C20 D000

LA CUEVA, EL CAMINO AND NORTH CAMINO ARROYOS DRAINAGE FACILITY PLAN

Prepared For:

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Prepared By:

ENGINEERS AND ENVIRONMENTAL SCIENTISTS
1720-B Randolph Road SE, Albuquerque, NM 87106
Telephone (505) 243-7300
Fax (505) 243-7400

July 1999

LA CUEVA, EL CAMINO AND NORTH CAMINO ARROYOS DRAINAGE FACILITY PLAN

Table of Contents, Volume I

EXECUTIVE SUMMARY i
Adopting Resolution 1999-11 iv

1. INTRODUCTION 1

2. HYDROLOGY 6
   A. Methodology 6
   B. Land Treatments 6

3. HYDROLOGY MODEL 11
   A. General 11
   B. Current Development Model 11
   C. Future Full Development Model 11
   D. Proposed Conditions Model 11

4. SEDIMENT TRANSPORT ANALYSIS 14
   A. General 14
   B. Input Parameters 15
   C. HEC-2 Modeling and Arroyo Rating Curves 17
   D. Sediment Transport Capacity 17
   E. Bulking Factors 18

5. HYDRAULIC ANALYSIS OF EXISTING ARROYO FACILITIES 28
   A. General 28
   B. Nor Este Channel 28
   C. North La Cueva Channel 28
   D. South La Cueva Channel 28
   E. North Camino Channel at Sunset Hills 29
   F. I-25 Crossing Structures 29

6. AVULSIONS 33
   A. General 33
   B. Consequences 33
   C. Avulsion Control 34

7. FACILITIES PLANNING 42
A. General 42
B. North Albuquerque Acres/Sandia Heights Drainage Plan, Phase I 42
C. Alameda Boulevard East Corridor Study 43
D. North Albuquerque Acres Transportation Plan 43
E. North Albuquerque Acres Master Drainage Plan 44

8. ARROYO FACILITIES PLAN 56
A. General 56
B. North Camino Arroyo 56
C. El Camino Arroyo 59
D. La Cueva Arroyo 60
E. Summary of Proposed Recommendations for Arroyo Facilities and Avulsion Control Measures 74
F. Cost Estimates 76

ADDENDUM NUMBER ONE - COMMUNITY RESPONSE 89

APPENDIX A Computing Approximate Sediment Bulking Factors
APPENDIX B 1. Basin Characteristics
2. AHYMO Summary Files
3. Hydrology Schematics
4. AHYMO COA MDP Summary Files
APPENDIX C Cost Estimates
APPENDIX D AMAFCA Resolutions

Technical Appendix, Volume II

List of Tables

Table	Title	Page
2.1	Land Treatments	7
3.1	Existing and Future Flow Rates	13
4.1	Hydrograph Frequency Factors	19
4.2	Summary of Existing Conditions North Camino Arroyo	22
4.3	Summary of Existing Conditions North Camino Tributary	23
4.4	Summary of Existing Conditions El Camino Arroyo	24
4.5	Summary of Existing Conditions La Cueva Arroyo	25
4.6	Summary of Existing Conditions La Cueva Diversion Channel	26
4.7	Bulking Factors for Sediment as a Function of Flow Rate	27
5.1	I-25 Structure Crossing Capacities	30
6.1	North Camino Arroyo and North Camino Tributary Arroyo, Worst Case	39
6.2	El Camino Arroyo, Worst Case	40
6.3	La Cueva Arroyo, Worst Case	41
7.1	COA MDP Cost Estimates	52
8.1	Avulsion Number 4, Cost Estimates	73
8.2	Arroyo Facilities Plan, Cost Estimates	77
8.3	DMP Area Cost Estimates	78

List of Figures

Figure	Title	Page
1.0	Existing Structure Location Map	5
2.1	Land Treatment and Drainage Basin Map	8
2.2	Land Treatment and Drainage Basin Map	9
2.3	Land Treatment and Drainage Basin Map	10
4.1	Sediment and Erosion Map	20
4.2	Sediment and Erosion Map	21
5.1	Typical Channel Section	31
5.2	Typical Channel Section	32
6.1	Avulsion Location Map	35
6.2	Avulsion Location Map	36
6.3	Avulsion Control Schematic	37
6.4	Avulsion Control Schematic	38
7.1	Planning/Study Boundaries	53
7.2	Avulsion Number 2 Plan and Profile	54
7.3	Avulsion Number 3 Plan and Profile	55
8.0a	Proposed Juan Tabo Avulsion Training Dike	62
8.0b	Proposed Juan Tabo Avulsion Training Dike Cross Sections	63
8.1	Proposed Hamilton Dam	64
8.2a	Avulsion Number 5 Plan View	65
8.2b	Avulsion Number 5 Profile	66
8.3	Avulsion Number 4, Option 1	67
8.4	Avulsion Number 4, Option 2	68
8.5	Avulsion Number 4, Option 3	69
8.6	Avulsion Number 4, Option 4	70
8.7	Avulsion Number 4, Alternative 4	71
8.7a	Proposed Facilities Vicinity Map	79
8.7b	Proposed Facilities, B-18	80
8.7c	Proposed Facilities, B-19	81
8.7d	Proposed Facilities, B-20	82
8.7e	Proposed Facilities, B-21	83
8.7f	Proposed Facilities, B-22	84
8.7g	Proposed Facilities, C-18	85
8.7h	Proposed Facilities, C-19	86
8.7i	Proposed Facilities, C-20	87
8.7j	Proposed Facilities, C-21	88
8.7k	Proposed Facilities, C-22	89

