Site Review and Water Measurement Recommendations for the Pojoaque Valley Irrigation District (PVID) and the Indian Pueblos of Nambe, Pojoaque, and San Ildefonso

by

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Introduction

The Pojoaque Valley Irrigation District (PVID) and the Indian pueblos of Nambe, Pojoaque, and San Ildefonso receive supplemental irrigation water from Reclamation's San Juan-Chama Project from Nambe Falls Dam and reservoir completed in 1976. Most of the river diversion structures, concrete-lined irrigation canals, and measurement structures were constructed by Reclamation. The Native American Affairs Office has allotted funding for the improvement of water measurement and recording devices for the three tribes served by PVID. The Albuquerque Area Office will be providing technical support to the district and pueblos for this program. The Water Resources Research Laboratory (WRRL) was asked to assist by providing an overall impression of the district facilities and to recommend possible improvements.

Purpose

To review the conveyance facilities of the PVID and make recommendations regarding possible improvements to the existing water measurement and recording sites and type of water measurement devices and equipment for the additional proposed sites.

Review of Facilities

Karl Martin, Water Operations Manager and Team Leader for this project, and I toured the facilities with David Vigil from PVID and Herbert Yates from the Nambe Pueblo. Both were extremely helpful during our review by providing information about the water delivery system and operations and their visions for the future.

The PVID water is supplemented by storage water from Nambe Falls Dam. Reclamation, at the time of building the dam, provided conveyance systems and measurement devices in many locations throughout the district. There are diversion structures in the river downstream from the dam at many canal headings with turnouts leading to concrete-lined canals (figure 1). Other turnouts in the river require earthen berms be constructed in the river to channel flow toward the turnout. The two largest conveyance canals, Highline and Consolidated, have effective sand traps and sluices that return to the river. These keep the sediment in the canals to a minimum, providing much less canal maintenance and better measurement accuracy. In some locations, the concrete canal or pipe lining runs throughout the entire conveyance canal. In other locations, there are unlined canal sections downstream from the concrete-lined sections.

There are 14 existing measurement sites throughout the area monitored by PVID. The measurement sites all have Parshall flumes, either 1-, 1.5-, or 2-ft-wide constructed inside concrete-lined trapezoidal canals. Each measurement site has staff gages that are manually recorded at the H_a and H_b locations in the flume, with taps to a stilling well with a chart recorder. The ability of these sites to produce good measurements is hampered by sediment buildup, trash, overgrowth of vegetation (i.e. watercress, moss, etc) and possibly improper installation of the flume. In general, the ditch rider reported good data at the sites where the canals were well maintained, i.e. sediment traps and free

Figure 1. - River diversion for the Highline Canal from the Nambe River just downstream from the dam. Note the turnout in the far right, downstream from the gabion structure. Not all turnouts have diversion dams.

of vegetation. A typical Parshall flume installation is shown on figure 2 with a stilling well and strip chart recorder housing. These sites were all installed by Reclamation with typical capacity of up to 5 ft^3/s except for the Highline and Consolidated canals which typically convey up to 20 ft^3/s.

The pueblos are interested in adding additional measurement sites to define Indian and non-Indian use of the water. The top priority site is upstream from Nambe Falls Dam to measure the year-round base flow from the Nambe River. This is now computed from dam releases (measured at the stream gaging station downstream from the dam) and the reservoir elevation. The other potential sites are on the Community, Nueva, and Llano ditches. These are currently unlined canal sections with capacity of about 2-5 ft^3/s.

In addition to installing more measurement stations, the district, pueblos, and the Albuquerque Area Office would like real-time data to better manage water in the system. The district is not very big, but access to several sites is obtained by driving up the river channel and/or walking quite a way into the site.

General Recommendations

General recommendations are made regarding the existing and proposed measurement sites with comments on the appropriate level of instrumentation.

Existing measurement sites - The district must ensure accuracy of the existing Parshall flume measurement installations prior to installing more modern data acquisition and transmitting equipment. Many of the sites visited were in a poorly maintained state. Discussions with the ditch rider indicated that sediment and weeds were a common problem throughout the irrigation season. The amount of debris in the canal and the Parshall flume sections was clogging the head taps and/or

Figure 2. - Typical Parshall flume installation monitored by PVID. The 1-ft-wide flume is located on the Rincon Canal.

causing severe submergence of the flume. Several Parshall flumes were reported by the ditch rider to be routinely operating under submerged flow conditions above 95 percent. To prevent submergence effects, Parshall flumes should not be submerged above 70 percent. Reclamation's Water Measurement Manual [1] offers corrections to the free flow discharge for submergence levels up to 96 percent for a 1- to 8-ft-wide flume, however, operation in this range is <u>not</u> recommended. Current and ongoing research efforts [2] have shown that wide variations in discharge are reported with high submergence levels. Other authors [3] do not recommend the use of a Parshall flume as a measurement device when the submergence ratio, H_b/H_a, exceeds the practical limit of 0.90.

Under the existing conditions, the head readings from the Parshall flumes are not accurate enough to consider telemetry of this data for operations use. The following recommendations would help verify the potential of each existing site to provide accurate readings and ensure accurate measurements in the future:

1. Clean out each canal reach, survey the Parshall flume and the canal invert and cross section for a good distance upstream and downstream from the flume. While surveying the flume, check the crest level in both directions and the level of the downstream channel at the end of the flume. The physical ability of the device to provide accurate measurement can then be determined assuming knowledge of the design values for the flume. In addition, historical discharge data should be examined to determine if the flumes operated at less than 90 percent submergence at any time since installation.

2. Ensure proper maintenance at each measurement site. This includes routinely cleaning out the canals during irrigation season to ensure quality data. Weeds, debris, and sediment must be cleared from the area upstream, in, and downstream from the flume. Localized efforts at the flume do not ensure accurate measurements due to the possibility of downstream (backwater) effects that can submerge the flume. Methods of controlling sediment such as constructing sand traps and sluices at the river turnout should be considered.

3. While the system is operating, cross check the head measurements using the staff gages and the stilling well measurements to ensure that data gathering techniques are acceptable and the flumes are operating properly.

4. Measurement devices that are poorly installed (always operate under high submergence) should be moved or abandoned.

Potential sites - 1. Obtain survey information on the average cross section and invert slope of the canal, elevations of the adjacent lands, historical maximum water surface and flow rate, potential for impact on existing upstream or downstream checks or turnouts, and impact on existing operations.

2. Recommend installation of a ramp flume or long-throated flume or a new Parshall flume for the potential canal sites. Ramp flumes require only the measurement of the upstream water level and are less susceptible to sediment and vegetation problems and may be operated under greater submergence levels than Parshall flumes. Properly installed and maintained Parshall flumes would offer consistency of measurement devices throughout the district.

3. Install head level instrumentation and data loggers that can at a later date be expanded to transmit the data to a central location.

4. If proceeding with measurement of the inflow to Nambe Falls Reservoir, installing a permanent stable measurement structure is recommended. Two locations were identified during the trip and both show the potential for installing a measurement device.

Data acquisition and transmission - Upgrade the recording and transmission capability of perhaps 1 or 2 existing measurement sites or the new site on the inflow to Nambe Falls reservoir. Good candidates would be the heading on the Highline and/or the Consolidated where history has proven these to be well maintained and provide accurate discharge readings. This will allow the operators and users to become familiar with the equipment and determine if the value gained is worth the investment.

Long-Throated Flume Advantages and Design

Obviously, there are any number of water measurement devices [1,3] that could be considered at each site. Not all devices are appropriate for each site, and the device selection should be based upon its expected performance in relation to the design constraints that will be encountered. In addition, each device should be able to easily be used with an electronic flow totalizer or data logger that will store and, perhaps at a later date, transmit the data to a control center.

Once sites are selected, an important aspect of the project is obtaining the dimensions of the canal sections, including the bottom slope, for selection and design of a water measurement device. A field assessment of the available head is also needed. Therefore, water surfaces upstream and downstream

from the potential water measurement device installation sites are needed. Measurement of the water surfaces and the top of the canal banks will determine if adequate freeboard is available.

The potential lack of available head, coupled with weed and debris problems and requirements to keep costs low, led to the conclusion to use long-throated flumes wherever possible in the system. These flumes, also referred to as ramp flumes or Replogle flumes, are very easy to install, are accurate, and are easily modified to fit the site situation.

Flume Design - Flume design is based upon the work by the Agricultural Research Service (ARS) and the U.S. Bureau of Reclamation [4,5]. The flumes are critical flow devices, meaning that when critical flow occurs in the throat section of the flume, a unique relationship is established between the upstream head and the discharge. The long-throated flume consists of an approach channel, upstream transition, horizontal throat section, downstream transition, and tailwater channel. The parts of the flume design are shown on figure 3. Any of the flume components may be customized for an individual site. Normally, a rating curve or table can be computed with an error of about 2 percent.

