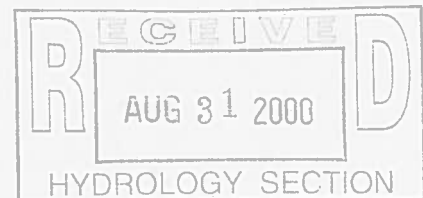# Drainage Report for
PNM "Roy" Substation
North Balloon Fiesta Park
Albuquerque, New Mexico

Prepared for   **Public Service Company of New Mexico**
Albuquerque, New Mexico

August 31, 2000

CARL M. ABRAMS
NEW MEXICO
13617
REGISTERED PROFESSIONAL ENGINEER
8/31/00

Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100 • Albuquerque, New Mexico 87109

Drainage Report for PNM "Roy" Substation
North Balloon Fiesta Park Albuquerque, New Mexico

1. Introduction

On behalf of the Pueblo of Sandia, Daniel B. Stephens & Associates, Inc. (DBS&A) has completed a drainage analysis of a proposed electrical substation to be located within an existing PNM easement on land owned by the Pueblo. The purpose of the drainage analysis is to ensure that the construction of the substation does not adversely impact the surrounding property.

2. Location and Description

The Public Service Company of New Mexico (PNM) "Roy" substation is proposed to be located near the northeast corner of Albuquerque Balloon Fiesta Park, off of Balloon Fiesta Parkway. The land on which the substation will be located is owned by the Sandia Pueblo, as is most of the surrounding land to the west, north, and east. A small parcel to the east is currently owned by another party. The Balloon Fiesta Park borders the property to the south. The site and surrounding lands to the west, north, and east are currently undeveloped, and the Balloon Fiesta Park has only minor development bordering the site at this time.

PNM is proposing a 110-foot-wide by 210-foot-long gravel pad on which the substation will be located. The pad will be roughly aligned north to south as shown on the plans in Appendix A. The substation will be centered on the gravel pad within a concrete block wall 100 feet wide by 200 feet long. The gravel pad will be constructed approximately 5 feet above existing grade, and sideslopes not to exceed 3:1 will extend away from the pad to match existing ground.

A gravel road will provide access onto the pad from the existing Balloon Fiesta Park. The access road, substation facilities, and block wall will be located within an existing PNM utility right of way (ROW). The 5-foot-wide portion of the pad outside the walls will be located within the existing ROW, while the pad sideslopes on the west will lie outside of the existing ROW and

will require an additional easement as indicated on the plans (Appendix A). PNM will construct several concrete equipment pads of various sizes and depths within the concrete wall. The design of these pads and other substation components within the wall is not part of this project scope and will be performed by PNM.

3. Methodology

The hydrology for this project was analyzed using the January 1993 revision of the City of Albuquerque Development Process Manual, Section 22.2. The specific values used for this analysis are as follows:

- Precipitation zone 2 (between Rio Grande and San Mateo)
- Design storm: 100-year, 10-hour duration
- 100-year, 10-hour storm depth: 2.35 inches
- Land use:
  - For substation area: 85 percent type C and 15 percent type D
  - For existing ground surrounding gravel pit: type A
  - For gravel pit floor and sideslopes: type C

The Quick Calc hydrologic calculations for the runoff volumes and peak flow rates are included in Appendix B for both existing and proposed conditions. The basin numbers are designated on the drainage plan in the design drawing package in Appendix A.

4. Proposed Drainage Basins

Proposed drainage basins A and B will remain unchanged from existing conditions. Basin C consists of ground that lies within the confines of the existing gravel pit and was divided into three Sub-basins, C1, C2, and C3, to aid in the analysis of proposed conditions.

- Sub-basin C1 represents the major portion of the existing gravel pit that will remain unchanged by construction of the PNM substation.

- Sub-basin C2 represents the portion of the gravel pit to the east of the proposed substation pad in which a diversion ditch will be constructed to convey runoff around the pad and into Sub-basin C1, the same sub-basin that runoff flows to under current condition.

- Sub-basin C3 represents the portion of the gravel pit that will be located within the confines of the substation block walls.

As discussed above, storm water within the confines of the substation walls (Sub-basin C3) will be contained as is typical at all of PNM substation facilities. Although Basin C was broken into sub-basins for analytical purposes, drainage patterns will remain virtually unchanged from existing to proposed conditions. The proposed Drainage Plan was designed to perform under current site conditions, yet can be adapted to fit with future drainage plans for the vicinity.