Resource Technology, Inc.
1720 - B Randolph Rd. SE Albuquerque, NM 87106
Telephone: (505) 243-7300
FAX: (505) 243-7400

June 14, 1999

John Kelly, P.E.
Interim Executive Director
Albuquerque Metropolitan
Arroyo Flood Control Authority
2600 Prospect NE
Albuquerque, NM 87106

RE: Executive Summary of La Cueva, El Camino and North Camino Arroyos Drainage Facility Plan
RTI File No. 95-190

Dear Mr. Kelly:

This facility plan for the North Camino, El Camino and La Cueva Arroyos addresses the drainage issues associated with these watersheds in far northeast Albuquerque from the Sandia Mountains to the North Diversion Channel. In addition to updating the hydrological analysis of this twelve square mile area to meet current standards, existing flood control facilities and potential avulsions have been evaluated.

In conjunction with drainage planning efforts by the City and County the following recommendations for major arroyo facilities and avulsion control measures have been drafted for the consideration by the AMAFCA Board of Directors, staff and, ultimately, by other public officials with flood control responsibilities in the Albuquerque metropolitan area. These recommendations are intended to guide the development of drainage facilities in the watershed areas so that as individual projects are needed or as funding becomes available, facilities will be designated to fit into an integrated flood control plan. Such development may be by AMAFCA, the City of Albuquerque, Bernalillo County or private developers acting alone or in jointly funded projects.

The following are the major elements, by reach, for an Arroyo Facilities Plan for the La Cueva, El Camino and North Camino Arroyos.

John Kelly, Interim Executive Director
AMAFCA
June 14, 1999

North Camino Arroyo

• From North Diversion Channel to I-25 - see North Camino Study by AMAFCA

1. From I-25 to Louisiana - Concrete lined channel. (C-1)
2. From Louisiana east to Municipal Limits - Concrete lined channel with Training Dike. This will also control Avulsion No. 8. (C-1)
3. Municipal Limits east to mountains - Natural Channel, except as modified by 4 below.
4. Avulsion Number 1 - Controlled by detention dam at Eubank and Glendale or a dike on U.S.F.S./Sandia Pueblo land near Juan Tabo Picnic Area access road. (AV-1)

North Camino Tributary

5. From confluence with North Camino to Louisiana - Concrete lined channel. (C1-a)
6. From Louisiana, east - Natural channel, except as modified by 7 below.
7. Avulsion Number 7 - Controlled by dip-section and dike on Venice. (AV-7)

El Camino Arroyo

• From North Diversion channel to I-25 diverted to La Cueva. Local drainage addressed by existing storm drains.

8. I-25 to Wyoming - Local drainage conveyed to existing El Camino diversion at I-25 by miscellaneous storm drains.
9. From La Cueva Channel to Wyoming and Glendale - Closed conduit diversion. (SD-6)
10. Wyoming to Barstow - Closed conduit. (SD-6)
11. Barstow to Ventura - Closed conduit with de-silting basin at Ventura. (SD-6)
12. Ventura, east - Natural channel, except as modified by 13 below.
13. Avulsion Number 5 - Controlled by riprap channel and dip-section west of Holbrook. (AV-5)

La Cueva Arroyo

• From North Diversion Channel to I-25, existing concrete channels.

14. From I-25 to Wyoming - Concrete lined channel. This will also control Avulsion Number 6. (C-3, AV-6)
15. From Barstow to Holbrook - Concrete lined channel and/or improved conveyance along Alameda. (C-4)
16. From Barstow to 1000-feet west of Eubank - Improved conveyance. (C-11)
17. From 1000-feet west of Eubank 500-feet east of Eubank at Eagle Rock - lined channel or improved conveyance. (C-8)
18. From 500-feet east of Eubank at Eagle Rock to Browning and Glendale - lined channel improved conveyance. (C-9, AV-4)
19. From Browning east to U.S. Forest Service land - Natural channel.

