in the PNM intake channel.

proceed with the concept of constructing a water intake structure independent of the existing PNM intake facility and to include independent sediment removal facilities. It was assumed that the new concrete structure would be located just upstream from the existing intake/turnout on the north side of the San Juan River.

The structure would have a side intake with a trash rack and fish screen. The flow was assumed to be 0.5 foot per second through the trash rack. There would be a ramp at a 10:1 slope down which equipment would be driven to the pumping plant sump from which silt buildup would be removed. A pump would also be provided to remove sediment from the sump. The pumping plant would have a maximum capacity of 60 cubic feet per second (cfs). Each of the vertical turbine pumps would be rated at 100 horsepower. At the top of the ramp would be a 24-foot square parking/loading area. The entire site would be fenced with a 7-foot-high chain link fence. The pumping units would pump from the sump to settling basins and the treatment plant.

Infiltration Gallery System.—The San Juan River Infiltration Alternative includes an IGS that would obtain water from the San Juan River downstream of the Hogback and upstream of its confluence with the Chaco River. This diversion option would tie into the previously proposed alignment for the SJRPNM Alternative at the most feasible point. The proposed IGS components would include a series of infiltration galleries placed in the river alluvium, collection wells and pumps, a collection manifold system and tank, a pumping plant, and a pipeline to the proposed water treatment plant site.⁴ The gallery caissons were spaced approximately 500 feet apart along the San Juan River and were at locations influenced by environmental considerations. For this study, the yield of each well was estimated at 1.5 MGD (2.33 cfs).

A typical collector well is constructed of a concrete caisson typically ranging from 12 to 20 feet in diameter and approximately 20 feet deep. Each collector well would include a pump and a backup pump housed in a weatherproof enclosure. Numerous infiltration pipes would radiate out from the caisson into the river alluvium. The infiltration pipe would be perforated to allow water filtering through the alluvium to enter the pipe and be transported to the collector well, from which it would then be pumped. The well pumps would convey water through a collection manifold that would gather the water from the entire infiltration gallery (well field) to a collection sump and pumping plant. The pumping plant would lift the water approximately 120 feet in elevation from the river elevation to the bluffs south of the San Juan River into the water treatment plant.

⁴ The location and cost estimate for the collection wells were prepared by Ranney, a company that specializes in the design and construction of infiltration gallery systems.

Cutter Dam and Reservoir (Existing Features of the NIIP).—The Cutter Lateral is part of the San Juan River alternatives and would serve communities in the eastern portion of the Navajo Nation and the Jicarilla Apache Nation. The Cutter Lateral would obtain water from Cutter Reservoir via the river outlet works. Cutter Dam and Reservoir are existing features of the NIIP. 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.

Description of the Alternatives

NIIP Moncisco Alternative

The NIIP Moncisco Alternative would utilize two laterals to deliver water to different portions of the Navajo Nation, but both would begin at one location, the proposed Moncisco Reservoir (figure IV-1). This alternative would use existing NIIP canals and features to convey water to the proposed Moncisco Reservoir during the irrigation season. From the proposed water treatment plant near Moncisco Reservoir, the East Lateral would convey water south to communities in the eastern portion of the Navajo Nation and the Jicarilla Apache Nation. The West Lateral would convey water south to communities in Navajo chapters along Highway 491 in the eastern portion of the Navajo Nation and to the city of Gallup. Several sublaterals would convey water to the communities of Window Rock, Arizona, and the Nahodishgish Chapter/Dalton Pass, New Mexico.

Water for the NIIP Moncisco Alternative would be conveyed from the existing Burnham Lateral to the proposed Moncisco Reservoir via a proposed stabilized channel. The NIIP system would convey water from Navajo Reservoir and through a series of canals, siphons, and tunnels to the Gallegos Pumping Plant, which conveys water to Burnham Lateral. An existing wasteway in Burnham Lateral would be used with the proposed stabilized channel to convey water to Moncisco Reservoir. Moncisco Dam and Reservoir would be constructed specifically for the proposed project and would have an approximate capacity of 12,000 acre-feet of active storage. This storage would be provided because the NIIP system would not operate during the winter months. Previous designs, estimates, and quantities from two Reclamation reports⁵ were evaluated and refined, and the costs for these designs were indexed for this study.

A water treatment plant would be located immediately downstream of Moncisco Dam and Reservoir to treat the water before it is conveyed to the Navajo communities, the Jicarilla Apache Nation, and the city of Gallup. The treatment plant would utilize an

⁵ Technical Memorandum No. GG-8311-2, “Gallegos Dam, Reconnaissance Design Summary” and *Water Supply and Storage Options, Gallup Navajo Pipeline Project, Engineering and Cost Estimates Appraisal Level Report*.

enhanced coagulation and hollow fiber ultrafiltration treatment system. Treated water would be pumped into the West and East Laterals. The NIIP Moncisco Alternative would have an expected flow capacity requirement of 67.52 cfs (43.6 MGD).

NIIP Cutter Alternative

The NIIP Cutter Alternative would be similar to the NIIP Moncisco Alternative, but would not require the construction of Moncisco Dam and Reservoir (figure IV-2). Water would be released from Navajo Reservoir and conveyed through the existing NIIP system to Cutter Reservoir throughout the year, requiring improvements for winter use of a portion of the existing NIIP facilities. The treatment plant would be constructed at the base of Cutter Dam. Water would be pumped from the base of Cutter Dam through the Cutter Lateral to Highway 550, at which point the pipeline would serve the East and West Laterals following the same alignments as the NIIP Moncisco Alternative.

NIIP Coury Lateral Alternative

The NIIP Coury Lateral Alternative is similar to the NIIP Moncisco Alternative, but instead of constructing Moncisco Dam and Reservoir, the existing NIIP facilities would be winterized to convey project water throughout the year (figure IV-3). A turnout structure would divert water from the Coury Lateral and tie into the alignment proposed in the NIIP Moncisco Alternative. The turnout structure was sized based upon a standard canal turnout with a 48-inch-diameter outlet pipe. This alternative requires a 4,500-acre-foot lined storage pond located near the Coury Lateral, which would provide storage capacity for the summer months when NIIP facilities could not provide both peak irrigation demand and project demands (volume II, appendix B). The pond was assumed to be square, with a 20-foot water depth and 3 feet of freeboard. The pond was partially excavated below original ground, and a compacted embankment was assumed to be 5 feet above original ground and 6 feet wide at the top. The interior was assumed to be lined with a 40 mil membrane liner and 6 inches of riprap.

The water treatment plant, as described in the NIIP Moncisco Alternative, would be located near the storage pond and the Coury Lateral, and flows would be the same as those discussed under that alternative.

All flows for the proposed project remain the same, as described in the NIIP Moncisco Alternative.