5. Existing Drainage Conditions

The proposed gravel pad will be located within the confines of a gravel pit that is no longer in operation. The interior sideslopes of the gravel pit have recently been revegetated with high-desert-type grasses and weeds. In addition, straw has been disked into the sideslopes to provide erosion protection. Existing sideslopes of the pit range between 1½:1 and 3:1. The existing gravel pit floor slopes generally to the west at approximately 2 to 3 percent. Runoff from the proposed pad site flows toward the west as sheet flow within the gravel pit.

6. Off-Site Drainage

The area outside the gravel pit slopes from east to west at approximately 2 to 3 percent. The proposed pad location is subject to runon from the east, both from within the gravel pit and from land above the crest of the pit. An existing 24-inch corrugated metal culvert runs under I-25 and the frontage road and contributes storm water toward Basin A (Appendix B). The culvert collects storm water generated from the median in I-25 as well as along the eastern frontage road. Based on DBS&A's site inspection, it appears that this storm water meanders and flows into the North Camino Arroyo; however, a clear flow path is not apparent. In order to

conservatively analyze storm water flows, DBS&A considered the culvert drainage to contribute to Basin A. The flow for this culvert was computed based on the maximum flow through a culvert of this size and slope (Appendix B) and has been added to Basin A.

An existing berm along the rim of the pit redirects runoff from entering the gravel pit in the vicinity of the proposed substation. The substation pad site is not subject to runon from the north, west, or south.

7. Proposed Conditions

The proposed substation pad will be constructed within the confines of the former gravel pit, approximately 2 to 5 feet above existing grade. The construction of the pad will require moderate earthwork; however, it will not substantially affect existing runoff patterns or volumes. Because the substation pad will be constructed several feet above existing grade, storm water control measures will be required as described below.

Currently the North Camino Arroyo meanders in excess of 300 feet (approximately 500 feet) south of the proposed substation site and does not pose an erosion threat to the proposed substation. However, this arroyo is slated to be relocated just south of the southern property boundary for the proposed substation site. Final design location and grades, and completion date for the channel realignment have not been determined at this time. The realigned channel is proposed to be a concrete-lined trapezoidal channel located approximately 80 feet south of the PNM substation. Although the proposed channel location is substantially closer to the substation, because it will be concrete lined, there should be no potential for erosion to the substation pad. Conceptual design information is available, and it was taken into account during the substation design. Access across the relocated channel into the substation will need to be addressed as part of the final design of the channel realignment.

The grade along the access road to the substation was designed to match existing elevations along the southern property boundary and was based on allowable grades for the transformer delivery truck. The final pad elevation was set as low as feasible in order to more closely match the conceptual design information available for the north end of the Balloon Fiesta Park,

including the realigned North Camino Arroyo, which will likely require that final grades along the dividing property boundary be lower than existing grades. PNM requires an underground power feed running south from the substation and connecting to existing poles. This line will need to run underneath the realigned North Camino Arroyo; therefore design grades for the channel will be required prior to installing the power line in order to prevent costly future relocation of the power line.

The 100-foot by 200-foot pad area within the block wall (Basin C3) will be graded such that no runoff will be generated, as is typical for all PNM substation facilities. Final grading of the pad surface within the walls will be performed by PNM during construction and installation of the substation components. Based on hydrologic calculations for the storm water generated by the 100-year, 10-day storm water event, the volume will be approximately 0.06 acre-feet (ac-ft), or about 2½ inches deep within the walls. PNM will need to account for this volume in designing final grades within the substation walls.

The only areas of new construction to generate runoff will be the 5-foot-wide buffer outside the block wall and the 3:1 pad sideslopes.

- The 5-foot-wide portion of the pad located outside the substation walls will be sloped to drain away from the walls at a 2 percent minimum slope. Both the sideslopes and pad outside of the walls will be landscaped with native plants for erosion protection and aesthetics.