John Kelly, Interim Executive Director
AMAFCA
June 14, 1999

La Cueva Tributary

20. Avulsion Number 2 - Controlled by bridge and channel at Modesto. (C-10, AV-2)
21. Avulsion Number 3 - Controlled by dip-section at Eagle Rock. (AV-3)

The estimated cost of the above facilities, as described in the following report, is $18,939,910.00, including right-of-way. This does not include the cost of storm drain collection systems within the municipal limits (approximately $5.1 million) or numerous road crossing structures in the unincorporated areas for arroyos to be left in their "natural" state.

The above facilities are sized assuming that all upstream avulsions have been controlled. In terms of downstream impact on both cost of facilities and threat to life and property, control of Avulsion Number 1 and 4 are the most critical.

The July 10, 1998 Draft of this Report was distributed to other public officials and members of the general public who had expressed interest in the findings. A public meeting, held at the Double Eagle Elementary School, was conducted on August 19, 1998. This was followed by a briefing for public agency officials on the 15th of September. Bernalillo County Commissioner Barbara Seward and City of Albuquerque Councilors Sam Bregman and Alan Armijo, the elected officials representing the residents of the project area, were briefed on the 28th of October, 1998. Minutes and other comments generated by these meetings and briefings are included as Addendum One at the end of the Report.

RESOURCE TECHNOLOGY, INC.

Charles N. Thompson, P.E.
Senior Staff Engineer

CNT/ljc

RESOLUTION 1999-11
FURTHER MODIFICATIONS OF THE NORTHEAST HEIGHTS DRAINAGE MANAGEMENT PLAN

WHEREAS, the recommendations of the Northeast Heights Drainage Management Plan were adopted in August of 1974 which called for the construction of detention and channel facilities on the North Pino, South Pino, North Domingo Baca, South Domingo Baca and Camino arroyos.

WHEREAS, in 1983 the Northeast Heights Drainage Management Plan was refined by the adoption of AMAFCA Resolution 1983-11 which added facilities on the La Cueva Arroyo and deferred the final decision on construction of the Hamilton Dam on the Camino arroyo.

WHEREAS, in 1983 the Northeast Heights Drainage Management Plan was further refined by the adoption of AMAFCA Resolution 1983-13 which added the North La Cueva Training Dike at Wyoming Boulevard.

WHEREAS, in 1985 the Northeast Heights Drainage Management Plan was modified by the adoption of AMAFCA Resolution 1985-12 which called for the diversion of the El Camino arroyo to the La Cueva Arroyo near Louisiana Boulevard.

WHEREAS, in 1992 the Northeast Heights Drainage Management Plan as it pertained to the North and South Domingo Baca Arroyos was modified by AMAFCA Resolution 1992-3 to include the recommendations of the North and South Domingo Baca Arroyos and Paseo del Norte Corridor Drainage Management Plan.

WHEREAS, in 1993 the Northeast Heights Drainage Management Plan was modified by the adoption of AMAFCA Resolution 1993-10 which moved the location of the diversion of the El Camino to the La Cueva arroyo, referred to in AMAFCA Resolution 1985-12, from west of I-25 to east of I-25.

WHEREAS, since 1974 AMAFCA has completed the construction of the South Domingo Baca Dam (1979), North Domingo Baca Dam (1982), the North La Cueva Dike (1985), the Lower Baca Dam (1995), the La Cueva Tributary Diversion Channel (1995) and the Camino Diversion Channel (1995) and participated with others in the construction of the North La Cueva Channel (1985), the South La Cueva Channel (1986), the I-25 La Cueva Box Culverts (1985), the South Domingo Baca Channel (1986), several major arroyo crossing structures at Tramway (1990) and the North Domingo Baca Channel at Window G (1998).

WHEREAS, since 1974 other parties have completed several major infrastructure projects that have been turned over to AMAFCA for operation and maintenance, including a one half mile reach of the La Cueva Arroyo east of Wyoming (1986), a one half mile reach of the North Domingo Baca east of Lowell (1995) and a one half mile reach of the North Camino along Elena (1996).

WHEREAS, in September of 1995 the AMAFCA Board authorized the preparation of a

Drainage Facility Plan for the La Cueva, El Camino and North Camino Arroyos.

WHEREAS, said Drainage Facility Plan has been prepared, with input and assistance from community agencies, tribal governments, private landowners and the general public.

WHEREAS, at the June 24, 1999 AMAFCA Board meeting Resolution 1999-8 was adopted which authorized staff to acquire right of Way for the Camino Dam site, one of the facilities recommended by the Drainage Facility Plan.