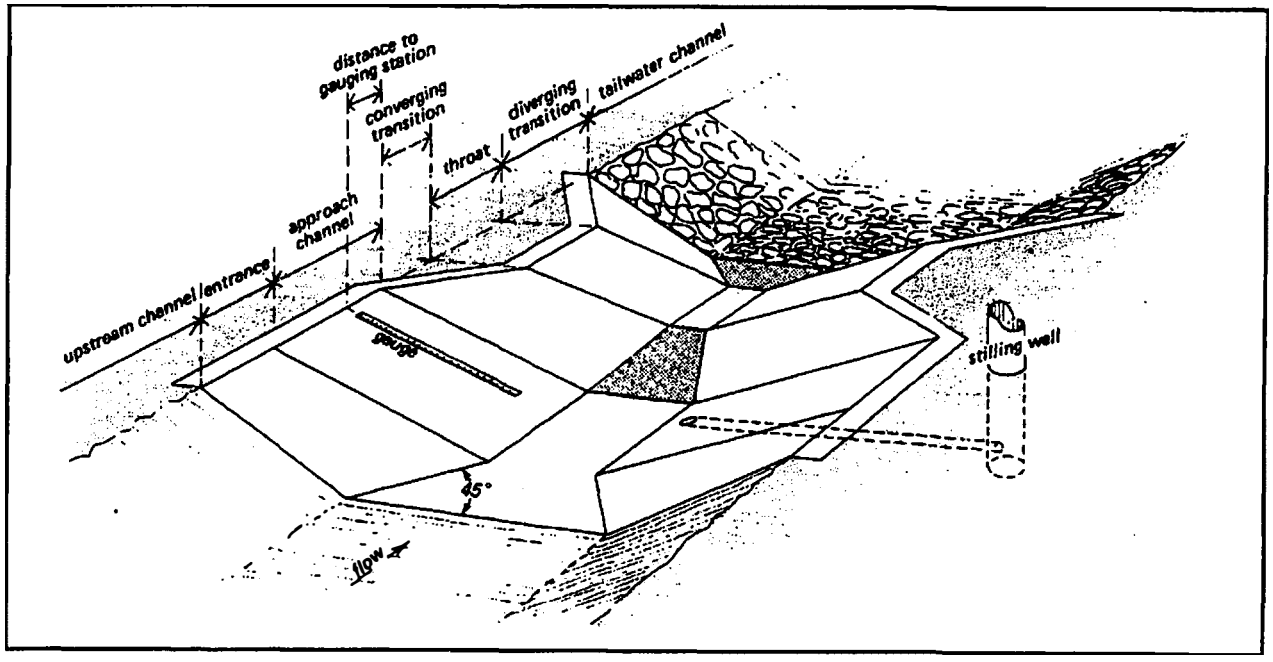

Figure 3. - Components of a general long-throated or Replogle flume. A ramp flume is a simplified version with no side contraction.

A computer program, FLUME, developed by ARS is being used to design flumes [4]. The FLUME program is used to determine the dimensions of the water measurement structure for a given canal geometry with estimates of the water surfaces. Setting the sill height is critical to preventing submergence of the flume and maintaining accuracy. In general, submergence should be limited to 90 percent or less.

Instrumentation - Instrumentation is needed to measure the total flow delivered. To accomplish total flow measurements, an open channel flow meter is needed. The meter is an electronic instrument with a remote ultrasonic transducer that records the upstream water surface or head. These are mounted above the water surface (or in a stilling well) at a specific distance upstream of the flume based upon a function of the head. The instrument measures the water surface by transmitting a pulse signal to the transducer which then emits ultrasonic pulses that echo off the water surface. The time for a pulse to echo back from the water surface is temperature compensated and converted into a head measurement. A discharge equation, developed during the flume design, is programmed into an electronic data logger. The instrument then uses this equation to convert the head measurement into flow rate. The flow rate is totalized and stored in a comprehensive data log for access manually, by printing, or remote telemetry. The instrument provides continual readout of the actual and totalized flow. Several instrument companies are currently in the process of modifying their available products to supply a simpler version of a flow totalizer that will hopefully be available in the near future.

There is no electricity at any of the sites, so all data logging and transmitting must be accomplished with batteries and/or solar panels. A staff gage with a chart that will convert head to discharge may also be installed at sites for quick checks on the accuracy of the electronic measurements.

Measurement Structure at Inflow to Nambe Falls Dam

Measurement of inflows to Nambe Falls Dam could be accomplished in any number of locations. The stream is very stable and not sediment-laden or filled with woody debris because the upstream watershed is well vegetated and quite rocky. During peak spring runoff, transport of small rocky material does occur, but this does not appear to be a major concern. Vandalism is not an issue. Hubert Yates was quite interested in constructing a stable measurement device that would pass small rock and debris during the spring runoff. The low flow condition is, however, the critical measurement.

Two potential sites for measurement were visited. One, upstream from a rock drop created in the river to prevent upstream migration of the fish in the reservoir to the natural river, Site A, and the other at the rectangular box culverts forming the road crossing just upstream from the reservoir, Site B. Both sites appear viable from a measurement standpoint. There is significantly better access at the box culverts.

Initial computations have been made for both these potential measurement sites on the Nambe river upstream from the reservoir. Computations were made based upon approximate dimensions of the culverts, width and slope (20 percent) of the river channel, and discharges ranging from 3 to 500 ft^3/s.

Site A - The river section located upstream from the fish barrier (drop) is an ideal location for a measurement station, other than construction access is somewhat poor. The river channel is about 18 ft wide with rocky stable side slopes and a rocky bottom with clear flowing water. Flow is supercritical and the drop would ensure good hydraulic conditions (figures 4 and 5).

The flume sill would be located at the river level with control obtained using side contractions. This would enhance the capability of the flume to pass sediment or rocky debris. An initial "ball park" design included a trapezoidal approach section 18 ft wide at the bottom with 1.5:1 side slopes converging into a 2-ft-long trapezoidal control section with a bottom width of about 5 ft and 1.5:1 side slopes. The side walls forming the convergence would be about 6 ft high to contain flows up to 500 ft^3/s. The basics of the flume design are shown on figure 6. This would be constructed just upstream from the drop created by the fish barrier.

The cost for site A would be for construction of the concrete flume section. The foundation should be good. The upstream head must be measured, recorded, and transmitted. The cost for construction of this flume includes mobilization, diversion (10 percent), formed reinforced concrete, unlisted items (10 percent) and contingencies (20 percent). The structure would require about 33 yd^3 of formed reinforced concrete at \$300/yd^3 for a total cost of about \$13,860. After initial calibration of the structure, further current metering should be unnecessary.

Figure 4. - Constructed rock fish barrier (about 5-ft drop) in river upstream from Nambe Falls Reservoir (Site A).

The USGS will provide an estimate for installation and maintenance of a typical rated section with an orifice and bubbler system and a data collection platform including a Sutron and GOES satellite transmitter. The disadvantage of this installation is that it needs current metering to initially calibrate the section and periodically ensure quality rating.

Figure 5..- Stream bed upstream from rock fish barrier on Nambe River upstream from the reservoir (Site A).

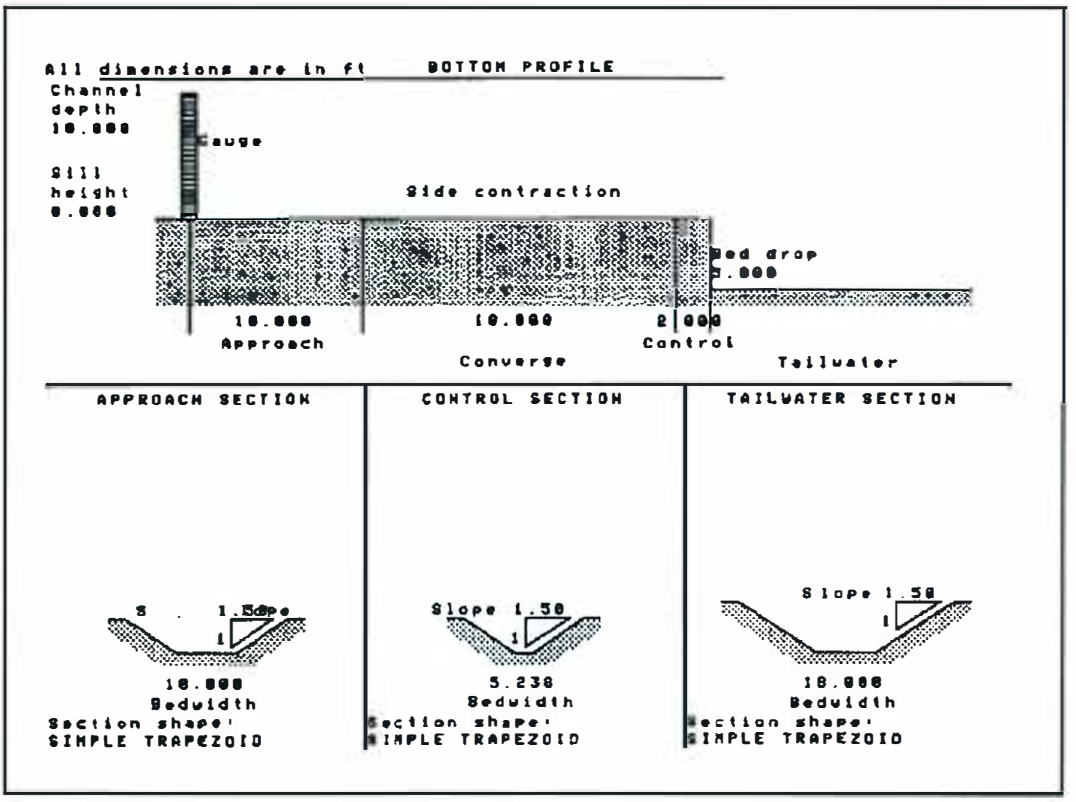

Figure 6. Basic schematic of flat bottom flume with side contractions for Site A.

Site B - The second site investigated was the box culverts under the roadway (figure 7). The design would incorporate a ramp flume designed for a discharge of 3 to 100 ft^3/s inside the far left culvert looking downstream. The remaining 400 ft^3/s would be passed over a weir structure spanning the three remaining culverts. The elevation of the weir would be such that it would begin overtopping as the water surface exceeded that of the 100 ft^3/s flow rate. This should allow accurate measurement of low base flows and the normal spring runoff discharge over the ramp flume and additional flows over the weir. The ramp flume would be about 0.5 ft high with a rectangular cross section. The converging approach section would be 6 ft long with an initial width of 10 ft (assumed culvert opening). The control section would be 4.5 ft long with a 5.7-ft width. The downstream expansion section would have a 6:1 slope, truncated after 1 ft. The ability to pass the inflow design flood has not yet been checked. These initial designs must be checked once the true culvert dimensions, discharge data, and field data has been obtained, but it does appear that this approach would be valid. The height of the flume has been minimized to reduce ponding upstream.