- Because the pad will be located above existing grade, runoff generated from its sideslopes will need to be addressed. Runoff generated along the south and west sides of the pad will simply flow to the same sub-basin as in existing conditions. Runoff generated along the east and north sides of the substation pad will flow to a drainage ditch to be constructed along the east and north sides of the pad (Appendix A). The proposed ditch is designed to intercept runon from the gravel pit wall to the east and transport both it and the runoff from the pad sideslopes away from the substation pad. The ditch will convey runoff from south to north, along the east side of the pad, then curve to the west and discharge to the main gravel pit (Sub-basin C1). Peak runoff

calculations for the pad sideslopes (Sub-basin C2) are included in Appendix B and describe the flows that the drainage ditch will convey. The ditch will require erosion control measures along the flowline as well as at its discharge point, as indicated on the plans in Appendix A. The runoff will be less than historical conditions, and historical drainage patterns will remain unchanged.

In addition to the realignment of the North Camino Arroyo, conceptual planning has begun for development of the Balloon Fiesta Park. At that time it will be possible to convey the storm water from Sub-basin C2 into the relocated arroyo. Due to the conceptual nature of the plans for channel realignment, development of the Balloon Fiesta Park, and potential development of Pueblo land surrounding the substation, plans for drainage within the vicinity of the proposed PNM substation will likely be changed in the future.

Once the arroyo realignment has been finalized, the Albuquerque Metropolitan Arroyo and Flood Control Authority, PNM, and the Pueblo of Sandia will need to discuss how to address site drainage issues. One potential alternative for conveying storm water from Sub-basin C2 into the relocated North Camino Arroyo would be to perform minor regrading of the ditch and gravel pit sideslopes to redirect runoff, as shown on the Conceptual Future Site Plan (Appendix A). Performing the site regrading as shown on the Conceptual Future Site Plan will involve approximately 1,000 cubic yards of earthwork, and estimated construction costs should be less than $5,000. A concrete run down to the arroyo may also be required.

8. Future Drainage Issues

Currently, no other development is slated within the limits of the gravel pit. If future development within the gravel pit blocks drainage from the proposed pad site, it will be necessary for the future developer to provide measures to intercept the runoff and transport it to a safe discharge location, which may be the North Camino Arroyo, if it has been realigned by that time.

Future development of the land above the gravel pit rim to the east has the potential to drastically affect runon into the gravel pit in the vicinity of the proposed PNM substation pad. In

order to handle storm water flows under current conditions, DBS&A proposes to enhance the existing diversion berm along the eastern rim of the pit as shown on the plans in Appendix A. The berm size was determined by analyzing storm water runoff based on current flow conditions (Appendix B). Runoff from the land to the east will continue to be diverted to the north, as it is under current conditions, so that it will not flow onto the proposed substation pad area. The diverted runoff will flow into the northeast corner of the gravel pit, as it historically has.

Future storm water flows were analyzed (Appendix B) in order to determine the potential runoff generated by Basins A and B if they are developed. The parcels are currently zoned for commercial use, and runoff volumes are based on 90 percent type D and 10 percent type C land treatment development. The existing and future runoff for Basins A and B are 62 and 150 cubic feet per second, respectively. As the surrounding parcels are developed, the storm water flows will be diverted into the North Camino Arroyo, so storm water runoff onto the proposed PNM substation site should decrease in the future.

Conceptual grades for the relocation of North Camino Arroyo were taken into account during the substation design, and the relocation should not have any affect on the substation as far as drainage issues are concerned. The only effect that the arroyo relocation might have on the substation is future access. As previously mentioned, access across the relocated channel into the substation will need to be addressed as part of the final design of the channel realignment.

9. Floodplain Status

Flood Insurance Rate Map (FIRM) Panel 350001C0129D indicates that no portion of the proposed PNM substation encroaches the 100-year floodplain. The FIRM Panel shows that the proposed building site is included in a Zone X (Appendix C).

Though the site does not lie within a floodplain area, the confines of the gravel pit have the potential to cause storm water to pond. Accordingly, storm water volumes were analyzed in order to determine if the substation was in danger of flooding. Storm water from Basins A and B as well as Sub-basins C1 and C2 flows into the gravel pit under current and proposed conditions. The total 100-year, 10-day storm water volume for these basins is calculated to be

approximately 3.7 acre-feet (Appendix B). The gravel pit is approximately 25 acres in size, with a rim low point elevation of 5,071 feet above mean sea level (ft-msl). The substation pad design elevation is set at 5,080 ft-msl; therefore, there is no possibility of the pad becoming flooded by storm water ponding within the gravel pit. Based on the 100-year, 10-day storm water volume, the approximate pond surface elevation would be 5,051 ft-msl.