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY:

1. The improvements recommended by the La Cueva, El Camino and North Camino Arroyos Drainage Facilities Plan, dated July, 1999, are hereby adopted, subject to the following:

    a. Modifications to the adopted plan may be made as circumstances dictate, but shall be approved by the AMAFCA Board of Directors.

    b. Final decisions regarding arroyo treatments shall be made in accordance with existing and future planning documents, including but not limited to the La Cueva Sector Plan, the Facility Plan for Arroyos, the Bikeways Master Plan , the Trails Facility Plan, the Sandia Heights/North Albuquerque Acres Drainage Study and North Albuquerque Acres Master Drainage Plan.

    c. The Drainage Facility Plan utilizes various criteria to establish general project priorities from a technical perspective, these do not necessarily reflect the intent of the AMAFCA Board of Directors as priorities for funding and construction. Specific projects will be funded and scheduled by AMAFCA Board action based on evaluation of public safety needs, cost sharing benefits, orderly development of flood control infrastructure, overall community needs and regional planning requirements.

    d. The Drainage Facility Plan identifies drainage and flood control infrastructure necessary to provide protection to the community from storm water runoff, the adoption of this plan does not imply a commitment on the part of AMAFCA Board of Directors to build any or all of said facilities. Financing and scheduling of improvements are subject to the availability of public funds and to initiatives by the private sector.

2. The adoption of this Resolution modifies the Northeast Heights Drainage Management Plan and any other previous Resolutions or actions by the AMAFCA Board of Directors

regarding the La Cueva, El Camino and North Camino Arroyo drainage basins.

PASSED, ADOPTED AND SIGNED THIS 22nd DAY OF July, 1999

Ronald D. Brown, Chairman

ATTEST:

Clifford E. Anderson, Secretary/Treasurer

LA CUEVA, EL CAMINO AND NORTH CAMINO ARROYOS DRAINAGE FACILITY PLAN

1. INTRODUCTION

The La Cueva, El Camino and North Camino Arroyo systems in far northeast Albuquerque have a combined watershed area of approximately fourteen square miles at the point where they are intercepted by the North Diversion Channel (NDC). As such, they comprise 13% of the total contributing area to this major flood control facility. These watersheds, largely undeveloped until recently, include not only unincorporated areas of Bernalillo County but also extensive U.S. Forest Service land in the Sandia Mountains and Sandia Indian Reservation land.

Most of the land not under control by the U.S. Forest Service or Sandia Pueblo was subdivided in the 1930's as part of the North Albuquerque Acres Subdivision. The original North Albuquerque Acres plat consisted of a uniform grid that ignored topographic and drainage features. During the mid-1960's the area east of Tramway Boulevard was re-platted and the new configuration was somewhat more sensitive to topographic features and made some attempts at providing for public drainage via dip section crossings and poorly defined drainage easements.

Prior to 1980 the only significant developments in these areas were:

- Sandia Heights Subdivision east of Tramway Boulevard, in the Sandia Mountain foothills.
- Interstate 25 and Tramway Boulevard, both of which traverse all three watersheds from north to south.
- Coronado Airport at I-25 and Tramway Road.
- A gravel pit immediately east of the North Diversion Channel.
- Some commercial development in the area adjacent to I-25, including a cemetery at Glendale Avenue and San Pedro Drive, immediately south of the airport, and an auto salvage yard.

Since 1980, the rate of development of this area has accelerated and now includes:

- Several major manufacturing plants west of I-25 as well as increased commercial development east of I-25.

- Approximately 300-acres of replatted land divided amongst several major subdivisions east of I-25 on the La Cueva Arroyo, between Ventura Street and Wyoming Boulevard.

- A privately owned sports complex and City of Albuquerque owned solid waste transfer station east of I-25.

- Approximately 30% of the original North Albuquerque Acres lots east of I-25 have been developed in the original or slightly modified configuration of one dwelling unit per acre.

- Annexation of Coronado Airport and all of the area south of Florence and west of Ventura by the City of Albuquerque.

- A proposed Balloon Fiesta Park between I-25 and the North Diversion Channel.

- Extensive road work east of I-25, including major improvements to Tramway Boulevard, the paving of Wyoming Boulevard, Eubank Boulevard, Lowell, Tennyson and Ventura Streets and portions of Elena, Barstow, Modesto, Eagle Rock, Venice and Browning.