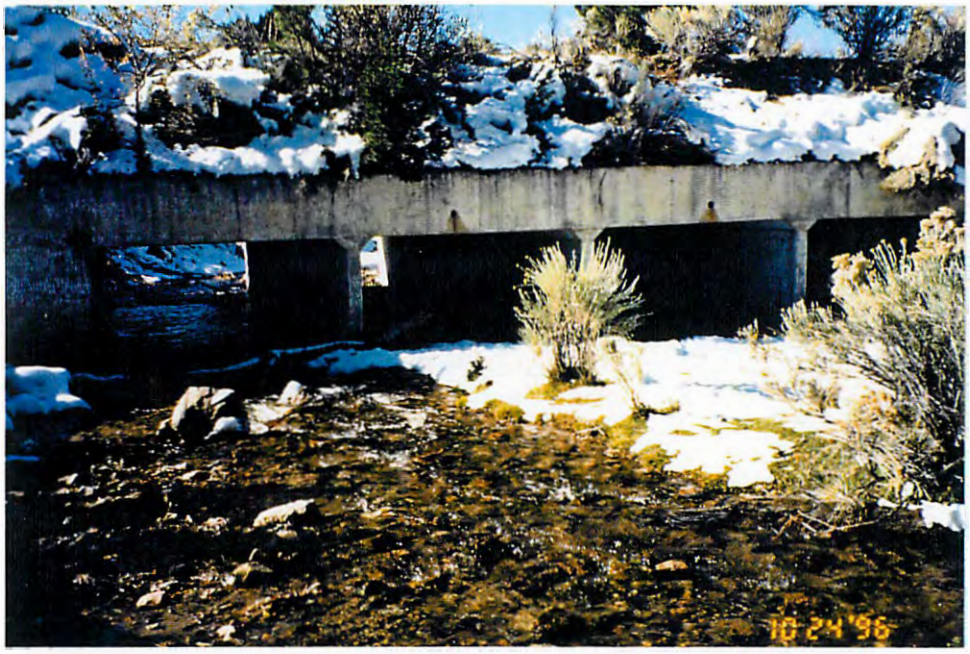

Figure 7. - Box culverts underneath road upstream of Nambe Falls Reservoir (Site B).

A "ball park" cost estimate for construction of the ramp flume and weir (9 yd^3 at \$300/yd^3) at the box culvert including site preparation, diversion (10 percent), formed reinforced concrete structures, unlisted items (10 percent), and contingencies (20 percent) is \$3780.

Both of these estimates are based upon estimates of the physical structures and the river characteristics. They are for feasibility-level decisions only and the structures must be finally designed after receiving the appropriate site data.

Flow Measurement at the Dam- The discharge leaving the dam is currently measured at a rated section downstream from the dam by the USGS. Another possibility for measuring all river flow is to measure the change in the reservoir level and the outflow from the dam. Primarily, flow is released through the outlet works and a small 6-in jet flow gate by-pass. The two 14-in jet flow gates and the 6-in by-pass have Venturi flow meters installed in the pipelines with flow transmitters or pressure

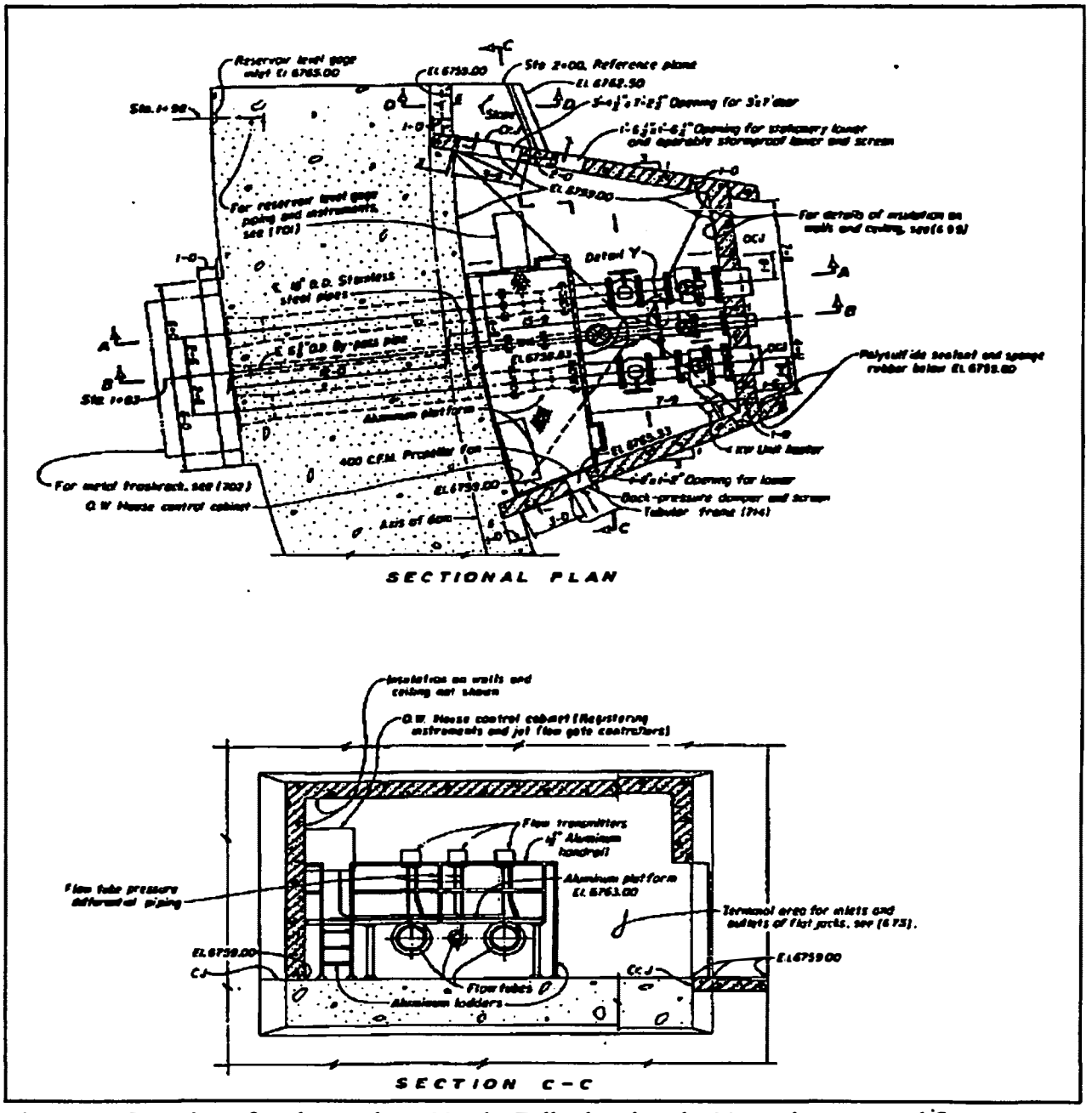

Figure 8. -Drawing of outlet works at Nambe Falls showing the Venturi meters and flow transmitters.

transducers (figure 8). These reportedly do not operate properly. Venturi meters should be very accurate, reliable measurement devices, and probably the flow transmitters are the problem. This situation could be inspected and, most likely, easily corrected with upgraded flow transmitters. The instruments for the reservoir level could also need upgrading. This alternative could be very cost

effective and allow the rated section downstream (maintained by the USGS) to be abandoned. This would significantly reduce operations and maintenance costs at the site. Reliable measurements at the dam would preclude the need to construct another measurement structure upstream from the reservoir.

Measurement Devices for New Unlined Canal Applications or Replacement of Existing Devices

The unlined canals are small and fairly heavily vegetated above the normal water surface. The normal conveyance capacity is about 2- to 4-ft^3/s. They are generally located downstream from long sections of concrete-lined canals.

Prefabricated metal long-throated flumes may be purchased and installed or concrete flumes may be constructed on site. The prefabricated flumes have a rectangular approach shape, side contractions, and adjustable sill heights. These would need to be installed with a seepage barrier (probably a short lined concrete section) into the existing canals. Basically, a short section of the canal would need to be lined and the flume installed. The advantage of using a prefabricated flume would be that the sill height is adjustable, therefore, unknowns in the canal water surfaces, freeboard, or operations can be handled.

Prefabricated Parshall flumes may also be purchased and would need the same type of installation. Table 2 gives estimates of the cost for the prefabricated flumes based upon the expected range of operation.

Table 2. - Costs for prefabricated long-throated flumes.

Discharge Range (ft^3/s)	Purchase Price of Prefabricated Long-throated Flume ($)	Purchase Price of Prefabricated Parshall Flume ($)
0-2	315	825
0-4	426	1150
0-6	495	?

Construction of a concrete flume would also require a short section of canal be lined with the flume formed inside. The necessary flume would probably not need side contractions or the downstream transition and would be very easy to construct. Lining a short section (about 10 ft) of canal would be common to both methods of installation. The concrete would be mixed on site and placed into a clean canal section at a cost of labor and about 1 yd^3 of concrete. Construction of a small concrete flume in the newly lined canal section would be very inexpensive, about $150-$250.

The total installation cost of a flume in a lined canal section, if any of the existing Parshall flume measurement devices need replacement, would be less because the flume would be formed inside the existing lining. A concrete flume inside an existing canal would cost only about $150- $250 and

would be less expensive than purchasing a prefabricated flume and installing it. Because the prefabricated flume would still have installation costs, the simpler method is probably to construct a concrete flume.

The instrumentation needs would need to be determined, but would probably be similar to those discussed for the existing sites.

Conclusions

Several of the existing water measurement sites equipped with Parshall flumes were reported to be routinely operating under submerged flow conditions above 95 percent. Discharge is reduced through a 1- to 8-ft-wide flume above 70 percent submergence. Corrections for various submergence levels are published, but the use of a Parshall flume as a measurement device when the submergence ratio, H_a/H_b, exceeds the practical limit of 0.90, is <u>not</u> recommended.

The accuracy of the existing Parshall flume measurement sites must be evaluated. The evaluation could also, in addition to the previous on site investigations, include looking at existing records to determine if the flumes have ever operated at less than 70 percent submergence. It is best not to operate submerged, where only the upstream head measurement, H_a, is recorded. If these measures are taken and the submergence ratio will exceed 70 percent, then the device should be abandoned.

At a good measurement site, data logging and telemetry is a good idea, and would be a way to demonstrate to the users the latest technology.

At the proposed new measurement sites, the canal or river channel is unlined. In these instances, the preferred measurement device is the ramp or long-throated flume. These are easy to install, operate over a wider range of submergence, require very little available head, easily pass floating debris and fines, and are cost effective. Measurement of the upstream head is the only requirement for computing discharge. Parshall flumes, properly installed, are also an option and would perhaps provide a good comfort level within the district because of familiarity with the devices.