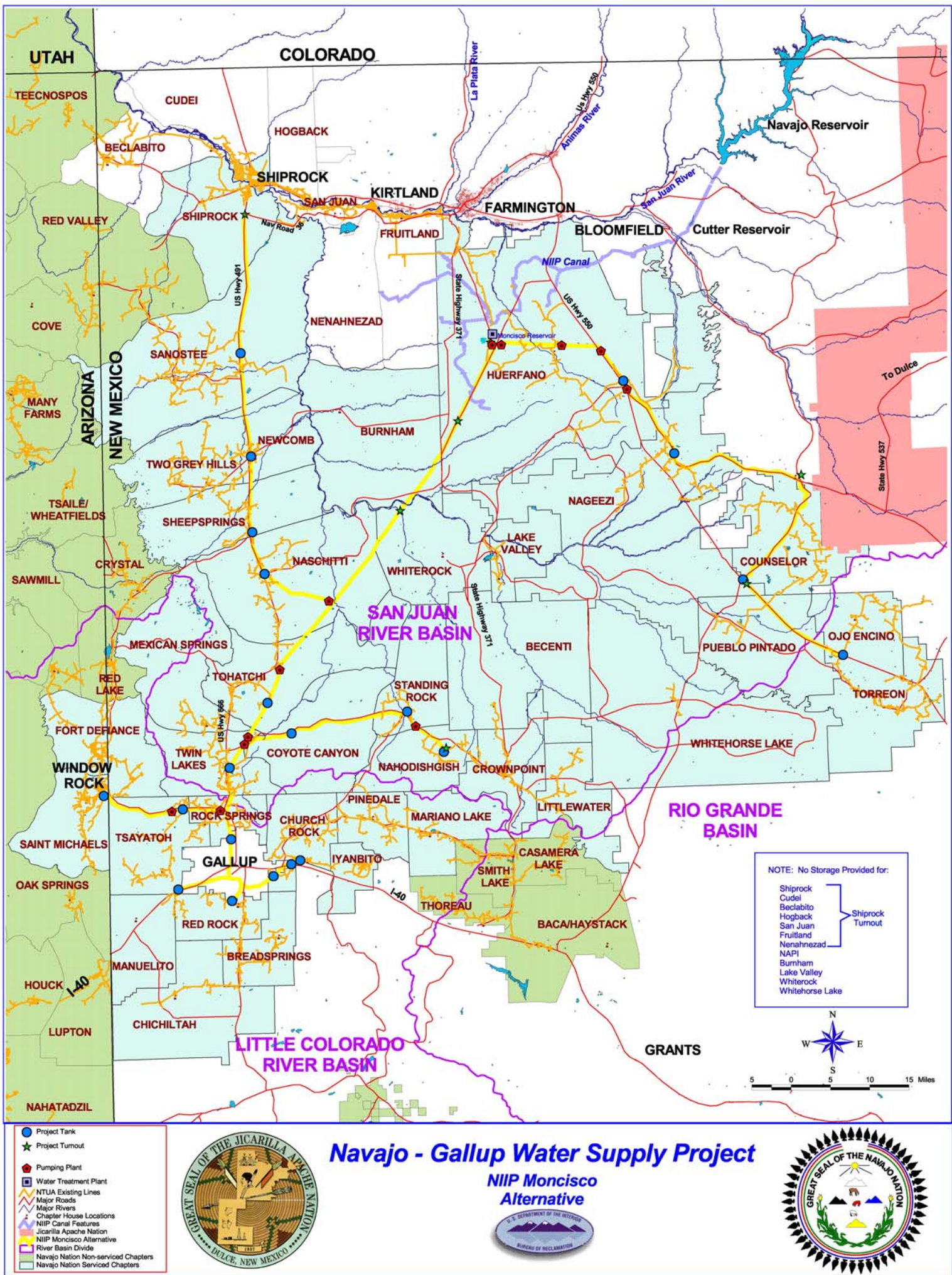


Figure IV-1.—NIIP Moncisco Alternative.

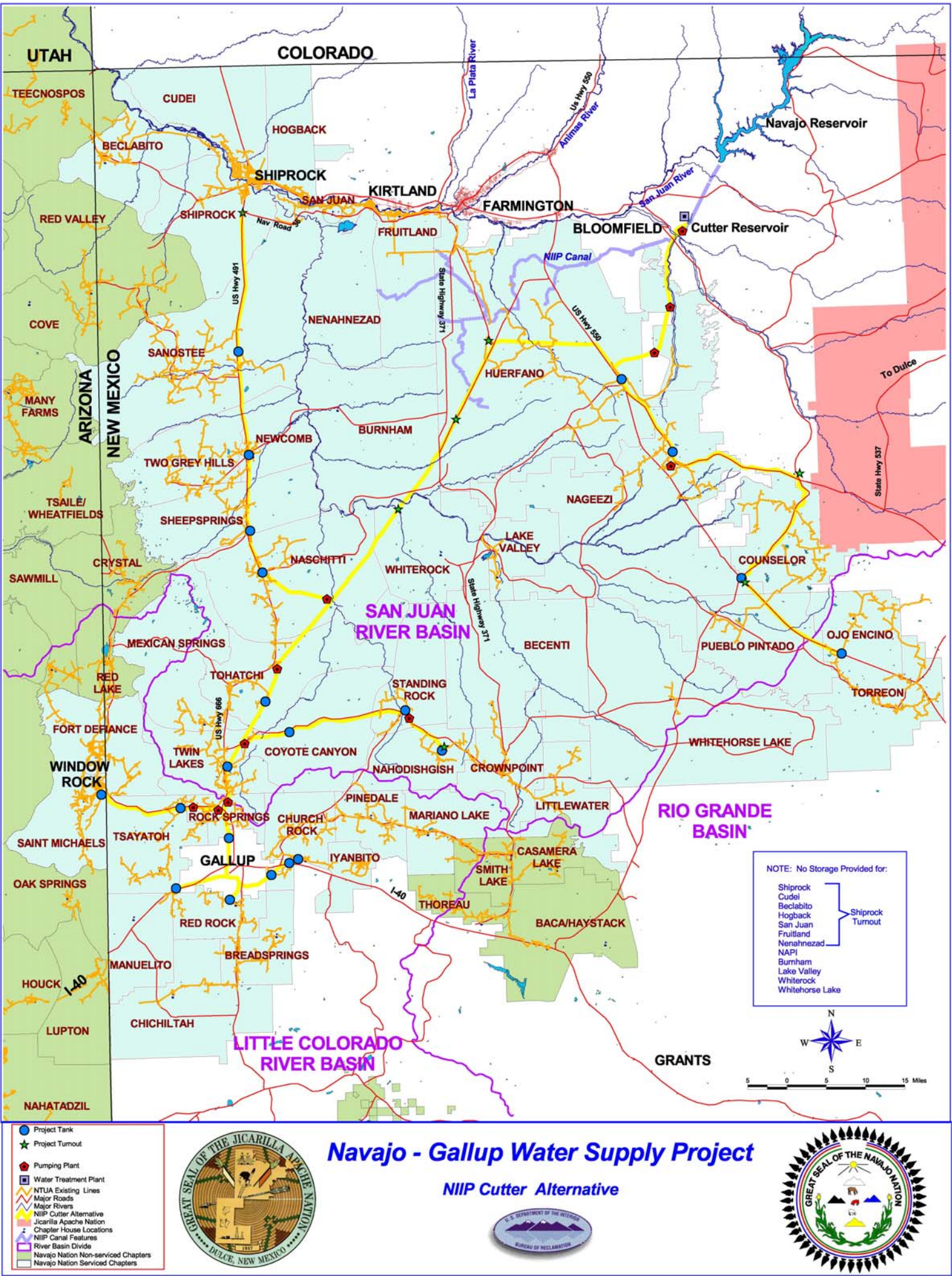


Figure IV-2.—NIIP Cutter Alternative.

