HISTORICAL DOCUMENTATION OF MIDDLE RIO GRANDE FLOOD PROTECTION PROJECTS
Corrales to San Marcial

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Office of Contract Archeology
University of New Mexico

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Prepared for

U.S. Army Corps of Engineers, Albuquerque District
Contract No. DACW47-94-D-0019
Delivery Order No. 0006

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OCA/UNM Report No. 185-555

July 15, 1997

ABSTRACT

This document provides an historical summary of flooding and the need for flood control in the middle Rio Grande valley. History of the former, of course, stretches deep in to geologic time, but here we are concerned only with the late 19th and early 20th centuries, when communities in the floodplain experienced ruinous and repeated flooding which resulted in a public clamor for assistance in flood protection. Numerous projects were eventually undertaken by individual communities and, later, the Middle Rio Grande Conservancy District (MRGCD) so that, by the 1930s, a majority of the communities were protected in some way. Nevertheless, more than twenty years ago it was determined that flood protection in the middle valley was inadequate, given the nature and extent of development in the area. A series of studies and plans have been developed in the ensuing years to upgrade the levees within the MRGCD. Documents such as the 1979 *Middle Rio Grande Flood Protection Bernalillo to Belen, New Mexico. Interim Feasibility Report* set the stage for the current project (proposed action) which includes levee rehabilitation in three of the four Divisions of the MRGCD. These are: the Albuquerque Division, Corrales Unit; the Belen Division; and the Socorro Division, San Acacia to Bosque del Apache Unit (San Acacia). The proposed action will include the removal of the old levee alignments followed by construction of new (better engineered) levees in the same location, which are capable of providing greater flood protection.

The agency primarily responsible for the design and implementation of the proposed action is the U.S. Army Corps of Engineers (COE), Albuquerque District. Preparation of this report was undertaken by the Office of Contract Archeology, University of New Mexico and Karen Lewis: Historic Preservation as Contract No. DACW47-94-D-0019, Delivery Order No. 0006.

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ACKNOWLEDGMENTS

Our efforts in producing this document were greatly aided by a number of people and institutions. For a list of sources (libraries, archives) searched, please see the administrative summary below. Specifically, we would like to thank Dr. Ron Kneebone of the U.S. Army Corps of Engineers, Albuquerque District, and Middle Rio Grande Conservancy District staff: Subhas K. Shah, Chief Engineer; Johnny Mounyo, Socorro Division Manager; Anabel Gallegos; and Leonard Utter, Assistant Engineer. Dr. Richard Melzer provided valuable clues in locating information on the Belen area, as well as generously offering a copy of his published article on San Marcial. Laurie Schuller kindly loaned us a copy of her master's thesis, which provided an overview of middle valley floods and irrigation. Mary Davis and Ernest Alary, both of Corrales, are appreciated for their insights into that village's history. Benny Barreras, who should be made an official goodwill ambassador of the City of Socorro, was very conscientious in his efforts to provide us with introductions to the city's officials, as well as information about the 1995 reunion of former San Marcial residents. John and (especially) Phyllis Reiche, of Socorro, were also kind to take time out of their day to lead us in the right direction for historical resources. Spencer Wilson, of Albuquerque, has done considerable research on the Socorro area and was quite valuable in identifying potential references. For anyone interested in historic photos of the Socorro area, we recommend that you contact Holm Bursom, president of First State Bank, for a tour of his collection; you will recognize that he has made a significant contribution to local efforts of historic preservation. Finally, we would like to thank Monique Durham, of the Robb Archive of Southwestern Music at UNM's Center for Southwest Research, for her success in tracking down not only the words, music, and audio recording of "El Corrido de San Marcial," but also the name of the individual we have to thank for that recording. Mr. Vicente Saucedo, of Albuquerque, is the sole surviving member of a musical trio named Los Conquistadores. Mike Cardenas and Eddie Gallegos, who actually sings on this recording, have passed away, but Mr. Saucedo kindly gave us permission to use it on their behalf.

I. INTRODUCTION

The Middle Rio Grande Flood Protection Project has been designed and will be implemented by the U.S. Army Corps of Engineers, Albuquerque District. The project consists primarily of replacing spoil embankments with engineered levees. This report was prepared under contract with the Office of Contract Archeology and Karen Lewis Historic Preservation. The historic documentation presented in this report has been undertaken to meet the COE's requirement to comply with section 106 of the National Historic Preservation Act of 1966.

COE policy for all civil works construction projects requires a local sponsor. A sponsor may be any non-federal government or governmental entity having the legal authority to perform the terms of a project cooperation agreement and the financial ability to share in the cost of a study or project. Local sponsorship for this project is provided by the MRGCD.

LOCATION: The Corrales Unit is part of the Albuquerque Division of the MRGCD. The area of the proposed action runs parallel to the Rio Grande on the west side. It begins north of the Village of Corrales where the main Corrales ditch siphon crosses the river and extends for approximately 11.6 miles (mi) downstream to Montaño Boulevard in Albuquerque, New Mexico.

The MRGCD Belen Division runs on both the east and west sides of the Rio Grande. On the east side of the river the levee begins 400 ft north of Highway 147 (the Isleta Bridge) and continues to the railroad bridge in Belen. On the west side of the river the levee begins just south of the Isleta marsh and continues to 2 mi south of the Belen railroad bridge.

The San Acacia unit of the MRGCD Socorro Division, runs parallel to the river on the west side. It begins at the San Acacia dam and extends approximately 46 mi downstream. (Figure 1).

USGS QUADRANGLE MAPS (1:100,000 SCALE):

Corrales Unit:	Alameda, Bernalillo, and Los Griegos
Belen Division:	Belen
Socorro Division:	Truth or Consequences, Oscura Mountains, Socorro, and San Mateo Mountains

DATE OF CONSTRUCTION: From 1930 to 1935 the MRGCD constructed 190 mi of levees in the middle Rio Grande valley as a part of their district-wide plan to adequately drain the valley farmlands and provide flood protection. The levees present in Corrales, Belen, and San Acacia date to this period. However, documents at the MRGCD archives and other sources from the 1920s refer to existing levees, dikes, irrigation canals, etc. throughout the middle Rio Grande valley.

In Corrales, most of the historically documented flood protection structures were located on the east side of the river protecting Albuquerque, but it may be likely that there was flood protection for Corrales as well. Some of the east side structures include the 1884, 5,000 foot (ft) long dike that was constructed north of Alameda and the railroad grade elevations which served as informal levees.[1] In the Belen area there were probably flood protection structures and there is a reference in the July 1955 *New Mexico Historical Review* to "*burros*" or levees being constructed in Tomé to protect the plaza.[2] Within the Socorro Division there were also flood protection structures prior to the work of the MRGCD. Although many references to these are oblique or general, there is a plan of the San Marcial area, produced by the MRGCD in the 1920s prior to the initiation of construction, which shows existing and proposed levees.

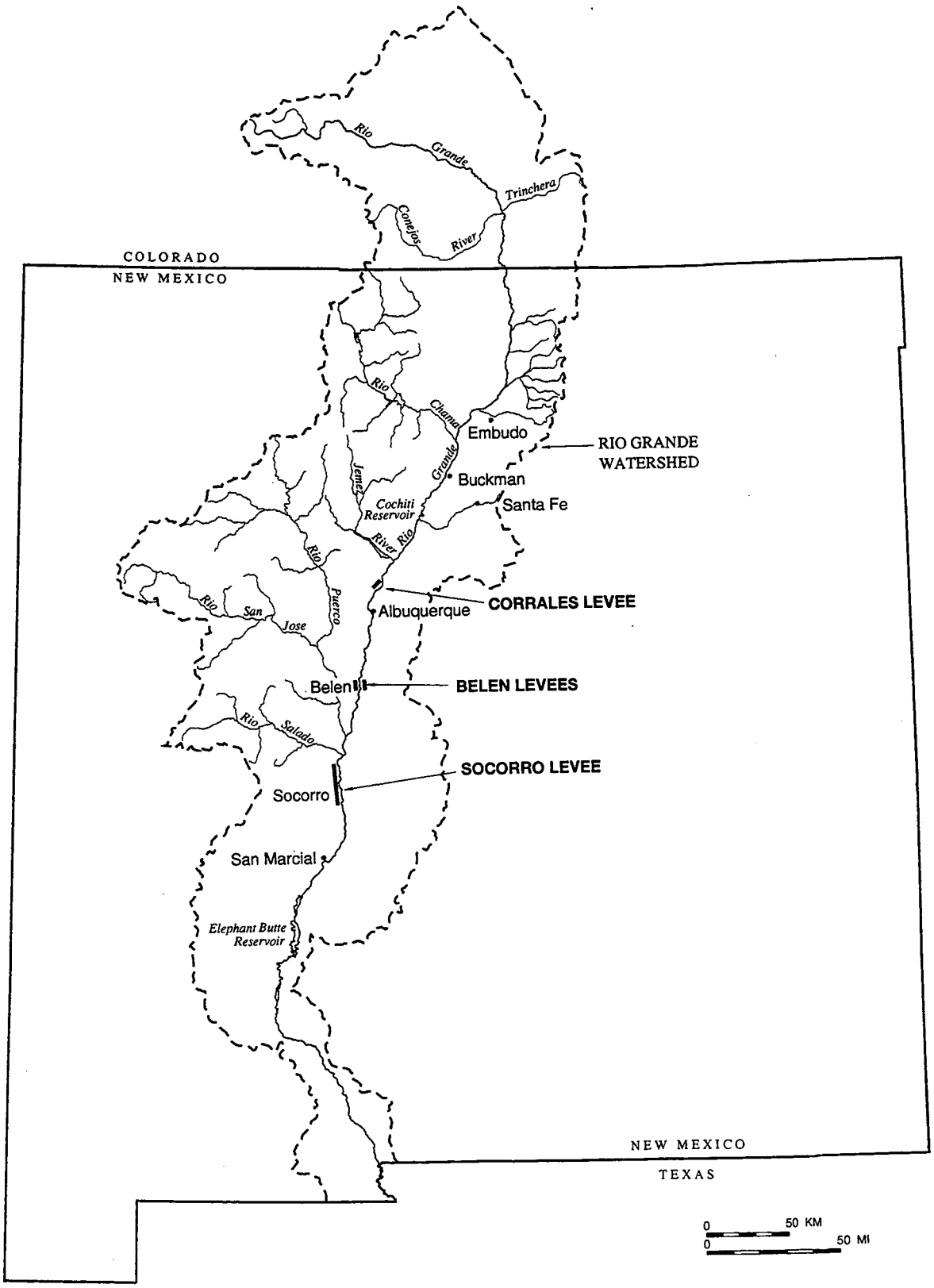


Figure 1 Location Map for Middle Grande Flood Protection Projects: Corrales, Belen, and Socorro Levees. Source: 1928 MRGCD Official Plan

Although there were informal and site-specific irrigation and flood protection structures throughout the middle Rio Grande valley, there were not any successful attempts at organized flood control in this area until the formation of the MRGCD in 1925.

PRESENT OWNER: Middle Rio Grande Conservancy District

PRESENT USE: The existing levees within the MRGCD Albuquerque, Belen, and Socorro Divisions provide some measure of security for valley communities from the threat of flood from the Rio Grande. Flood protection provided by the Corrales levee is currently at the 19-year frequency, or a discharge of approximately 7,500 cubic feet per second (cfs). Levees in the Belen Division currently provide protection up to the 7-year frequency, or approximately 7,000 cfs. The current level of flood protection in the Socorro Division is at the 7-year frequency level, which is equivalent to a discharge ranging from 12,200 cfs at San Acacia to 6,500 cfs at San Marcial. At these discharges, soil at the base of the spoilbank levees becomes saturated, threatened their structural integrity.

SIGNIFICANCE: The works of the MRGCD have had a dramatic impact on the welfare of populations along the Rio Grande. The flood control, irrigation, and drainage systems constructed and employed by the MRGCD have enabled communities to thrive where once the threat of flood was eminent and the high water table made living on the land nearly impossible.

The major floods that occurred in the the late 19th and early 20th centuries destroyed crops and, indeed, whole communities. The floods were the most dramatic and awesome demonstrations of the need to control the Rio Grande. Perhaps more mundane, but equally significant, was the status of land use along the valley during this time of increasing settlement. Daily farming operations were made nearly impossible in the late 1800s due to the swampy, alkaline conditions of riverside land. Unable to drain itself, the valley became waterlogged, making the land virtually useless. By 1912, the water table rose to an average of 23 inches below ground surface over 90 percent of the valley.[3] The 1930s work of the MRGCD to drain the valley, control the channel, and provide flood control, resulted in revitalizing a waning agricultural community. Changes in the vegetation of the valley between 1935 and 1989 (see Appendix A) are in part the result of this MRGCD construction.

II. ADMINISTRATIVE SUMMARY

HISTORIANS: Karen Lewis, Karen Lewis: Historic Preservation
K. Lynn Berry, Consultant

DATES OF RESEARCH: Fall of 1995 and Spring of 1996

SOURCES SEARCHED:

Center for Southwest Research, John Donald Robb Archive of Southwestern Music
City of Albuquerque Planning Library
City of Socorro Library
City of Socorro Offices
MRGCD Archives
New Mexico Institute of Mining and Technology Library
Valencia County Historical Society
Village of Corrales Historic Preservation Committee
Village of Corrales Library
Village of Corrales Offices

State of New Mexico, Office of Cultural Affairs, Historic Preservation Division
U.S. Army Corps of Engineers, Albuquerque District
University of New Mexico Center for Southwest Research
University of New Mexico Fine Arts Library
University of New Mexico Valencia Campus Library
University of New Mexico Zimmerman Library

METHODOLOGY:

Karen Lewis: Historic Preservation (Lewis Preservation) was contracted in August 1995 to conduct historical documentation of the MRGCD levees prior to proposed improvements to the system. The levee system currently in place is a spoil embankment capable of containing only the 19-year flood frequency level (7,500 cfs) in Corrales, the 7-year frequency level in Belen (ca. 7,000 cfs), and the 7-year frequency (12,200 cfs) in San Acacia. Proposed enhancements to the levees are designed to withstand the 270-year flood frequency level. Documentation of the existing levees follows the guidelines and standards of the Historic American Engineering Record (HAER), Level II. On-site graphic documentation of the levees in each unit were completed by the U.S. Army Corps of Engineers (COE) during 1995. Three separate drawing sets produced by the COE and incorporated as part of the graphic documentation each include:

1. a vicinity map;
2. site location map;
3. a key map for the drawing set;
4. photographs along the levee showing existing conditions and the location of the proposed baseline for the new levee;
5. a key plan for these photographs;
6. aerial photographs which show the Rio Grande and levees;
7. levee profiles (both longitudinal and cross section);
8. proposed construction details, and;
9. field data.

Archival research was completed by Lewis Preservation to provide an historical narrative and background information on the construction of the levees, the formation of the MRGCD, and its effect on the communities along the middle Rio Grande who depend on the management of its waters.

III. HISTORICAL INFORMATION

DATE OF ERECTION: 1930–35

ENGINEERS: Middle Rio Grande Conservancy District
Joseph L. Burkholder, Chief Engineer

HISTORICAL NARRATIVE:

MRGCD Water System Overview

The MRGCD includes 150 mi along the Rio Grande and varies in width from 1 to 5 mi. The MRGCD runs through 6 pueblos and four New Mexico counties. There are four divisions within the MRGCD, the Cochiti Division, Albuquerque Division, Belen Division, and the Socorro Division. Three of the four divisions are affected by the proposed action: Albuquerque Division, Belen Division, and Socorro Division. Within the MRGCD there are

approximately 85 drains, 15 canals, 79 acequias, 117 laterals, 24 feeders, and 27 wasteways. Structures associated with the water management system include levees, dikes, jetty jacks, culverts, fences, bridges, and roads.

Unit/Division-Specific Histories

The Rio Grande channel has been roughly in its present location for the last one to two thousand years[4], but the lack of significant channel migration belies the active and powerful forces which have been so destructive in the past. Flooding along the Rio Grande has been frequent and devastating. Records of floods prior to the 1800s are scant, but early mission records reflect that churches and their associated settlements often suffered from the proximity to the river during deluges.[5] In the following narrative we will briefly summarize available information on past flooding for each of the levee units in the flood protection project.

CORRALES UNIT: Systematic stream gaging did not begin in the middle Rio Grande valley until the late 1890s (and not in Albuquerque until 1941), but despite a lack of official records, one early flood in particular stands out. In the spring of 1874 a flood hit the valley and was talked about for decades. Heavy snowmelt followed by excessive rainfall produced a flow that was estimated to be 100,000 cfs at its peak. This is an enormous flow. Remember, the Corrales levee as it stands today can only withstand 7,500 cfs and with improvements will be able to withstand 42,000 cfs. Needless to say, the 1874 flood made a vivid impression on those who were in its path. R.G. Hosea, with the MRGCD circa 1920–30s, reported that valley inhabitants even composed a song commemorating the event. It began:

> Año de mil ochocientos setenta cuatro Dia veinte uno de Mayo, vimos el rio correr
> (In the year 1874, the 21st day of May, we saw the river run)[6]

Diaries of the Jesuits at San Felipe de Neri in Old Albuquerque recorded their observations of the flood. A translation of part of the diaries appears in R. G. Hosea's report, "The Flood Menace to Albuquerque and the Middle Rio Grande Valley." The following is a portion of those diaries:

1874

May 20th.	In these days, the river enters by Rinconada (the bend above Alameda) and threatens Alameda.
May 22nd.	The river floods Alameda and goes by way of Los Lomas and threatens Los Griegos.
May 23rd.	The river approaches Albuquerque; many seek refuge on the hills. Great fear during the night. At two o'clock in the morning the bells of the church rang to call the people together to save the plaza from the onrush of the river. Early in the morning, the river turning towards the hills opens its way through Los Barelas and the two arms, and the new and the old unite. Fathers Gasparri, Persone and D'Aponte went to help the people in staying the river.
May 25th.	The printing press and other appurtenances of the church are carried to the hills for fear of the river.
May 26th.	New consternation on account of the river.
May 29th.	The river began to fall.[7]

1904 brought another disastrous flood resulting in the typical loss of homes and property, but also resulted in the loss of a community's traditional name. Lurlie Silva, of Corrales, described the aftermath of the flood, reporting that the walls of adobe houses "melted like sugar," and she told the story of how Corrales temporarily lost its identity. According to Silva, men working in the fields at the time of the flood were able to partially divert the water via ditches into one or two large fields which served as holding basins. The sacrifice of one of these fields, she says, was the cause of a significant dispute.