It is worth investigating the possibility of rehabilitating the measurement capability at the dam. This option could produce reliable flow measurement and be very cost effective.

References

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SAN JUAN-CHAMA PROJECT, COLORADO-NEW MEXICO
POJOAQUE UNIT

TECHNICAL MEMORANDUM
ON
APPRAISAL OF DISTRIBUTION SYSTEM CONSOLIDATION
FOR
POJOAQUE VALLEY IRRIGATION DISTRICT

AUGUST 1980

SAN JUAN-CHAMA PROJECT, COLORADO-NEW MEXICO

POJOAQUE UNIT

TECHNICAL MEMORANDUM

ON

APPRAISAL OF DISTRIBUTION SYSTEM CONSOLIDATION

FOR

POJOAQUE VALLEY IRRIGATION DISTRICT

WATER AND POWER RESOURCES SERVICE

AMARILLO, TEXAS

August 1980

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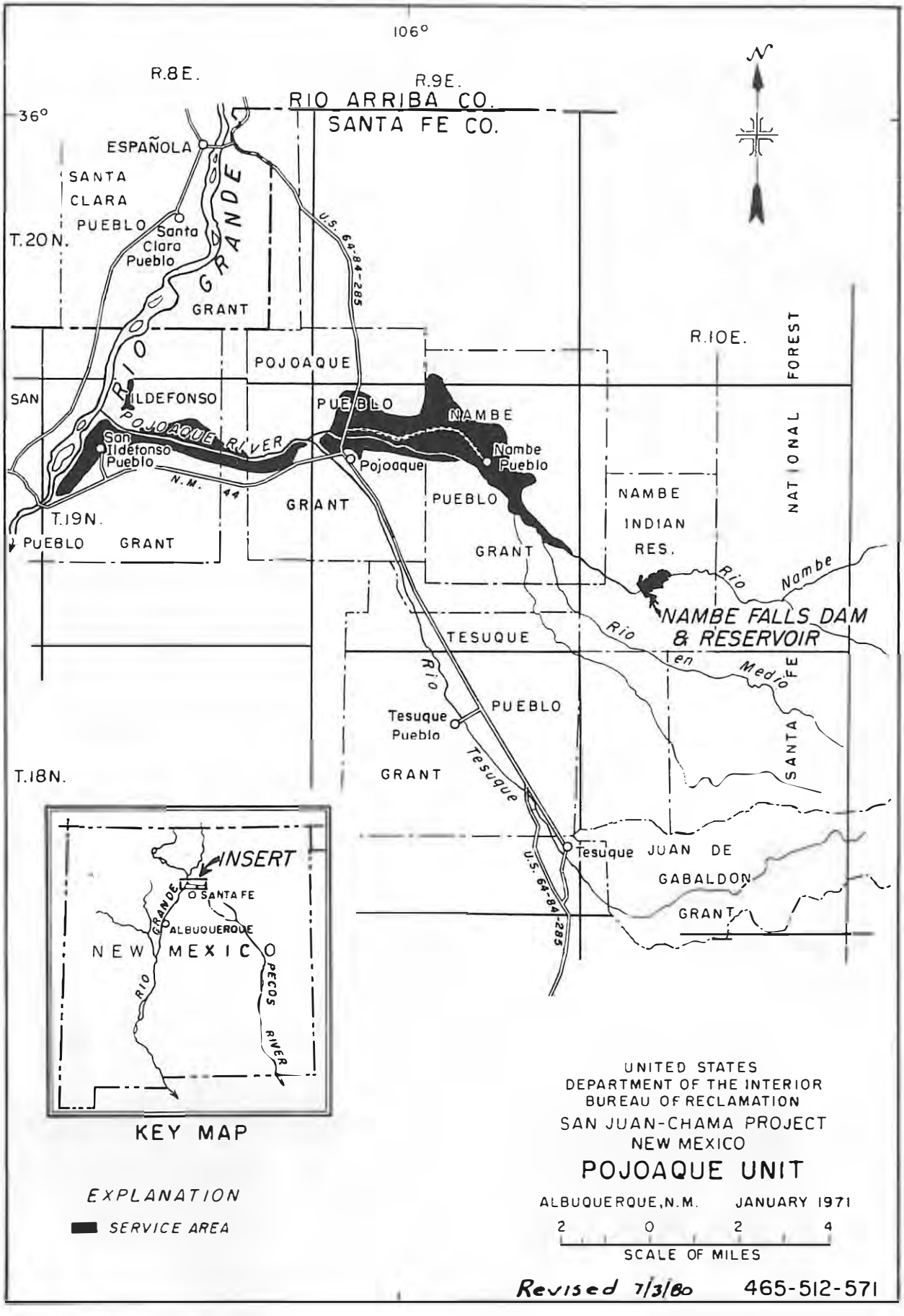
INTRODUCTION

Public Law 87-483, signed by the President on June 13, 1962, authorized the Secretary of the Interior to construct, operate, and maintain the initial stage of the San Juan-Chama Project. The definite plan report (DPR), volume I, revised June 1964, presented the definite plan for the diversion and regulation element of the authorized San Juan-Chama Project. This element, as was eventually constructed, consists of three diversion dams on the upper tributaries of the San Juan River in Colorado, a tunnel conduit system to convey water into the Rio Grande Basin, Heron Dam and Reservoir on Willow Creek to provide regulation, and a new enlarged outlet works at El Vado Dam. The definite plan for the Pojoaque Unit of the San Juan-Chama Project was presented in the Volume II DPR of August 1967, revised March 1968. That DPR proposed the construction of Nambe Falls Dam as the principal storage feature for the Pojoaque Unit. Construction of Nambe Falls Dam began in June 1974 and was completed in June 1976. Irrigation water service to the newly formed Pojoaque Valley Irrigation District (PVID) was initiated in 1976 under a separate surplus water contract. Normal irrigation season service to the lands of the district with water from storage in Nambe Falls Reservoir began in 1977. The location of the Pojoaque Unit is shown on drawing No. 465-512-571.

BACKGROUND

The original plan of development proposed for the Pojoaque Unit as presented in the San Juan-Chama Project authorizing report completed in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POJOAQUE
PUEBLO
SAN ILDEFONSO
POJOAQUE RIVER
San Ildefonso Pueblo
N.M. 44
Pojoaque
NAMBE
Nambe Pueblo
PUEBLO
GRANT
T.19N.
PUEBLO GRANT
NAMBE INDIAN RES.
NATIONAL FOREST
Rio Nambe
NAMBE FALLS DAM & RESERVOIR
TESUQUE
Rio en Medio
SANTA FE
Rio Tesuque
Tesuque Pueblo
PUEBLO
GRANT
T.18N.
Tesuque
JUAN DE GABALDON GRANT
INSERT
SANTA FE
ALBUQUERQUE
NEW MEXICO
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KEY MAP
EXPLANATION
SERVICE AREA
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SAN JUAN-CHAMA PROJECT
NEW MEXICO
POJOAQUE UNIT
ALBUQUERQUE, N.M. JANUARY 1971
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465-512-571

1955 proposed the construction of Nambe Falls Dam and Reservoir as well as a diversion dam and consolidated canal system to serve project lands. The use of the existing Nambe Diversion Dam and the construction of a new Pojoaque Diversion Dam were principal features for the new distribution system. The proposed diversion improvements and improvements to the existing distribution systems consisted of those considered the minimum necessary to provide dependable consolidated irrigation service to the project lands.

After project authorization, Pojoaque Unit studies were made during the period of 1963 to 1965 that lead to the eventual DPR. During this study period, the plan for the Pojoaque Unit as authorized was reviewed in light of conditions at that time. It was determined that the consolidation plan for the diversion and canal system as contained in the authorizing report, which was of a reconnaissance nature, was inadequate. The main reasons leading to that determination were:

1. A detailed inventory of the existing irrigation works completed in 1963 indicated that many more structures in the existing ditches were involved than were recognized in the reconnaissance plan. The 1965 General Map of the Pojoaque Unit is shown on drawing No. 465-512-400.

2. Higher irrigation capacities than previously determined were required for the canal distribution system and structures.

3. A permanent-type diversion dam of steel sheet piling (Rincon Diversion Dam) had been constructed since the reconnaissance plan that could possibly be used for the plan of development.

4. Requirements for the diversion dams design floods were greatly increased from those used in the reconnaissance plan.

5. New studies for reservoir sizing and geologic explorations had led to higher construction costs for the Nambe Falls Dam and Reservoir.

During the course of the definite plan studies for the Pojoaque Unit, several alternative consolidation plans for serving the project area were studied. The estimated costs for these alternatives proved to be much higher than the cost provided for in the authorized plan. As a result, the final DPR for the Pojoaque Unit recommended only the construction of Nambe Falls Dam and Reservoir. Any future consolidation and/or rehabilitation of the irrigation ditches and diversions within the project area would have to be accomplished under other Federal or State programs.

ALTERNATIVE CONSOLIDATION PLANS STUDIED (1963-65)

During the definite plan study period for Pojoaque Unit, numerous alternative plans were studied, evaluated, and cost estimated in an effort to arrive at a feasible plan that could be recommended for construction. All these plans can be placed into three main basic categories for consolidating the diversion and canal system.

The first plan concept was premised essentially on project features as authorized. This provided for two diversion dams, Nambe and Pojoaque, and the associated canals and necessary distribution structures. The second plan concept followed essentially the same scheme as in the authorized plan by using existing ditch locations but revised the plan to use the existing Rincon diversion structure. This plan concept then had a distribution system utilizing three diversion dams and the necessary canals and distribution structures to provide irrigation service. The third plan concept studied involved an effort to provide a canal and distribution system at a lower cost by locating the main canal system adjacent to the river in the flood plain, thereby eliminating the high cost of existing ditch right-of-way. This concept similarly utilized the three diversion dams--Nambe, Rincon, and Pojoaque. This concept was originally nicknamed the "backbone system."

