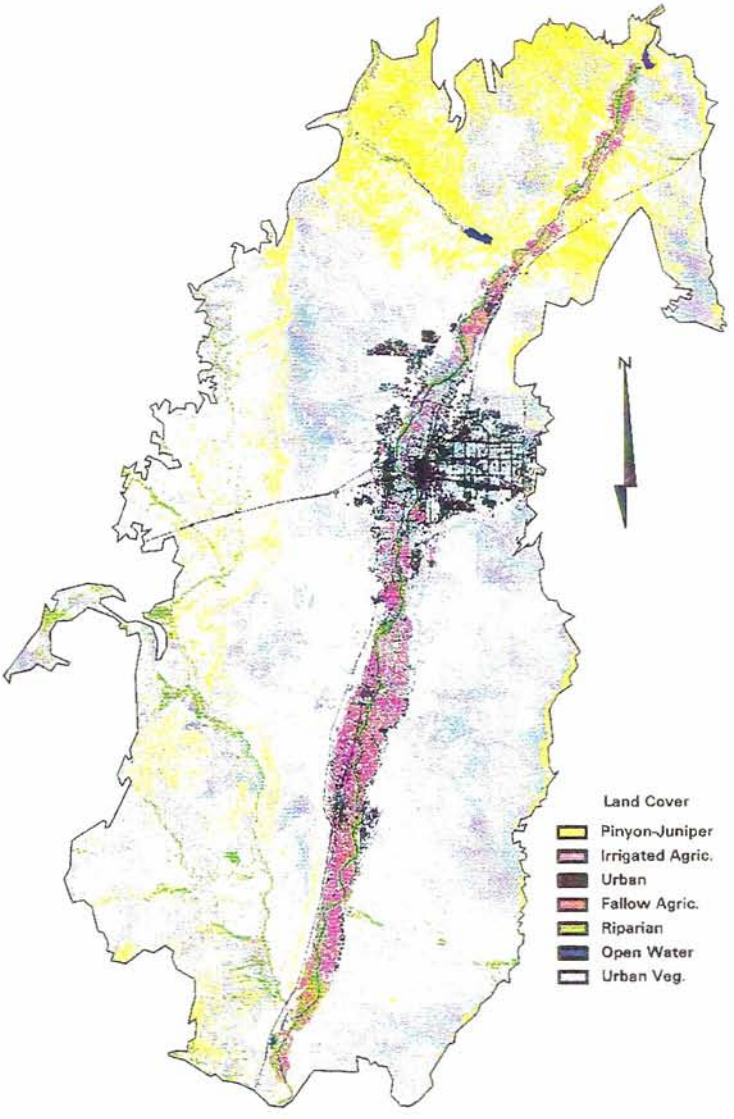
Middle Rio Grande Water Assessment

Middle Rio Grande Land Use Trend Analysis Geographic Information System Data Base



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BUREAU OF RECLAMATION
DENVER OFFICE
PO Box 25007
Building 67, Denver Federal Center
Denver, Colorado 80225-0007

IN REPLY REFER TO:

D-3744

SEP 26 1994

Memorandum

To: Head, Remote Sensing and Geographic Information Section
Attention: D-3744

From: Alan D. Bell, Physical Scientist
Karen R. Blaney, DP and Associates
Karri J. Oliver, Physical Science Technician
Ron E. Miller, Physical Scientist

Applied Sciences Referral Memorandum No. 94-4-4

Principal Investigator: Alan D. Bell

BACKGROUND

The purpose of the Rio Grande land use trend analysis (LUTA) is to identify and quantify land use trends in the Albuquerque basin, New Mexico, over the past 58 years. Land use data from the LUTA will be used as a component in a Bureau of Reclamation (Reclamation) enhanced version of a U.S. Geological Survey (USGS) computer model, with the goal being to identify groundwater recharge enhancement opportunities in the Albuquerque basin. Cost of the LUTA was equally shared between Reclamation and the City of Albuquerque (City).

The LUTA is primarily concerned with those lands in the Albuquerque basin whose uses were, are, or will be associated with water uses that significantly impact groundwater resources. In general terms, the study area includes the riparian vegetation, agricultural, and urban lands along the Jemez river and Rio Grande. The LUTA study area begins just north of Cochiti dam, follows the Rio Grande south, and ends in the vicinity of San Acacia dam. The Jemez river riparian and agricultural lands from the vicinity of Jemez Pueblo to the Jemez/Rio Grande junction are also included in the LUTA study area.

Reclamation and the City identified four periods of time for the LUTA: 1935, 1954/55, mid 1970's, and 1992/93. A Geographic Information System (GIS) database was constructed for each of the four time periods.

METHODOLOGY

Historic and current aerial photography and 1992 Landsat TM satellite imagery were used as primary data sources for compiling the LUTA (GIS) database. Appendix A lists the characteristics of each set of aerial photography.

In addition to the photography/imagery, data was incorporated into the LUTA from these supplemental sources:

1. 1993 Inventory GIS database created by Reclamation in partnership with the Middle Rio Grande Conservancy District (MRGCD). This database was compiled from fieldwork and interpretation of June 1992 1:12,000 scale color infrared (CIR) aerial photography. Coverage was of the MRGCD serviced lands from below Cochiti Dam to San Acacia.

2. Bureau of Indian Affairs (BIA), Southern Pueblos Agency, supplied us with agricultural land use data for the Zia and Jemez Pueblo lands from their 1993 field check.

3. A Reclamation GIS database, completed in July 1991, which encompassed the Rio Grande riparian corridor (Bosque) from Cochiti dam to San Acacia. The database was compiled from field work, 1989 CIR aerial photography, Army Corps of Engineers and U.S. Fish and Wildlife Service (FWS) vegetation maps (Appendix D).

4. FWS National Ecology Research Center (NERC) supplied us with a copy of their 1935 Middle Rio Grande GIS database, Cochiti dam to San Acacia riparian corridor which was compiled from 1935 aerial photography (Appendix E).

To create the LUTA GIS database using a combination of aerial photography and other sources the general work flow was:

A. Assess supplemental data sources and GIS databases for potential use and LUTA study area coverage.

B. Interpret current and historic aerial photography (P.I.). Four time periods of photos; 1935, 1954/55, mid-1970's, and 1992/93.

C. Transfer of P.I. data to controlled base map scale (USGS 7.5 minute quadrangle maps).

D. Digitize P.I. data into the GIS.

E. Merge supplemental GIS databases with our digitized P.I. data to create complete GIS database.

F. Create map plots from the GIS database.

The 1992/93 aerial photography, which was field checked, was interpreted for 33 land use classes (Appendix B). Because of the uncertainty of reliably identifying crop type on the historic aerial photography these databases (1935, 1954/55, mid-1970's) do not contain specific crop type classes. The historic databases contain up to 22 land use classes.