With the increased level of development has come increased concern with drainage issues and efforts to control storm water runoff. Beginning in 1974, with the Leonard Rice "**Northeast Heights Drainage Management Plan,**" a series of drainage management studies have been conducted that have resulted in the construction of flood control facilities to serve some of the needs in the area. These facilities, shown in Figure 1.0, are concentrated in the I-25 to the North Diversion Channel and the Tramway Boulevard areas. The four-and-one-half miles separating Tramway Boulevard and I-25 has seen only isolated drainage improvements, reflecting the relatively sparse development in this area. The last comprehensive drainage management study of the area was conducted by Bohannan-Huston, Inc., fifteen years ago, in 1983. The Literature Review in the Appendix D contains a summary of these as well as other significant drainage documents.

The study area, between Tramway Boulevard and I-25, as well as the area between I-25 and the North Diversion Channel that lies north of the concrete lined North La Cueva Arroyo, is characterized by the three major arroyo systems traversing it from east to west. The watershed produces significant amounts of sediment in response to major rainfall events. The natural arroyos, which are seldom deeply incised, have alternating reaches of sediment aggradation and degradation. The eastern half of this area is experiencing moderate levels of single family home construction on the original platted lots. The western portion is being developed either as commercial/industrial or replatted for higher density residential development.

There is extensive evidence that, over time, the main arroyo channels change flow paths on a regular, if unpredictable, basis. These changes in flow paths, or avulsions, as they have come to be called, are a matter of major concern in the area. First documented in the 1974 Rice

report, attempts to quantitatively evaluate these avulsions have been unsuccessful to date but several structures, such as the Signal Avenue and Eagle Rock training dikes, have been constructed to control areas where major arroyo flow changes were judged qualitatively to have a high probability of occurrence. The Signal Avenue dike, built as the result of recommendations in the Espey Huston 1980 "**Review and Refinement of the Northeast Heights Drainage Management Plan**" was partially washed out during a 1990 storm and rebuilt and upgraded in 1994 by AMAFCA. However, there are still numerous potential avulsions that have been identified, but not yet controlled, that pose a hazard to downstream property owners as well as existing public flood control facilities.

The avulsion problem has caused difficulties with floodplain revisions in the North Albuquerque Acres Area. A major re-study of the floodplains associated with the La Cueva, El Camino and North Camino Arroyos was submitted to FEMA in 1993. It attempted to map floodplains utilizing a probabilistic methodology to evaluate the impact of avulsions. This methodology was rejected by FEMA. Unfortunately, FEMA did not clearly state what methodology they would accept to evaluate these problems. As a result, the only floodplain revisions that have been made in the study area since the original 1983 floodplain mapping has been through the Letter of Map Revision (LOMR) process. While this piecemeal approach is expensive and time consuming, some progress has been made in revising floodplains in this manner. To date the following LOMR's have been approved:

- Nor Este Channel on the main branch of the La Cueva Arroyo between Barstow and Wyoming.
- The La Cueva Tributary at Tramway.
- The La Cueva Tributary Diversion to the North Domingo Baca Dam at Browning.
- The North Camino Arroyo Channel at Sunset Hills between Eubank and Ventura.