The second and third basic plan concepts included many studies to consider different ideas proposed by local project sponsors of properly interconnecting various ditches. Studies utilizing open earth canal construction versus concrete pipeline were made in an effort to balance the right-of-way costs with construction costs. One important fact determined during the 1963 inventory of the existing irrigation system in the Pojoaque Valley was the extensive amount of constructed property development that was along and adjacent to the existing irrigation ditches. To utilize the existing ditch alinements to provide an adequate distribution system, tight right-of-way was encountered in many

areas resulting in high construction costs. This finding necessitated the idea of developing the "backbone system" to provide interconnecting irrigation service to the many existing ditches. The plans that still utilized the existing alinement concept of canal construction through areas of tight right-of-way restrictions employed concrete pipe instead of open canal construction. Another costly item in the utilization of the existing alinements for ditch interconnections were the numerous existing structures that would have to be replaced with new ones as the result of any new construction. During the 1963 Pojoaque ditch inventory, a total of 952 individual structures were found to exist. The following breakdown illustrates the extent of the number of irrigation structures that existed in the Pojoaque Valley at that time.

Farm turnouts	409
Lateral turnouts	32
Road culverts	203
Arroyo siphons	18
Arroyo flumes	48
Canal checks	56
Canal drops	21
Wasteways	30
Vehicular bridges	43
Footbridges	28
Distribution boxes	18
Canal underchutes	32
Parshall flumes	14

ALTERNATIVE CONSOLIDATION PLANS - UPDATED

General

At the request of the PVID, the alternative consolidation plans studied for the Pojoaque Unit DPR purposes were reanalyzed and the appraisal

costs updated to reflect current prices (January 1980). The reanalysis consisted of reviewing the work done in previous studies and incorporating and condensing the many plans studied into two schemes that would provide basic sound irrigation distribution service. What had been learned concerning the need for irrigation canal structures during the period when the definite plans were being studied for the Llano and Taos Units of the San Juan-Chama Project was applied to the Pojoaque Unit reanalysis. The irrigation systems for those two proposed units were studied at considerable feasibility level detail, and the structural designs and costs developed were modified and used to arrive at a method to develop appraisal costs suitable for the Pojoaque reanalysis. It is felt the appraisal costs are realistic and representative for rebuilding and consolidating the Pojoaque Valley ditch system to provide the most efficient irrigation service.

Table 1 lists the ditches located within the PVID, the acres served, and the required ditch capacity for that service. The acres served by the ditches are those utilized in the 1963-1965 studies and are based on the Pojoaque River Hydrographic Survey completed by the New Mexico State Engineer at that time. The required capacity is the amount of irrigation water required to provide service to the acres indicated for each individual ditch and is based on studies done in 1964. The capacities are based on consumptive-use data developed at that time as well as ditch seepage loss estimates based on ditch cross sectional dimensions as determined in the 1963 inventory. The Pojoaque Unit schematic

Table 1
Pojoaque Unit Ditches

A. Ditches within the Pojoaque Valley Irrigation District:

Diversion number	Ditch name	Area served (acres)	Required capacity ft^3/s
2	Nambe Highline Canal	148.8	6
	La Mocha Ditch 1/	40.8	3
3	Acequia de Juan Vigil	6.8	2
4	La Nueva Acequia (Llano Frio)	257.6	9
5	La Acequia del Llano	171.1	6
6	Community Ditch	232.7	8
7	Ortiz Acequia	141.4	6
9	Garduños Ditch	19.1	2
10	Juan Sena Ditch	5.9	1
11	Jose G. Ortiz Ditch	16.9	2
12	Caño Ditch	178.3	7
13	Rincon Ditch	136.0	6
14	La Acequia de la Joyas	172.5	7
15	Ancon Ditch	17.4	2
16	Trujillo Acequia	76.2	3
17	Barranco Alto Acequia	94.0	4
18	Acequia Larga	150.6	7
19	Barranco Acequia	101.1	5
20	Acequia de la Otra Banda	212.5	8
21	El Rancho Ditch	64.9	3
22	Acequia de los Indios	174.1	7
23	Acequia del Medio (del Rio)	107.3	5
	Ortiz Ditch	177.8	7
	Los Ojitos Acequia	30.1	2
	Montoya Ditch	23.8	2
24	Acequia del Alamo	44.1	2
2-T	Jaconita Ditch 2/	38.2	2
Subtotal		(2,840.0)	

1/ Served via the La Mocha Feeder from the Nambe Highline Canal.
2/ Inventoried in 1963 as being supplied from the Rio Tesuque.

B. Inactive ditches within the Pojoaque Valley Irrigation District:

Diversion number	Ditch name	Area served (acres)	Required capacity ft^3/s
1	Oak Ditch	6.6	2
8	Old Bernardino Ditch (Mill Ditch)	9.2	2
Subtotal		(15.8)	
Total		2,855.8	

C. Ditch not within the Pojoaque Valley Irrigation District:

Diversion number	Ditch name	Area served (acres)	Required capacity ft^3/s
1-T	Barranco Blanco Ditch	62.6	3

diagram of the existing irrigation system graphically represents the layout of the individual diversions and ditches within the Pojoaque Valley as based on data developed during the 1963-1964 period.

Riverside alinement (backbone) distribution system plan

This plan represents the unifying and updating of several "backbone" delivery systems studied during 1963-65. The best features of these plans are incorporated into this system. Exhibit A shows the layout details for this consolidation plan.

The three original diversion dams at Pojoaque, Rincon, and Nambe would be used. The Pojoaque Diversion Dam would be a new structure designed to accommodate a 50-year design flood of 12,400 cubic feet per second (ft^3/s). This would require an overflow wier crest 230 feet in length. The dam would have gated headworks at both abutments to provide service to the Pojoaque Canal Right and Pojoaque Canal Left. The existing Rincon Diversion Dam could be adequately rehabilitated to accommodate additional irrigation service demands. The existing wier of the diversion dam can safely pass a flow calculated at 1,480 ft^3/s with 1/2-foot freeboard. However, in 1965, the 50-year design flood was calculated at 7,620 ft^3/s. The diversion dam obviously could not accommodate this flood without overtopping the structure and any new headworks. The updated analysis for use of the Rincon Diversion Dam provides two cost estimates, one for the utilization of the existing structure with additional headworks and another for the construction of a complete new

diversion dam designed and built to Water and Power Resources Service (Water and Power) specifications.

The Nambe Diversion Dam is an existing structure that could likewise be used without the need for any significant structural rehabilitation. The existing wier can pass a flow calculated at 1,230 ft^3/s with a 1-1/2-foot freeboard. The existing canal headworks at the right abutment can handle an estimated maximum diversion of 65 ft^3/s. All that would be necessary to utilize this structure would be the construction of an arroyo control dike about 5 feet high and 200 feet long. However, the flood analysis made in 1964 determined the 50-year frequency design flood at this location would be 5,060 ft^3/s. A new diversion dam with a 75-foot wier would be required to adequately handle this design flood. As for the Rincon Diversion Dam structure, two cost estimates are provided in the Nambe Diversion Dam updating—one for the construction of an arroyo control dike and the other for a complete new structure designed and built to Water and Power specifications.

Pojoaque Canal Right provides service to the existing Acequia de La Otra Banda, and a diversion capacity of 10 ft^3/s is required. The Pojoaque Canal Left provides service to 723.2 acres and requires a diversion capacity of 20 ft^3/s. The following ditches are interconnected and served by lateral turnouts from this canal.

Barranco Acequia
El Rancho Ditch
Acequia de Los Indios
Acequia del Medio
Ortiz Ditch
Los Ojitos Acequia
Montoya Ditch
Acequia del Alamo (El Alamo Ditch)

The Pojoaque Canal Right would be a short stretch of ditch that would cost an estimated $38,000 (January 1980) to construct. A Parshall flume would be the only needed structure.

Pojoaque Canal Left has a total estimated construction cost of $526,000 (January 1980) and would include the following features:

1 - Parshall flume
5 - Arroyo siphons
7 - Road culverts
9 - Canal drops
3 - Lateral turnouts
1 - Wasteway
3 - Canal checks
6 - Drainage inlets

The estimated construction cost of these structures is $415,000. The estimated construction cost for the open canal earthwork is $93,000. The canal right-of-way requirements are estimated at 14 acres with a cost of $18,000.

The proposed new Pojoaque diversion dam has an estimated construction cost of $1,265,000 (January 1980).

The Rincon Canal Right would provide irrigation service to 727.2 acres of land and would provide consolidated service to the following ditches:

Caño Ditch
Acequia de Los Joyas
Ancon Ditch
Trujillo Acequia
Barranco Alto Acequia
Acequia Larga
Jaconita Ditch

A headworks capacity of 15 ft^3/s would be required at Rincon Diversion Dam to serve the Rincon Canal Right. The cost of installing a headworks in the right abutment at the Rincon Diversion Dam is estimated at $30,000 (January 1980). A new Rincon Diversion Dam structure built to Water and Power standards for this plan would cost an estimated $693,000 (January 1980). The new structure would include a headworks at the left abutment to serve the existing Rincon Ditch. The Rincon Canal Right would have the following structures.

1 - Parshall flume
2 - Arroyo siphons
1 - Siphon under Rio Pojoaque
8 - Road culverts
8 - Canal drops
4 - Lateral turnouts
2 - Wasteways
4 - Canal checks
2 - Drainage inlets

The estimated construction cost for the structures is $387,000. The estimated construction cost for the canal earthwork is $39,000. The right-of-way requirements are estimated at 9 acres with a cost of $17,000. The total estimated cost for the Rincon Canal Right is $443,000 (January 1980).

The Nambe Canal, as shown on Exhibit A, would provide irrigation service to 1,041.1 acres and would interconnect and consolidate the following ditches.

Nambe Highline Canal
Acequia de Juan Vigil
La Nueva Acequia
La Acequia del Llano
La Mocha Ditch (served via feeder from Nambe Highline Canal)
Community Ditch
Ortiz Acequia
Gardunos Ditch
Juan Sena Ditch
Jose G. Ortiz Ditch

A headworks capacity at Nambe Diversion Dam of 20 ft^3/s would be required for service to Nambe Canal. The existing headworks can easily accommodate this demand. The cost for adding an arroyo control dike at the diversion dam is estimated at $10,000 (January 1980). The construction cost for a new Nambe Diversion Dam built to Water and Power specifications is estimated at $516,000. Nambe Canal would have a total estimated construction cost of $702,000 and would have the following structures.