Mylar overlays were attached to individual aerial photographs. Land use classes were interpreted/identified and delineated as polygons on these mylar overlays. These land use polygons were then transferred onto mylar overlay fitted USGS quadrangle maps. Saltzman vertical reflecting projectors were used for the transfer process. Next, the land use polygons were converted to a digital format using either a Anatech Eagle 4080 ET scanner or a Altek digitizing tablet. The digital files were then converted into Arc/Info coverages and edited on a Hewlett Packard Series 700 computer workstation using Arc/Info GIS software version 6.1. Final map plots were made using a Hewlett Packard Design Jet 650C plotter.

The minimum mapping unit generally was 2 acres. However, some of the supplementary GIS databases contained land use polygons smaller than 1 acre. These smaller polygons were left intact for the LUTA.

The LUTA GIS database is divided by year at its highest level; 1935, 1954/55, mid-1970's, and 1992/93. Within each year the database is subdivided by county; Sandoval, Bernalillo, Valencia, and Socorro. Each county contains a vegetation/land use class, hydrology, and base transportation coverage. Map projection is UTM zone 13. Directories within each year contain a notebook file, which define the naming conventions used, a short explanation on methodology, and tables for understanding the polygon and line coverages.

Potential problems can exist in all projects of this nature in the photointerpretation (P.I.), transfer, and digitizing procedures. The LUTA study area covers a large geographic area. Over such a large area identical crops are planted and harvested at different times, the amount of water applied can vary dramatically from field-to-field, differences in soil type, insect infestations, and other factors can affect the consistency of vegetation appearance on aerial photography. The agricultural lands presented more of a P.I problem; on some sets of photos, we keyed in on the color, tone, texture, shape, field patterns/cuts, and time of year for help in agriculture class determination. If a piece of ground appeared to have been cleared or worked for agricultural use anytime in the past it was classified as either active agricultural, fallow, or idle. At times it was difficult to discriminate between active agriculture and fallow or idle, particularly on the black and white aerial photography.

To assist in maintaining consistency during photointerpretation it was necessary to go to the field with MRGCD staff during the summer of 1992 and correlate specific crop types to specific field locations on the June 1992 CIR aerial photography as much as possible. The June 1993 CIR aerial photography was field checked by Reclamation and enhanced by 1993 field check data provided by BIA for the Jemez river pueblo agricultural lands.

The field work done for the 1992/93 aerial photography helped the photointerpreters develop a mental key for use during interpretation of the historic aerial photography.

The objective when evaluating historic aerial photography sources was to use large scale, early summer aerial photography covering the LUTA study area. In reality, to obtain maximum LUTA study area coverage we used medium (1:20,000) to small (1:80,000) scale, mostly black and white, 9-inch by 9-inch contact prints. In some places, such as the east side of Albuquerque/Kirtland AFB/Manzano weapons depot area in 1954/55 photos were not available. The quality of the earlier aerial photography was poorer, with the 1935 air photos poorest in quality. Forward motion compensation was a problem in earlier mapping camera systems, the result being that some photographic images are less crisp/somewhat blurry when compared to current mapping camera systems. We obtained the 1935 black and white prints from the National Archives in Washington, D.C., they could not tell us during what month the photos were obtained. The best guess is over several months, including part of the growing season. The January and February 1954 dates on some of the Army Map Service photos are suspect because in some areas the leaves are still on the cottonwood trees. These were all factors in and increased the difficulty of the P.I. work, but none were project defeating.

When possible, delineation of land use classes was confined to the central portion of aerial photographs to minimize the distortion that occurs toward the outer edges of all non-differentially rectified aerial photography. An average pencil width (0.5 millimeters) on the mylar overlays represents 39.4 feet ground distance at 1:24,000 scale. The 7.5 minute USGS quadrangles (1:24,000 scale) were used as base maps during the transfer process for control purposes and to minimize alignment and angular relationship problems. The digitizing process has proven reliable and accurate, introducing little error into a project when done properly.

Landsat TM satellite data was purchased for the entire state of New Mexico through a multi-agency cooperative agreement and New Mexico State University and EOSAT. The full basin area required portions of two Landsat scenes. The images were processed separately and combined after the classification process. The path 33, row 35 acquisition date was August 15, 1992 and the path

34, row 35 date was September 7, 1992. The images were rectified to Zone 13N of the Universal Transverse Mercator (UTM) projection and aligned with the North American Datum (NAD) 1927. The rectification work was performed by EISYS (Earth Information Systems). The image classification was designed to identify eight categories within the basin area. They are desert scrub, pinon-juniper, irrigated agriculture, urban, fallow agriculture, riparian vegetation, open water, and urban/residential vegetation. The data was processed using the ERDAS IMAGINE image processing and GIS software on a high performance UNIX workstation.

The satellite project area was delineated by rock strata from the Cenozoic geologic period and digitized from 1:1,000,000 scale USGS geologic maps. This was performed by the USGS Albuquerque office, Water Resources Division. An Arc/Info GIS coverage was created and used to define the satellite imagery boundary. The area includes approximately 650 square miles and contains irrigated agriculture and riparian vegetation along the middle Rio Grande, Jemez, and Rio Puerco Rivers and also includes the city of Albuquerque. The satellite study area covers the entire defined Albuquerque basin, including areas outside of major water usage along the Rio Grande and Jemez river.

Preprocessing is performed to minimize errors in the satellite data and better approximate actual ground conditions. Radiometric errors are distortions that occur between the ground and the sensor that affect the reflected values such as haze, particulate, sun angle differences and sensor noise. Geometric errors are distortions caused by relief displacement, earth curvature, and non-linear errors relative to map and ground scale and distances. The image data was analyzed for these errors and histograms were generated for the six bands to be used in each scene. Band 6, the thermal infrared band was not used for the study. Some sensor error occurred in patches of the desert scrub areas which should not affect classification.

Image enhancement is performed to enhance the ability to extract and classify specific information in the satellite data. The objective is to create a new data set from the original to optimize the potential to extract the desired land cover classes in the basin. The original Landsat data was comprised of 6 bands representing visible and infrared spectral ranges within the electromagnetic spectrum. These bands tend to contain a significant amount of correlation or redundant information between them. For this project, a vegetation transformation was performed prior to the classification procedure. The "tasseled cap" transformation was selected because of the high amount of vegetation to be identified in the basin. This is a sequential orthogonal transform technique, in which three new unique bands are created representing soil brightness, vegetation greenness,

and soil moisture. The transformation was developed specifically for vegetation identification and also worked well for urban areas. The new bands are not correlated and provided the base for the land cover classification.