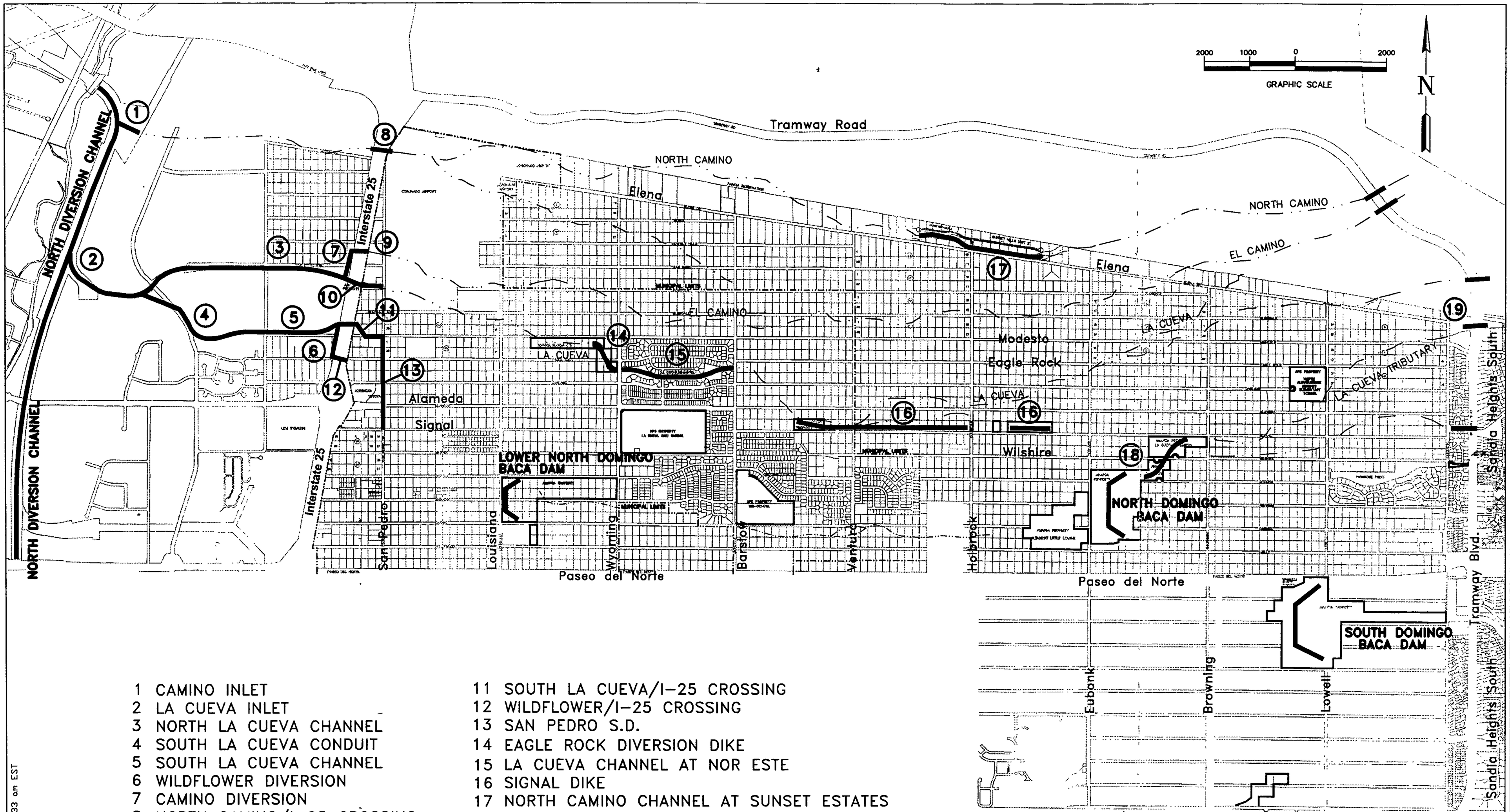
A LOMR for the Eagle Rock training dike at Wyoming and the El Camino diversion to the La Cueva Arroyo at I-25 has been submitted but not yet approved.

Because of the continued concern with drainage issues resulting from increased levels of development, on-going floodplain issues, sediment/erosion problems and the need for a comprehensive drainage review of the area, the AMAFCA Board of Directors has authorized this Drainage Management Plan.

Since the initiation of this current AMAFCA study in the fall of 1995, the following documents have been submitted:

1. **Literature Review for the La Cueva, Camino and North Camino Arroyos Drainage Management Plan**, April, 1996.
2. **Hydrology Report: La Cueva, El Camino and North Camino Drainage Management Plan**, September, 1996.
3. **Report on North Albuquerque Acres Arroyo Avulsion Problems**, March, 1997.
4. **Drainage Easement Maps** (1" = 200") showing documented drainage easements within the study area, updated through July, 1997.

The **Hydrology Report** is now contained in the Hydrology Section of this study and the other two documents are contained in the Appendix. All three documents have been used extensively by other public agencies in their attempts to keep up with infrastructure demand in this rapidly growing area. The City of Albuquerque's **North Albuquerque Acres Master Drainage Plan (Revised Draft), March, 1998** has utilized the **Hydrology Report** as a starting point for the northern half of its drainage master planning efforts and is considering adoption of some of the conceptual avulsion control plans from the **Avulsion Report** as part of the infrastructure requirements for recently annexed areas. The **Hydrology Report** also provided a portion of the hydrology analysis incorporated into Bernalillo County's **Hydrology Report for the North Albuquerque Acres/Sandia Heights Drainage Plan (Draft), November, 1997.**



1 CAMINO INLET
2 LA CUEVA INLET
3 NORTH LA CUEVA CHANNEL
4 SOUTH LA CUEVA CONDUIT
5 SOUTH LA CUEVA CHANNEL
6 WILDFLOWER DIVERSION
7 CAMINO DIVERSION
8 NORTH CAMINO/I-25 CROSSING
9 CAMINO/I-25 CROSSING
10 NORTH LA CUEVA/I-25 CROSSING
11 SOUTH LA CUEVA/I-25 CROSSING
12 WILDFLOWER/I-25 CROSSING
13 SAN PEDRO S.D.
14 EAGLE ROCK DIVERSION DIKE
15 LA CUEVA CHANNEL AT NOR ESTE
16 SIGNAL DIKE
17 NORTH CAMINO CHANNEL AT SUNSET ESTATES
18 LA CUEVA DIVERSION CHANNEL
19 LA CUEVA TRIBUTARY PIPE