1 - Parshall flume
6 - Arroyo siphons
1 - Siphon under Pojoaque Creek
3 - Road culverts
13 - Canal drops
9 - Lateral turnouts
2 - Wasteways
5 - Checks
4 - Farm turnouts
2 - Drain culverts
1 - Canal chute

The total estimated construction cost for these structures is $607,000.

Thirteen acres are estimated as required for right-of-way for Nambe Canal at a cost of $24,000. The earthwork construction for the canal is estimated to cost $71,000 (January 1980).

Existing ditch distribution system plan

This plan incorporates the best of several plans studied using the alinements of existing ditches for interconnecting irrigation service. The locations and costs for the Pojoaque and Nambe Division Dams are the same as for the riverside or "backbone" alinement alternative. The costs for the Rincon Dam are more because of the need for a second headworks. Included in this section are those features and costs directly associated with the utilization of various Pojoaque Valley ditches for consolidated irrigation service.

Pojoaque Canal Left would utilize major reaches of the Barranco, Acequia, El Rancho Ditch, and Acequia de Los Indios with reaches of interconnecting ditches between them to provide continuous service. The total estimated construction cost for this canal is $1,361,000 (January 1980). The following structures would be required:

1 - Parshall flume
9 - Arroyo siphons
1 - Wasteway
40 - Road culverts
4 - Lateral turnouts
79 - Farm turnouts
5 - Canal drops

The estimated cost for these specific structures is $947,000. The Pojoaque Canal Left includes certain reaches of concrete pipe that would be necessary in restricted right-of-way areas. This concrete pipe includes 900 feet of 30-inch-diameter pipe and 2,800 feet of 27-inch-diameter pipe; 27- and 30-inch-diameter pipe sections are used for canal interconnection requirements. The total estimated construction cost for all the necessary sections of concrete pipe is $285,000. Fifteen-acres of right-of-way are required for this plan and amount to an estimated cost of $38,000. The earthwork construction cost for the open canal reaches is estimated at $91,000 (January 1980 cost).

The cost for the Pojoaque Canal Right is the same as under the previous alternative, or $38,000.

The Rincon Canal Right would provide service to four ditches or 444.4 acres. A headworks capacity of 12 ft^3/s would be required at the Rincon Diversion Dam. The Rincon Canal Left would provide service to 419.0 acres and serve four existing ditches. The required headworks capacity at the left abutment of the Rincon Diversion Dam would be 12 ft^3/s.

Refer to Exhibit B for details. The estimated cost for Rincon Canal Right is $205,000 (January 1978) and the estimated cost for Rincon Canal Left is $461,000. The cost of modifying the existing left headworks at the Rincon Diversion Dam is $5,000. This cost plus $30,000 for a new right abutment headworks amounts to an estimated $35,000. The estimated construction cost to build a new dam to Water and Power specifications is $720,000.

Details for the Rincon Canal Right are as follows:

Structures:
1 - Parshall flume
1 - Arroyo siphon
2 - Road culverts
3 - Lateral turnouts
8 - Farm turnouts
2 - Pipe drops
1 - Canal drop
3 - Canal checks

The cost of these structures is estimated at $156,000. Four-hundred feet of 24-inch-diameter concrete pipe would be required in a restricted right-of-way area. The estimated construction cost for this feature amounts to $17,000. A total of 4 acres would be required for right-of-way at an estimated cost of $12,000. The construction cost for canal earthwork is estimated at $20,000.

Details of the Rincon Canal Left are as follows:

Structures:
1 - Parshall flume
4 - Arroyo siphons
1 - Wasteway
11 - Road culverts
1 - Lateral turnout
31 - Farm turnouts
1 - Pipe drop (700 feet long)
2 - Canal drops
2 - Canal checks
2 - Drainage inlets

The total estimated cost for these structures is $334,000. One thousand eight hundred feet of 24-inch-diameter pipe would be required for the canal located in restricted right-of-way areas. The estimated construction cost for the pipe is $74,000. The right-of-way requirements would amount to 8 acres at an estimated cost of $25,000. The earthwork cost for the reaches of open canal is estimated at $28,000.

In 1964, a local project sponsor in the Nambe Canal service area recommended some specific changes to the original "backbone" plan concept that would utilize a major portion of the La Nueva Acequia in combination with the new Nambe Canal for service deliveries (refer to Exhibit B for this layout). This plan would utilize the same initial 1.8 miles of the alinement from Nambe Diversion Dam as included in the "backbone" plan. La Nueva Acequia would then be followed for 1-1/2 miles with irrigation service to the ditches across the Pojoaque Creek being provided by a 2,200-foot-long concrete pipe drop adjoining the original "backbone" alinement at the Pojoaque Creek siphon. All the irrigated land between the Acequia del Llano and Pojoaque Creek and east of the concrete pipe chute would continue to be served from the La Mocha feeder originating at the Nambe Highline Canal. A concrete pipe chute would be provided to interconnect La Mocha Ditch and the Community Ditch. The total estimated cost for the Nambe Canal under this alternative consolidation plan is $539,000 (January 1980). The following structures would be required:

1 - Parshall flume
2 - Arroyo siphons
1 - Siphon under Pojoaque Creek
2 - Road culverts
7 - Lateral turnouts
10 - Farm turnouts
1 - Wasteway
6 - Check drops
2 - Drain culverts
1 - Canal chute
La Mocha pipe chute

The estimated cost of these structures is $352,000. The cost for the 2,200 foot-long concrete pipeline chute is estimated at $85,000 and would consist of 300 feet of 24-inch-diameter pipe and 2,000 feet of 21-inch-diameter pipe. Nine acres are estimated as required for right-of-way needs and amount to $17,000 in cost. The cost for the earthwork construction for the open canal sections is estimated at $85,000.

Summary

The following tabulation is a summary listing of the estimated construction costs (January 1980) for the two alternative consolidation plans.

Riverside alinement (backbone) plan:

Pojoaque Diversion Dam		$1,265,000
Pojoaque Canal Right		38,000
Pojoaque Canal Left		526,000
Rincon Diversion Dam		
Headworks installation only	$30,000	
New diversion dam		693,000
Rincon Canal Right		443,000
Nambe Diversion Dam		
Arroyo control dike only	10,000	
New diversion dam		516,000
Nambe Canal		702,000

Total Cost: Plan with all new dams.....$4,183,000
Plan with existing dams and Pojoaque diversion.....3,014,000

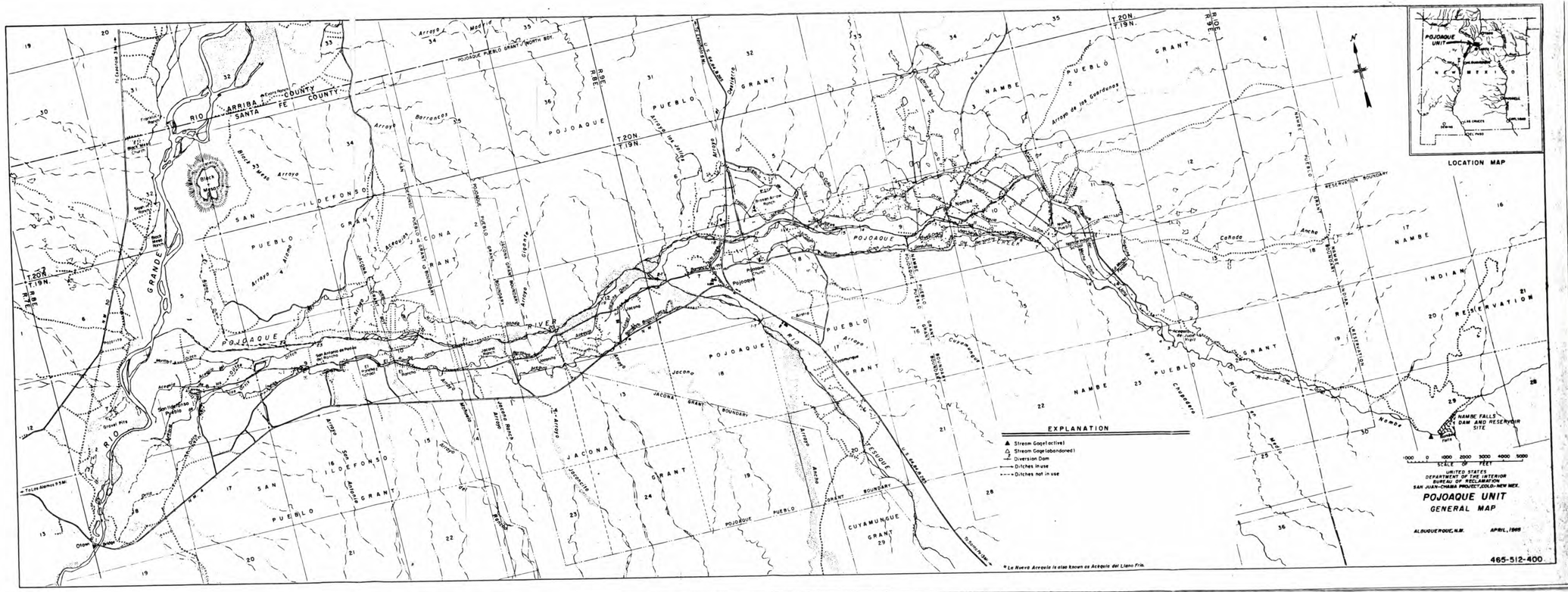
Existing ditch system plan:

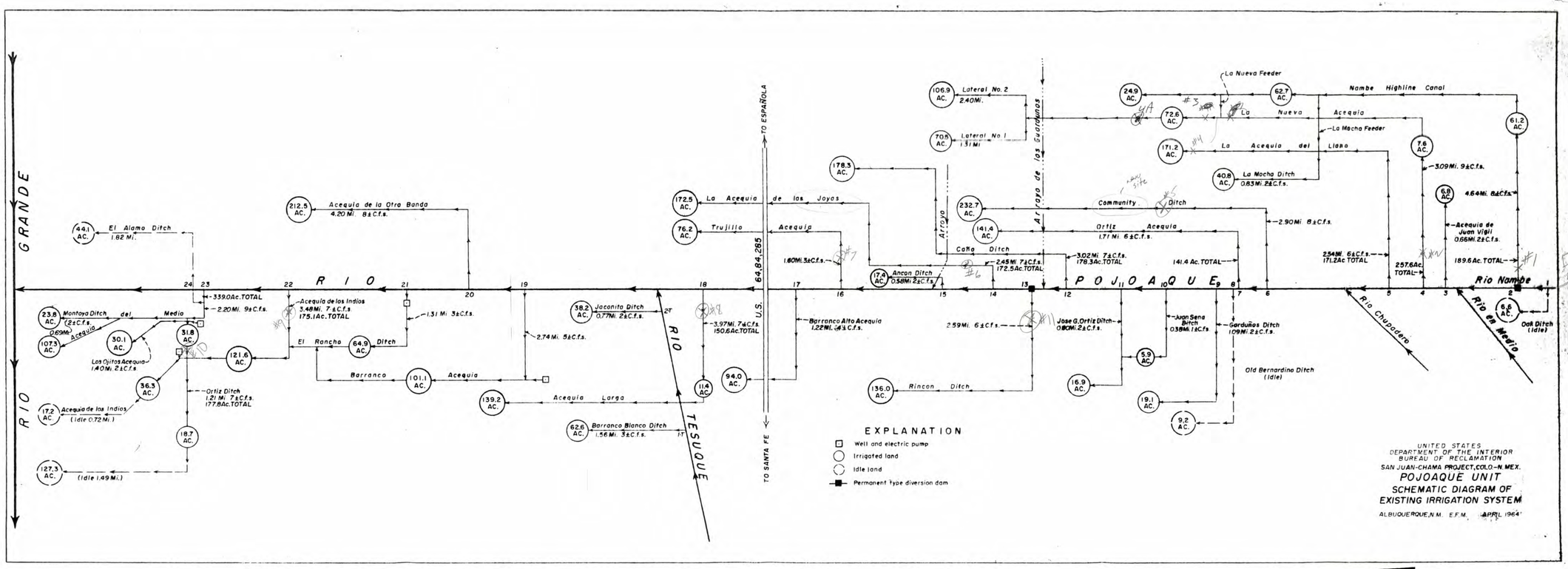
Pojoaque Diversion Dam		$1,265,000
Pojoaque Canal Right		38,000
Pojoaque Canal Left		1,361,000
Rincon Diversion Dam		
Headworks installation only	$35,000	
New diversion dam		$720,000
Rincon Canal Right		205,000
Rincon Canal Left		461,000
Nambe Diversion Dam		
Arroyo control dike only	10,000	
New diversion dam		516,000
Nambe Canal		539,000

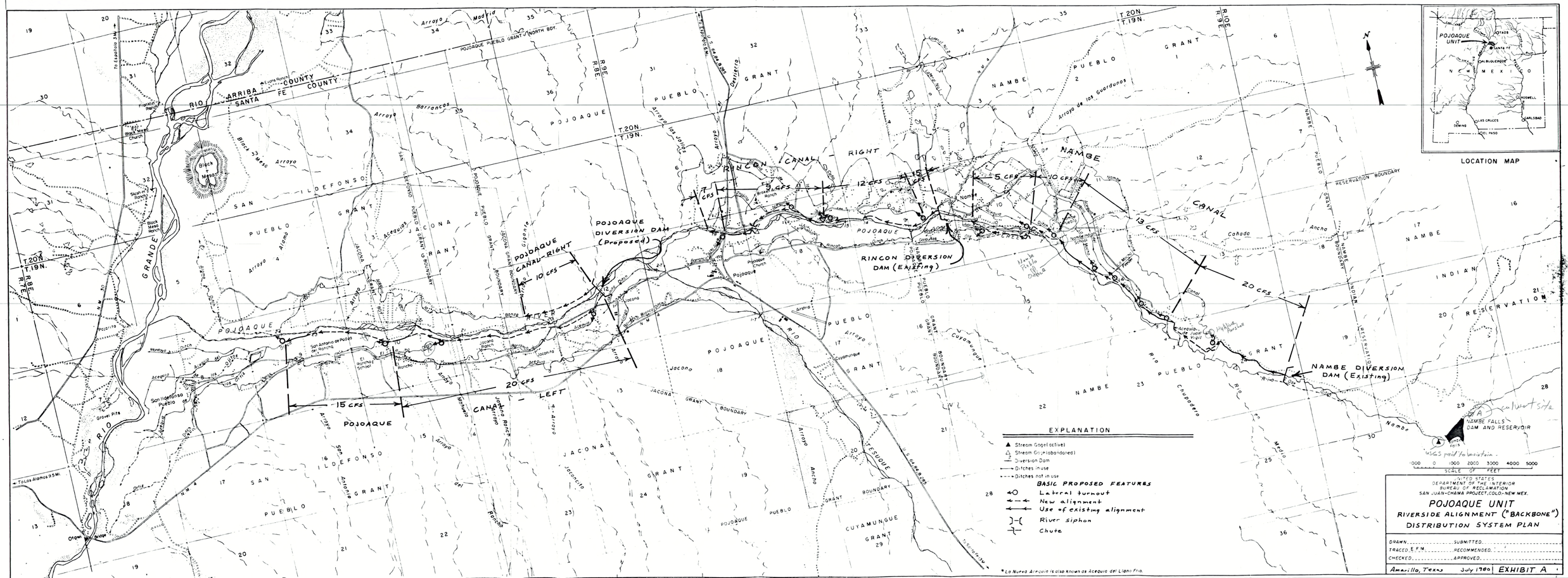
Total Cost: Plan with all new dams.....$5,105,000
Plan with existing dams
and Pojoaque diversion.....3,914,000

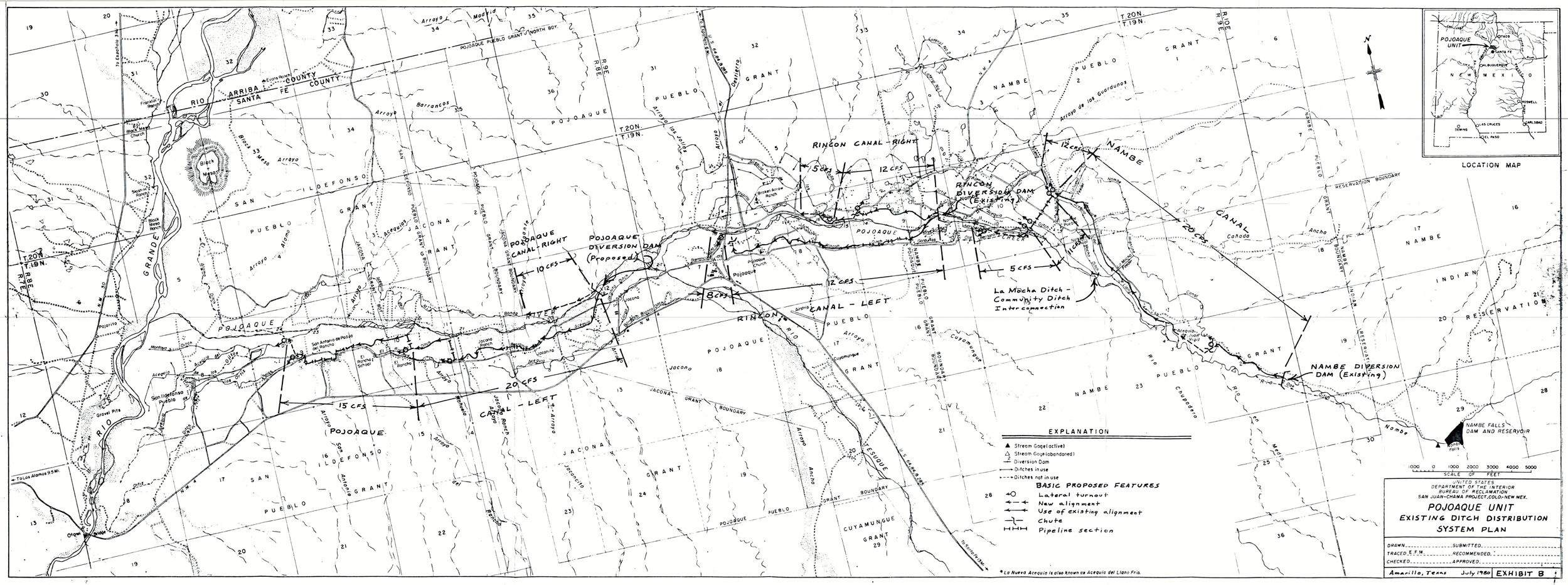
The total cost for either plan reflects the same consolidation scheme for all three Pojoaque Valley irrigation divisions-Pojoaque, Rincon, and Nambe. Note that the consolidation schemes readily lend themselves to using different plans for different divisions. Depending on the determination of special local needs, problems, and technical requirements, segments of either the riverside (backbone) plan or the ditch interconnection plan could be employed. This could drastically modify the total estimated project construction picture.

The Water and Power Resources Service is of the opinion that it cannot at this time conclude or recommend which consolidation plan or combination of plans would be the most feasible. Possible changes in local physical and public attitude conditions since 1963-65 preclude any such determination. The updated costs included in this technical memorandum reflect conditions almost 20 years ago. Any continued studies for a PVID consolidation plan would have to start from a current data base.