It was determined that an unsupervised classification procedure was the best method to identify land cover for the basin. Detailed ground truth information was available for the Rio Grande corridor, but not for the remaining areas which makes up the majority of the basin. This method relies on the computer and analysis software to identify unique areas in the data that can be organized and assigned a land cover class. Since the two image scenes were three weeks apart, atmospheric and illumination differences could be significant. Each scene was analyzed, separate statistics sets were created and each scene was classified individually. Each scene was broken down into four areas representing river vegetation, open water, urban, and remaining outlying basin. The outlying area had to be subdivided into smaller areas to delineate the sparse desert scrub and juniper vegetation. The computer clusters of differing land cover were then labeled using a previously developed GIS of the middle Rio Grande and aerial photography. When the final land covers were complete, the classified satellite images were assembled in an additive fashion for each path/row. The results were mosaiced together for the final classification analysis and map plots.

RESULTS

The GIS database and hardcopy map products best represent and depict land use classes in the LUTA study area over the past 58 years. The database is subdivided by year and county. All the GIS data is retrievable and referenced to ground coordinates.

Tables 1-16 contain acreage totals, by land use class, for each county in each year of the GIS database.

The changes in groupings of land use classes are summarized in Tables 17a and 17b, and Figures 1 through 3. The maximum acreage of all agricultural classes combined, with the exception of idle agriculture, occurred in the 1970's (63,827 acres), as shown in Figure 1. There was a 5 percent increase in the combined agricultural classes between 1935 (48,976 acres) and 1992/93 (51,266 acres). During the same period, idle agriculture doubled from 7,908 acres. The combined residential and urban land use classes increased by 80,326 acres, or about 754 percent, in the 58-year LUTA period of analysis study (Figure 2), while the desert scrub class concurrently decreased by 90,394 acres. The total riparian vegetation land use classes were at their highest levels in 1935, then decreased by 23 percent by the mid-fifties.

There was little net change in riparian acreage between 1954/55 and current conditions; minus 797 acres. Likewise, the most dramatic drop in area of open water occurred in the first 20 years of the period of analysis when the total dropped by almost 5,000 acres, or 36 percent. There was actually a small increase (239 acres) from the fifties to current conditions.

The satellite data indicates that the desert scrub class was the highest in terms of total area. It contains little or no vegetation, various scrub growth could also contain sparsely populated juniper vegetation. The pinon-juniper class contains medium to heavy density of juniper at the lower elevations while at higher elevations the class contained more pinon pine, ponderosa pine and other forest vegetation in addition to juniper. These two classes were the most difficult to identify, especially in the lower elevations where the vegetation is very sparse. The irrigated agriculture contained a wide variety of crops and were identified fairly easily. The urban classes were divided into general urban and urban/residential vegetation. The general urban class contained the infrastructure of the cities, roads and industrial areas. The urban/residential vegetation class contained housing, lawns, parks and golf courses. The fallow agriculture was somewhat more difficult to identify as it was spectrally similar to idle or desert scrub areas. It was interdispersed in the agriculture areas along the river. Idle fields that had not been worked for a period of time appeared as desert scrub to the classifier. The riparian class contained the naturally occurring vegetation along the rivers such as cottonwood, tamarisk, willow, and Russian olive stands. Open water was easily identified and included the river and reservoirs, and ponds. Classification results and areas/acreages are listed in Table 18 and Figure 4 is a small scale raster satellite map plot of the Albuquerque basin.

This database can form the basis for subsequent data sets and long term monitoring of the middle Rio Grande valley.

cc: R. Leutheuser ALB-700 (5)
D-3740
D-3744 (4)
(w/encl to each)

APPENDIX A: AERIAL PHOTOGRAPHY

DATE	SCALE	FILM	SOURCE
1935	1:31,680	B&W	National Archives; They could not determine month photos were taken. Best guess is over several months.
Jan/Feb 1954	1:54,000	B&W	Army Map Service/USGS
June 1955	1:20,000	B&W	ASCS
May/June 1973	1:20,000	B&W	ASCS
June 1973	1:31,680	Color	BLM
Feb./Nov. 1974	1:40,000	B&W	ASCS
June 1975	1:76,000	B&W	USGS
June 1977	1:80,000	B&W	USGS
June 1992	1:12,000	CIR	USBR
June 1993	1:24,000	CIR	USBR

APPENDIX B: LAND USE CLASSES

AGRICULTURE*

Alfalfa	Pasture grasses
Sorghum/Sudex	Wheat
Corn	Chile peppers
Grapes	Fallow agriculture
Idle agriculture	Miscellaneous vegetables
Tree fruit	Nursery stock
Oats	Miscellaneous fruit
Melons	* Active Agriculture

RESIDENTIAL/URBAN

Urban vacant	Commercial/Industrial
Residential	Residential-dense
Urban irrigated	Parks/Golf courses

UPLAND

Desert scrub	Pinon/Juniper
Arroyo	

RIPARIAN

Saltcedar	Riparian woodland
Riparian shrub	Marsh vegetation
** Bosque	

MISCELLANEOUS

Quarry/borrow pit	Miscellaneous grasses
Open water	Agricultural complex
Jemez river channel	

* Crop type class is listed only for the 1992/93 database. Agricultural lands are identified only as active, fallow, or idle agriculture or tree fruit/nursery stock in the historical (1935, 1954/55, and mid 1970's) databases.

** The Bosque polygons were consolidated and taken from the 1991 Bosque GIS database; used in 1992/93 database only (Appendix D).

APPENDIX C: LAND USE CLASS (LUCLASS) DEFINITIONS USED IN THE LUTA

Active agriculture
: Active agricultural lands. Crop types defined pursuant to the State of New Mexico classifications, down to a series level at a minimum (1992/93 only).

Fallow agriculture
: Agricultural lands not currently planted, but undergoing active land treatment (plowed or disked).

Idle agriculture
: Agricultural lands abandoned for more than one year, as evidenced by invasion of weeds and shrubs.

Residential
: Areas dominated by single or multiple unit dwellings.

Dense residential
: Areas dominated by multiple unit dwellings.

Urban irrigated
: Non-agricultural irrigated lands associated with individual residences.

Parks and Golf courses
: Public irrigated lands used for parks and recreational areas.

Urban vacant
: Undeveloped or abandoned lands whose land surface is bare; or dominated by desert scrub vegetation, or weeds and shrubs (Urban designation determined by juxtaposition to surrounding land use).

Commercial/Industrial
: Areas of urban development dominated by commercial and industrial activities, such as: parking lots, industrial yards, railroad yards, junkyards, manufacturing, wholesale, and retail businesses, office buildings, etc... .

Riparian woodland
: Undeveloped woodland areas consisting of cottonwood, willow, Russian olive, or other tree species with 50% or greater canopy cover.

Saltcedar riparian
: Includes both homogenous and salt cedar dominant communities.

Riparian shrub
: Areas of riparian grasses, forbs, and shrub species with less than 50% tree canopy cover.

Marsh vegetation
Areas dominated by cattail and bulrush.

Desert scrub
Areas of upland arid vegetation communities dominated by grasses, creosote bush, cacti, and some juniper.

Pinon/juniper
Areas of undeveloped land dominated by pinon/juniper vegetation. Juniper predominates at lower elevations, while pinon pine, ponderosa pine, and other woodland species become more prevalent at higher elevations.