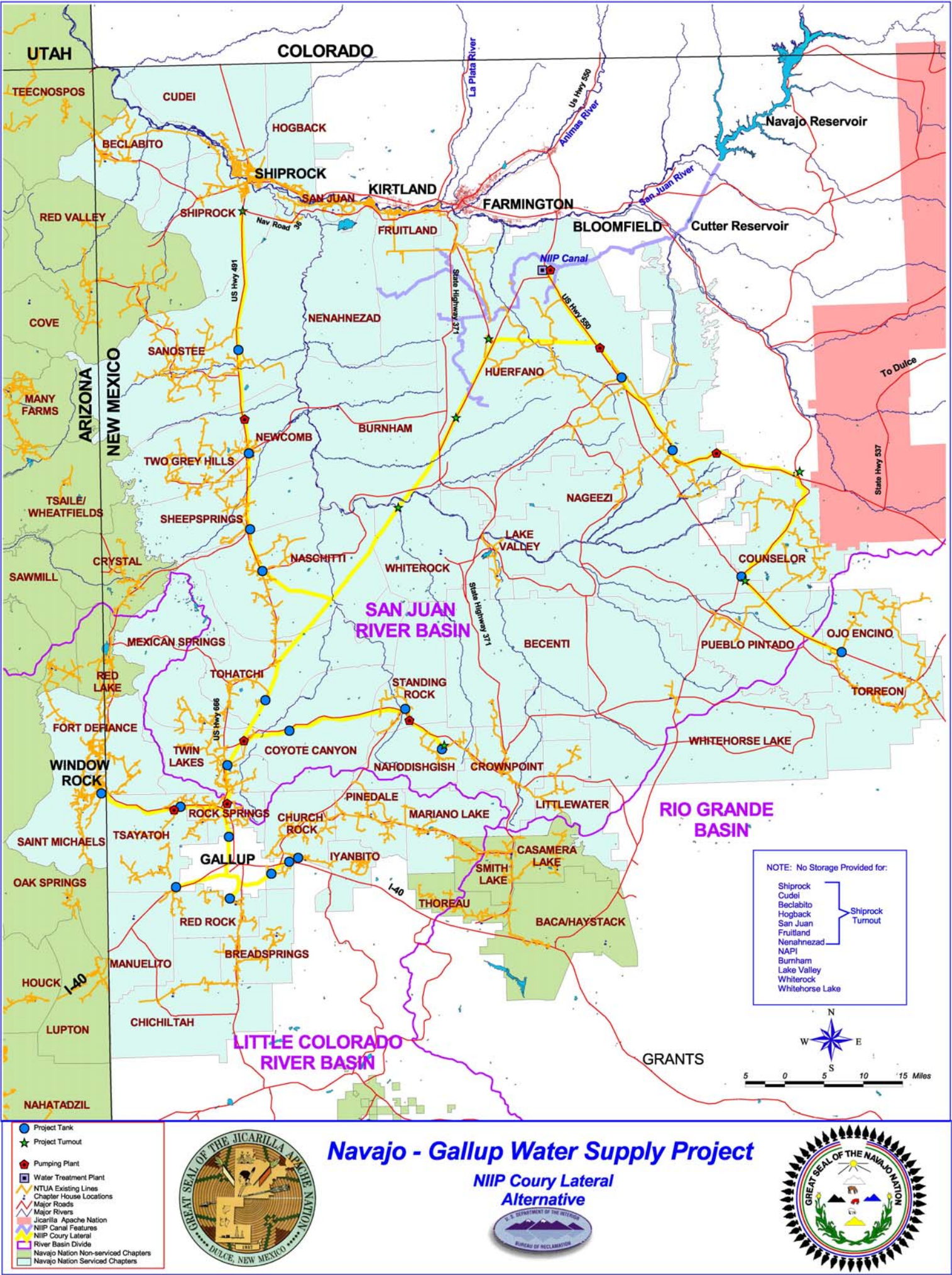


Figure IV-3.—NIIP Courty Lateral Alternative.

NIIP Amarillo Alternative

The NIIP Amarillo Alternative is similar to the NIIP Coury Lateral Alternative in that the existing NIIP facilities would be improved for winter use to convey project water throughout the year (figure IV-4). However, this alternative diverts water from the end of the Amarillo Canal for one lateral, as well as from Cutter Reservoir for the Cutter Lateral. A turnout structure would divert water from the Amarillo Canal and tie into the alignment proposed for the SJRPNM Alternative (see below). The turnout structure was sized based upon a standard canal turnout with a 48-inch-diameter outlet pipe. This alternative requires a 4,500 acre-foot lined storage pond located near the canal.

A water treatment plant would treat the water from the Amarillo Canal before the water was transmitted to the Navajo communities and the city of Gallup. Another treatment plant immediately downstream of Cutter Dam would provide treated water to the eastern portion of the Navajo and Jicarilla Apache Nations. Both treatment plants would utilize an enhanced coagulation and hollow fiber ultrafiltration treatment system. Flows would be divided between the Amarillo Canal and Cutter Reservoir.

SJRPNM Alternative

The SJRPNM Alternative is made up of two separate lateral systems—the San Juan Lateral and the Cutter Lateral (figure IV-5). The San Juan Lateral would divert water from the San Juan River downstream of Fruitland, New Mexico, and treat and deliver the water west along Highway N36 and south along Route 491 (formerly Route 666) to communities in the eastern portion of the Navajo Nation in New Mexico and the city of Gallup. This lateral utilizes several sublaterals to serve such communities as Window Rock, Arizona, and the Nahodishgish Chapter/Dalton Pass, New Mexico. As noted, the SJRPNM Alternative would divert water from the San Juan River just upstream from the existing PNM diversion structure. A side channel inlet structure would be designed with a sump, and water would then be pumped to settling basins and a treatment plant. The Cutter Lateral would obtain water from the NIIP system at the existing Cutter Reservoir and treat and deliver the water south to communities in the eastern portion of the Navajo Nation and the Jicarilla Apache Nation.

A water treatment plant would treat the water from the San Juan River before the water was transmitted to the Navajo communities and the city of Gallup. Another treatment plant immediately downstream of Cutter Dam would provide treated water to the eastern portion of the Navajo and Jicarilla Apache Nations. Both treatment plants would utilize an enhanced coagulation and hollow fiber ultrafiltration treatment system.

San Juan River Infiltration Alternative

The San Juan River Infiltration Alternative is the same as the SJRPNM Alternative, except that the water would be diverted from the San Juan River through an IGS just downstream from the Hogback irrigation diversion, an existing structure further downstream than the PNM diversion (figure IV-6). All other aspects would be the same as for the SJRPNM Alternative.

Overall Operational Configuration

Each of the proposed alternatives would be fully automated systems. The water treatment plants would operate automatically to maintain availability of treated water. The system downstream of the treatment plants would be a series of pumping plants, regulating or forebay tanks, and community storage tanks. Each pumping plant operation along the main water transmission line would be controlled by float level switches in the forebay or a regulating tank upstream from that plant. During periods of low water demand from a local community, water altitude valves in the community storage tanks would reduce flows into the storage tank at predetermined elevations by shutting down pumps as demand decreased. As demand increased, staged pumps (one pump for each increment of 10 cfs) would start. The pumping plants would not need to be attended on a full-time basis, but would require a daily physical inspection. Each pumping plant would have one backup pump and an emergency generator capable of meeting full load power requirements for that plant in the event of a power outage (Reclamation, 2002c).

Pumps.—The pumps at the pumping plants were assumed to be of equal size with a maximum capacity of 10 cfs each. There is one standby pump unit at each pumping plant. The majority of the pumps would be horizontal split-case type. Each pump would have a suction and discharge valve with an electric or hydraulic operator. The pumps in the relift pumping plants and the turnout deliveries all would require a minimum of 15 feet of head on the suction side. Pumps would be controlled by level switches that sense the water levels in the regulating, forebay, and storage tanks. There are also two pumps (one plus standby) rated at 2.32 cfs at each infiltration well (Infiltration Gallery) system.