FIGURE 1.0
CAMINO, NORTH CAMINO, AND LA CUEVA ARROYOS
DRAINAGE MANAGEMENT PLAN
EXISTING STRUCTURE LOCATION MAP

Resource Technology, Inc.
ENGINEERS AND ENVIRONMENTAL SCIENTISTS

Job No. 95-190

5

Dmpbsprp.dwg 7-7-98 9:10:33 am EST

2. HYDROLOGY

A. Methodology

The methodology utilized in this study is generally consistent with the City of Albuquerque Development Process Manual (DPM), Section 22.2, Hydrology (rev. Jan. 1993) and the companion computer hydrology program, AHYMO (rev. Jan. 1994). The one exception to the standard DPM procedure was to treat rock outcrops in the mountain areas as land treatment Type C rather than as Type D. It was felt that the initial abstraction and uniform loss rates associated with Type C land treatments more closely approximated conditions found in these areas.

Preliminary drainage basin delineation relied on previous work performed by RTI for the Federal Emergency Management Agency in the project area. These preliminary basins were modified based on field verification and more recent aerial photography and topographic mapping performed for AMAFCA in 1994 by Thomas R. Mann, Inc., under a separate contract, and in 1995 by Koogle & Pouls, Inc., as part of this contract. The Muskingcum-Cunge Method was used for all channel routings and the Variable Storage Coefficient Method was used for closed conduit flow. Bulking factors were not added to the basic hydrology models, see discussion in Section 4.

B. Land Treatments

Existing conditions land treatments were determined from aerial photography, other documented studies and field verification. Standard definitions of land treatments were taken from Chapter 22.2 of the COA DPM. Treatment types and slopes were adjusted for "steep slope" conditions for the mountainous basins per the DPM.

Future Conditions land treatments had to be based on several assumptions concerning future development in specific areas. These were:

- Sandia Heights/Tramway Boulevard (SH/TB): This area would be built out in patterns reflecting existing development.

- North Albuquerque Acres (NAA): The area between Ventura Street and Tennyson Street as well as the area east of Coronado Airport and north of Florence Avenue would continue to develop at one dwelling unit per acre.

- Residential (R): The area west of Ventura Street, south of Modesto Avenue and east of Louisiana Boulevard would develop as relatively high density residential.

- Commercial/Industrial (C/I): The area west of Louisiana Boulevard, north of Modesto Avenue and east of I-25 would develop as high density commercial and industrial.

- Medium Density Industrial (MI): Areas west of I-25 and east of Jefferson Boulevard would continue to develop as large scale industrial facilities with somewhat less impervious areas than the commercial/industrial area east of I-25.