Arroyos
Lined and unlined flood event water conveyance channels. Designated as linear features with desert scrub vegetation association.

Open Water
Areas of open water. For the purposes of this study the bank-to-bank Rio Grande channel is to be considered open water. Drains, canals, and ditches were considered linear features.

Quarry/borrow pit
Quarry and borrow pit areas that were used for the removal of rock, gravel, or sand.

Agricultural complex
Agriculture and farm related areas with little or no vegetation ground cover. Areas dominated by barns and various types of farm buildings or sheds, cattle/pig feed lots, stockyards, or corral areas.

Miscellaneous Grasses
Areas with a mixture of grasses/weeds/shrubs or trees associated primarily with linear features such as roads, canals, or ditches.

Jemez river channel
The somewhat braided stream portions of the Jemez river. Interspersed with the braided channels was usually light desert scrub or riparian vegetation. This class was used on the drier sections of the Jemez river, to give users a feel of where the Jemez channel activity was likely to be concentrated, when it contained water. On some sets of aerial photos the Jemez river channel was virtually dry.

Bosque
The riparian vegetation corridor located along either side of the Rio Grande. It is a compilation of the Appendix D vegetation communities in the 1991 Bosque GIS database, grouped together as one "Bosque" land use class. It is similar to a riparian woodland/riparian shrub/saltcedar/marsh LUCLASS combination. Used for 1992/93 database only.

APPENDIX D: 1991 BOSQUE GIS DATABASE; USED FOR 1992/93 RIO GRANDE RIPARIAN CORRIDOR

RIVER REACHES:

COCHITI REACH-	Cochiti dam to Angostura diversion dam
MIDDLE REACH-	Angostura dam to Rio Puerco confluence
SOCORRO REACH-	Rio Puerco confluence to North boundary of Bosque del Apache National Wildlife Refuge

** VEGETATION COMMUNITIES AND SYMBOLS (HINK AND OHMART, 1984):

Amorpha	A
Agriculture	Ag
Atriplex canescens (Fourwing Saltbrush)	ATX
Baccharis (Seepwillow)	B
Cottonwood	C
Cattail	CAT
Coyote Willow	CW
Ponded Water	H2O
Juniper	J
Lycium (Wolfberry)	LY
Mulberry	MB
Marsh	MH
New Mexico Olive	NMO
Opening	OP
Russian Olive	RO
Screwbean Mesquite	SB
Saltcedar	SC
Siberian Elm	SE
Tree Willow	TW

River Channel- Defined as that portion of the floodway within which water normally flows. It is generally bordered by riparian woodland, sandy, and without perennial vegetation.

** The listed vegetation community and river channel classes were combined into two classes (Bosque and Rio Grande channel/open water) for use in the 1993 Inventory database.

This 1991 database was constructed using two different sources:

1. U.S. Army Corps of Engineers Biological Resource Inventory Maps. 1984. Hink and Ohmart was used to interpret vegetation community and structure. This data was used from Cochiti dam to San Acacia diversion dam.

2. Interpretation and field verification of 1989 1:20,000 scale CIR aerial photographs. These were taken by the U.S. Fish and Wildlife Service and loaned to BOR. Their use was from San Acacia diversion dam to San Marcial.

APPENDIX E: FISH AND WILDLIFE SERVICE (NERC) 1935 GIS DATABASE TRANSFORMED CLASSES

The following NERC riparian and upland vegetation classes were transformed/related to a corresponding LUTA land use class (LUCLASS):

LUCLASS	NERC VEG_1935
1	UAc Upland Agricultural cropland
	UAm Upland Agricultural mixed
8	URm (subdivided) Upland Range mixed
9	URm (subdivided)
10	UUr (subdivided) Upland Urban residential/commercial
12	UUr (subdivided)
13	UUr (subdivided)
14	UUr (subdivided)
15	UUr (subdivided)
16	RpFOCW Riparian Forested Cottonwood
	PFO Palustrine Forested
18	RpSS Riparian Scrub/Shrub
	PSS Palustrine Scrub/Shrub
19	PEM Palustrine Emergent
	PUS Palustrine Unconsolidated Shore
20	URm Upland Range mixed
22	R4 Riverine intermittent
23	R2 Riverine lower perennial
	L1 Lacustrine limnetic
	L2 Lacustrine littoral
24	URm (subdivided)
26	URm (subdivided)
28	UAo Upland Agricultural orchards

TABLE 1: SANDOVAL COUNTY 1992/93

LAND USE CLASS	LUCLASS NUMBER	ACRES
Alfalfa	1	2980
Pasture grasses	2	2935
Sorghum/Sudex	3	133
Wheat	4	7
Corn	5	781
Chile peppers	6	172
Fallow agriculture	8	777
Idle agriculture	9	5962
Residential	10	8073
Residential-dense	11	168
Urban irrigated	12	117
Parks/golf courses	13	475
Urban vacant	14	743
Commercial/industrial	15	1014
Riparian woodland	16 *	520
Salt cedar	17 *	97
Riparian shrub	18 *	4477
Marsh	19 *	67
Desert scrub	20	44487
Pinon/juniper	21	35158
Arroyo	22	2272
Open water	23	4224
Miscellaneous grass	24	93
Quarry/borrow pit	25	566
Agricultural complex	26	161
Melons	27	29
Tree fruit	28	239
Nursery stock	29	95
Oats	30	76
Miscellaneous fruit	32	5
Miscellaneous vegetables	33	341
Bosque	34	7908
Cochiti dam	35	235
Jemez river channel	36	68

TABLE 2: BERNALILLO COUNTY 1992/93

LAND USE CLASS	LUCLASS NUMBER	ACRES
Alfalfa	1	4060
Pasture grass	2	3643
Sorghum/sudex	3	81
Corn	5	172
Chile peppers	6	70
Grapes	7	14
Fallow agriculture	8	564
Idle agriculture	9	2833
Residential	10	42289
Residential-dense	11	2274
Urban irrigated	12	705
Parks/golf courses	13	2955
Urban vacant	14	4518
Commercial/industrial	15	19598
Riparian woodland	16 *	252
Riparian shrub	18 *	210
Marsh	19 *	88
Desert scrub	20	95876
Pinon/juniper	21	4046
Arroyo	22	3232
Open water	23	1880
Miscellaneous grass	24	1746
Quarry/borrow pit	25	1162
Agricultural complex	26	459
Melons	27	52
Tree fruit	28	79
Nursery stock	29	72
Oats	30	141
Miscellaneous fruit	32	6
Miscellaneous vegetables	33	99
Bosque	34	4582