> Mr. Alejandro Sandoval was the rich man of Corrales and Bernalillo. He owned everything and always took his irrigation water first. But he treated his workmen like coyotes, and lots of people didn't like him. That time after the flood in 1904 he came riding down the ditchbank in his fancy buggy from his fancy home in Bernalillo, and demanded that the workmen open the ditch and drain his property, even if it meant the water would run onto someone else's field.
>
> The men refused to obey him, and stood their ground. He turned red in the face and waved his whip in the air. His horses got scared and jumped, and turned the buggy over, spilling Mr. Alejandro Sandoval right into the ditch. He looked just like a big red, wet turkey, and none of the men offered to help him out of the ditch.[8]

Some weeks later Sandoval returned and asked the farmers of Corrales to sign a petition for government aid in the aftermath of the flood. Not reading or speaking much English, the farmers signed, unknowingly agreeing to a village name change from Corrales, to Sandoval. And so it remained for almost seventy years until the powers that be reversed the decision.[9]

On October 1, 1904, the Albuquerque Journal reported the flood as follows:

> **Rio Grande Goes on Rip-Roaring Wild Rampage**
>
> The swollen Rio Grande has found its way around both ends of the Alameda Dike . . . Alameda, Los Corrales, and Barelas are as usual the heaviest sufferers. In Barelas yesterday the water stood 2 feet deep in many of the houses and the people moved out all their belongings that could be taken at short notice. The same condition prevailed at Alameda and Corrales . . . Looking down from the mesa, it looked as if the entire valley from foothill to foothill, was under water. Just west of the city (Albuquerque) the Rio Grande was fully four miles wide and yesterday the water found its way up to the grandstand in the fairgrounds . . . [10]

The 1929 flood is still within reach of Ernest Alary's memories. Alary's great grandparents settled in Corrales in 1879 and the family farm is still a village landmark. Ernest was six years old in 1929 and vividly remembers trying to save a bunch squawking chickens when he suddenly felt something crawl up his pants leg. A young, frightened gopher had temporarily found refuge there before Ernest could remove him.[11] Since the MRGCD works of the thirties, the levees have protected the village of Corrales, but according to Ernest, the levees have come close to failing many times. There are particularly weak spots, he says, north of his farm where a calm Rio Grande takes a bend, but where raging floodwaters would rather keep heading south. He remembers seeing workers piling up old cars and fallen cottonwoods along the slopes of the levees to shore them up during the 1941 flood.[12]

BELEN DIVISION: At first glance, flooding in the Belen area appears to have been slightly less of a problem than in other parts of the valley. Local history hasn't entirely centered around the lore of catastrophic flooding as it has in the areas surrounding San Marcial, for example (see below). But the Rio Grande roared more than once in that part of the valley and communities there certainly were not immune to the hazards of heavy rain or snowmelt. In fact, the area that is now Bosque Farms got its start from such an event. In 1769 a major flood actually caused the

river to change its course south of Isleta. A new channel, approximately 2 mi west of the old one, was formed and the area between the old and new channels came to be known as Bosque de Los Pinos.[13]

Despite the hazards of proximity to such a potentially violent force, most communities along the Rio Grande have relied for centuries on the rich farm land adjacent to the river. Belen was no exception. Fray Francisco A. Dominguez wrote in 1776, "About a league downstream (from Pajarito) to the south, some widely separated ranches began, located all over the river meadow downstream. They belonged to a settlement of ranchos called Belen which is opposite Tome, six leagues from the mission. It lies on the river meadow mentioned so many times. It has good farmlands, which are irrigated from the said river, and they yield very good and copious crops of everything."[14] In 1843, Lieutenant Emory described the area this way, "Below Tomé, for a few miles, the valley widens, the soil improves and the cultivation is superior to any other part, particularly that of the rancherias around the pleasant little village of Belén."[15] The 1790 census records for Belen further authenticate the story of Belen as a farming community. The number of farmers and ranchers is nearly 3/4 of the total occupations listed (Table 1).

Table 1 Occupation of Belen Residents Listed by Ethnic Background circa 1790. *Source:* Horvath 1980

OCCUPATIONS	GENIZARO	INDIO	COYOTE	MESTIZO	ESPANOL	MULATO	TOTALS
Farmer*	8	4	-	16	30	1	59
Rancher**	-	-	-	-	17	-	17
Weaver	-	-	1	1	6	-	8
Shepherd	1	1	-	1	2	-	5
Laborer	1	1	2	1	-	-	5
Wool Carder	2	1	1	-	-	-	4
Blacksmith	-	-	-	3	-	-	3
Carpenter	-	-	-	1	1	-	2
Silversmith	-	-	-	-	2	-	2
Tailor	-	-	-	-	1	-	1
Shoemaker	-	-	-	1	-	-	1
Musician	-	-	-	-	1	-	1
Blind Beggar	-	-	-	-	1	-	1
Unemployed	-	-	1	-	-	-	1
Disabled	-	-	1	-	-	-	1
Absent	-	-	-	1	-	-	1
Vagabond	2	-	-	-	-	-	2
TOTALS	14	7	6	26	61	1	114

* One of the Español farmers was given the title "Don."
** Three of the Español ranchers were given the title "Don."

This thriving community was proud to build its first church in 1793, having previously travelled to the Franciscan mission of San Agustin de Isleta for its weddings, baptisms and funerals. Flooding was something of a concern to Belen residents at the time; F. Stanley writes that two towers, a rock base and flat rocks on the roof protected the church "against Indians, ***floods***, rain, snow and flaming arrows usually shot on roofs in the hopes of penetrating to the twigs, branches and vigas that were combustible."[16] Unfortunately, efforts to protect the church were inadequate. Parish records report that "stringent measures like facing the adobe church with flat rocks and raising the land of the church did not solve the problem."[17] The church was destroyed in 1855 "due to repeated inundation of the river [and] it was deemed advisable by the pastor to have the church located in [the] new town, away from the river. A letter under date of April 15, 1856 states that he (the Bishop) had been deceived by some of the parishioners of Belen and that the Vicar General (afterwards first Bishop of Denver) having been upon the ground had selected a much better place to locate the new church, and in accordance with the wishes of the local pastor."[18] Belen did, in

fact, opt for a new church in the new part of town (though considerable opposition was raised by old town loyalists who preferred to rebuild in the same spot), and by 1860 it was completed.[19] Still, that didn't stop Father P. Luis Benavidez from dubbing the community "Ciudad Charcos" — or City of Stagnant Pools — when he was temporarily on assignment there in 1869.[20]

According to Fray Dominguez, there were numerous floods that threatened to destroy the low-lying houses and the church at nearby Tomé in the eighteenth and nineteenth centuries,[21] but the flood that most stands out in local history is the one of 1884. After breaking its banks near Chical (south of Isleta), the river inundated the east bank, flooding the valley for approximately 18 miles down to La Constancia. Water was "five feet deep from Los Pinos to Tome,"[22] or "to the tops of the trees" by some accounts.[23] Local residents fled for high ground. Fr. Ralliere, pastor at Tomé from June 1858 to July 1913,[24] is said to have "set up his altar beside a tamarisk tree and assemble his large household nearby. Then, on horseback, he travelled up and down to the various groups, bringing cheer and distributing provisions to the people."[25] The provisions came by way of Catholic churches in Santa Fe, Las Vegas, and Bernalillo, as well as merchants and residents of other valley communities such as Peralta. The following song was composed by a man whose claim to local fame, according to Ellis,[26] "rests equally upon this lyric and the fact that he still could crack nuts with his baby teeth (he never acquired a second set) at the age of 97."

Indita del '84

I

Año de mil ochocientos — ochenta y cuatro allegado
Año de mil ochocientos — ochenta y cuatro allegado
Una creciente varaz — que no la hemos sopartado.
Una creciente varaz — que no la hemos sopartado.

CHORUS

¡AY! Indita del Rio Grande — ¡Ay! Que ingrata te estas mostrando
¡AY! Mira esas pobres mujeres — ¡AY! Con sus colchones rodando.

II

El Rio se nos rompio — viniendo la luz del dia —
El Rio se nos rompio — viniendo la luz del dia —
Dios me lo perdonara — lo rompio Jesus Garcia
Dios me lo perdonara — lo rompio Jesus Garcia

III

Salgan todos los correos — los de a'caballo y de a'pie
Salgan todos los correos — los de a'caballo y de a'pie
Lleven pronto la noticia — que el rio va pá Tomé.
Lleven pronto la noticia — que el rio va pá Tomé.

IV

El señor don Jesus Baca — no ha dijado confuso —
El señor don Jesus Baca — no ha dijado confuso —
Si se quedan en Valencia — alli no se encuentro Refugio.
Si se quedan en Valencia — alli no se encuentro Refugio.

V

Toda la genta se fue — de Valencia para el cerro —
Toda la genta se fue — de Valencia para el cerro —
No se han quedado en la casa — mas que el gatito y el perro.
No se han quedado en la casa — mas que el gatito y el perro.

VI

Sale el padre Ralliere — con toda su compatriota
Sale el padre Ralliere — con toda su compatriota
Todos los dias preguntan: — "¿No se ha caido la parroquia?"
Todos los dias preguntan: — "¿No se ha caido la parroquia?"

VII

A la gente de Peralta — arrisenle desde aquí —
A la gente de Peralta — arrisenle desde aquí —
Salgan todos de la casa — corriendo hasta Picuri.
Salgan todos de la casa — corriendo hasta Picuri.

The translation of the chorus is as follows:

Ay! My love of the Rio Grande Ay! How ungrateful you show yourself
Ay! Look at the poor women — Ay! With beds and everything pell-mell.

1884 may have been "the big one," but it unfortunately was not the first or last. Other floods on record include those of 1828, 1851, 1865, 1874, 1884, 1886, 1903, 1904, 1905, 1911, 1920, 1929, 1935, 1941, and 1942. Most of these floods occurred during the spring and were a result of snowmelt or warm rain on top of an existing snowpack."[27]

SAN ACACIA UNIT: No place stands out in the history of Rio Grande floods like San Marcial. Tales abound of the tragic deluge which destroyed a once thriving town. Other area floods are noted, to be sure. Phyllis Reiche wrote that "In the early 1900s a flood destroyed vineyards, farms and homes in the Polvedera area, including those of Paul Jean Frassinet whose family had emigrated from France in 1876.[28] And, "On Tuesday afternoon, July 30, 1895, the city of Socorro was visited by the greatest flood ever known in the history of the city since the time of the first settlement here," according to a report in *The Socorro Chieftain.*[29] Several townspeople were killed, damages were estimated to be as high as $200,000, and truly horrific scenes were witnessed. One resident recalled, "While the Wickhams and the Armijos watched the water rolling down the arroyo, they saw all manner of things pass: animals, wagons, furniture and, most pitiful of all, a cradle with a baby's hand sticking out of the water above it."[30] Yet San Marcial has remained, to a great extent, *the* flood story of the Rio Grande (Appendix B). Undoubtedly, the fact that not one, but two major floods hit the community within weeks of each other, and finally the beleaguered town was unable to recoup or rebuild, must account for the staying power of the drama. Perhaps, also, it is the undying affection former residents still have for their once promising and flourishing town. In a 1992 video produced for the city of Soccoro, Connie Martinez, who lived in San Marcial as a little girl, wept before the camera as she spoke of her childhood memories and the loss of her home — and this, 63 years after the fact.[31]

A reunion was held in August of 1995 for residents and descendants of San Marcial at which 300–400 people were in attendance. Organizers of this event collected photos and various documents, and sketched a map of the town as they remembered it (Figure 2).[32] The San Marcial story has become something of a legend.

In the early part of this century, the citizens of San Marcial knew they were living with a great risk. By the late 1920s, the MRGCD had completed numerous studies regarding the need for drainage and flood control along the middle valley, including "The Situation at San Marcial" which warned of the grave danger of potential overflow.[33] Indeed, it was widely acknowledged that as the town grew (closer and closer to the river and the railroad tracks), it was precariously dependent on the meager protection offered by the railroad grade and associated dikes. Residents were "ever mindful" of the flood threat.[34]

Heavy rains in August of 1929 eventually resulted in the worst case scenario for the railroad town.[35] Huge volumes of water surpassed the capacity of the Elephant Butte reservoir, and the river continued to rise. Many residents fled, expecting the worst, and others stayed behind to attempt to strengthen the dikes. All the sandbags in the county would not likely have saved the town, though, as the water crashed through and reached the second stories of many

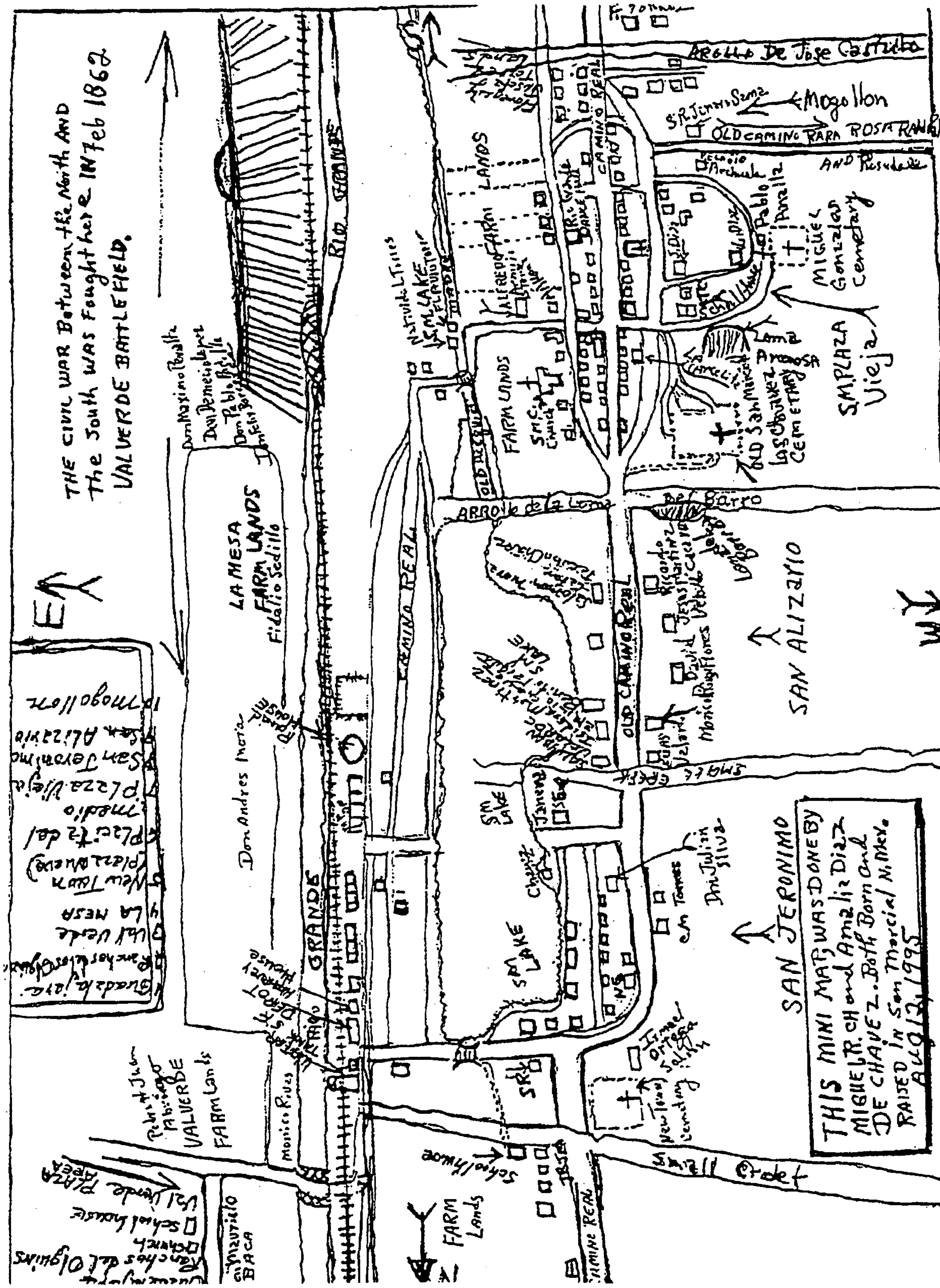


Figure 2 Map of San Marcial drawn by former residents at August 1995 reunion

buildings. Surprisingly, there was no loss of human life in the flood. Entire buildings and numerous possessions, and certainly a host of domestic animals, did not fare so well. The disaster was great enough to warrant emergency assistance from Governor Richard Dillon via the Red Cross, as well as a dispatch of National Guardsmen, and state health officials providing typhoid fever vaccinations.[36]

"El Corrido de San Marcial" commemorates the tragedy (Appendix C):

I
El dia venite de agosto[37]
no me quisiera acordar,
que se llevo el Rio Grande
la plaza de San Marcial.

II
La gente andaba excitada
pues no hallaba que pensar
si marcharse para El Paso
o quedarse en San Marcial.

III
Pobrecita de mi gente,
ah, que suerte les toco!
Todos sus casas perdieron,
no mas el Harvey quedo.

IV
Ah, que lastima de Pueblo!
como quedo destrozado!
Por el medio de las calles
lomas de arena quèdaron.

V
Les compuse este corrido
a los paisanos de alli.
Quiero decirles mu nombre
pá que se acuerden de mi.

VI
Pues mi nombre es Ramon Luna,
yo so nativo de alli,
pues por cierto es que me duele
el pueblo donde naci.

VII
Pobrecita de mi gente!
Todos debemos rogar
que Dios les mande consuelo
a todos: perdieron su hogar.

VIII
Pobrecita de mi gente!
Todos debemos rogar.
Aqui se acaba el corrido
del final de San Marcial.

I
The twentieth day of August
I would rather not recall
For on that day the Rio Grande
Flooded the town of San Marcial.

II
The people were all upset
Because they couldn't decide
Whether to go to El Paso
Or to remain in San Marcial.

III
My poor people,
What a sad plight has touched them!
They all lost their houses;
Only the Harvey House remained.

IV
How sad that the town
Was destroyed so completely!
In the middle of the streets
Mounds of sand remained.

V
This corrido was composed
For the natives of that region.
I want to tell them my name
So that they may remember me.

VI
Well, my name is Ramon Luna,
I was born there,
And I am certainly sorry
For the town where I was born.

VII
My poor people!
We all ought to pray
For God to send consolation
To all who lost their homes.

VIII
My poor people!
We all ought to pray.
This is the end of the Corrido
Of the destruction of San Marcial.