Air Chambers.—A typical air chamber size would be a 20-foot-diameter sphere. It was assumed that this would be an average size air chamber, and this size was used at all locations where an air chamber was needed.

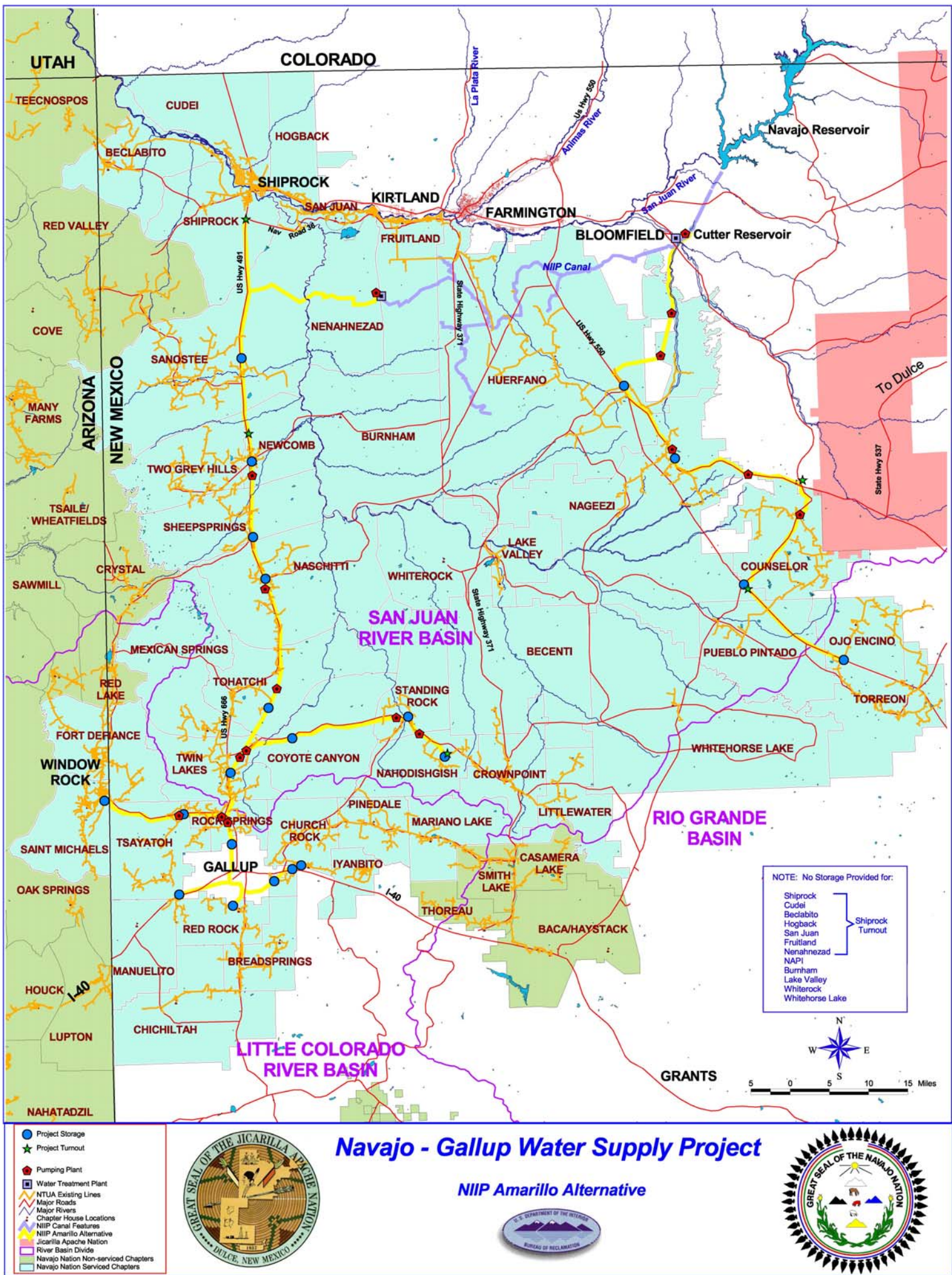


Figure IV-4.—NIIP Amarillo Alternative.

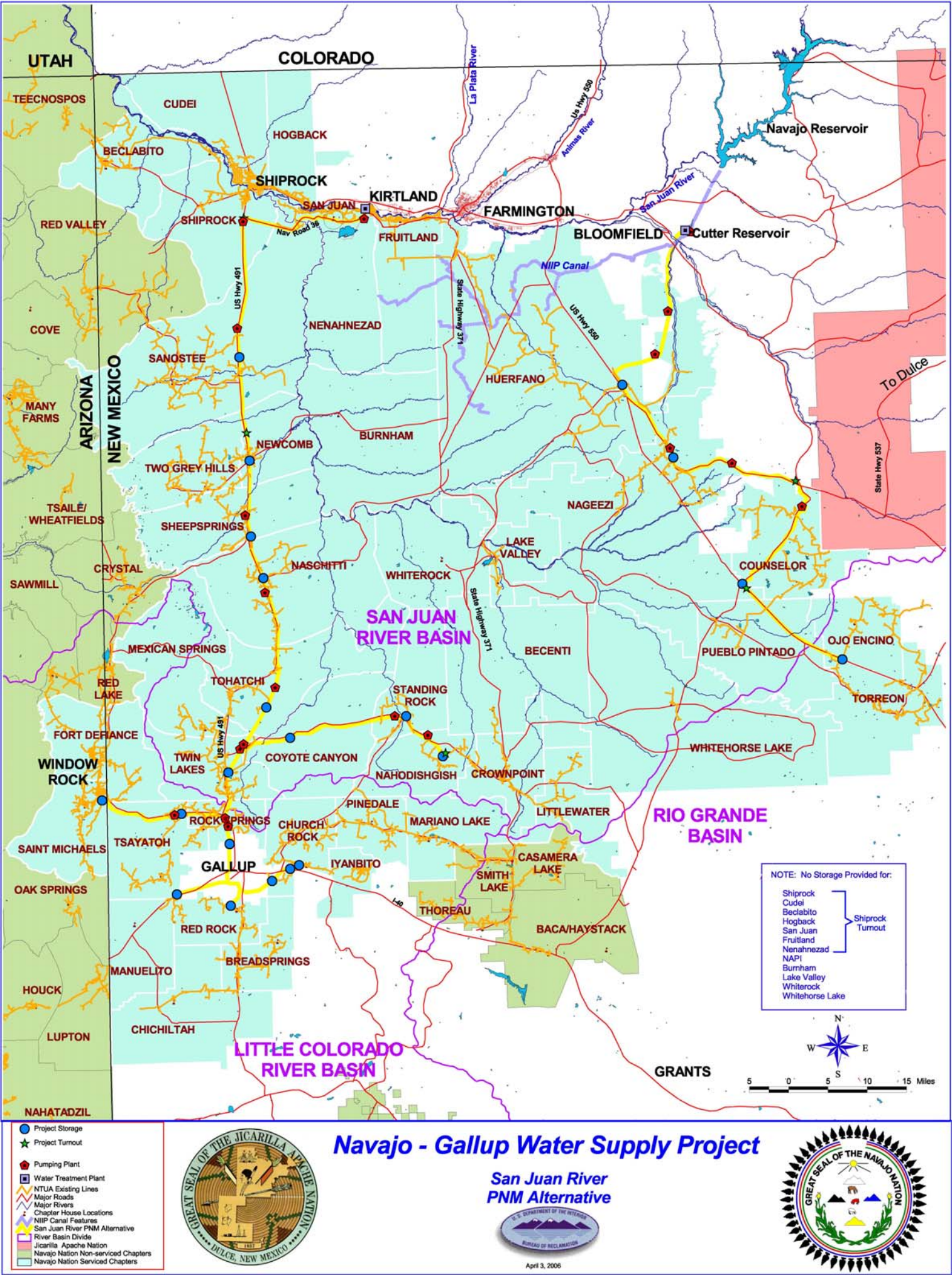


Figure IV-5.—SJRPNM Alternative.