TABLE 3: VALENCIA COUNTY 1992/93

LAND USE CLASS	LUCLASS NUMBER	ACRES
Alfalfa	1	14476
Pasture grass	2	9835
Sorghum/sudex	3	237
Wheat	4	90
Corn	5	826
Chile peppers	6	94
Grapes	7	72
Fallow agriculture	8	323
Idle agriculture	9	5112
Residential	10	6238
Residential-dense	11	38
Urban irrigated	12	8
Parks/golf courses	13	80
Urban vacant	14	264
Commercial/industrial	15	1239
Riparian woodland	16 *	110
Riparian shrub	18 *	178
Marsh	19 *	192
Desert scrub	20	14308
Arroyo	22	100
Open water	23	1721
Miscellaneous grass	24	5114
Quarry/borrow pit	25	20
Agricultural complex	26	725
Tree fruit	28	136
Nursery stock	29	36
Oats	30	1386
Miscellaneous vegetables	33	266
Bosque	34	4407

TABLE 4: SOCORRO COUNTY 1992/93

LAND USE CLASS	LUCLASS NUMBER	ACRES
Alfalfa	1	2577
Pasture grass	2	2194
Sorghum/sudex	3	107
Wheat	4	104
Corn	5	294
Chile peppers	6	85
Grapes	7	138
Fallow agriculture	8	220
Idle agriculture	9	1947
Residential	10	156
Urban vacant	14	16
Commercial/industrial	15	6
Riparian woodland	16 *	61
Riparian shrub	18 *	311
Marsh	19 *	113
Desert scrub	20	15400
Arroyo	22	147
Open water	23	1397
Miscellaneous grass	24	1116
Agricultural complex	26	99
Oats	30	63
Miscellaneous vegetables	33	84
Bosque	34	10772

* These riparian classes occurred outside of the 1991 Bosque GIS database boundary.

TABLE 5: SANDOVAL COUNTY 1975

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	9652
Fallow agriculture	8	1132
Idle agriculture	9	3231
Residential	10	2815
Residential-dense	11	102
Urban irrigated	12	29
Parks/golf courses	13	182
Urban vacant	14	70
Commercial/industrial	15	165
Riparian woodland	16	4724
Salt-cedar	17	91
Riparian shrub	18	8591
Marsh	19	454
Desert scrub	20	50299
Pinon/juniper	21	35037
Arroyo	22	2157
Open water	23	4352
Miscellaneous grass	24	530
Quarry/borrow pit	25	600
Agricultural complex	26	91
Tree fruit/nursery	28	478
Cochiti dam	35	258

TABLE 6: BERNALILLO COUNTY 1975

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	12420
Fallow agriculture	8	1037
Idle agriculture	9	1574
Residential	10	29848
Residential-dense	11	366
Urban irrigated	12	141
Parks/golf courses	13	1915
Urban vacant	14	1971
Commercial/industrial	15	12094
Riparian woodland	16	3536
Riparian shrub	18	2885
Marsh	19	248
Desert scrub	20	122993
Pinon/juniper	21	902
Arroyo	22	1520
Open water	23	1855
Miscellaneous grass	24	719
Quarry/borrow pit	25	1001
Agricultural complex	26	461
Tree fruit/nursery stock	28	247

TABLE 7: VALENCIA COUNTY 1975

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	29479
Fallow agriculture	8	3724
Idle agriculture	9	4781
Residential	10	4913
Residential-dense	11	10
Urban irrigated	12	19
Parks/golf courses	13	42
Urban vacant	14	294
Commercial/industrial	15	701
Riparian woodland	16	4361
Salt-cedar	17	361
Riparian shrub	18	1153
Marsh	19	82
Desert scrub	20	15355
Arroyo	22	271
Open water	23	1674
Agricultural complex	26	245
Tree fruit/nursery stock	28	114

TABLE 8: SOCORRO COUNTY 1975

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	4461
Fallow agriculture	8	1043
Idle agriculture	9	1262
Residential	10	290
Riparian woodland	16	2765
Salt-cedar	17	861
Riparian shrub	18	8521
Marsh	19	467
Desert scrub	20	15213
Arroyo	22	717
Open water	23	1749
Agricultural complex	26	22
Tree fruit/nursery stock	28	40

TABLE 9: SANDOVAL COUNTY 1955

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	9526
Fallow agriculture	8	2462
Idle agriculture	9	2629
Residential	10	989
Urban irrigated	12	27
Urban vacant	14	14
Commercial/industrial	15	90
Riparian woodland	16	6694
Riparian shrub	18	5965
Marsh	19	610
Desert scrub	20	56508
Pinon/juniper	21	31703
Arroyo	22	3650
Open water	23	2668
Miscellaneous grass	24	173
Agricultural complex	26	9
Tree fruit/nursery stock	28	519
Jemez river channel	36	1232

TABLE 10: BERNALILLO COUNTY 1955

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	15551
Fallow agriculture	8	1248
Idle agriculture	9	3171
Residential	10	14225
Residential-dense	11	30
Urban irrigated	12	52
Parks/golf courses	13	452
Urban vacant	14	991
Commercial/industrial	15	4869
Riparian woodland	16	2923
Riparian shrub	18	1941
Marsh	19	65
Desert scrub	20	131329
Pinon/juniper	21	1803
Arroyo	22	1490
Open water	23	2376
Miscellaneous grass	24	288
Quarry/borrow pit	25	502
Agricultural complex	26	176
Tree fruit/nursery stock	28	520
No photo coverage	37	13764

TABLE 11: VALENCIA COUNTY 1955

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	21278
Fallow agriculture	8	7088
Idle agriculture	9	8743
Residential	10	773
Urban irrigated	12	2
Parks/golf courses	13	16
Urban vacant	14	30
Commercial/industrial	15	92
Riparian woodland	16	1700
Riparian shrub	18	3716
Marsh	19	27
Desert scrub	20	21525
Pinon Juniper	21	3
Open water	23	2056
Agricultural complex	26	360
Tree fruit/nursery stock	28	167

TABLE 12: SOCORRO COUNTY 1955

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	1745
Fallow agriculture	8	325
Idle agriculture	9	1568
Residential	10	93
Riparian woodland	16	1026
Salt-cedar	17	415
Riparian shrub	18	10060
Marsh	19	53
Desert scrub	20	19967
Arroyo	22	289
Open Water	23	1883
Tree fruit/nursery stock	28	4

TABLE 13: SANDOVAL COUNTY 1935

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	8637
Idle agriculture	9	3056
Residential	10	1018
Riparian woodland	16	5196
Riparian shrub	18	7574
Marsh	19	1131
Desert scrub	20	69898
Pinon/juniper	21	20641
Arroyo	22	3031
Open water	23	2983
Tree fruit/nursery stock	28	552
Jemez river channel	36	1748

TABLE 14: BERNALILLO COUNTY 1935

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	14872
Idle agriculture	9	1951
Residential	10	5578
Urban irrigated	12	31
Parks/golf courses	13	305
Urban vacant	14	102
Commercial/industrial	15	421
Riparian woodland	16	1899
Riparian shrub	18	5450
Marsh	19	1263
Desert scrub	20	146845
Arroyo	22	1798
Open water	23	3749
Miscellaneous grass	24	41
Agricultural complex	26	39
Tree fruit/nursery stock	28	1432
No photo coverage	37	11996