If that had been the last of the bad news, San Marcial might have been able to rebuild. Several weeks later, however, barely emerging from the gloom of the first flood, another hit. A memorandum within the MRGCD described it this way:

> It appears that the river came down in a rush, flowed over the tracks of the A.T.& S.F Ry. near the ranch of Mr. Simmons and flowed on down and began to seriously erode about the location where the road crossed from the west side to the east side and then followed along between the track and the old ditch . . . A marooned passenger train and twenty-five or thirty cars . . . were noted near San Acacia station. These cars were all standing vertically on that date . . . Part of the track was on edge instead of lying horizontally . . . It is believed that the river has abandoned the channel of two weeks ago from a section about a mile below San Acacia to a section about a mile above the Escondido bridge . . . The breaks in the dikes at San Marcial occurred about two o'clock in the afternoon on Tuesday, at a section about a mile and a half above the depot. About four-thirty in the afternoon a break occurred near the Harvey House and it is said that another break occurred about eight o'clock near the coal chutes. The height of the water at San Marcial is said to have been about five feet in the Harvey House, or higher than the lunch counter in the lunch room."[38]

MRGCD Response to Floods

These and other floods throughout the late 1800s and early 1900s caused great concern throughout the middle Rio Grande valley. Certainly by the 1880s, there were increasing calls for action by the residents of the valley. In 1883 a Board of River Commissioners was formed and soon they were in a position to levy an assessment for potential works along the river. In March of 1884, the commission toured and inspected the river upstream from Albuquerque from a point about two miles north of Alameda. The commission determined that a levee should be built and by May of the same year the "Alameda Dike" was constructed. It was approximately 5,000 ft long, 4 ft high and 6 ft wide at the top. In 1891, despite a scuffle over who should pay for improvements, the dike was enlarged and lengthened. The improvements resulted in a levee 5,350 ft long, 32 ft wide at the base, 8 ft high and 12 ft wide on top, and lined with terrone (sod) blocks and willow trees to stabilize the slopes. Similar structures were constructed throughout the 1890s, and by the turn of the century there were piecemeal, non-engineered systems of bank protection from Alameda to Albuquerque.[39] The same can be generally said for the rest of the middle Rio Grande valley, though documentation of these structures is scant. It is reasonable to assume, nevertheless, that the residents of many communities along the river made efforts to protect themselves in some way.

As for official, well-planned, and engineered control of the river, that was slower in coming (Appendix D). According to Rodey and Burkholder[40], as early as the late 1890s, plans were being discussed by various organizations and individuals for improvements to the system of canals and ditches. Fifteen years later a small drainage district was attempted south of Albuquerque. In 1917, Joseph Burkholder (later Chief Engineer of the MRGCD) appeared before a meeting of the Albuquerque Chamber of Commerce to discuss the city's drainage needs. Soon the Chamber formed and fostered a voluntary association called the Middle Rio Grande Reclamation Association. By 1921 the Rio Grande Valley Survey Commission was created. This organization entered into a contract with the U.S. Reclamation Service (now the U.S. Bureau of Reclamation) to prepare a report on the Middle Rio Grande project. The report was published in 1923. In 1925, the MRGCD was organized as a political subdivision of the State of New Mexico. Its objective was to provide irrigation, drainage, and flood control for about 128,000 acres from White Rock Canyon near Cochiti to San Marcial.

The organization of the MRGCD was, as previously illustrated, a long-awaited and much-needed development. In addition to flooding, irrigation and drainage were primary concerns. The total acres of middle Rio Grande farmland documented in 1880 was 124,800 and by 1927 it had been reduced to 45,000 through waterlogging and alkali conditions (Figure 3). There were two primary reasons for the waterlogging, alkali, and flood conditions along the middle Rio Grande:

1) Increased use upstream caused less water to flow into middle Rio Grande, thus increasing the silt and raising the water stream elevation.

2) The unregulated construction of ditches and use of water since colonial times effected raising the water table of the agricultural lands along the valley.[41]

The 1928 MRGCD *Report of the Chief Engineer: Submitting a Plan for Flood Control, Drainage, and Irritation of the Middle Rio Grande Conservancy Project* (*Official Plan*) stated that the channelization of the Rio Grande through bank stabilization, bridges, and railroads had caused the riverbed to rise, which in turn raised the water surface elevation and exacerbated the waterlogging and alkali problems. These changes also increased the risk of floods as the river could not carry as much water in its bed. Percolating water[42] from the Rio Grande exacerbated the problem. Waterlogging was described in an early MRGCD report as:

> the natural consequence of irrigation. It is the result of an oversupply of water for given soil conditions and existing topographic features. The rise of alkali which usually accompanies water-logging greatly increases and complicates the seriousness of the problem . . . The condition thus wrought is a menace to irrigation farming and the combating and prevention of the damage caused thereby is the problem of drainage.[43]

The Chief Engineer of the MRGCD backed up this statement asserting that the use of *acequias* throughout the valley without coordination or organization had resulted in exacerbating the waterlogging problems. These problems were so great when the MRGCD plan was being created that the Chief Engineer stated, "The need for drainage in the middle Rio Grande valley is so self evident and so well known that little need be said in regard to it."[44]

In 1928, the MRGCD's *Official Plan* included sections on "Seeped Areas" and "Causes in Decrease of Cultivated Areas." It was reported that there were 50,000 acres of valley land which was waterlogged and affected by alkalinity (Figure 4), only 2,000 acres which were unaffected. Of the 50,000 acres of valley land approximately 45,000 acres were intended for agricultural use. Table 2 shows the 1926–27 classification of land in the middle Rio Grande valley. Throughout the valley approximately 72% of the agricultural lands had a water table which occurred from 0 to 4 ft below the surface. According to the *Official Plan*, once the water table rises to less than 4 ft from the surface, it is almost impossible to farm the land. During 1926–27, the MRGCD considered 3,038 acres in Corrales as agricultural valley lands. Of the 3,038 acres, 2,227 were considered non-farmable.[45]

Because the irrigation *acequias* were built locally and not designed as a comprehensive system, there was duplication of effort, a large loss of water, and the development of waterlogging throughout the valley. River diversion dams built by *acequia* associations with trees and brush were often washed out. Also, where a diversion ditch crossed an arroyo the ditch was usually destroyed during a flood event. Continuous upkeep by individual *acequia* associations were required to maintain water flow to fields. A considerable amount of effort was spent diverting water from the Rio Grande.

> They (*acequia* associations) had to divert the water in the river by means of dams made of trees and brush to make the water rise and divert it so that it would go into the ditches at the main gate. Some of the people would be assigned to cut branches, logs in the woods, and haul rocks to divert the water. They had to take off their clothes to enter the water and place these reeds and trees and poplar branches so that the water could pass into the designated *acequias* that flowed into the valley. Then when the river flooded it would take the diversion away, and they would have to start all over again.[46]

Figure 3 Waterlogging. Original MRGCD caption reads, "View showing seep swamp land in the Corrales District. Property of Francisco Garcia." *Source:* Middle Rio Grande Conservancy District, No. 813, Plate 1

Figure 4 Alkali conditions. Original MRGCD caption reads. "Showing airplane view of Belen Riverside Drain and levee. Scene of the 'Battle of Los Chavez' Note Alkali land. May 26, 1930". *Source:* Middle Rio Grande Conservancy District, No. 202

Table 2 1926–27 Classification of Middle Rio Grande valley. *Source:* Middle Rio Grande Conservancy District Official Plan (1928)

CLASSIFICATION 1926–27	ACRES	TOTAL ACRES	PER CENT	PER CENT
Orchard and Garden	3,408		2.28	
Alfalfa and Grain	40,001		26.69	
Pasture and Hay	1,355		.90	
Homesites	820		.55	
Total Irrigated		45,584		30.42
Salt Grass	48,603		32.43	
Bosque	37,821		25.24	
Swamp and Lake	3,324		2.21	
River Wash and Arroyo Wash	1,290		.86	
Barren Alkali	275		.18	
Sand Dunes and Gravel	4,400		2.94	
Fallow Land	4,980		3.32	
Homesites	3,588		2.40	
Total Non-Irrigated		104,281		69.58
TOTAL	149,865	149,865	100.00	100.00

Note: Above areas include about 28,500 acres of Indian lands located in 6 different pueblos.

The MRGCD Chief Engineer called for a consolidated ditch system that would control waterlogging, provide water to farmers, and reduce flood damage. In effect it would revitalize the farmland and allow the farmers to expend their effort on farming rather than diverting water from the Rio Grande. The engineering issues involved in reclaiming and maintaining the farmland were drainage, irrigation, and flood protection. In discussing the MRGCD levees, it must be clear that the levee flood protection was intertwined with drainage and irrigation. "The drain ditches not only drain the land, but they also develop water for irrigation, and the excavated material partly builds the levees which protect against floods (Figure 5)."[47]

MRGCD official construction of the riverside drains, laterals, and levees began in 1930 and continued to 1935. It included four diversion dams, three diversion headings (Figure 6), 630 miles of irrigation canals and laterals, 340 miles of interior and riverside drainage ditches (Figure 7), and 190 miles of riverside levees (Figure 8) — all at a cost of nine million dollars.[48]

IV. ENGINEERING INFORMATION

SITE:

The middle Rio Grande valley is in a synclinal fold, rock strata which slope inward to meet at a central point. The syncline is filled in with gravel and sand. Throughout most the valley water flows through the gravelly infill; this is the underground aquifer which provides Albuquerque with its water supply. Emergent vegetation around the levee and riverside drain consists of cattail, sedge, rush, watercress, and bulrush. This vegetation is usually trimmed and maintained by the MRGCD. Other vegetation in the area includes forbs, coyote willow, and Russian olive. A variety of fish and wildlife inhabit the riverside drain.[49]

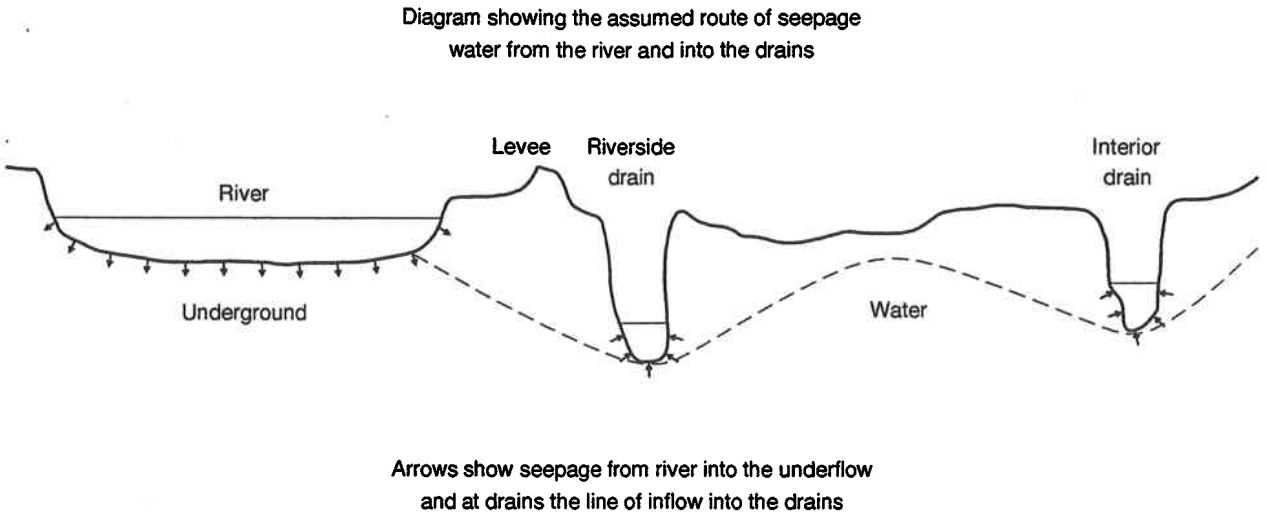


Figure 5 Diagram showing how the leeves and drains work together. *Source:* "Developing Water by Drainage Canals in the Middle Rio Grande Valley," by H.F. Robinson

Figure 6 Construction of a diversion channel on the middle Rio Grande. *Source:* Middle Rio Grande Conservancy District, No. 495, Plate 33

CHARACTER:

Maintenance roads run along the tops of the levees and are approximately 10 to 12 feet (ft) wide. From the edge of the maintenance road the levee angles outward and down, so that at the base it is approximately 20 to 25 ft wide. On the riverside of the levees, between the levee and the river, is a riparian environment consisting of cottonwood and the vegetation noted above (Figure 9). On the inland side of the levee there is a flat piece of land, the width of

Figure 7 Interior drain. Original MRGCD caption reads, "View showing portion of the Bosque Interior Drain looking North from (Station 86)." *Source:* Middle Rio Grande Conservancy District, No. 706, Plate 1

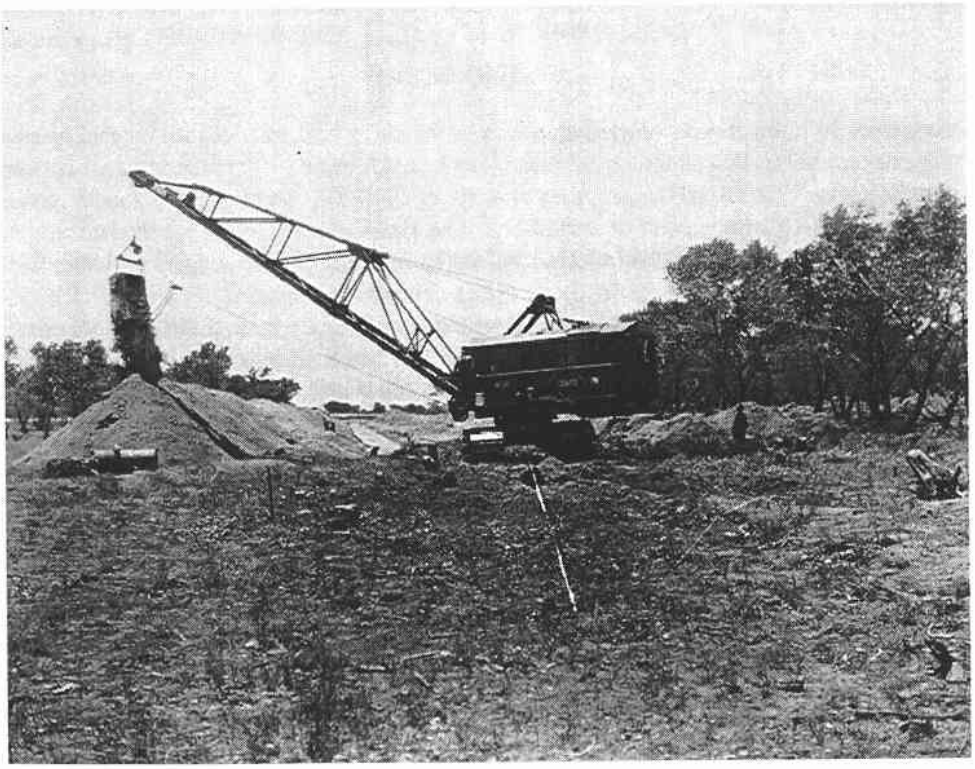
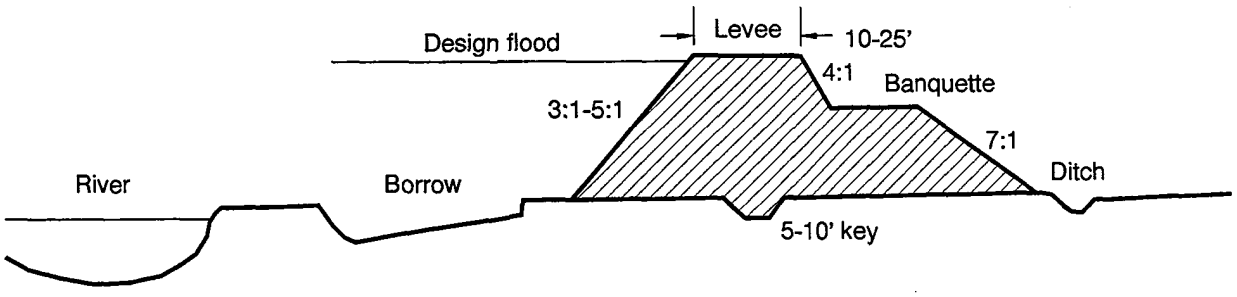
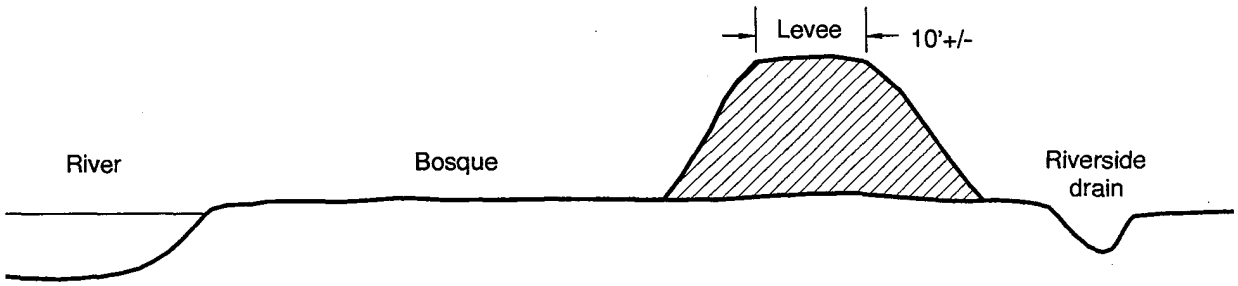


Figure 8 Construction of a riverside drain and spoil embankment. Original MRGCD caption reads, "View showing nature of material excavated. June 12, 1930. Belen Division - Bosque District." *Source:* Middle Rio Grande Conservancy District, No. 114, Plate 2



Typical engineered levee section
(No scale)



Typical existing MRGCD levee section
(No scale)

Figure 9 Comparison of typical engineered levee and the MRGCD spoil embankments

this varies from approximately 3 ft to 15 ft along the length of the levee. The riverside drains, on the landside of the levees, are adjacent to this flat strip, which also varies in depth and width (Figure 10).

The Corrales Unit levee runs between the Rio Grande and the Corrales Drain and is parallel to the river. The levee crosses the Calabacillas Arroyo and all access to the levee is by locked gates. In Corrales the drain is generally about 3 ft wide and 3 ft deep. On the west side of the Corrales Drain is residential property, often including fences, agricultural land, and farm animals. Land values along the levee have risen substantially in recent years. Access to the levees is through a series of locked gates.