TABLE 1

100-YEAR HYDROLOGIC CALCULATIONS

BASIN #	AREA (acre)	LAND TREATMENT				WEIGHTED E (in)	V (6-hr) (acre-ft)	V (6-hr) (cu-ft)	V (10 day) (acre-ft)	V (10 day) (cu-ft)	Q (cfs)
		A (%)	B (%)	C (%)	D (%)						
						EXISTING CONDITIONS					
A*	20.00	100.00	0.00	0.00	0.00	0.53	0.88	38,478	0.88	38,478	46.53
B	9.50	100.00	0.00	0.00	0.00	0.53	0.42	18,277	0.42	18,277	14.82
C	23.30	0.00	0.00	100.00	0.00	1.13	2.19	95,574	2.19	95,574	73.16

* note: 15.33 cfs was added to Basin A to account for additional runon from culvert

		A	B	C	D	
EXCESS PRECIP.		0.53	0.78	1.13	2.12	E_i (in)
PEAK DISCHARGE		1.56	2.28	3.14	4.7	Q_{Pi} (cfs)

WEIGHTED E (in) = $(E_A)(\%A) + (E_B)(\%B) + (E_C)(\%C) + (E_D)(\%D)$

$V_{6\text{-}HR}$ (acre-ft) = (WEIGHTED E)(AREA)/12

V_{10DAY} (acre-ft) = $V_{6\text{-}HR} + (A_D)(P_{10DAY} - P_{6\text{-}HR})/12$

Q (cfs) = $(Q_{PA})(A_A) + (Q_{PB})(A_B) + (Q_{PC})(A_C) + (Q_{PD})(A_D)$

ZONE = 2

$P_{6\text{-}HR}$ (in.) = 2.35

$P_{24\text{-}HR}$ (in.) = 2.75

P_{10DAY} (in.) = 3.95

TABLE 2

100-YEAR HYDROLOGIC CALCULATIONS

BASIN #	AREA (acre)	LAND TREATMENT A (%)	B (%)	C (%)	D (%)	WEIGHTED E (in)	V (6-hr) (acre-ft)	V (6-hr) (cu-ft)	V (10 day) (acre-ft)	V (10 day) (cu-ft)	Q (cfs)
						PROPOSED CONDITIONS					
A*	20.00	0.00	0.00	10.00	90.00	2.02	3.37	146,725	5.77	251,269	106.21
B	9.50	0.00	0.00	10.00	90.00	2.02	1.60	69,694	2.74	119,353	43.17
C1	23.30	0.00	0.00	100.00	0.00	1.13	2.19	95,574	2.19	95,574	73.16
C2	1.50	0.00	0.00	100.00	0.00	1.13	0.14	6,153	0.14	6,153	4.71
C3	0.50	0.00	0.00	85.00	15.00	1.28	0.05	2,320	0.06	2,756	1.69

* note: 15.33 cfs was added to Basin A to account for additional runon from culvert

	A	B	C	D	
EXCESS PRECIP.	0.53	0.78	1.13	2.12	E_i (in)
PEAK DISCHARGE	1.56	2.28	3.14	4.7	Q_{Pi} (cfs)

WEIGHTED E (in) = $(E_A)(\%A) + (E_B)(\%B) + (E_C)(\%C) + (E_D)(\%D)$

$V_{6\text{-}HR}$ (acre-ft) = (WEIGHTED E)(AREA)/12

V_{10DAY} (acre-ft) = $V_{6\text{-}HR} + (A_D)(P_{10DAY} - P_{6\text{-}HR})/12$

Q (cfs) = $(Q_{PA})(A_A) + (Q_{PB})(A_B) + (Q_{PC})(A_C) + (Q_{PD})(A_D)$

ZONE = 2
$P_{6\text{-}HR}$ (in.) = 2.35
$P_{24\text{-}HR}$ (in.) = 2.75
P_{10DAY} (in.) = 3.95

Enhanced Berm Triangular Channel Capacity
Worksheet for Triangular Channel

Project Description

Worksheet	Enhanced Berm Triangular Channel
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.035	
Slope	0.014000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	40.00	H : V
Discharge	46.6	cfs

Results

Depth	0.87	ft
Flow Area	16.2	ft²
Wetted Perimeter	37.50	ft
Top Width	37.35	ft
Critical Depth	0.78	ft
Critical Slope	0.024546	ft/ft
Velocity	2.87	ft/s
Velocity Head	0.13	ft
Specific Energy	1.00	ft
Froude Number	0.77	
Flow Type	Subcritical	