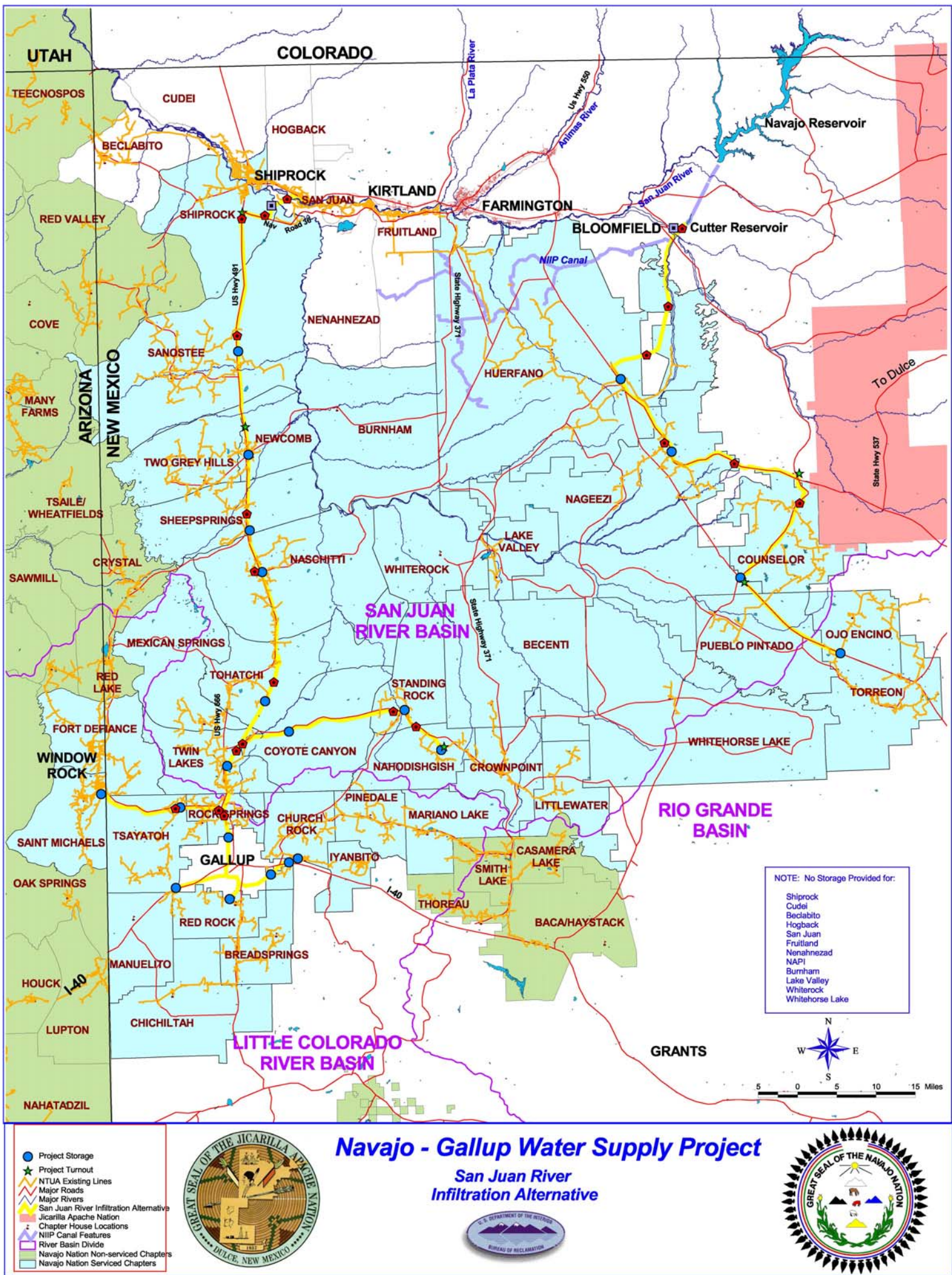


Figure IV-6.—San Juan River Infiltration Alternative.

Tanks.—Forebay tanks would be required upstream of almost every pumping plant to supply water during startup of the pumps and during shutdown to reduce damages. Altitude valves would be installed at most sites to prevent the forebay tanks from overtopping (volume II, appendix B). All of the forebay tanks were estimated to be 8 feet in diameter and 40 feet tall. In the next level of study, each of these tanks would be sized on an individual basis.

Where possible, regulating tanks were placed at high points, and gravity flow could then be used to deliver water to lower points in the system. By assuming that the pumps in the pumping plants would be 10 cfs or less and that the minimum run time was 15 minutes, the regulating tank diameters were found to be 40 feet. Then, depending on the number of pumps, the heights of the tanks were computed. Tank heights ranged from 9 to 22 feet. The height included 2 feet for bottom dead space and 5 feet for overflow and top freeboard space. Tank water surfaces would be the primary control for automatically stopping and starting the pumps. Storage tanks were provided at the delivery turnouts for the communities that had existing water distribution systems. These tanks store a 5-day water supply for the community, which is then boosted by the pumping plant to a pressure of 70 psi into the community water system. It was assumed that the height of the storage tanks would be 20 feet, and the diameters were computed based on the values for the 5-day storage for 2020 demands.

Electrical.—Several locations would be tapped to provide power for the pumping plants and miscellaneous equipment. The NTUA is installing a 115 kilovolt (kV) line (energized at 69 kV) from Tohatchi to Newcomb. This proposed powerline was assumed to be constructed by the time the proposed project began. The proposed project would extend this NTUA powerline along Route 491 north to Shiprock and south along the pipeline alignment to Window Rock and the Nahodishgish Chapter/Dalton Pass, New Mexico.

The pumping plants located in the eastern portion of the Navajo Nation would obtain power from an existing 230-kV powerline owned by PNM. There are two locations where this powerline could be tapped to provide power, depending on the alternative plan and the distance of new transmission line construction. The transmission line would include one overhead optical ground wire for T1 fiber optic communications. A small switchyard with at least one circuit breaker would be required to provide electrical protection for the downstream facilities.

The following are transmission lines and substations for each alternative:

SJRPNM Alternative	107 miles and 1 substation near Nageezi
San Juan River Infiltration Alternative	107 miles and 1 substation near Nageezi
NIIP Moncisco Alternative	73 miles and 1 substation near Moncisco
NIIP Coury Lateral Alternative	74 miles and 1 substation near Nageezi
NIIP Cutter Alternative	93 miles and 1 substation near Nageezi
NIIP Amarillo Alternative	107 miles and 1 substation near Nageezi

The substations would tap power from a 230-kV line owned by PNM and would convert to 69 kV. Kutz substation would be used to serve the pumping plant near the Coury Lateral of the NIIP Coury Lateral Alternative. Transmission line lengths may change due to pumping plant location changes.