The Belen Division levees are located on both the east and west sides of the river and run roughly parallel to the river. The riverside drains are much wider than in Corrales, and along most of the levee they run about 15 to 20 ft wide. On the east side of the river the drain is called the Tome Drain and on the west side of the river it is called the Los Chavez Drain. The landside of the levee consists of lumber yards, low to middle income housing (trailer parks, older homes, and new subdivisions), a sewage treatment plant, a general aviation landing strip, and some agricultural land. There is more agricultural land on the east side of the river than the west. Hunting and fishing are allowed by permit and access to the levees is through a series of locked gates.

Figure 10 Riverside drain and spoil embankment. Original MRGCD caption reads, "View showing section of floodway with riverside drain near outlet. March 17, 1931." *Source:* Middle Rio Grande Conservancy District

The San Acacia levee is located on the west side of the river and runs between the Bureau of Reclamation (BOR) low flow channel and the Lemitar Riverside Drain. At the San Acacia Dam, water is diverted into the Socorro Main Canal and the Atchison, Topeka, & Santa Fe (AT&SF) grade acts as a levee. The AT&SF grade works as a levee from the dam to the point where the levee stops heading west and begins to head south. At this point the BOR low flow canal and associated levee begins; on the landside of the BOR levee is the low flow channel and to the west of that is the old MRGCD levee and the Lemitar Riverside Drain. Both levees begin near the San Lorenzo Settling Basin, which was used to collect silt from the low flow drain before water headed south to Elephant Butte. The old MRGCD levee begins just south of the settling basin and weaves its way south along the river. Virtually the entire length of this unit within the proposed action lies within an agricultural area.

CONDITION:

The vegetation on the riverside of the levee, is natural and appears unmaintained. As a result, in many locations, the vegetation has encroached upon the levee and in some cases new trees have sprouted on the maintenance road. Encroachment of vegetation on the road occurs primarily in the Corrales Unit, vegetation reduces in density as the levees move southward. In Corrales there are areas of the levee which have deteriorated leaving large ruts in the maintenance road and slumping of the slope. In areas along the Socorro Division the levee is virtually flat in some locations and in other locations the levee was used as fill for the BOR low flow channel spoil embankment.

There are also conditions which affect the stability of the levee, but which are not visible. The levees are described as "highly erodible." They also have no seepage control features and as a result experience piping and "severe backside sloughing" at flows much less than the rated capacity.[50] Basically, because the levees are spoil embankments, they lack the design features which promote stability, and as a result are beginning to deteriorate.

ENGINEERING DATA:

Description of Levees

Levees are basically longitudinal dams. Dams are constructed perpendicularly to a river in order to retain water and levees are constructed parallel to a river in order to mitigate a flood. Dams continuously retain water along a river and levees are designed to trap water in the flood plain when a river rises above its normal capacity. Without the levee or if the levee were to fail, communities would be flooded, resulting in damage and destruction of improved properties.

Levees are usually constructed of earthen material and are required to meet the same structural stability and criteria that are used for earthen dams. The construction of modern earthen dams began in the late 18th century in England.[51] The development of design elements became fairly standardized by the late 1800s. In fact, "the design principles . . . evolved leading to safe and fairly reasonably economic large earth dams."[52] The elements which became standard details to reduce the hydrostatic pressure within dams, include variation of material, impervious cores, seepage collars, and puddling of clayey materials.

As both levees and dams are designed to retain water, the standard design details for earthen dams apply to the construction of earthen levees. Concrete seepage collars are used around pipes or other structures which penetrate dams or levees. These collars run perpendicular to the pipe and stop water from travelling along the pipe through the embankment. The variation of earthen material is commonly used to slow the movement of water through these earthen structures. In levees, the riverside portion is constructed using small particle fill, such as silt and clay, which is packed to achieve high density and the landside portion is constructed using larger fill, consisting of sand and gravel. Earthen dams have a constant line of saturation, while levees develop a line of saturation during a flood event. In both cases, to ensure stability, the line of saturation should exist in relative equilibrium. Varying the material to create a relatively impervious upstream slope and a pervious downstream slope aids in protecting these earthen structures from failure through saturation.

In some cases concrete flood walls are constructed along rivers to retain water in the event of a flood, but levees are more often used for flood mitigation because of their low cost. They are usually constructed of material taken from borrow pits on the riverside of the levee. These borrow pits run parallel to the levee. A bermed area is left between the borrow pit and the toe of the levee to provide stability for the ditch bank.[53] The tops of levees are usually a minimum of 10 ft wide to provide room for maintenance equipment. Often the slope of the sides is relatively flat to avoid erosion. In addition, the sides can be stabilized with vegetation or riprap.

MRGCD Work Along the Rio Grande

In the 1928 *Official Plan* the MRGCD Chief Engineer stated that the construction was planned to cause the least amount of disturbance as possible and that most of the existing ditches would be reused by adapting them to the engineered design and augmenting them with headgates. The MRGCD canals and laterals were designed to take water within a half mile of every farm, and from that point private ditches would deliver the water to individual farms. The recommendations for levee construction included the following:

1) 8–10 ft heights;
2) 8–10 ft crowns;
3) slope of 1½ to 1 on the land side and;
4) slope of 2½ to 1 on the river side.

Water reclaimed from the riverside drains became an important asset for water supply to the MRGCD lands (Figure 5). In 1928 it was determined that the amount of water reclaimed by the drains provided a surplus of water, even though the result would be increased water use for irrigation of the reclaimed agricultural lands.[54] The drains were

also important to the development of flood protection. The *Official Plan* states that "The riverside drains will supply the major portion of the material for the construction of levees without materially adding to the cost of these drains."[55] It also states that the spoil banks for the interior drains would provide a second line of defense against floods and that draining the land would also provide added protection in that the land would have the capacity to allow infiltration of water. The MRGCD also included jetty jacks or retards in their designs. These were intended to aid in depositing silt in predetermined locations[56], thereby channelizing the Rio Grande (Figure 11). Channelization keeps water from dispersing across the land; when confined, water tends to move faster and deposit less silt. In 1928 it was determined that a combination of levees and jetty jacks provided the best level of flood protection for the money expended. There are basically 3 types of jetty jacks or retards which have been used in the MRGCD: felled trees (Figure 12), vertical logs with wire mesh (Figure 13), and steel jacks with wire mesh.

The Corrales, Belen, and Socorro Division levees were constructed during the 1930s middle Rio Grande project. Spoil embankments resulted from the creation of the drainage ditches constructed to alleviate the adjacent agricultural lands of waterlogging and alkali conditions. A spoil embankment is a levee constructed of material transferred from an adjacent borrow pit, which is mounded to create the embankment (Figure 9 shows relationship of borrow to levee). In the MRGCD, earth was taken from the riverside drains (Corrales, Los Chavez, Tome, Lemitar, and Luis Lopez) and piled between the drain and the river to serve as flood protection (Figure 14). Spoil embankments are not engineered, thus they do not have keys at grade, seepage relief at the landside toe, variation of earthen material, or the proper slope (Figure 9). As a result, spoil embankments have low resistance to emergency flows (as compared to higher resistance of engineered embankments). It is believed that the existing Corrales and Belen levees can withstand a 7,500 to 10,000 cubic ft per second (cfs) flow, while the new levee, to be constructed during 1996, is designed to withstand the 270-year flood, a 42,000 cfs flow.[57] The existing Socorro Division levee can withstand a seven year flood, approximately 12,200 cfs[58] and the designed dam would withstand the 100-year flood with a 51,000 cfs at the diversion dam decreasing to 39,000 cfs at the lower end.[59]

The levees are one part of a system which was created to provide flood protection and alleviate the waterlogging of agricultural lands. The other elements include siphons, drains, laterals, canals, and *acequias*. Water which is diverted from the Rio Grande for use in Corrales and Albuquerque is taken at the Angostura Diversion near Algodones, New Mexico, about 20 mi north of Albuquerque. The water is moved through the Albuquerque Main Canal on the east side of the river, then diverted into the Corrales Main Canal north of Albuquerque and brought underneath the river with the Corrales Siphon at the north end of Corrales. The Corrales Siphon, an inverted siphon, was constructed with a 40 inch diameter concrete pipe and is 1200 ft long.[60] Water is brought into Corrales through the Corrales Main Canal. This canal is the westernmost water supply ditch in Corrales and is uphill from the others. Water is gravity fed into the Corrales and Sandoval laterals; the Sandoval Lateral is closest to the river. Between the two laterals is the Corrales Drain. East of, and below, the Sandoval Lateral is the Corrales Riverside Drain (Figure 15). This riverside drain is the drain whose spoil resulted in the embankment levee. The levee is intended to provide flood protection, the drains keep land from becoming waterlogged, while the canals and laterals supply water for irrigation. Leading from the canals and laterals are *acequias*. The *acequias* are the ditches that supply water to individual farms and properties.[61]

Water is diverted from the Rio Grande for use in Belen at the Isleta Diversion Dam. Water is diverted into the Belen High Line on the west side of the river and the Peralta Main Canal (Chical Lateral) on the east side of the river. The Belen High Line canal has the highest capacity in the MRGCD system and was designed with a base width of 30 ft and a depth of 8 ft and was intended to carry 1,000 cfs.[62] This canal terminates at mile post 943 on the AT&SF. The Peralta Main Canal has a maximum width of 12 ft and depth of 4.8 ft and terminates below Cerro Tome (Figure 16).[63] As with the Corrales Unit, the high line and laterals in Belen supply irrigation water through laterals and *acequias*.

Water diverted from the Rio Grande for use along the Socorro Division is diverted at the San Acacia Dam. The dam is a "low weir or a barrage of gates with headworks for regulating flow into canals and sliceways for clearing the control gates."[64] The water is gravity fed into the Socorro Main Canal and laterals (Figures 17 and 18). From these larger supply sources, the water is then fed into *acequias*.

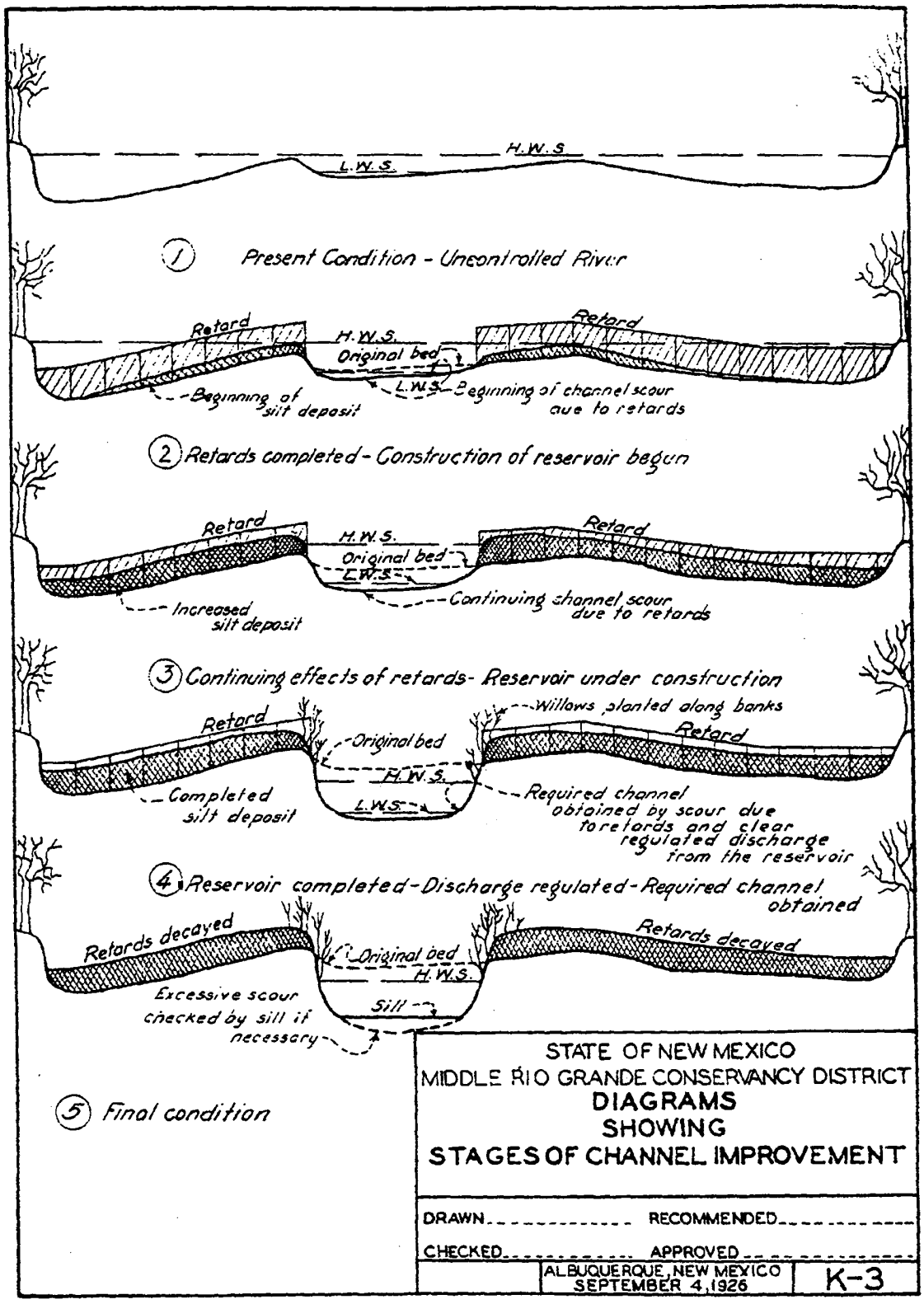


Figure 11 Diagram showing how the river could scour its own channel once retards and jetty jacks were in place. Channelizing the river was meant to increase the flow thereby reducing silt and resulting in less change of flooding. *Source:* "Rio Grande Channel Improvement," C.H. Howell

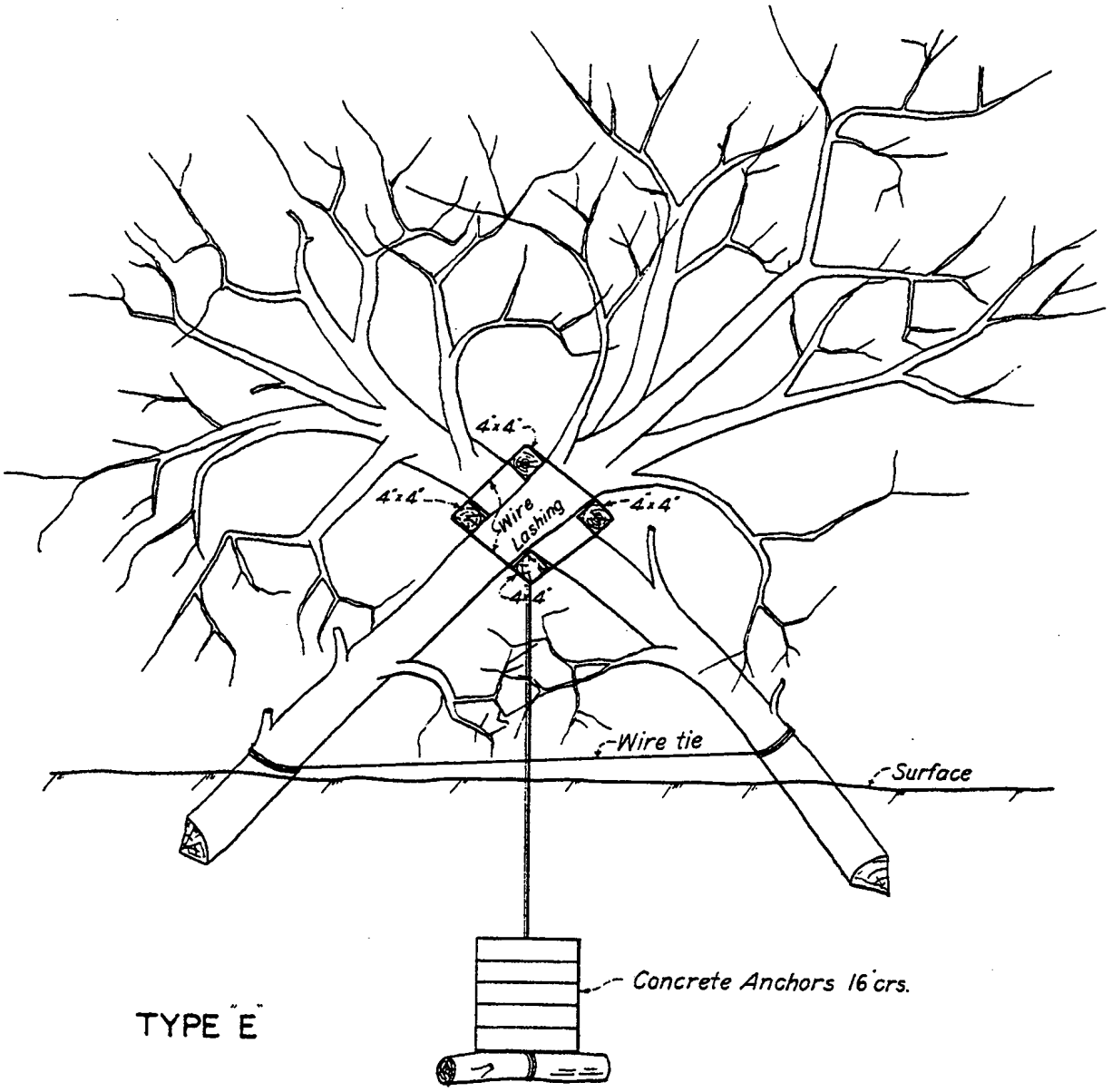


Figure 12 Felled trees with a concrete anchor. *Source:* "Rio Grande Channel Improvement," by C.H. Howell

Corrales Unit

In the *Official Plan*, Burkholder states that the dikes above Alameda (on the east side of the river) and the banks of the irrigation ditches provide protection from the flooding of Albuquerque, but that an exceptional flood would not be held by these structures. This area around the Corrales Drain (west side of the river) and the Alameda Lateral (east side of the river) is the location of a large bend in the Rio Grande. If water was to flow at a high rate, it would leave the banks of the river and flow into Albuquerque. It also had the potential to back up and flood Corrales, as it did many times. It would seem from the *Official Plan* reference to dikes and existing structures, that there may have been some sort of levee or flood protection on the Corrales side of the river before the engineered construction of the drains.