Title: SPCE
c:\haestad\fmw\spce.fm2
08/16/00 03:42:28 PM   © Haestad Methods, Inc.   37 Brookside Road   Waterbury, CT 06708 USA   (203) 755-1666

Daniel B. Stephens & Associates Inc

FlowMaster v6.0 [614d]
Page 1 of 1

Culvert Calculator Report
Worksheet-1

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	4.55 ft	Headwater Depth/ Height	1.25
Computed Headwater Elevation	4.55 ft	Discharge	15.33 cfs
Inlet Control HW Elev	4.35 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev	4.55 ft	Control Type	Outlet Control

Grades

Upstream Invert	2.05 ft	Downstream Invert	0.00 ft
Length	150.00 ft	Constructed Slope	0.013667 ft/ft

Hydraulic Profile

Profile	M2	Depth, Downstream	1.41 ft
Slope Type	Mild	Normal Depth	1.93 ft
Flow Regime	Subcritical	Critical Depth	1.41 ft
Velocity Downstream	6.47 ft/s	Critical Slope	0.021855 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev	4.55 ft	Upstream Velocity Head	0.41 ft
Ke	0.70	Entrance Loss	0.29 ft

Inlet Control Properties

Inlet Control HW Elev	4.35 ft	Flow Control	Unsubmerged
Inlet Type	Mitered to slope	Area Full	3.1 ft²
K	0.02100	HDS 5 Chart	2
M	1.33000	HDS 5 Scale'	2
C	0.04630	Equation Form	1
Y	0.75000		

c:\haestad\academic\cvm\project1.cvm
08/16/00 01:22:34 PM   © Haestad Methods, Inc.   37 Brookside Road   Waterbury, CT 06708 USA   (203) 755-1666

Academic Edition - Not Legal for Professional Use

Project Engineer: User
CulvertMaster v1.0
Page 1 of 1

LIMIT OF
DETAILED STUDY

LIMIT OF STUDY

ZONE AO
(DEPTH 1)

ELENA

CORPORATE LIMITS

DRIVE

ZONE X

ZONE X

VENICE AVENUE

BERNALILLO COUNTY
UNINCORPORATED AREAS
350001

HILLS AVENUE

7

ZONE X

DIEGO AVENUE

ZONE X

AVENUE

BOULEVARD

ZONE X

GLENDALE AVENUE

MODESTO AVENUE

35°11'15"
106°33'45"