TABLE 15: VALENCIA COUNTY 1935

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	18606
Idle agriculture	9	2041
Residential	10	2718
Commercial/industrial	15	89
Riparian woodland	16	3328
Riparian shrub	18	8134
Marsh	19	1151
Desert scrub	20	25199
Arroyo	22	132
Open water	23	3592
Miscellaneous grass	24	392
Tree fruit/nursery stock	28	2193

TABLE 16: SOCORRO COUNTY 1935

LAND USE CLASS	LUCLASS NUMBER	ACRES
Agriculture	1	2466
Idle agriculture	9	860
Residential	10	386
Riparian woodland	16	1494
Riparian shrub	18	5715
Marsh	19	3263
Desert scrub	20	19141
Arroyo	22	172
Open water	23	3636
Miscellaneous grass	24	58
Tree fruit/nursery stock	28	218

TABLE 17a:

RIO GRANDE LUTA: Selected Land Use Class (LUCLASS) Changes

LAND USE CLASS	1935	1954/55			1970's				
	Acres	Acres	Change from 1935		Acres	Change from 1935		Change from 1954/55	
			Acres	%		Acres	%	Acres	%
Agriculture: w/fallow,Tf/Ns	48,976	60,433	+11,457	23	63,827	+14,851	30	+3,394	6
Idle Agricult.	7,908	16,111	+ 8,203	104	10,848	+ 2,940	37	-5,263	33
Residential & Resid.-dense	9,700	16,110	+ 6,410	66	38,344	+28,644	295	+22,234	138
Urban irrig.	31	81	+ 50	161	189	+ 158	510	+ 108	133
Parks/golf c.	305	468	+ 163	53	2,139	+ 1,834	601	+ 1,671	357
Urban vacant	102	1,035	+ 933	915	2,335	+ 2,233	2189	+ 1,300	126
Comm./Indst.	510	5,051	+ 4,541	890	12,960	+12,450	2441	+ 7,909	157
Riparian:wood, shrub,marsh, bosque	45,598	35,142	-10,456	23	39,100	- 6,498	14	+ 3,958	11
Desert scrub; w/arroyo	266,216	234,758	-31,458	12	208,525	-57,691	22	-26,233	11
Open water	13,960	8,983	- 4,977	36	9,630	- 4,330	31	+ 647	7

TABLE 17b:

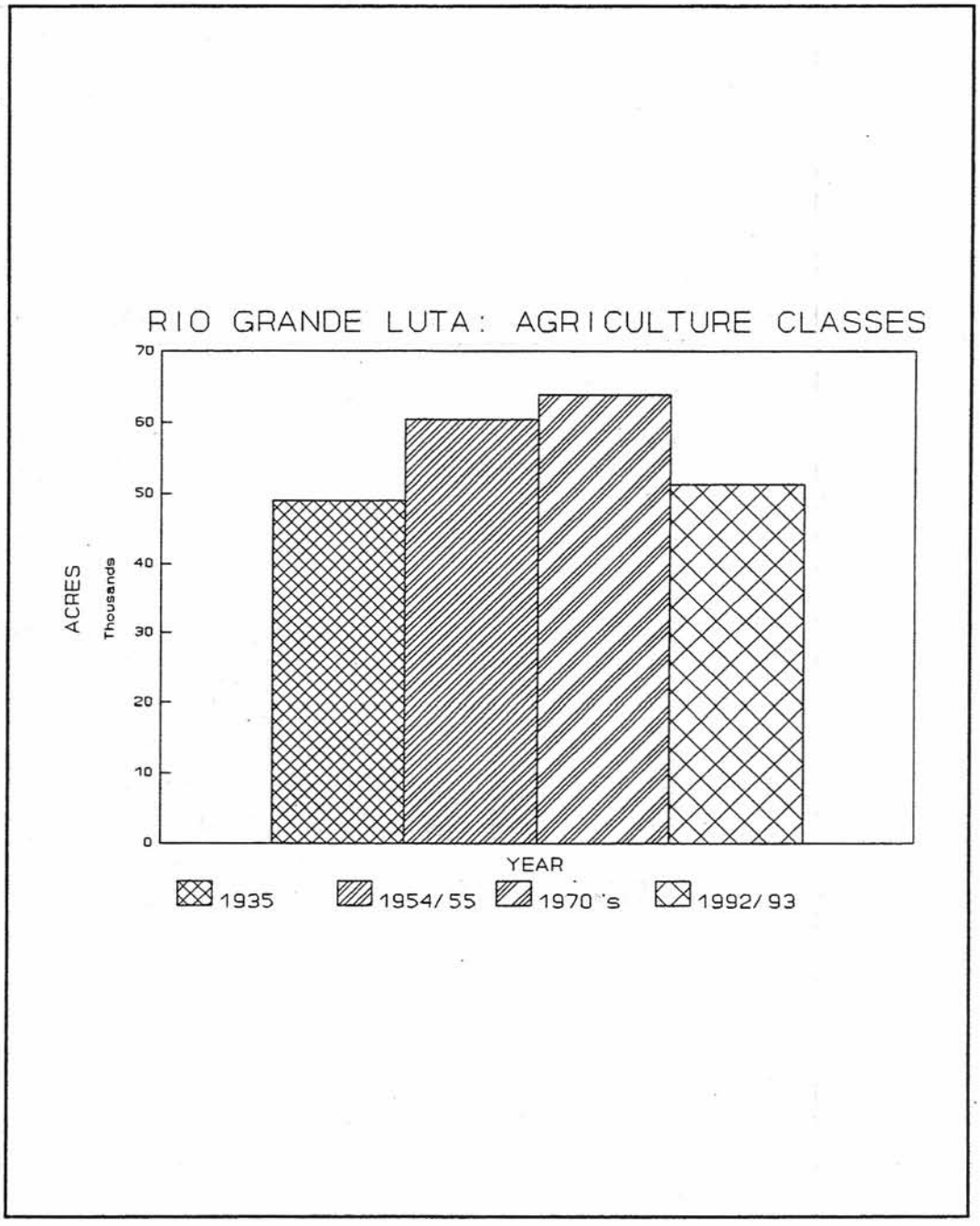
RIO GRANDE LUTA: Selected Land Use Class (LUCLASS) Changes