If there were flood protection structures in Corrales, the work of the MRGCD would have been the organized continuation of what the community had begun. The construction of the levee may have paralleled the irrigation work of the MRGCD, in that a traditional, less organized approach to provide flood protection and irrigation was

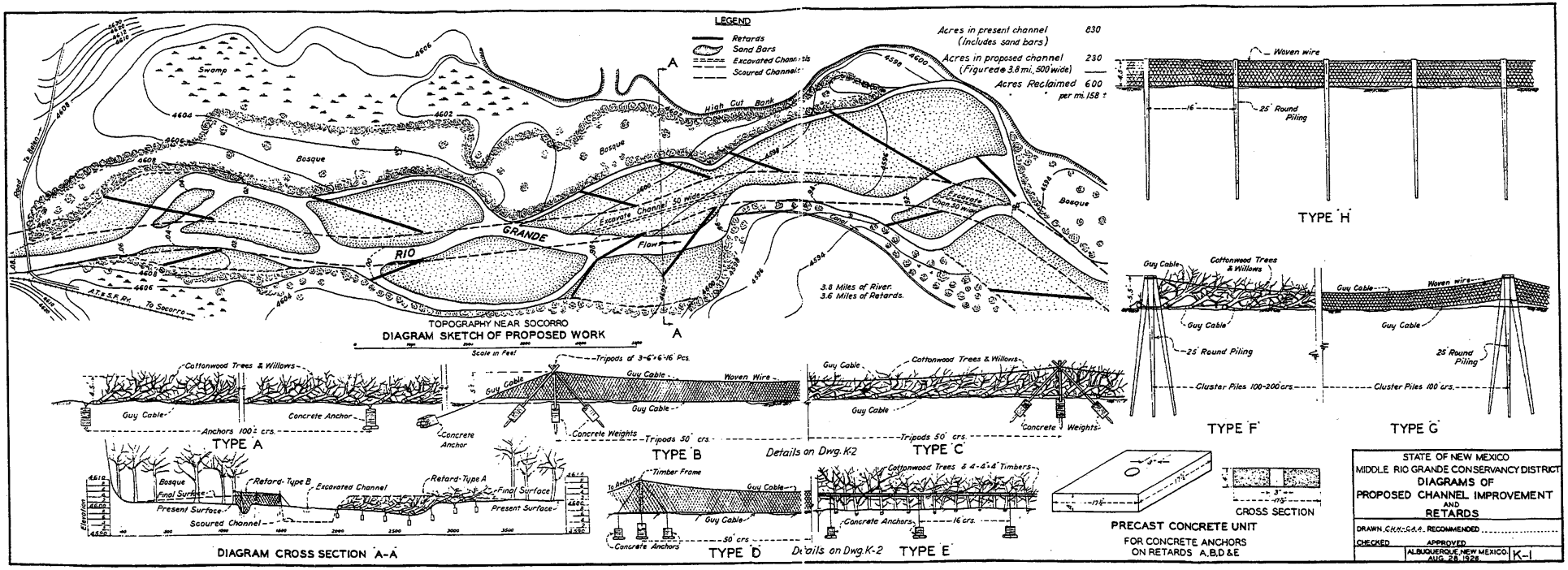


Figure 13 Various methods of channel improvements proposed by the MRGCD during the 1920s. *Source:* "Rio Grande Channel Improvement," by C.H. Howell

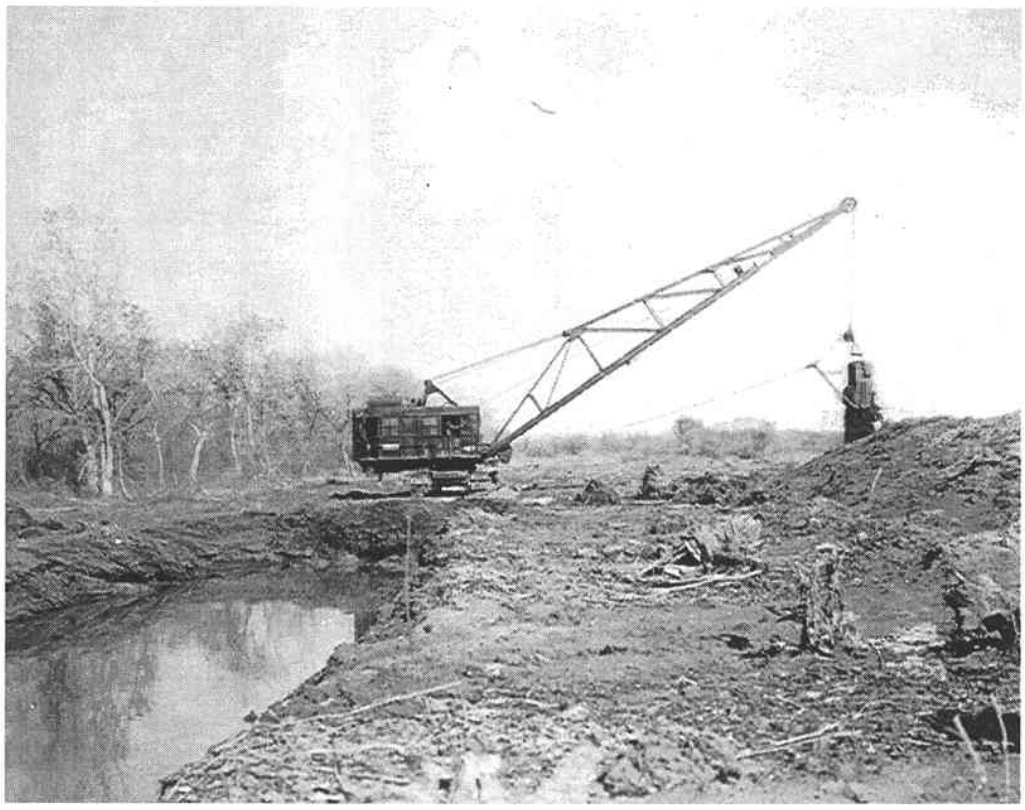


Figure 14 Construction of the Corrales Riverside Drain and Levee. *Source:* Middle Rio Grande Conservancy District, No. 118, Plate 4

incorporated into a large, regulated project. Drainage would have been the one portion of the project that was an entirely new development in Corrales. Unfortunately, we can only surmise about an earlier origin of Corrales flood protection, as written records and oral histories focus around waterlogging and damage caused by floods, rather than the existence of flood protection in Corrales prior to the MRGCD.

Belen Division

High line canals are water supply structures located on hills above a valley and are constructed to increase the amount of irrigable land in the valley. The construction of these canals are usually more costly than developing low line canals on the valley floor. In most cases in the MRGCD it was decided that high line canals would be expensive and difficult to construct because of the arroyos they would have to cross. In Belen, on the west side of the Rio Grande, little cross drainage was noted and it was determined that the area could benefit from a high line canal. Burkholder states that by incorporating a high line canal in the Belen District, "Some very fine land above the present ditches will . . . be brought under the new irrigation system"

The high line canal in Belen was investigated as a potential location for hydraulic power in the 1928 *Official Plan.* The plan states that there were two locations where a drop could be designed into the canal. At the base of these drops a power plant could be located. Through the combination of providing a wasteway and extra head in the canal to the power drop, both electricity and irrigation could be provided. The two locations identified in the *Official Plan* were: 2 mi west of Los Chavez and 16 mi below the head of the canal and 3 mi south of Belen. The first location required a 400 cfs flow and would result in 1220 horse power and the second location required a 400–500 cfs flow and would result in 1490–1990 kilowatts of power.[65]

Although both irrigation and power could have been provided from the Belen High Line Canal, it was decided to omit the power plants from the plan. It was decided to not include these as they would require continuous operation of the canal, making maintenance difficult and requiring water flow year-round rather than only during the 8 months

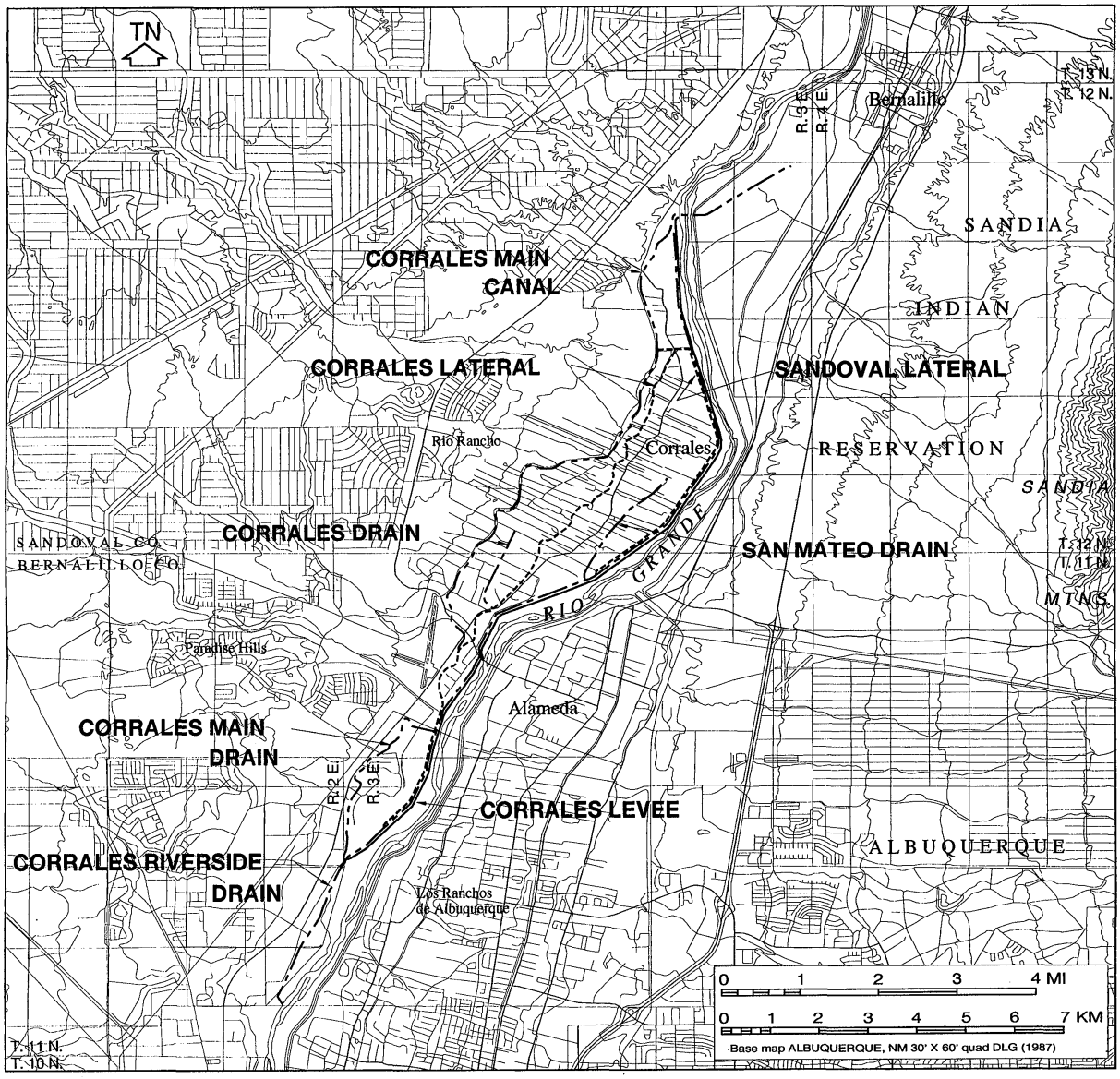


Figure 15 Map of irrigation, drainage, and flood protection, Corrales Unit (USGS 1:100,000 scale)

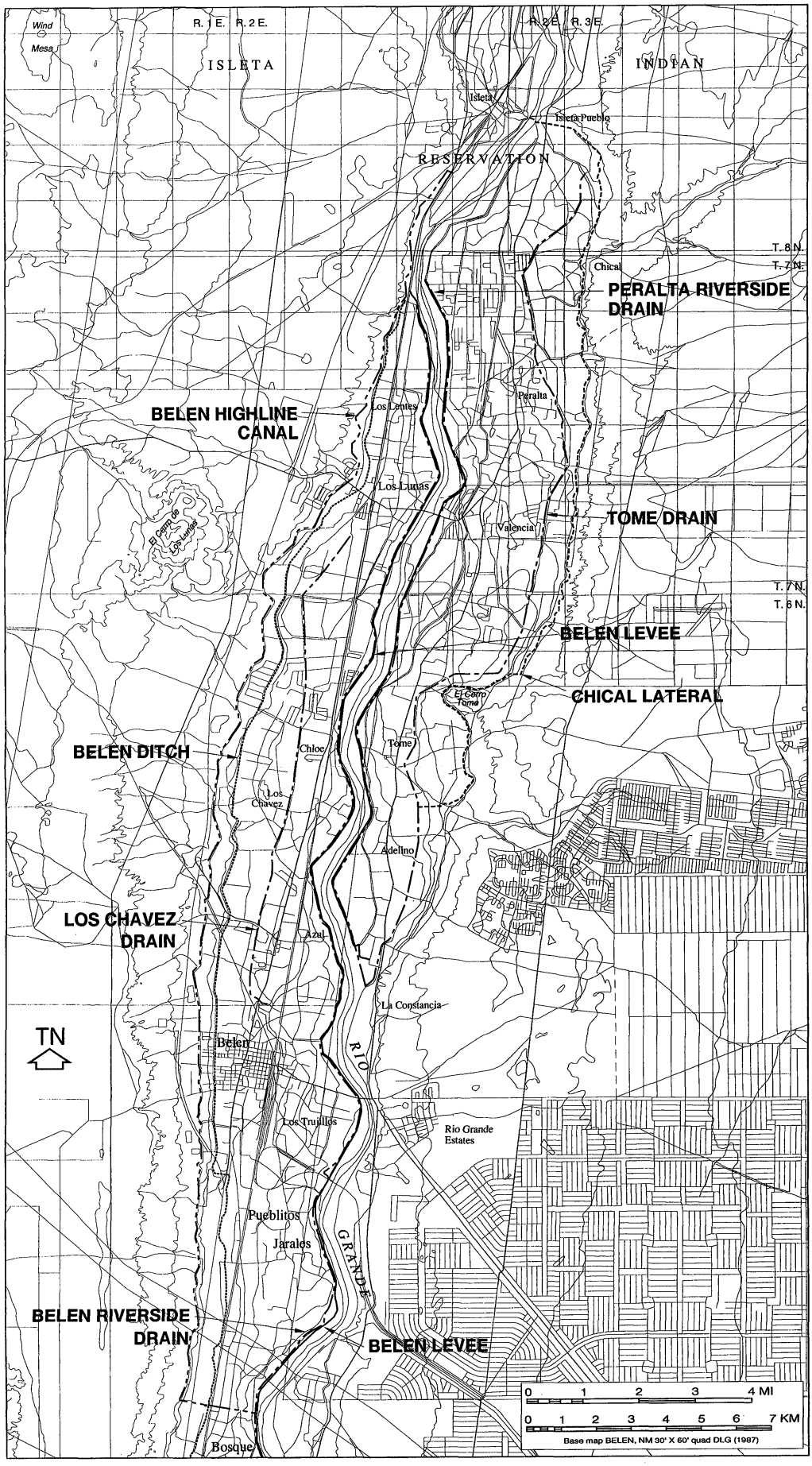


Figure 16 Map of irrigation, drainage, and flood protection, Belen Division (USGS 1:100,000 scale)

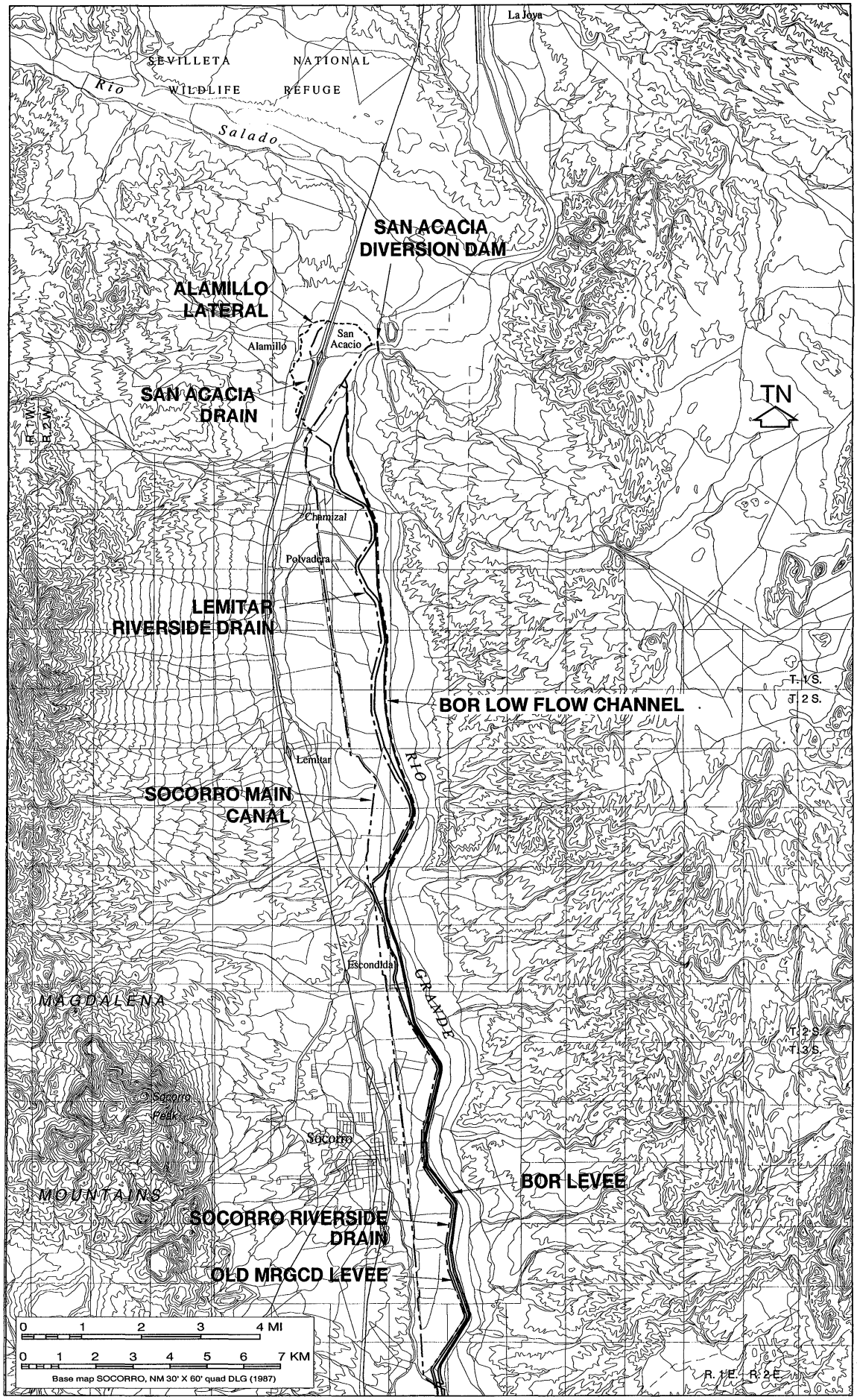


Figure 17 Map of irrigation, drainage, and flood protection, northern Socorro Division (USGS 1:100,000 scale)