Pipelines.—Design velocity would be about 5 feet per second or less and the maximum pump lift would be about 400 feet. The minimum system pressure along the pipe laterals was 15 feet. Pipe friction losses were limited to about 25 percent of the total dynamic head for the pumps. It was assumed that all of the lateral pipe would be mortar-lined steel pipe with full inside diameters.

OTHER ALTERNATIVE COST ATTRIBUTES

Land, Relocations, and Damages

Facilities of all alternatives are primarily located on Navajo Nation lands and public land with the exception of the water treatment plant for the SJRPNM Alternative. This plant and associated facilities would be located on private land, and purchase of land and relocation of existing families would be required, which is discussed in further detail in chapter V and attachment I. There is the possibility of crossing sections of private land and Tribal allotments with the pipeline, but specific pipeline locations have not yet been identified. It is assumed that a no-cost agreement can be made with private landowners and allottees or the pipeline would be realigned.

All land requirements and rights-of-way (ROW) required on Navajo Nation and public land are assumed to be at no cost except for identification, processing, and recording. Damages caused by construction of the proposed project would be paid to those impacted, as was estimated and included in the costs of all alternatives. Damages are based on the estimated number of families disrupted along the alignment of the alternative facilities and the proposed projected impact of facility construction, as discussed in further detail in attachment I. The estimated cost for each alternative is shown in table IV-4. The estimate includes ROW costs for the SJRPNM treatment plant only. Should it be determined that ROW for the rest of the features needs to be included in the proposed project costs, an additional \$30–60 million should be added.

All land rights would be acquired pursuant to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and the Uniform Relocation Act Amendments of 1987 (42 U.S.C. § 4601). It is the policy of Reclamation to compensate

for crop damages occasioned by nontortious⁶ activities of Reclamation during construction, operation, and maintenance under pipeline ROW or easements regardless of the method of acquisition.

Environmental Mitigation

Mitigation costs considered under all alternatives are determined by the impacts of construction and operating and maintaining the facilities. The mitigation is associated with land-disturbing activities and associated impacts to vegetation, wildlife, and other resources. Along the San Juan River, impacts to riparian areas are assumed to be mitigated with improvement in a ratio of 3 acres to every 1 acre impacted. Along the pipeline alignment and other facility locations, the improvement was assumed to occur in the disturbed area. Mitigation would be area-specific, but would generally consist of improved vegetation, fencing, and land management. Mitigation costs are directly related to the area that would be impacted by each alternative. The associated cost for each alternative is shown in attachment I and volume II, appendix B. Chapter IV further describes environmental commitments and mitigation measures.

Cultural Resources

The anticipated cost of mitigation of impacts to cultural resources is based on the cost of similar mitigation work on projects in the area—the Dolores and Animas-La Plata Projects. Four percent of the capital construction costs of each alternative is considered an appropriate relative cost to use in the evaluation of the alternatives. It should be noted that Public Law 111-11 limits this to 2 percent. A specific archaeological survey was completed on two project alternatives and was used to provide an impact analysis and cost estimate (Wharton and Cleveland, 2002). This information was used to define a specific mitigation plan used in the next step of defining the selected alternative.

SCREENING PROCESS

Eight alternatives were initially screened for meeting the *Principles and Guidelines*' four tests of viability, including the six structural alternatives at the 2020 design capacity. The result was that the six structural alternatives (2040 design capacity) were carried forward for a more detailed comparison for screening. The next level of screening, in part to meet *Principles and Guidelines*' four account requirements, included a comparison of the total

⁶ Nontortious actions do not involve civil actions for injury or damage.

costs of each alternative as measured by its present cost per-acre-foot value. The six action alternatives were then rated, weighted, scored, and ranked according to nine factors. More detail about the screening process is in attachment J.

The Principles and Guidelines

The Four Tests of Viability

The *Principles and Guidelines* describe four overarching tests of viability to be considered for each alternative. The tests assess the completeness, effectiveness, efficiency, and acceptability of the alternative plans. Alternatives that met a minimum standard under all four tests were considered viable plans and were investigated in greater detail.

Completeness – This factor measures the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.

Effectiveness – This factor measures the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

Efficiency – This factor measures the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities and is consistent with protecting the Nation’s environment.

Acceptability – This factor measures workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

Table IV-3 displays the results of applying the four tests of viability to the eight alternatives. The No Action and Water Conservation Alternatives did not meet the *Principles and Guidelines*’ four tests of viability; therefore, the Water Conservation Alternative was screened out and the No Action Alternative was retained solely to meet NEPA plan formulation requirements. Additionally, although the year 2020 design capacities for the six structural alternatives are not shown in table IV-3, they were found to be incomplete, ineffective, and unacceptable because they did not meet the proposed project’s objective of providing an M&I water supply to the year 2040.

Table IV-3.—Application of the viability tests

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
No Action	No	No	No	No
Water Conservation	No	No	No	No
SJRPNM	Yes	Yes	Yes	Yes
San Juan River Infiltration	Yes	Yes	Yes	Yes
NIIP Moncisco	Yes	Yes	Yes	Yes
NIIP Coury Lateral	Yes	Yes	Yes	Yes
NIIP Cutter	Yes	Yes	Yes	Yes
NIIP Amarillo	Yes	Yes	Yes	Yes

The Four Accounts

The four accounts specified in the *Principles and Guidelines* are used to evaluate information on the effects of viable plans—NED, EQ, RED, and OSE accounts. Each account describes particular aspects of anticipated effects of the viable alternatives on the economy and environment.

The NED account measures changes in the economic value of the national output of goods and services, while the RED account gauges changes in the distribution of regional economic activity. The EQ account measures significant effects on natural and cultural resources, and the OSE account measures effects from perspectives that are relevant but not reflected in the other three accounts. The *Principles and Guidelines* require that the plan chosen must maximize net NED benefits as the preferred alternative, or else Reclamation must obtain an exception from the Secretary of the Interior to formulate a plan to meet other needs. The economic benefits of each alternative are essentially the same; therefore, the alternative with the smallest present worth value (also referred to as the total project cost measured in terms of cost per acre-foot of water) would represent the alternative that maximized NED benefits, and those results are discussed in the following section.

Comparative Total Costs of the Alternatives

The next step was to calculate the total project cost or present worth value (capital, construction, and operation, maintenance, and replacement [OM&R] costs) of the proposed project in order to satisfy requirements for the NED—the most critical of the four *Principles and Guidelines* accounts. The alternatives are ranked from highest to lowest cost, and the total estimated costs of the alternatives are reflected in table IV-4.⁷

⁷ The alternative costs and present value for the SJRPNM Alternative (preferred alternative) were not updated here for comparison purposes with the other alternatives. Updated costs for the preferred alternative are included in attachment I.