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

500   0   500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

BERNALILLO COUNTY, NEW MEXICO AND INCORPORATED AREAS

PANEL 129 OF 825
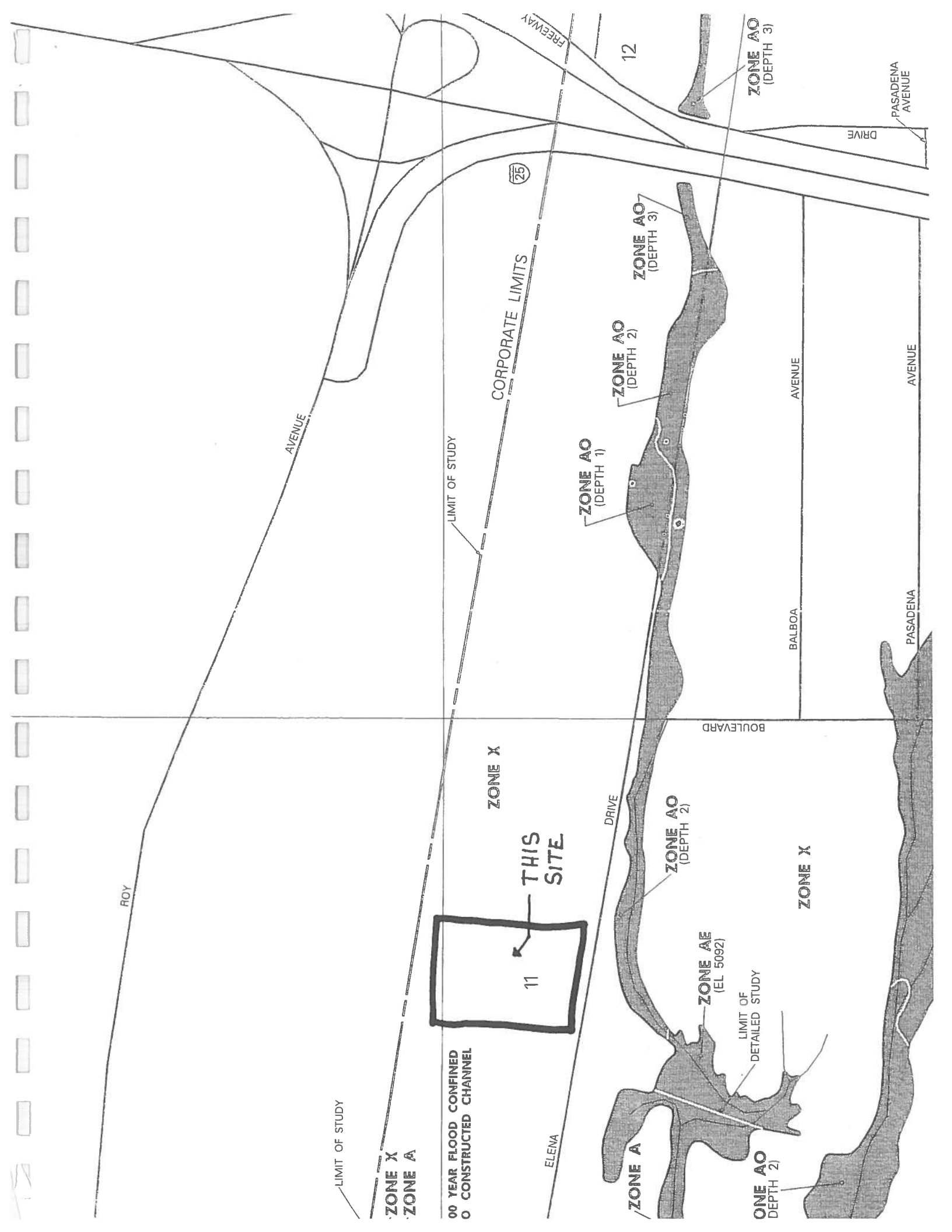
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ALBUQUERQUE, CITY OF	350002	0129	D
BERNALILLO COUNTY, UNINCORPORATED AREAS	350001	0129	D