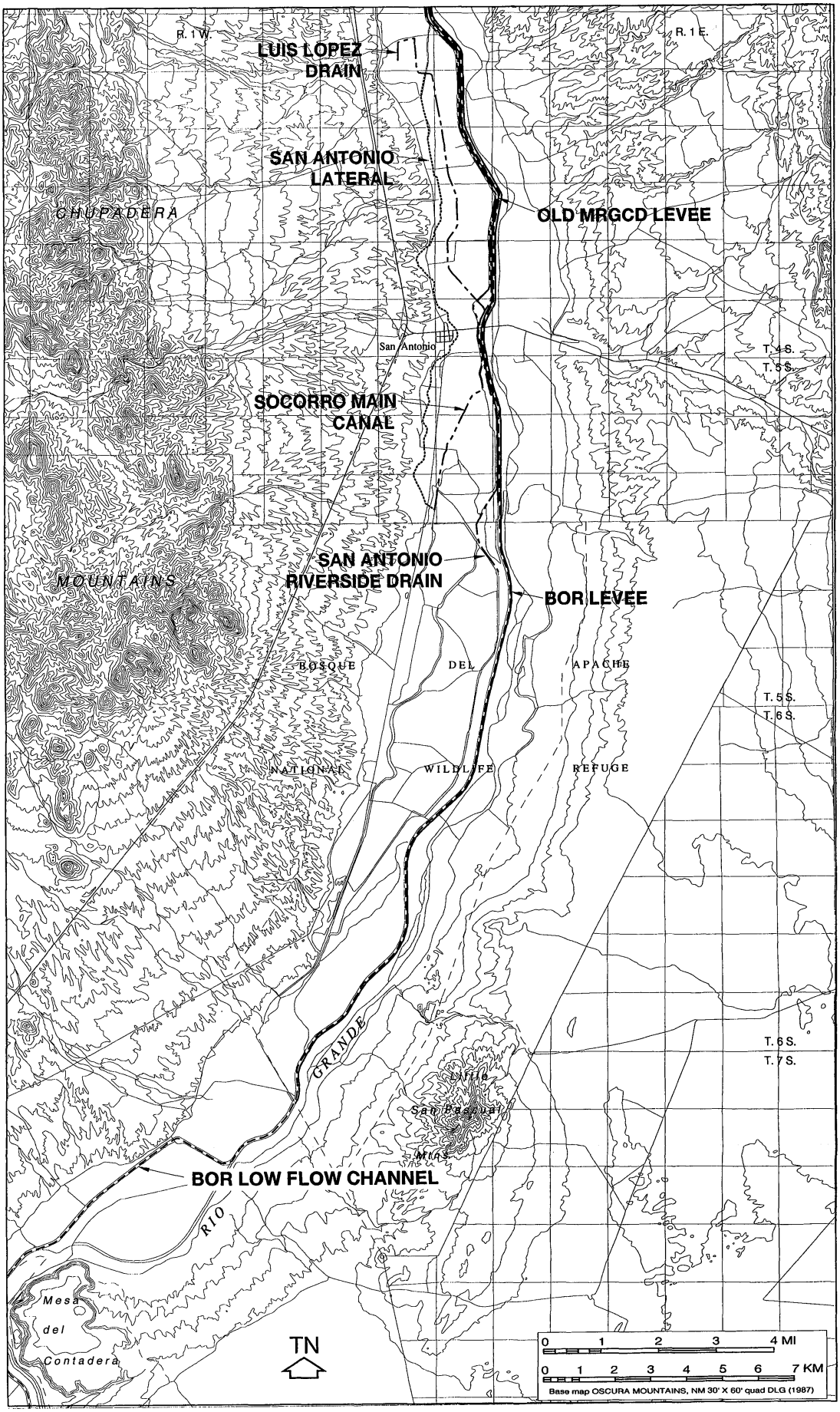


Figure 18 Map of irrigation, drainage, and flood protection, southern Socorro Division (USGS 1:00,000 scale)

of irrigation season. It was also determined that the density of development at that time did not merit the development of the power plants. The *Official Plan* did not recommend the construction of the plants at that time, but encouraged the consideration of such construction when the density of population could support such efforts and noted that they could be easily added with little change to the system as designed.[66]

As with most New Mexican towns, Belen is subject to surface flooding from arroyos, as well as from the Rio Grande. Belen has experienced many floods from the Rio Grande and has had additional problems caused by *arroyo* floods inundating the works of the MRGCD. The Highline Canal offers added flood protection to Belen during small flows, but during large flows it can actually add to the problem. In a 1969 flood, the *arroyo* flows entered the Highline Canal "at several points overloading it with flood water and a large amount of silt; the canal consequently breached at a number of points . . . water ponded in Belen at depths up to . . . 3 feet."[67] Part of the reason Belen is susceptible to flooding is that it is built at an elevation slightly lower than the bed of the Rio Grande.[68] Basically, Belen is the low point between the Highline Canal and the Rio Grande. When there are severe flooding conditions, Belen has the potential to be flooded from the east and west. As noted in the 1982 Federal Emergency Management Agency report, the levees in Belen had never been breached by floods, but the potential for this to occur existed.[69]

Socorro Division

Above Bernalillo, the river is well-defined and falls 8 ft per mi, while below Bernalillo, the channel is wide, fairly undefined, has a 4 ft fall per mi, and before the MRGCD improvements tended to flood at flows of 12,000 cfs. The channel width in 1928 ran from 400 ft above Bernalillo to 2,000 ft at San Marcial.[70] As the channel widens, the flow of the river spreads across the land, the velocity of flow slows, and silt accumulates. Because of this, the riverbed was raised 12 ft between 1880 and 1928 at San Marcial.[71] A 12,000 cfs flow in 1926 caused a flood water level 4.7 ft higher than the 1904 33,000 cfs flow; the 1926 waterline was 6 ft above the railroad tracks.[72]

In order to deal with the meandering flows, the *Official Plan* recommended low flow channels [in the riverbed]. These were intended to provide protection of the levees by defining a narrow channel where the river would increase its velocity and scour the bottom to keep silt from raising the riverbed (Figure 11).[73] These channels would have been most important in the southern ends of the MRGCD, as the silting problems were more extensive there.

In 1928, the railway grades south of Bernalillo were below the top of the proposed levees and were in danger of flooding. In 1927 railway grades near San Acacia were washed out by a flood which originated in the Rio Puerco and flowed at 20,000 cfs.[74] Where there was not room to construct a levee between the tracks and the river, the MRGCD proposed to raise the level of the railroad grade, so that the grade would serve as a levee in the event of a flood. This protection included adding riprap to the grade's riverside and would provide protection for floods of 50,000 cfs. The work of raising the grades was not in the jurisdiction of the MRGCD, but the design was coordinated between the AT&SF and MRGCD engineers.

"At San Marcial the flood menace is ever present and only perpetual vigilance and the expenditure of large sums of money by the A.T. & S.F. Ry., which has a large investment to protect, has averted disaster."[75] The primary flood protection for San Marcial were the levee/railroad grades constructed by the AT&SF and because of the raising of the riverbed the 1928 *Official Plan* stated that raising the railroad grade could not be continued indefinitely and this system must be abandoned. The water table at San Marcial was at the surface of the ground and because the riverbed was higher than the town, the MRGCD proposed that riverside drains be carried far downstream to ensure sufficient fall to adequately lower the water table in town. Another problem at San Marcial was a "silt delta" and the MRGCD proposed many alternative solutions. The preferred solution provided flood protection for flows up to 50,000 cfs with a series of high levees, the raising of railroad bridges and their approaches, a riverside drain whose outlet was near Fort Craig, and the channelizing the river with a series of jetty jacks (Figure 19).[76]

The improvements for San Marcial on the western bank of the Rio Grande and Val Verde on the eastern bank were never made. Protests to the MRGCD improvements were made by J. Fred Schoellkopf "on behalf of 8,300 acres of land at the lower end of the Socorro District."[77] It was determined that the elimination of the portion of the planned design, beginning at the north boundary of the Bosque del Apache Grant, would not affect the MRGCD as a whole.

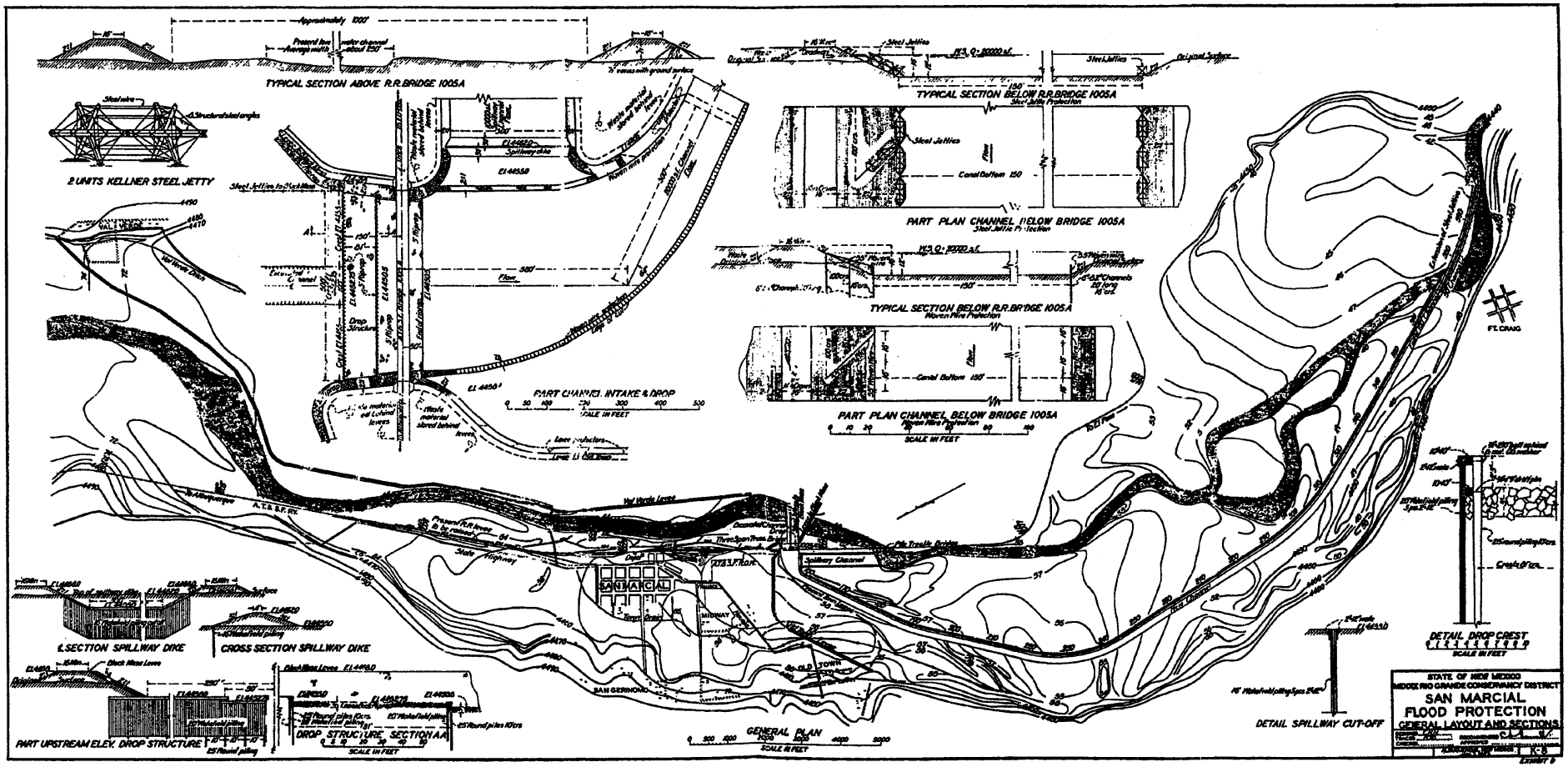


Figure 19 MRGCD flood protection design at San Marcial, 1927. Source: "The Situation at San Marcial", by C.H. Howell

Features which were left intact included jetty jacks to aid in silt control and an outlet for the San Antonio Riverside Drain, which extended 2.5 mi into the Bosque del Apache Grant. In the evaluation of the effects of eliminating this portion of the plan the MRGCD engineers noted benefits and disadvantages, below are two of them:

> *Advantage*
> The Modified Plan eliminates the most difficult engineering problem, the San Marcial silt problem, from the Plan and reduces further uncertainties in regard to maintenance of agriculture in the lower end of the District.
>
> *Disadvantage*
> The Town of San Marcial is now located on land which is lower than the bed of the Rio Grande. Its existence depends upon wholly inadequate dikes. Without the help of a comprehensive plan of improvement, it cannot exist much longer. The citizens of this town have been looking to the District for correction of their problems for many years.

On August 15, 1928, a decree was handed down by the district court of the 2nd Judicial District to accept the modified plan, without improvements below the north boundary of the Bosque del Apache Grant.[78] It seems that this sealed the fate of San Marcial, but in fact the 1929 flood occurred before improvements could have possibly been made in the Socorro District.

From 1951–59 the BOR constructed the low flow channel to transport water to Elephant Butte. The construction began at Elephant Butte in 1951 and proceeded up to Bosque del Apache by 1956. Between 1956 and 1959 the low flow channel continued into the San Acacia Unit.[79] The low flow channel was intended for use during dry seasons when the flow of the river slowed. Rather than let the water spread across the wide riverbed, which results in greater loss through infiltration and evaporation, the BOR channeled the water into a ditch which consolidated the flow and moved it more quickly to the reservoir, resulting in less loss to evaporation.

When the BOR low flow channel was constructed, a spoil embankment was constructed with it and portions of the original MRGCD earthen embankment were incorporated into the new BOR embankment.[80] The BOR spoil embankment is larger than the existing railroad grades and old levee and became the primary flood protection for the San Acacia Unit. When the BOR embankment became the primary flood protection, maintenance efforts were focused on the new levee and the original levee began to fall into disrepair. In some places the levee is quite flat [most likely where fill for the new levee was taken], and in others the form of the levee is distinct. Although the levee has not been the primary flood protection in the San Acacia Unit for many years, it is still distinguishable as a feature in the landscape.

By and large the levees throughout the MRGCD have served the communities well, as damage caused by floods has been kept to a minimum. Throughout their existence the levees have been repaired and maintained on a regular basis, though some repairs (as noted by Mr. Alary) may have been unorthodox. Vegetation has been removed, earth has been infilled, and gravel may have been added to the maintenance road surface.[81] The character of the levees, as with most exposed earthen structures, is of natural deterioration, which requires upkeep to maintain their stability. The material of the current levees will be included in the construction of the new levees and augmented with borrow from nearby, previously disturbed areas. In a sense, the improvement of the levee will be a continuum of its life, the adaptation and reuse of the earth which was used to create it, as has been completed throughout maintenance programs since its inception. The levees will change in size and shape, but will continue to provide the middle Rio Grande with flood protection.

GLOSSARY

***Acequia*:**	an small irrigation ditch.
Alkali:	a soluble mineral present in some soils, especially in arid regions, which is detrimental to agricultural vegetation.
Canal:	an artificial waterway used for irrigation. In Corrales this is the main water supply from which all other irrigation branches.
Dike:	an embankment for holding back water from a sea or river.
Ditch:	a long narrow excavation made in the ground used to transport water for irrigation.
Drain:	a ditch used to slowly and continuously withdraw water from land near the river.
High Line Canal:	a canal located on hills bordering a valley which uses gravity flow and small percentages of grade to move water. Their location above the valley and grade configuration can increase the amount of irrigable valley land.
Low Line Canal:	a canal located on the valley floor requiring drop structures to promote flow.
Lateral:	a canal which runs parallel to the river and distributes water from a main canal.
Levee:	an earthen embankment designed to prevent flooding.
Piping:	the removal of finer particles due to rate of pressure drop resulting from seepage. Usually occurs just downstream of the embankment.
Riparian:	vegetation situated on the bank of a river.
Siphon:	a conduit that uses atmospheric pressure to draw liquid from one container to another. In the Corrales case, a change in conduit height from one side of the river to the other is used to siphon water from the Albuquerque Main Canal into the Corrales Main Canal.
Terrones:	blocks of earth cut from the riverbank, including roots, to serve as bricks in construction.
Waterlog:	to soak, fill, or saturate so as to make soggy or useless.

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21. Horvath, p. 58

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32. Sketch map created by Miguel R. Chavez and Amalia Diaz de Chavez for the August 26, 1995 reunion of former San Marcial residents in Socorro, New Mexico. The map was slightly revised by Benny Barreras and later digitized by Felix Torres, Jr., both of Socorro. Charles and Darlene Hunter are the only current residents at the site of San Marcial.

33. Manuscript on file at the MRGCD archives, Albuquerque, New Mexico.

34. Richard Melzer, "Floods Haven't Washed Away Memories of Town," p. 87.

35. La Mesa de San Marcial was originally founded in the early 1850s on the east bank of the Rio Grande, but was also obliterated by a flood in 1866. The community reestablished itself on the west bank of the river on the Pedro Armendaris land grant. San Marcial was a fairly sleepy community until 1880 when the Atchison, Topeka, and Santa Fe Railroad established a division headquarters there. A roundhouse, freight depot, telegraph building, a Harvey House and numerous other enterprises were present when a fire nearly destroyed the town in 1881. Yet again the town bounced back. By 1929, when the floods hit, the population had grown to over 1400 and the town boasted a skating rink, a weekly paper, several churches of different denominations, and even such diversified businesses as a bicycle repair shop. (From "San Marcial," no date, author unknown, Socorro Library vertical files.)

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65. *Ibid.*, p. 93.

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69. *Ibid.*, p. 5.

70. MRGCD *Official Plan*, p. 69.

71. *Ibid.*, p. 52.