Table IV-4.—Present worth of alternatives (2001 \$)

	Alternatives					
	NIIP Moncisco	NIIP Coury	NIIP Cutter	NIIP Amarillo	SJRPNM	SJR Infiltration
Construction cost	570,000,000	550,000,000	620,000,000	470,000,000	440,000,000	470,000,000
Rank	2	3	1	4	6	4
Total project cost (construction, fish and wildlife, land, archaeology)	599,700,000	578,700,000	652,000,000	495,100,000	465,600,000	494,700,000
Rank	2	3	1	4	6	5
Total project cost (construction, fish and wildlife, land, archaeology) per acre-foot	15,881	15,325	17,266	13,111	12,330	13,100
Rank	2	3	1	4	6	5
OM&R costs NTUA	8,900,000	8,000,000	9,500,000	10,100,000	12,500,000	11,400,000
Rank	5	6	4	3	1	2
OM&R costs NTUA per acre-foot	236	212	252	267	331	302
Rank	5	6	4	3	1	2
OM&R costs CRSP	6,400,000	6,000,000	6,500,000	7,500,000	8,500,000	7,600,000
Rank	5	6	4	3	1	2
OM&R costs CRSP per acre-foot	169	159	172	199	225	201
Rank	5	6	4	3	1	2
Present worth total project NTUA	732,955,541	698,480,261	794,239,060	646,322,580	652,756,658	665,386,872
Rank	2	3	1	6	5	4
Present worth total project NTUA per acre-foot	19,409	18,496	21,032	17,115	17,286	17,620
Rank	2	3	1	6	5	4
Present worth total project CRSP	695,524,209	668,535,196	749,321,462	607,393,995	592,866,528	608,491,248
Rank	2	3	1	5	6	4
Present worth total project CRSP cost per acre-foot	18,418	17,703	19,843	16,084	15,700	16,113
Rank	2	3	1	5	6	4

Notes: Costs shown above are obtained from "Navajo-Gallup Water Supply Project, Appraisal-Level Design and Cost Estimates," Bureau of Reclamation, Technical Service Center, 2002c. Present worth costs include construction and OM&R costs for 50 years. 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.

Costs used in this analysis are at the October 2001 price level.⁸ The present worth analysis is based on a 50-year alternative life and an interest rate of 6.37 percent. OM&R cost estimates are shown for both Colorado River Storage Project (CRSP) and NTUA power costs. Results of this comparative analysis show that the SJRPNM and NIIP Amarillo Alternatives have the lowest present worth. The SJRPNM Alternative is the lowest using CRSP power rates, and the NIIP Amarillo Alternative is the lowest using NTUA power rates. The economic benefits of all the 2040 alternatives are essentially equal for this project, and the present worth is considered reflective of the NED account.

Alternatives Comparison and Weighting

Nine factors were identified to compare the alternatives:

- (1) Capital cost per acre-foot delivered
- (2) OM&R cost per acre-foot delivered
- (3) Impacts to endangered species
- (4) Impacts to environmental resources (aquatic, wildlife, vegetation, land use, and recreation)
- (5) Impacts to cultural resources
- (6) The quality of drinking water provided
- (7) Social and economic impacts
- (8) Acceptability to project participants
- (9) Risks associated with construction, implementation, and OM&R

For factor definitions, please see attachment J.

⁸ October 2001 cost estimates were available when this analysis was done. Since this analysis, costs and present worth for the SJRPNM Alternative (preferred alternative) were updated to 2007 dollars, shown in attachment I. Updated costs for the preferred alternative were not included here for comparison with the other alternatives.

Comparison of Alternatives by All Factors

Each alternative was rated within each factor and compared to each other numerically (1 through 12), with 12 being the least impacting or least costly. Each factor was then given a weight of importance for implementation of the proposed project (tables IV-5 and IV-6).⁹

Two separate analyses were done—one with all nine factors considered to reflect the overall alternative comparison and the other using only the environmental factors to reflect the environmentally preferred alternative (least impacting). The environmental factors—endangered species, environmental resources, socioeconomics, and cultural resources—were used to reflect the least impacting alternative.

The rating (1 through 12) of each alternative under each factor was multiplied by the weighting of each factor. The products for each were added together to give a total score of each alternative, and the alternatives were arranged, high to low, with high being the best. This process was done for the nine combined factors as well as only the environmental factors. For more information about the weighting process and the results, see attachment J.

Capital Cost.—The comparison of the total estimated capital cost per acre-foot of water delivered to implement the alternatives shows the SJRPNM Alternative is the least costly. These comparisons are based on October 2001 price levels. The SJRPNM Alternative was projected to have one of the shortest lengths of pipeline to construct for delivering water to the service area and had the least costly river diversion.

OM&R.—The NIIP Coury Alternative had the least projected cost per acre-foot to operate and had fewer facilities to maintain and the lowest power cost.

Endangered Species.—The NIIP Moncisco and NIIP Coury Alternatives had the least potential to impact endangered species because they had less potential for impacting critical habitat and populations of endangered aquatic, wildlife, and vegetation resources.

⁹ For weighting and ranking purposes, the 2020 design capacities were treated as viable alternatives.

Table IV-5.—Alternative selection criteria
(May 14, 2003)

Alternatives	Total cost per acre- foot	OM&R per acre- foot NTUA	Endangered species	Environmental resources	Cultural resources	Drinking water quality	Socio- economics	Acceptability	Risk	Total	Combined resource rank
SJRPNM	12	4	5.5	12	11	2.5	9.5	12	11		12
Rank*weight ¹	20.00	6.67	9.17	20.00	2.75	0.42	2.38	2.00	9.17	72.54	
SJR Infiltration	11	5	1	10	9	2.5	9.5	11	7		8
Rank*weight	18.33	8.33	1.67	16.67	2.25	0.42	2.38	1.83	5.83	57.71	
NIIP Mondisco	7	11	9.5	2	1	8.5	9.5	10	1		7
Rank*weight	11.67	18.33	15.83	3.33	0.25	1.42	2.38	1.67	0.83	55.71	
NIIP Coury	8	12	9.5	7	7	8.5	9.5	8	3		11
Rank*weight	13.33	20.00	15.83	11.67	1.75	1.42	2.38	1.33	2.50	70.21	
NIIP Cutter	5	10	7	1	7	8.5	9.5	9	7		5
Rank*weight	8.33	16.67	11.67	1.67	1.75	1.42	2.38	1.50	5.83	51.21	
NIIP Amarillo	10	8	3	4	7	8.5	9.5	7	4.5		6
Rank*weight	16.67	13.33	5.00	6.67	1.75	1.42	2.38	1.17	3.75	52.13	

¹ * denotes "multiplied by."**Notes:**

- Capital cost
 - OM&R
 - Endangered species
 - Environmental resources
 - Cultural resources
 - Drinking water quality
 - Socioeconomic
 - Acceptability
 - Risk
 - Total
- The costs of construction (including contract and noncontract [indirect]) per acre-foot of water.
- Operations, maintenance, replacement, and energy costs (energy costs are part of operations).
- Endangered species and environmental impacts (e.g., depletions from San Juan River, Southwestern willow flycatcher, Mexican frog, and cacti).
- Environmental other than endangered species (e.g., aquatic, land use, habitat, recreation, and regulatory).
- Impacts to archeological, ethnographic, and in-use sites.
- Quality of water from the source (all alternatives meet safe drinking water standards; NIIP water has a lower concentration of salts).
- Social and economic impacts.
- Project sponsor ranking (e.g., 2020 less acceptable than 2040, impacts to NIIP operations and future development, unit cost of water for year 2020 is higher for the city of Gallup and Jicarilla Apache Nation).
- Reliability and constructability.
- Total points including the weight.

For ranking and weighting purposes, there are 12 alternatives for the project (the 6 alternatives at 2 design capacities each—2020 and 2040). For all rankings, see attachment J. Each selection criterion is ranked between 1–12, with 12 being the preferred and 1 the least preferred. Each criterion is weighted and the points associated with an alternative for a specific criterion are then rank weighted for that criteria (e.g., a rank of 10 out of 12 with a weight of 20 derives 16.67 points).