LAND USE CLASS	1992/93						
	Acres	Change from 1935		Change from 1954/55		Change from 1970's	
		Acres	%	Acres	%	Acres	%
Agriculture: w/fallow,Tf/Ns	51,266	+ 2,290	5	- 9,167	15	-12,561	20
Idle Agricult.	15,854	+ 7,946	100	- 257	2	+ 5,006	46
Residential & Resid.-dense	59,236	+49,536	511	+43,126	268	+20,892	55
Urban irrig.	830	+ 799	2577	+ 749	925	+ 641	339
Parks/golf c.	3,510	+ 3,205	1051	+ 3,042	650	+ 1,371	64
Urban vacant	5,541	+ 5,439	5332	+ 4,506	4418	+ 3,206	137
Comm./Indst.	21,857	+21,347	4186	+16,806	333	+ 8,897	69
Riparian:wood, shrub,marsh, bosque	34,345	-11,253	25	- 797	2	- 4,755	12
Desert scrub; w/arroyo	175,822	-90,394	34	-58,936	25	-32,703	16
Open water	9,222	- 4,738	34	+ 239	3	- 408	4

TABLE 18: 1992 SATELLITE CLASSIFICATION DATA

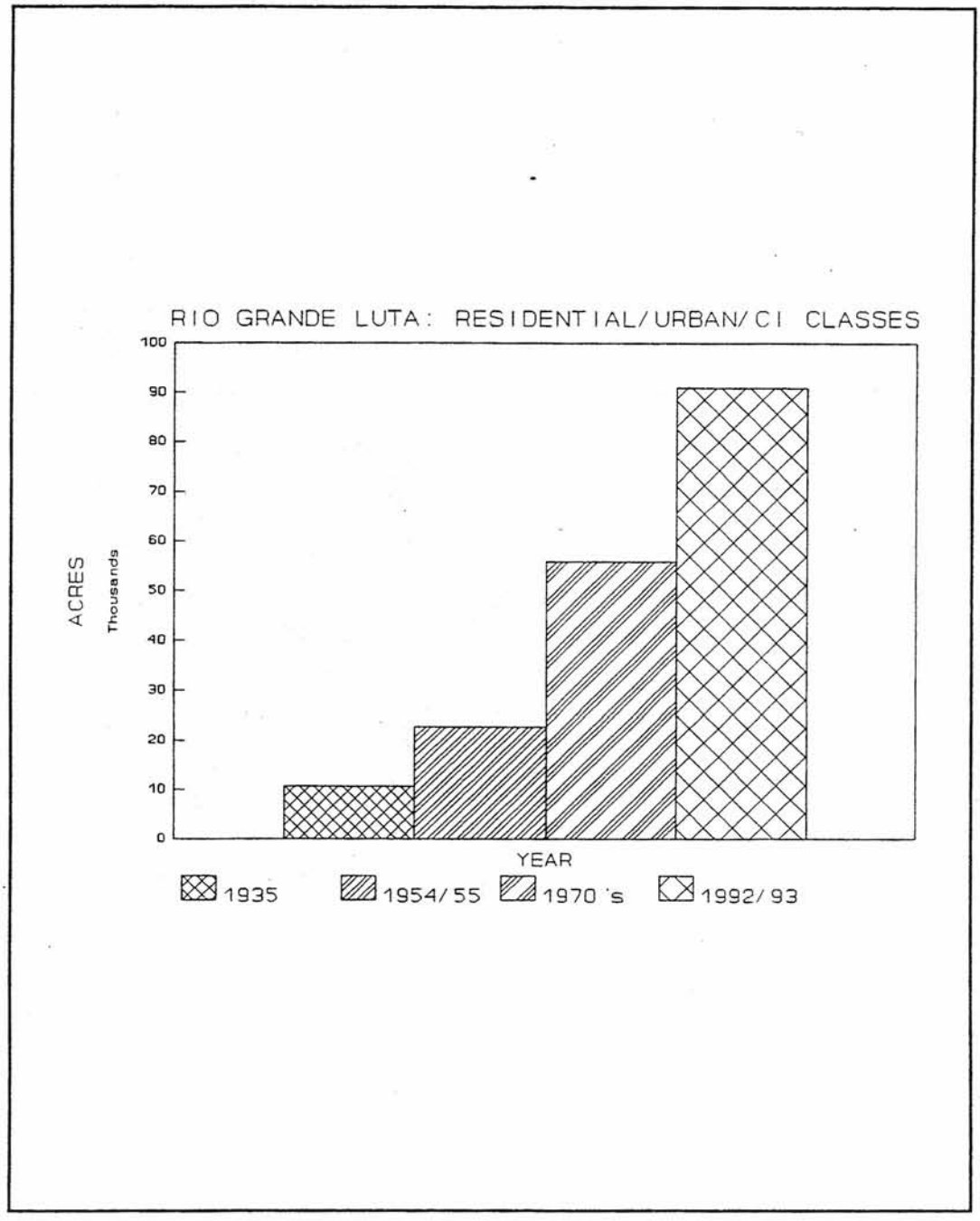
LAND USE CLASS	AREA (HECTARES)	AREA (ACRES)
Desert scrub	598,791	1,482,156
Pinon/juniper	101,790	251,956
Irrigated agriculture	23,747	58,782
Urban	23,601	58,419
Fallow agriculture	4,282	10,600
Riparian vegetation	22,240	55,051
Open water	3,501	8,666
Urban/residential vegetation	17,167	42,493
TOTALS	**795,119**	**1,968,123**