MAP NUMBER
35001C0129 D

EFFECTIVE DATE:
SEPTEMBER 20, 1996

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRAPHIC SCALE IN FEET

1000
500
250
0

CITY OF
Albuquerque
PLANNING DEPARTMENT

Map Amended through March 24, 1996

© Copyright 1996

LEGAL DESCRIPTION
TWN
RNG
SEC 11

UNIFORM PROPERTY CODE
1-012-056

B-17-Z

THIS SITE

North Boundary

Eleann Galfagos Grant

DIG

DIE

DIB

DICI
SU-2 IP-EP

SPERRY SITE & WILDFLOWER PARK

SU-2 M-1

SPERRY SITE & WILDFLOWER PARK

ST. DOMINIC

ORDER OF THE

SISTERS

PALMLA

SU-2 IP-EP

DIA

DID

SU-2 IP-EP

SU-2 IP-EP

SU-2 IP-EP

SU-1
APT - 30 DU/A

SU-2 IP-EP

RICHFIELD ST

IP

SU-2 IP-EP

WILDFLOWER PARK

NORTH DIVERSION CHANNEL DRAINAGE ROW

DRAINAGE ROW

BLVD

SAN MATEO

JEFFERSON ST

SAN DIEGO AV
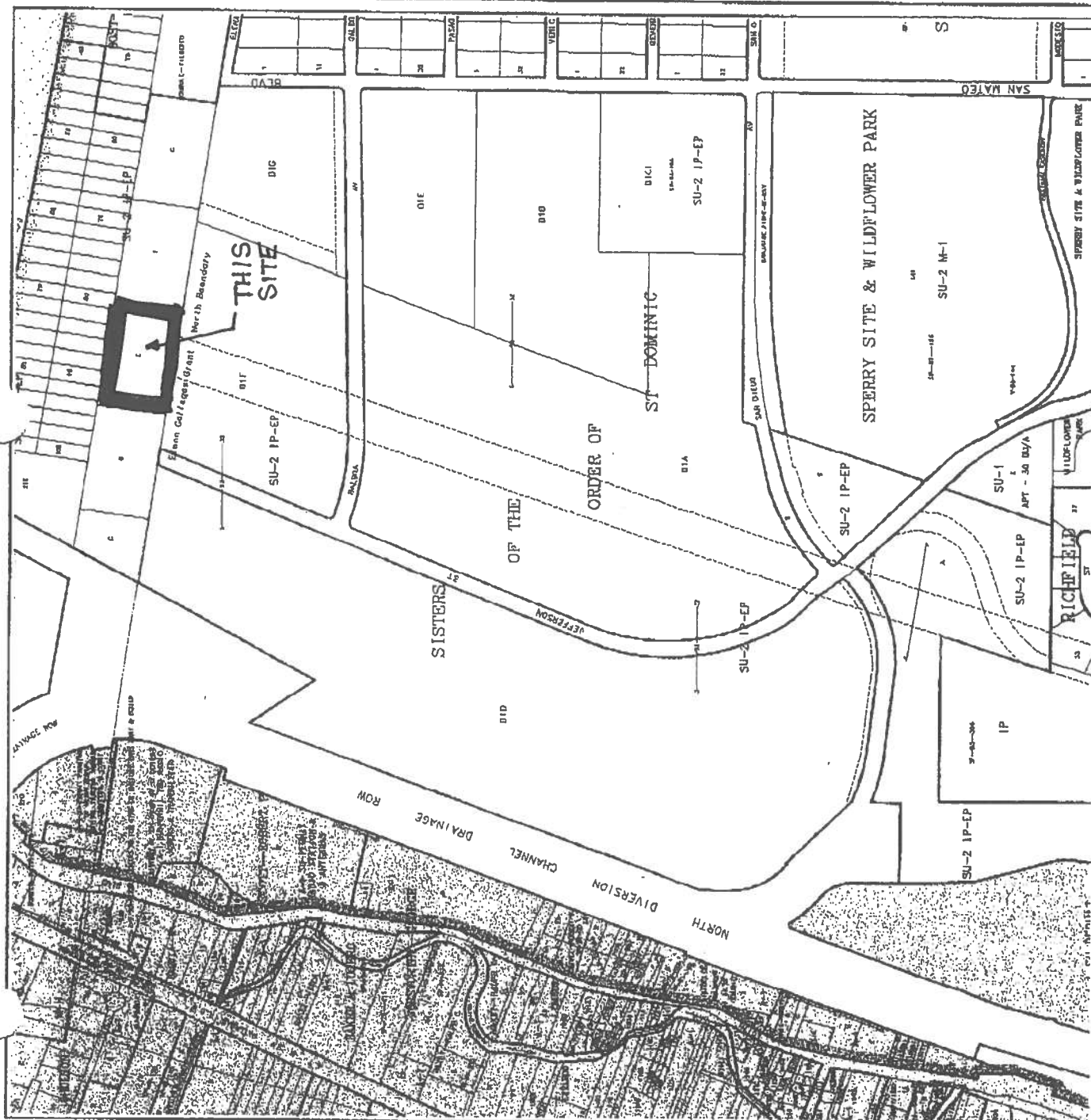
RONALD D. BROWN, CHAIR
DANIEL W. COOK, VICE-CHAIR
CLIFFORD E. ANDERSON, P.E., SECRETARY-TREASURER
LINDA STOVER, ASST. SECRETARY-TREASURER
DANIEL HERNANDEZ, DIRECTOR

JOHN P. KELLY, P.E.
EXECUTIVE ENGINEER

Albuquerque
Metropolitan
Arroyo
Flood
Control
Authority

FAXED 9/6/00

2600 PROSPECT N.E. - ALBUQUERQUE, NM 87107

PHONE: (505) 884-2215
FAX: (505) 884-0214

September 5, 2000

Carl Abrams, PE
Daniel B. Stevens & Associates
6020 Academy NE
Suite 100
Albuquerque, NM 87109

Re: Drainage Report for PNM "Roy" Substation (revised)
       Dated August 31, 2000 ZAP A-17

AMAFCA has no adverse comment on the revised Drainage Report and defers to City
Engineer.

Donald S. Dixon, PE
AMAFCA Drainage Engineer

Cc: Fred Aguirre, COA

whitney : please include in file with report. THx

Post-It® Fax Note   7671

To Fred Aguirre	From Dixon
Co./Dept.	Co.
Phone #	Phone #
Fax #	Fax #

Date 9/6   # of pages ▶ 1