LOCATION MAP
POJOAQUE UNIT
NEW MEXICO
EXPLANATION
Stream Gage (active)
Stream Gage (abandoned)
Diversion Dam
Ditches in use
Ditches not in use
NAMBE FALLS DAM AND RESERVOIR SITE
SCALE OF FEET
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SAN JUAN-CHAMA PROJECT, COLO.-NEW MEX.
POJOAQUE UNIT
GENERAL MAP
ALBUQUERQUE, N.M.
APRIL, 1965
465-512-400
*La Nueva Acequia is also known as Acequia del Llano Frio.
RIO ARRIBA COUNTY
SANTA FE COUNTY
RIO GRANDE
POJOAQUE
SAN ILDEFONSO
PUEBLO GRANT
JACONA GRANT
NAMBE
INDIAN RESERVATION
CUYAMUNGUE GRANT
T.20N.
T.19N.
R.8E.
R.9E.
POJOAQUE PUEBLO GRANT NORTH BDY.
Otowi
Pojoaque
Nambe


RIO GRANDE
RIO POJOAQUE
RIO TESUQUE
TO ESPAÑOLA
TO SANTA FE
U.S. 64,84,285
Rio Nambe
Rio en Medio
Rio Chupadero
Arroyo de los Guardunos
Arroyo
Nambe Highline Canal
La Nueva Feeder
La Nueva Acequia
La Macha Feeder
La Acequia del Llano
La Macha Ditch 0.83Mi. 2±C.f.s.
Community Ditch
Ortiz Acequia 1.71 Mi. 6±C.f.s.
Cotto Ditch 2.45Mi. 7±C.f.s. 172.5Ac.TOTAL
Ancon Ditch 0.58Mi. 2±C.f.s.
Lateral No. 2 2.40Mi.
Lateral No. 1 1.31Mi.
La Acequia de los Joyos
Acequia Trujillo
Acequia de la Otra Banda 4.20 Mi. 8±C.f.s.
El Alamo Ditch 1.82 Mi.
Montoya Ditch del Medio (2±C.f.s.)
Acequia 0.69Mi.
Los Ojitos Acequia 1.40Mi. 2±C.f.s.
Acequia de los Indios (idle 0.72 Mi.)
Ortiz Ditch 1.21 Mi. 7±C.f.s. 177.8Ac.TOTAL
(Idle 1.49 Mi.)
339.0Ac.TOTAL
2.20Mi. 9±C.f.s.
Acequia de los Indios 3.48Mi. 7±C.f.s. 175.1Ac.TOTAL
El Rancho Ditch
Barranco Acequia
1.31 Mi. 3±C.f.s.
2.74 Mi. 5±C.f.s.
Jaconita Ditch 0.77Mi. 2±C.f.s.
Acequia Larga
Barranco Blanco Ditch 1.56 Mi. 3±C.f.s.
3.97Mi. 7±C.f.s. 150.6Ac.TOTAL
1.60Mi. 3±C.f.s.
Barranco Alto Acequia 1.22Mi. 3±C.f.s.
2.59Mi. 6±C.f.s.
Jose G. Ortiz Ditch 0.80Mi. 2±C.f.s.
Rincon Ditch
Juan Sena Ditch 0.38Mi. 1±C.f.s.
Garduños Ditch 1.09Mi. 2±C.f.s.
Old Bernardino Ditch (idle)
3.02Mi. 7±C.f.s. 178.3Ac.TOTAL
141.4 Ac. TOTAL
2.90Mi. 8±C.f.s.
2.54Mi. 6±C.f.s. 171.2Ac TOTAL
257.6Ac. TOTAL
3.09Mi. 9±C.f.s.
4.64Mi. 8±C.f.s.
Acequia de Juan Vigil 0.66Mi. 2±C.f.s.
189.6Ac. TOTAL
Oak Ditch (idle)
EXPLANATION
Well and electric pump
Irrigated land
Idle land
Permanent type diversion dam
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SAN JUAN-CHAMA PROJECT, COLO.-N. MEX.
POJOAQUE UNIT
SCHEMATIC DIAGRAM OF EXISTING IRRIGATION SYSTEM
ALBUQUERQUE, N. M. E.F.M. APRIL 1964


POJOAQUE UNIT
SANTA FE
ALBUQUERQUE
NEW MEXICO
ROSWELL
LAS CRUCES
DEMING
EL PASO
CARLSBAD
LOCATION MAP
POJOAQUE PUEBLO GRANT NORTH BDY.
RIO ARRIBA COUNTY
SANTA FE COUNTY
T.20N.
T.19N.
R.9E.
R.8E.
Black Mesa
SAN ILDEFONSO PUEBLO GRANT
POJOAQUE PUEBLO GRANT
NAMBE PUEBLO GRANT
JACONA GRANT
CUYAMUNGUE GRANT
NAMBE INDIAN RESERVATION
RESERVATION BOUNDARY
RIO GRANDE
RIO CHAMA
POJOAQUE DIVERSION DAM (Proposed)
POJOAQUE CANAL-RIGHT
10 CFS
15 CFS
20 CFS
POJOAQUE CANAL-LEFT
RINCON CANAL-RIGHT
5 CFS
12 CFS
7 CFS
RINCON DIVERSION DAM (Existing)
NAMBE CANAL
13 CFS
NAMBE DIVERSION DAM (Existing)
NAMBE FALLS DAM AND RESERVOIR
EXPLANATION
Stream Gage (active)
Stream Gage (abandoned)
Diversion Dam
Ditches in use
Ditches not in use
BASIC PROPOSED FEATURES
Lateral turnout
New alignment
Use of existing alignment
River siphon
Chute
*La Nueva Acequia is also known as Acequia del Llano Frio.
SCALE OF FEET
1000 0 1000 2000 3000 4000 5000
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SAN JUAN-CHAMA PROJECT, COLO.-NEW MEX.
POJOAQUE UNIT
RIVERSIDE ALIGNMENT ("BACKBONE")
DISTRIBUTION SYSTEM PLAN
DRAWN
SUBMITTED
TRACED E.F.M.
RECOMMENDED
CHECKED
APPROVED
Amarillo, Texas
July 1980
EXHIBIT A



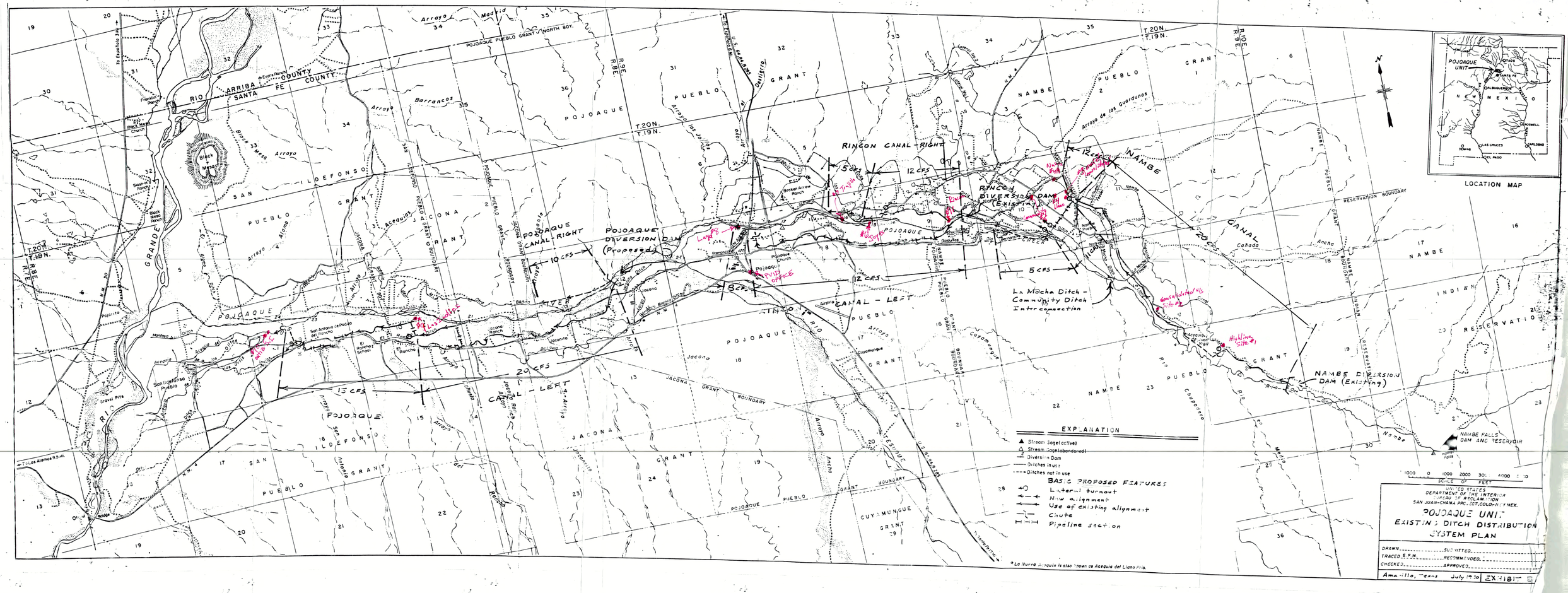
* La Nueva Acequia is also known as Acequia del Llano Frio.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SAN JUAN-CHAMA PROJECT, COLO.-NEW MEX.

POJOAQUE UNIT
EXISTING DITCH DISTRIBUTION
SYSTEM PLAN

DRAWN ________ SUBMITTED ________
TRACED E.F.M. ________ RECOMMENDED ________
CHECKED ________ APPROVED ________

Amarillo, Texas July 1980 EXHIBIT B


POJOAQUE UNIT
EXISTING DITCH DISTRIBUTION SYSTEM PLAN
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
SAN JUAN-CHAMA PROJECT, COLORADO-N. MEX.
DRAWN
TRACED, E.F.M.
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
Amarillo, Texas July 1930
EXHIBIT
SCALE OF FEET
EXPLANATION
Stream Gage (active)
Stream Gage (abandoned)
Diversion Dam
Ditches in use
Ditches not in use
BASIC PROPOSED FEATURES
Lateral turnout
New alignment
Use of existing alignment
Chute
Pipeline section
LOCATION MAP
POJOAQUE UNIT
NEW MEXICO
RINCON CANAL - RIGHT
RINCON DIVERSION DAM (EXISTING)
POJOAQUE DIVERSION DAM (Proposed)
POJOAQUE CANAL - RIGHT
POJOAQUE CANAL - LEFT
NAMBE CANAL
NAMBE DIVERSION DAM (Existing)
NAMBE FALLS DAM AND RESERVOIR
La Macha Ditch - Community Ditch Interconnection
RIO ARRIBA COUNTY
SANTA FE COUNTY
POJOAQUE PUEBLO GRANT
NAMBE PUEBLO GRANT
SAN ILDEFONSO PUEBLO GRANT
JACONA GRANT
CUYAMUNGUE GRANT
RESERVATION BOUNDARY
T.20N. T.19N.
R.10E. R.9E.
R.8E.
*La Nueva Acequia is also known as Acequia del Llano Frio.