72. *Ibid.*, p. 86.

73. *Ibid.*, p. 115.

74. *Ibid.*, p. 55.

75. *Ibid.*, p. 52.

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APPENDIX A

1935–1989 Vegetation Maps

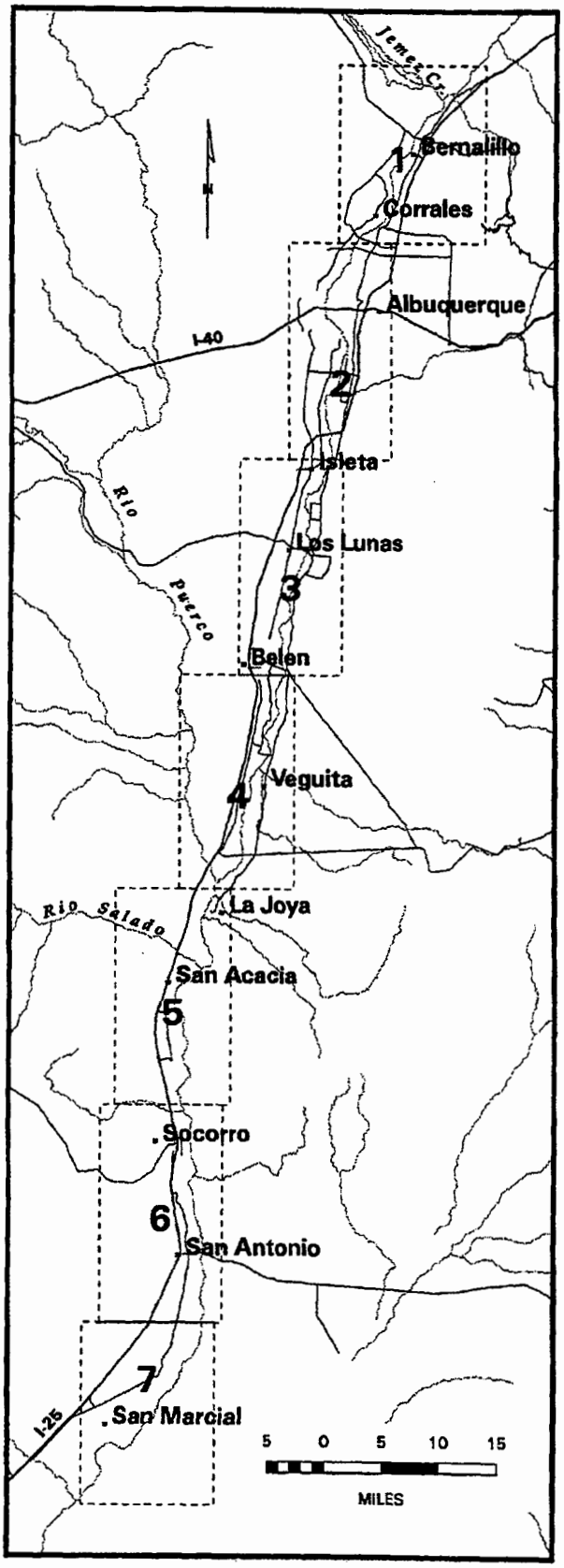
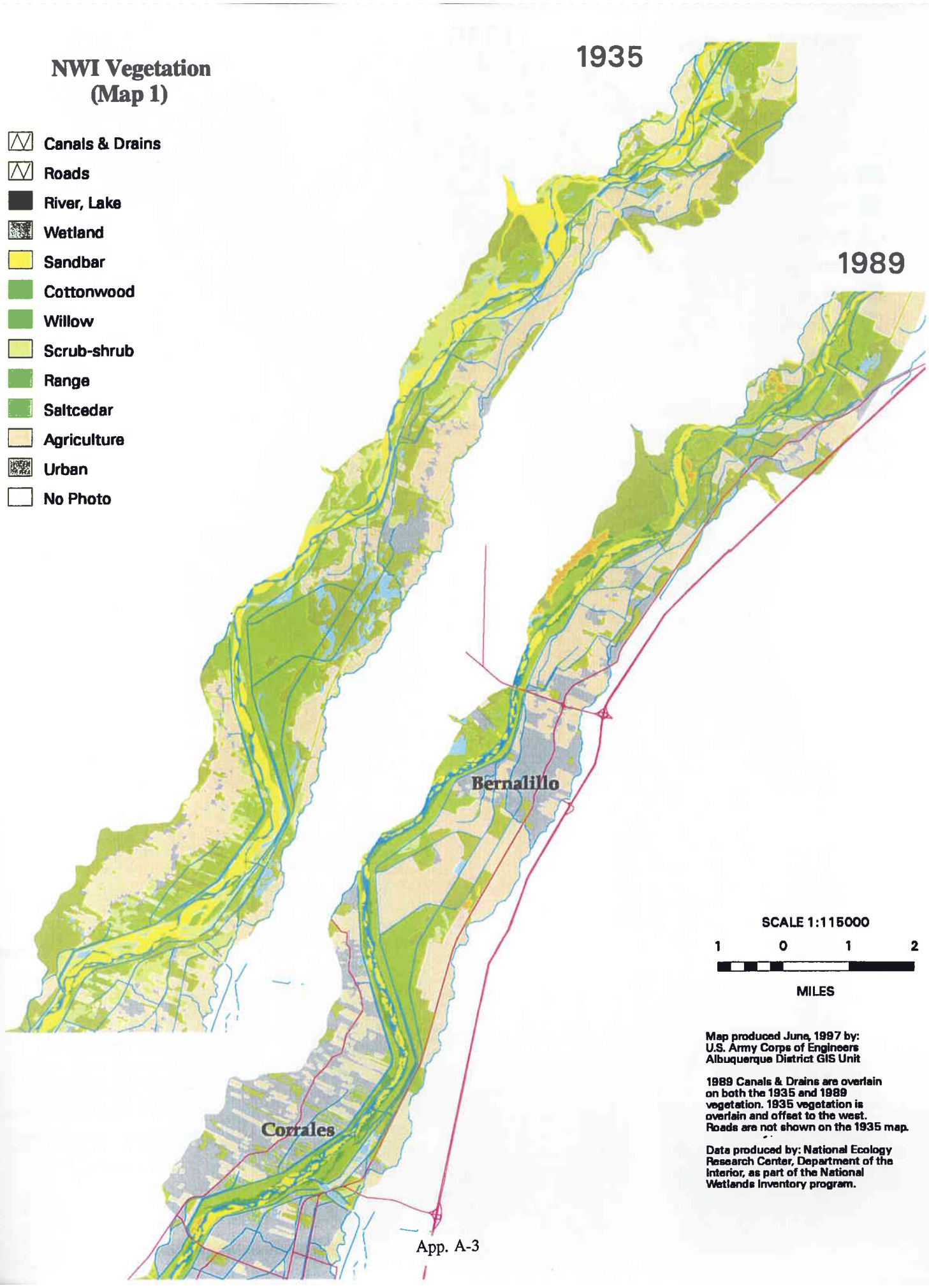
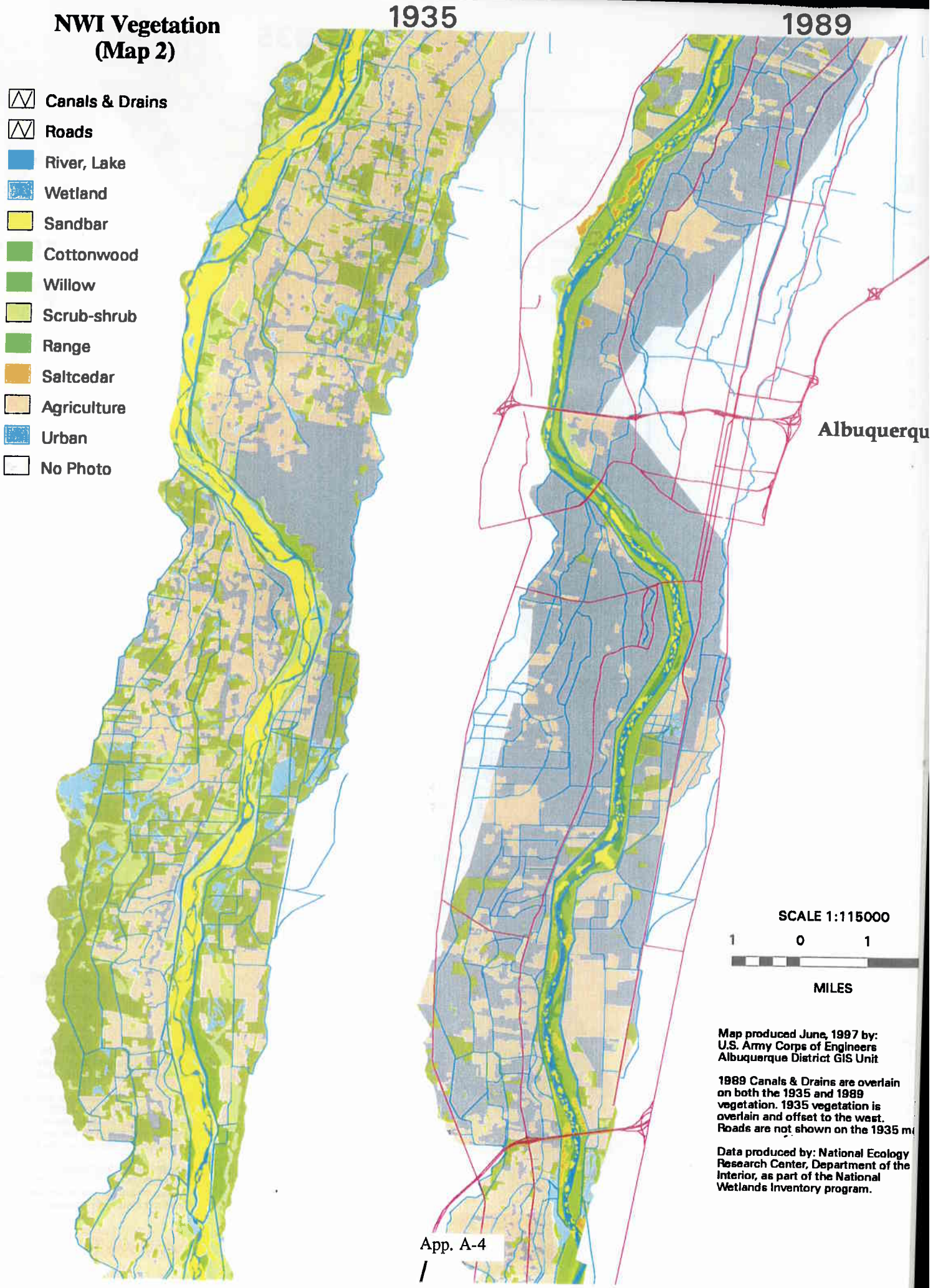
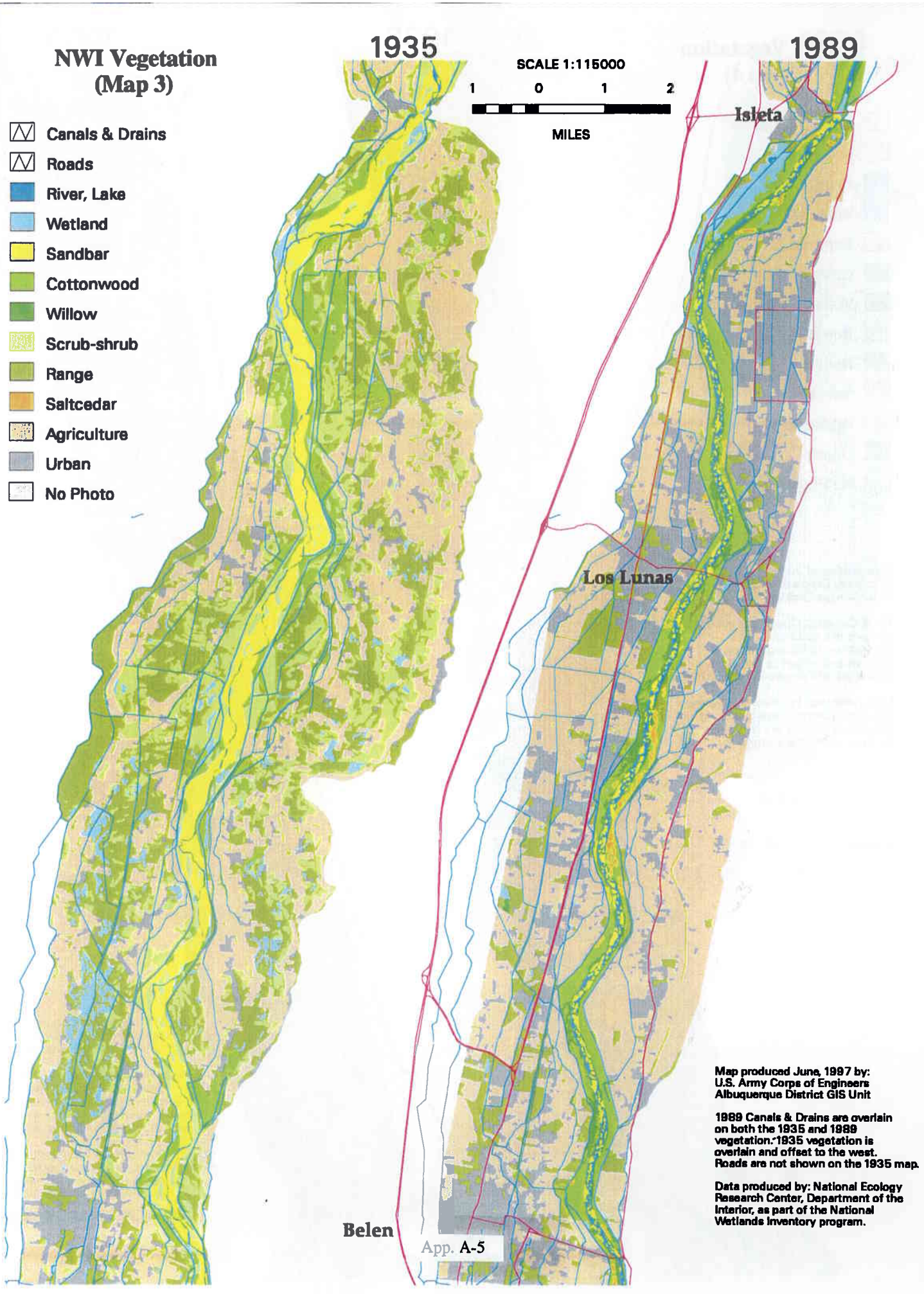


Figure A.1 Index to vegetation maps


NWI Vegetation
(Map 1)
Canals & Drains
Roads
River, Lake
Wetland
Sandbar
Cottonwood
Willow
Scrub-shrub
Range
Saltcedar
Agriculture
Urban
No Photo
1935
1989
Bernalillo
Corrales
SCALE 1:115000
1 0 1 2
MILES
Map produced June, 1997 by:
U.S. Army Corps of Engineers
Albuquerque District GIS Unit
1989 Canals & Drains are overlain on both the 1935 and 1989 vegetation. 1935 vegetation is overlain and offset to the west. Roads are not shown on the 1935 map.
Data produced by: National Ecology Research Center, Department of the Interior, as part of the National Wetlands Inventory program.

NWI Vegetation (Map 2)




NWI Vegetation
(Map 3)
1935
1989
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MILES
Canals & Drains
Roads
River, Lake
Wetland
Sandbar
Cottonwood
Willow
Scrub-shrub
Range
Saltcedar
Agriculture
Urban
No Photo
Isleta
Los Lunas
Belen
Map produced June, 1997 by:
U.S. Army Corps of Engineers
Albuquerque District GIS Unit
1989 Canals & Drains are overlain on both the 1935 and 1989 vegetation. 1935 vegetation is overlain and offset to the west. Roads are not shown on the 1935 map.
Data produced by: National Ecology Research Center, Department of the Interior, as part of the National Wetlands Inventory program.

NWI Vegetation (Map 4)

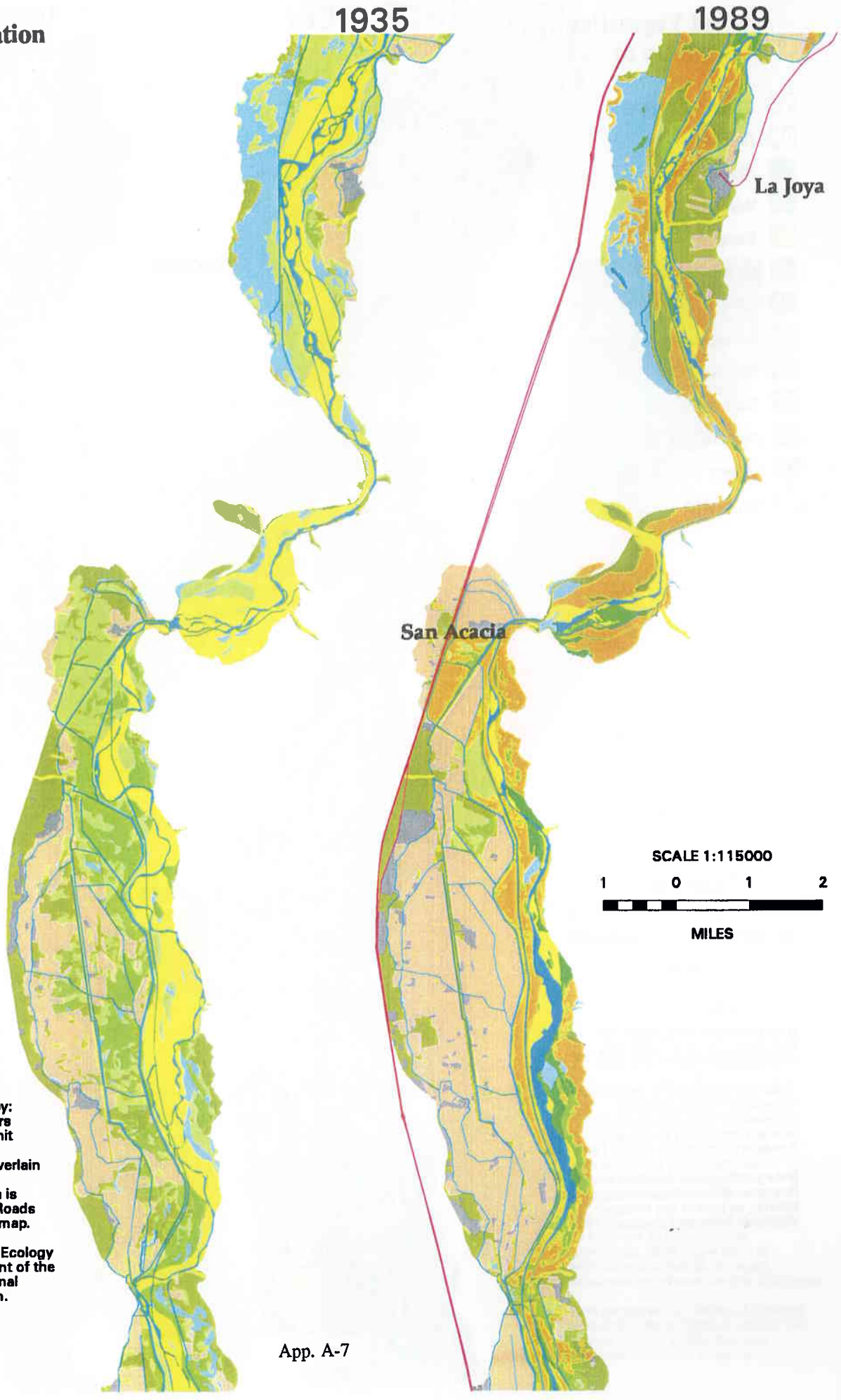
Map produced June, 1997 by:
U.S. Army Corps of Engineers
Albuquerque District GIS Unit

1989 Canals & Drains are overlain on both the 1935 and 1989 vegetation. 1935 vegetation is overlain and offset to the west. Roads are not shown on the 1935 map.