Table IV-6.—Alternative comparison for environmental factors
(May 14, 2003)

Alternatives	Endangered species	Environmental resources	Cultural resources	Socioeconomics	Total	Environmental preferred rank
SJRPNM	5.5	12	11	9.5		12
Rank*weight ¹	13.75	30.00	18.33	15.83	77.92	
SJR Infiltration	1	10	9	9.5		8
Rank*weight	2.50	25.00	15.00	15.83	58.33	
NIIP Moncisco	9.5	2	1	9.5		7
Rank*weight	23.75	5.00	1.67	15.83	46.25	
NIIP Coury	9.5	7	7	9.5		11
Rank*weight	23.75	17.50	11.67	15.83	68.75	
NIIP Cutter	7	1	7	9.5		5
Rank*weight	17.50	2.50	11.67	15.83	47.50	
NIIP Amarillo	3	4	7	9.5		6
Rank*weight	7.50	10.00	11.67	15.83	45.00	

¹ * denotes "multiplied by."**Notes:**

- Endangered species — Endangered species and environmental impacts (e.g., depletions from San Juan River, Southwestern willow flycatcher, Mexican frog, and cacti).
- Environmental resources — Environmental other than endangered species (e.g., aquatic, land use, habitat, recreation, and regulatory).
- Cultural resources — Impacts to archeological, ethnographic, and in-use sites.
- Socioeconomic — Impacts to quality of life and economic growth.
- Total — Total points including the weight.

Twelve alternatives for the proposed project (the 6 alternatives at 2 design capacities each—2020 and 2040—were evaluated; however, only 2040 design capacity alternatives are shown here). Each selection criteria is ranked between 1–12, with 12 being the preferred and 1 the least preferred. Each criterion is weighted and the points associated with an alternative for a specific criterion is then rank weighted for that criterion (e.g., a rank of 10 out of 12 with a weight of 20 derives 16.67 points).

Environmental Resources.—The SJRPNM and San Juan River Infiltration Alternatives had the least potential to impact non-endangered environmental resources because additional water would be released from Navajo Reservoir into the San Juan River to the diversion point. The San Juan River Infiltration Alternative has a larger riparian impact area and, therefore, had a lower ranking than the SJRPNM Alternative.

Cultural Resources.—The SJRPNM Alternative is predicted to have the fewest impacts to cultural resources.

Drinking Water Quality.—Water from Navajo Reservoir is expected to have better quality than water from the San Juan River. The proposed water treatment for all alternatives

would provide water that would meet Safe Drinking Water Act quality standards. Some quality parameters, such as total dissolved solids, would not be reduced by the proposed treatment and would reflect the raw water levels. All alternatives that would use water from Navajo Reservoir were ranked highest in this category.

Socioeconomics.—Providing water for quality of life improvement and economic growth were the primary socioeconomic factors used in comparing the alternatives. Alternatives that would provide water for the estimated population growth to year 2040 were ranked higher than the design capacities for 2020 needs. The temporary positive contribution to the economy through the infusion of construction money and jobs was not significantly different among the alternatives.

Acceptability.—This element is considered the proposed project participants' concept of the preferred alternative. The factors they considered in this element were political acceptability and compatibility with future development or vision. Letters were received from the Navajo Nation and the city of Gallup supporting the SJRPNM Alternative. The Jicarilla Apache Nation did not have a specific alternative preference under this criterion. The SJRPNM Alternative was given the highest ranking, followed by the San Juan River Infiltration Alternative.

Risk.—The factors under this criterion are constructability and reliability. Alternatives that were considered technically unproven or sophisticated with a high level of unknowns were rated lower for constructability. Alternatives that had less reliable elements (e.g., those that depended on other projects like the NIIP) were given a lower rating. The SJRPNM Alternative had the highest ranking because it would use proven technology, has fewer unknowns, and would be less dependent on the NIIP.

ALTERNATIVES CONSIDERED BUT ELIMINATED

Nonstructural Alternatives Eliminated

The No Action and Water Conservation Alternatives did not meet the *Principles and Guidelines*' four tests of viability; therefore, the Water Conservation Alternative was screened out and the No Action Alternative was retained solely for NEPA requirements.

Water Conservation – Water conservation opportunities are currently being implemented, and significant additional water conservation measures within the service area are not available. This is evident through the relatively high water rates and low use

in Navajo communities in the proposed project area and the city of Gallup. Continued conservation will help the city of Gallup meet short-term needs, and it would be essential in addition to the proposed project's surface water supply to meet long-term needs.

Water Reuse – Treated effluent is currently being used for the golf course and park irrigation and is seriously being considered for direct reuse as drinking water by the city of Gallup. The quantity of water available will only supplement the anticipated project surface water supply.

Conjunctive Use of Groundwater and Aquifer Storage – Conjunctive use groundwater, in addition to surface water, is considered part of the plan to provide a long-term water supply for the proposed project area. Aquifer storage and recovery would require further analysis to determine if it would be applicable. If feasible, storage and recovery could provide additional water management opportunities, but would not alleviate the need for a long-term surface water supply in addition to available groundwater.

Structural Alternatives Eliminated

The 2020 capacity alternatives were not retained for further analysis because their capacity would be exceeded by the time the proposed project was completed; therefore, the alternatives listed below are for the 2040 capacity.

NIIP Moncisco – This alternative had an overall combined ranking of 7 and an environmental ranking of 7 out of 12. Its present worth ranking was 2 out of 6. Therefore, it was not considered for further analysis.

NIIP Cutter – This alternative had an overall combined and environmental ranking of 5 out of 12. Its present worth ranking was 1 out of 6; therefore, it was not considered for further analysis.

NIIP Coury – This alternative had an overall and environmental ranking of 11. Its present worth ranking was 3 out of 6. This was a competitive alternative, but because of its high construction costs and risk factors associated with being tied to the NIIP Canal, it received a lower ranking and was not considered further.

San Juan River Infiltration – This alternative had an overall and environmental ranking of 8 out of 12. Its present worth ranking was 4 out of 6. Its weaknesses were risk associated with installing and maintaining the drainage gallery and a greater impact to the riverine area. This was a competitive alternative, but it was not as favorable as other alternatives in any factor.

PREFERRED ALTERNATIVE SELECTION

The result of all the analyses discussed in this chapter was the retention of the SJRPNM and NIIP Amarillo Alternatives. The No Action Alternative was retained for comparison and for NEPA compliance purposes.

The SJRPNM Alternative is the highest ranked in the comparison of the entire range of factors. The comparison of only the environmental factors also ranked the SJRPNM Alternative the highest, and for this reason, it is considered the environmentally preferred alternative. The present worth of the total alternative costs (capital and OM&R) is the factor used to compare the NED attributes of each alternative. The SJRPNM Alternative had the lowest present worth (highest ranked) assuming electrical power at CRSP rates.¹⁰ The NIIP Amarillo Alternative had the lowest present worth (highest ranked) assuming NTUA power rates.

The evaluation of these two action alternatives was continued into Chapter V–Affected Environment and Environmental Consequences. The result of this analysis, shown in table V-19, is that the SJRPNM Alternative has fewer negative and more positive impacts than the NIIP Amarillo Alternative.

The conclusion of this alternative analysis is that the SJRPNM Alternative is superior from an economic, environmental, and overall perspective. In addition, the Navajo Nation formally identified this alternative as their preferred alternative. More detailed environmental analyses are presented in later chapters. Attachment I presents a specific, detailed description of the SJRPNM Alternative, including a physical description and cost estimates at January 2007 levels, and an economic analysis, including cost allocation, cost/benefit analysis, socioeconomics, and associated project details.

¹⁰ Since this analysis, costs and present worth for the preferred alternative were updated to 2007 dollars, shown in attachment I.