Figure 1



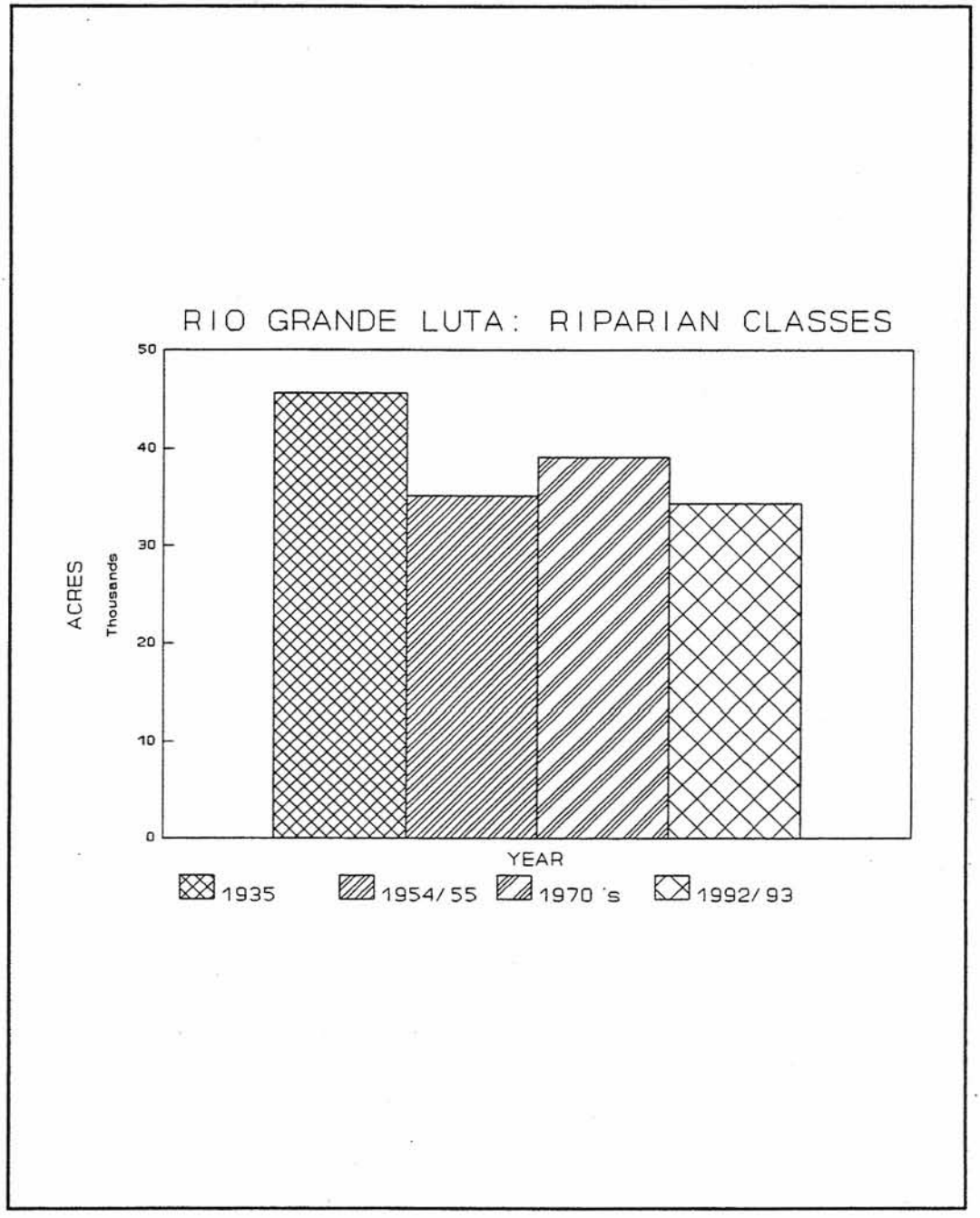
This agriculture class graph was compiled from the agriculture, fallow agriculture, crop type (1992/93 only), and tree fruit/nursery stock land use class (LUCLASS) acreage totals. Idle agriculture acreage totals were <u>not</u> included in this graph.

Figure 2

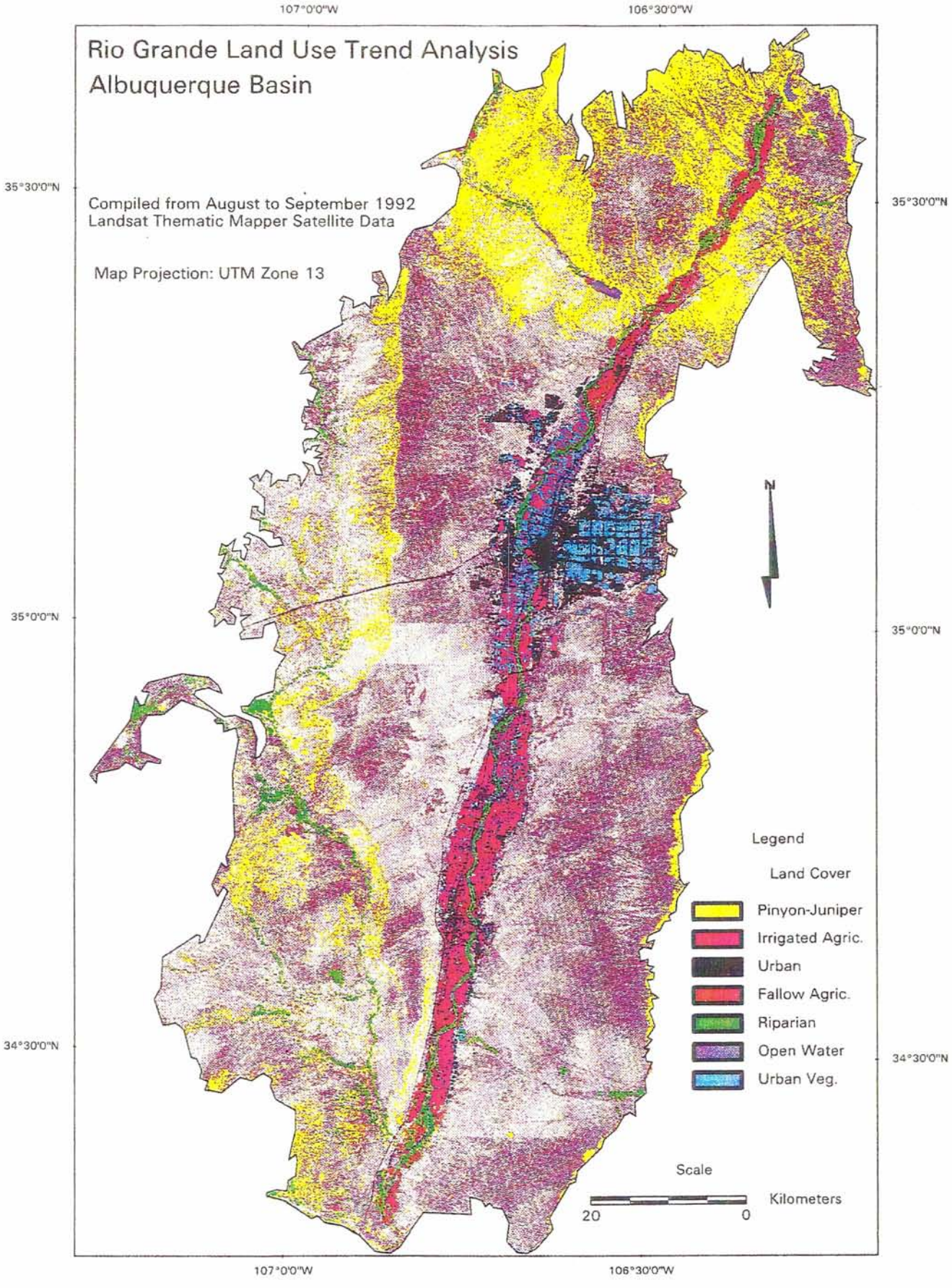


This residential/urban/CI class graph was compiled from the acreage totals of residential, residential-dense, urban irrigated, urban vacant, parks/golf courses, and commercial/industrial land use classes (LUCLASS).

Figure 3



This graph was compiled from acreage totals of riparian related land use classes (LUCLASS); riparian woodland, riparian shrub, marsh, salt cedar, and Bosque (1992/93 only).


Rio Grande Land Use Trend Analysis
Albuquerque Basin
Compiled from August to September 1992
Landsat Thematic Mapper Satellite Data
Map Projection: UTM Zone 13
107°0'0"W
106°30'0"W
35°30'0"N
35°0'0"N
34°30'0"N
N
Legend
Land Cover
Pinyon-Juniper
Irrigated Agric.
Urban
Fallow Agric.
Riparian
Open Water
Urban Veg.
Scale
20
0
Kilometers