Data produced by: National Ecology Research Center, Department of the Interior, as part of the National Wetlands Inventory program.

NWI Vegetation (Map 5)

- Canals & Drains
- Roads
- River, Lake
- Wetland
- Sandbar
- Cottonwood
- Willow
- Scrub-shrub
- Range
- Saltcedar
- Agriculture
- Urban
- No Photo



SCALE 1:115000

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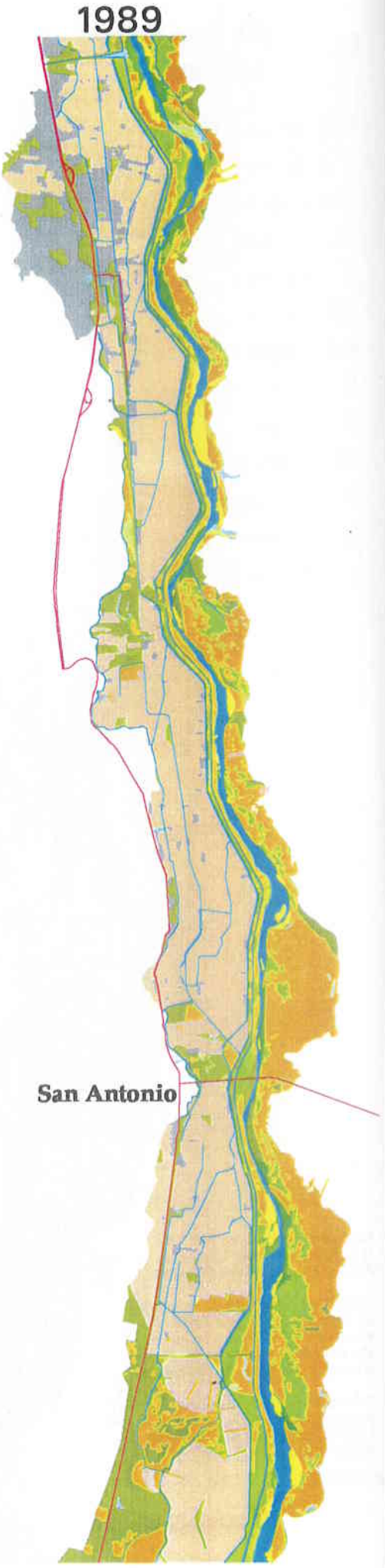
MILES

Map produced June, 1997 by:
U.S. Army Corps of Engineers
Albuquerque District GIS Unit

1989 Canals & Drains are overlain on both the 1935 and 1989 vegetation. 1935 vegetation is shown offset to the west. Roads are not shown on the 1935 map.

Data produced by: National Ecology Research Center, Department of the Interior, as part of the National Wetlands Inventory program.

NWI Vegetation (Map 6)



SCALE 1:115000

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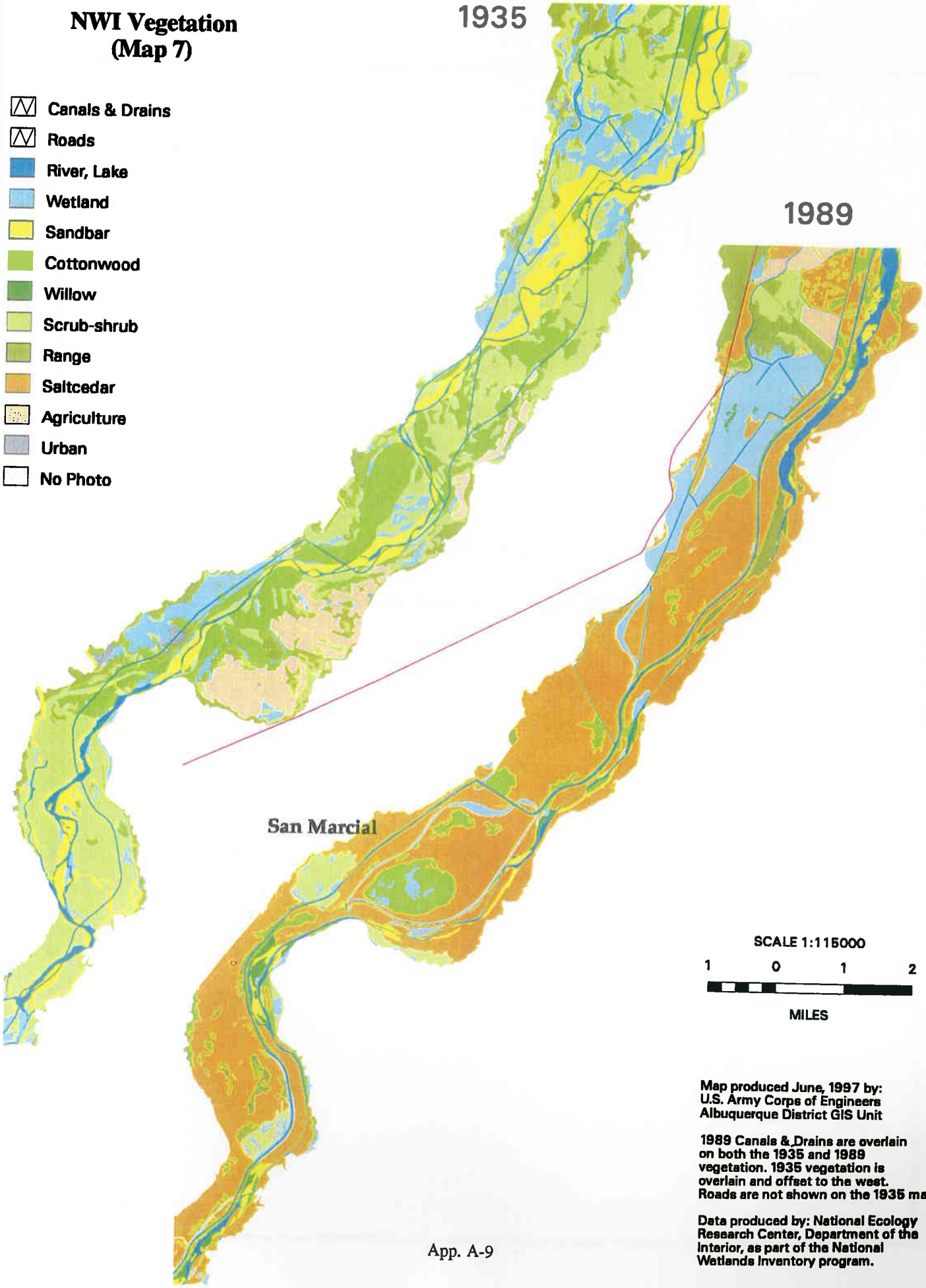
MILES

Map produced June, 1997 by:
U.S. Army Corps of Engineers
Albuquerque District GIS Unit

1989 Canals & Drains are overlain on both the 1935 and 1989 vegetation. 1935 vegetation is overlain and offset to the west. Roads are not shown on the 1935 map.

Data produced by: National Ecology Research Center, Department of the Interior, as part of the National Wetlands Inventory program.

NWI Vegetation (Map 7)



Map produced June, 1997 by:
U.S. Army Corps of Engineers
Albuquerque District GIS Unit

1989 Canals & Drains are overlain on both the 1935 and 1989 vegetation. 1935 vegetation is overlain and offset to the west. Roads are not shown on the 1935 map.

Data produced by: National Ecology Research Center, Department of the Interior, as part of the National Wetlands Inventory program.

APPENDIX B

Table of Floods at San Marcial

Table B.1 Floods at San Marcial 1897–1924

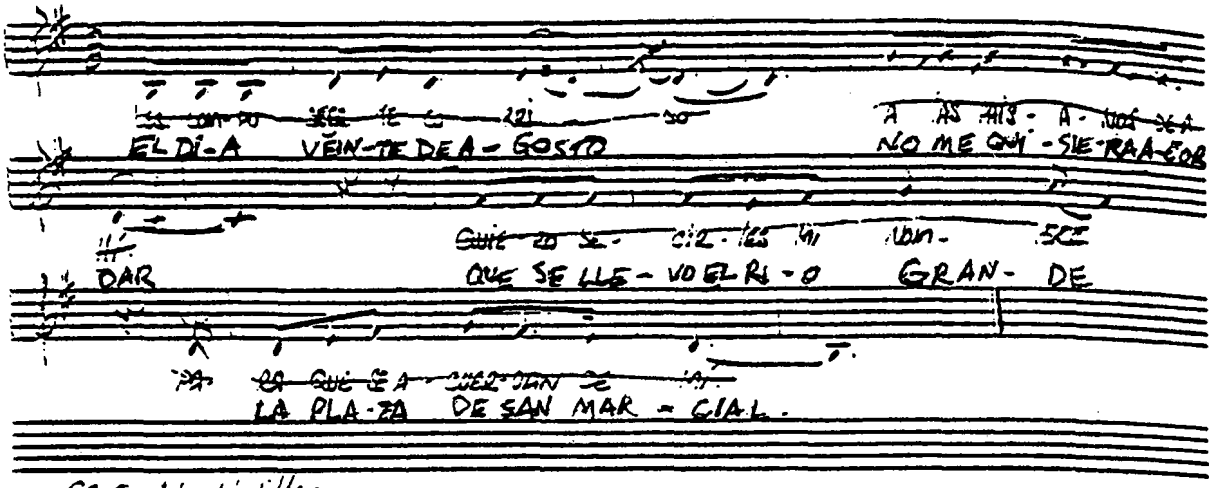
YEAR	FLOOD PERIODS	DAYS	MAX. DISCHARGE SEC. FT.
1897	May 6 – June 3	29	21,800
1897	October 10	1	15,500
1898	April 20	1	10,600
1898	April 30 – May 1	2	11,300
1898	July 16–18	3	16,800
1902	August 26	1	10,500
1903	June 9–25	17	18,800
1904	October 2–3	2	19,100
1904	October 9–15	7	33,000
1905	April 24–25	2	14,100
1905	May 4 – June 20	48	29,100
1906	May 13 – 15	3	10,400
1907	May 26– 30	5	11,500
1907	June 20 – 23	4	11,700
1907	August 31 – Sept. 1	2	10,600
1911	July 21 – 23	3	11,000
1911	October 7 – 11	5	11,800
1912	May 23 – June 12	21	15,300
1915	April 18	1	12,600
1915	May 21	1	10,400
1916	May 11 – 18	8	15,100
1916	October 15	1	11,400
1919	April 26 – May 1	6	12,700
1919	May 26 – 28	3	10,800
1920	May 12 – 18	7	13,100
1920	May 23 – June 21	30	22,500
1921	June 6 – 24	19	19,400
1921	July 25	1	10,900
1922	May 11	1	10,400
1924	April 18	1	10,000
1924	April 26 – 30	5	12,200
1924	May 12 – 28	17	12,400

Source: "The Situation at San Marcial," C.H. Howell

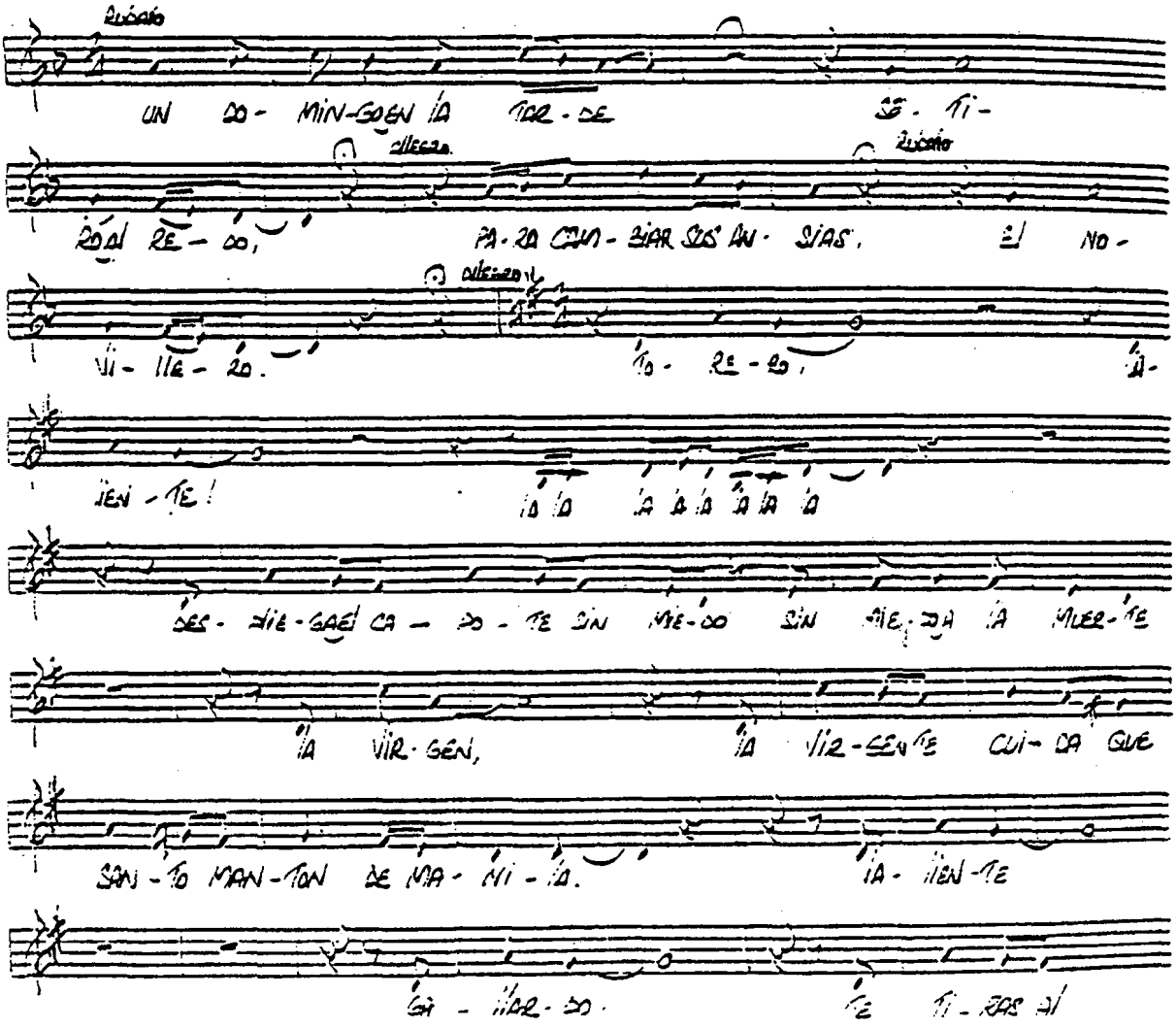
APPENDIX C

Sheet Music for *El Corrido de San Marcial*

924. El Corrido de San Marcial



925. El Novillero



APPENDIX D

Irrigation Developments Before 1926

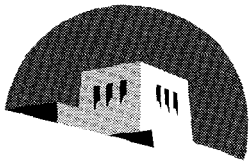
Table D.1 Middle Rio Grande Developments. *Source:* MRGCD Official Plan (1928)

TIME OF CONSTRUCTION	NUMBER OF DITCHES	SECOND FEET CAPACITY	1910 IRRIGATION (ACRES)	ADDITIONAL POSSIBLE (ACRES)	TOTAL UNDER DITCH (ACRES)
Ancient and very old	15	405	11,100	7,830	18,930
Old	40	946	20,285	25,815	46,100
About 1700	2	40	1,300	1,300	2,600
Before 1800	6	221	4,500	7,400	11,900
Before 1850	5	143	3,000	5,350	8,350
To 1880	6	184	3,500	10,000	13,500
To 1910	5	197	1,535	21,885	23,420
TOTALS	79	2,145	45,220	79,580	124,800

(This table is given by Mr. Hedke as a summary of an investigation made in 1910 by Mr. H. W. Yeo of the United States Reclamation Service, at present State Engineer of New Mexico.)

Table D.2 Showing the Progess of Irrigation Developments in the Middle Rio Grande Valley based on the reports of: W.W. Follett, Engineer, International Boundary Commission; H.W. Yeo, Engineer, United States Reclamation Service; State of New Mexico, 1918 Drainage Survey. *Source:* MRGCD Official Plan (1928)

TIME UP TO	NO. OF DITCHES	SEC. FT. CAPACITY	ACRES UNDER DEVELOPMENT	ACRES FAILED	REMARKS
1600	22	537	25,555		Indian development.
1700	61	1,445	73,580		Indian with Spanish.
1800	70	1,808	100,380		Above with Spanish grants.
1850	80	2,099	123,315		Natural increase.
1880	82	2,145	124,800		Transcontinental traffic and civil war demand, completed developments
1896	71	1,779	50,000	74,800	Due to short water supply, rising water table, R.R. supply competition and R.R. labor demand
1910	79	2,121	45,220	79,580	Further shortage and further rising water table.
1918	65	1,957	47,000	77,800	War period.
1925	60	1,850	40,000	84,800	Estimated present condition.



The University of New Mexico

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of Engineers