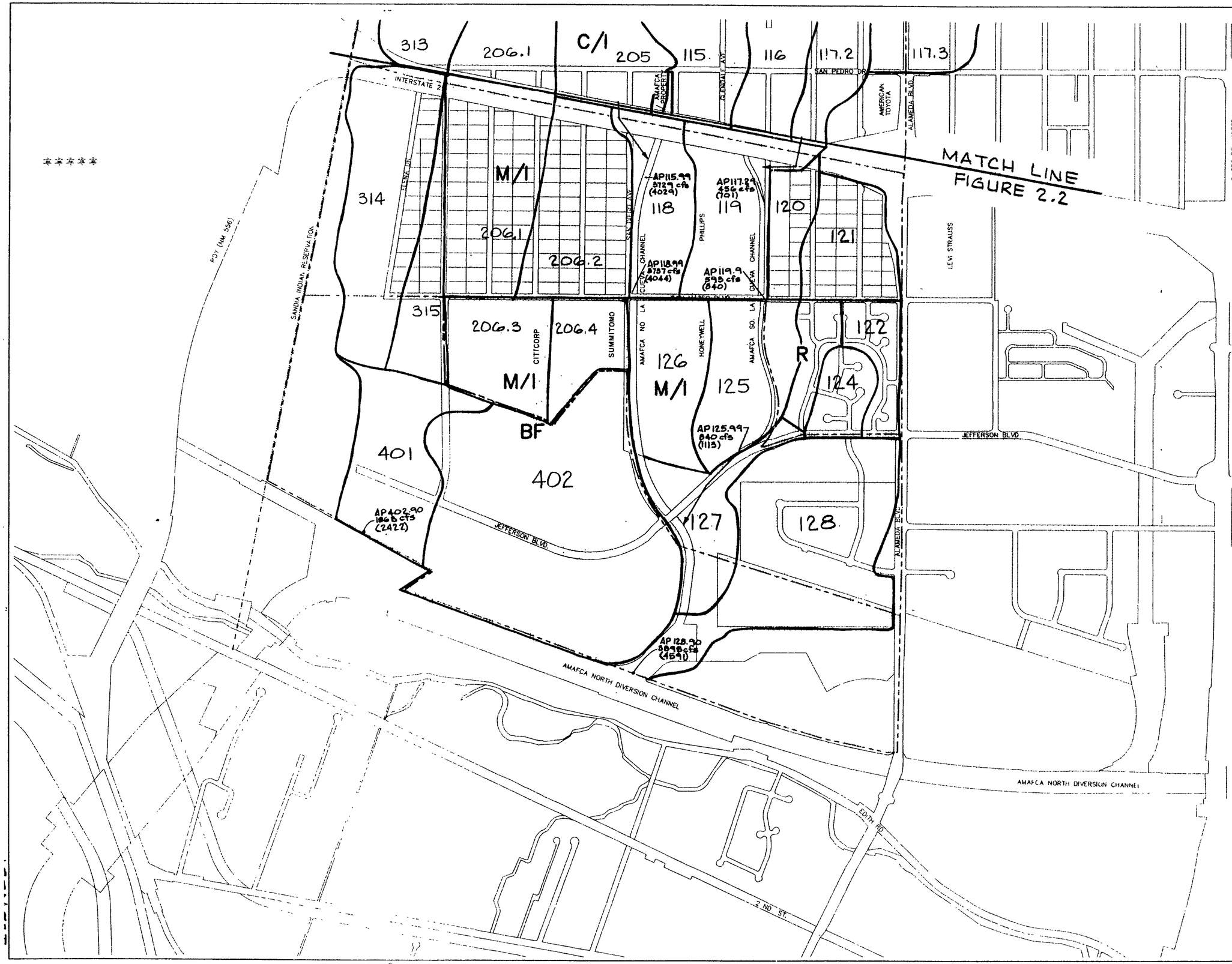
- Balloon Fiesta Park (BF): The new Balloon Fiesta Park, which will include some commercial/industrial areas, is still in the planning stages. However, due to the nature of the planned activity as well as the example of the current facility, it seems likely that there will be extensive paved parking as well as graded and compacted launch areas. Therefore, 80% of the land treatment for the area north of San Diego Avenue and west of I-25, including some currently developed industrial/commercial parcels, was considered to be Type C or D.

- Sandia Tribal Lands (ST): Sandia tribal lands south of Tramway Road and north of the Sandia Pueblo Grant Boundary were allocated land treatments consistent with moderate levels of development even though there are no current plans to develop this area.

Individual basin land treatment factors were assigned according to these assumptions as shown in Table 2.1. The areas to which they apply and drainage basins are shown on Figures 2.1, 2.2 and 2.3. Where a basin fell into more than one of these areas the land treatments were weighted. Future and existing land treatments, as well as other basin hydrologic characteristics, are shown in Tables B.1 through B.4 in Appendix B.

TABLE 2.1

	Land Treatments (%)			
	A	**B**	**C**	**D**
Sandia Heights/Tramway (SH/TB)	20	40	5	35
North Albuquerque Acres (NAA)	22	23	38	17
Residential (R)	0	34	16	50
Commercial/Industrial (C/I)	0	20	10	70
Medium Density Industrial (MI)	0	20	30	50
Balloon Fiesta Park (BF)	0	20	30	50
Sandia Tribal Lands (ST)	20	20	40	20



LEGEND

———	DRAINAGE BASIN BOUNDARY (EXISTING)
128	DRAINAGE BASIN DESIGNATION
ST	SANDIA TRIBE
BF	BALLOON FIESTA PARK
C/1	COMMERCIAL/INDUSTRIAL
M/1	MEDIUM DENSITY INDUSTRIAL
R	HIGH DENSITY RESIDENTIAL
— — —	LAND USE BOUNDARY (FUTURE)
— · — ·	MUNICIPAL LIMIT
	PROPERTY/R.O.W. LINE
	AREA WITHIN CITY LIMITS
———	AMAFCA OR APS PROPERTY LINE

100 YEAR FLOW RATES*
WITH AMUSIONS CONTROLLED

EXIST. COND.	1865 cfs
FUTURE DEVELOPED	(2422)

* BULKED

500 250 0 500 1000

SCALE: 1" = 500'

Resource Technology, Inc
ENGINEERS & ENVIRONMENTAL SCIENTISTS
CIVIL, ENVIRONMENTAL, WATER RESOURCES RESEARCH & PLANNING
2128 USLINA NE - SUITE 200, ALBUQUERQUE, NEW MEXICO 87113
TELEPHONE - (505) 345-3115

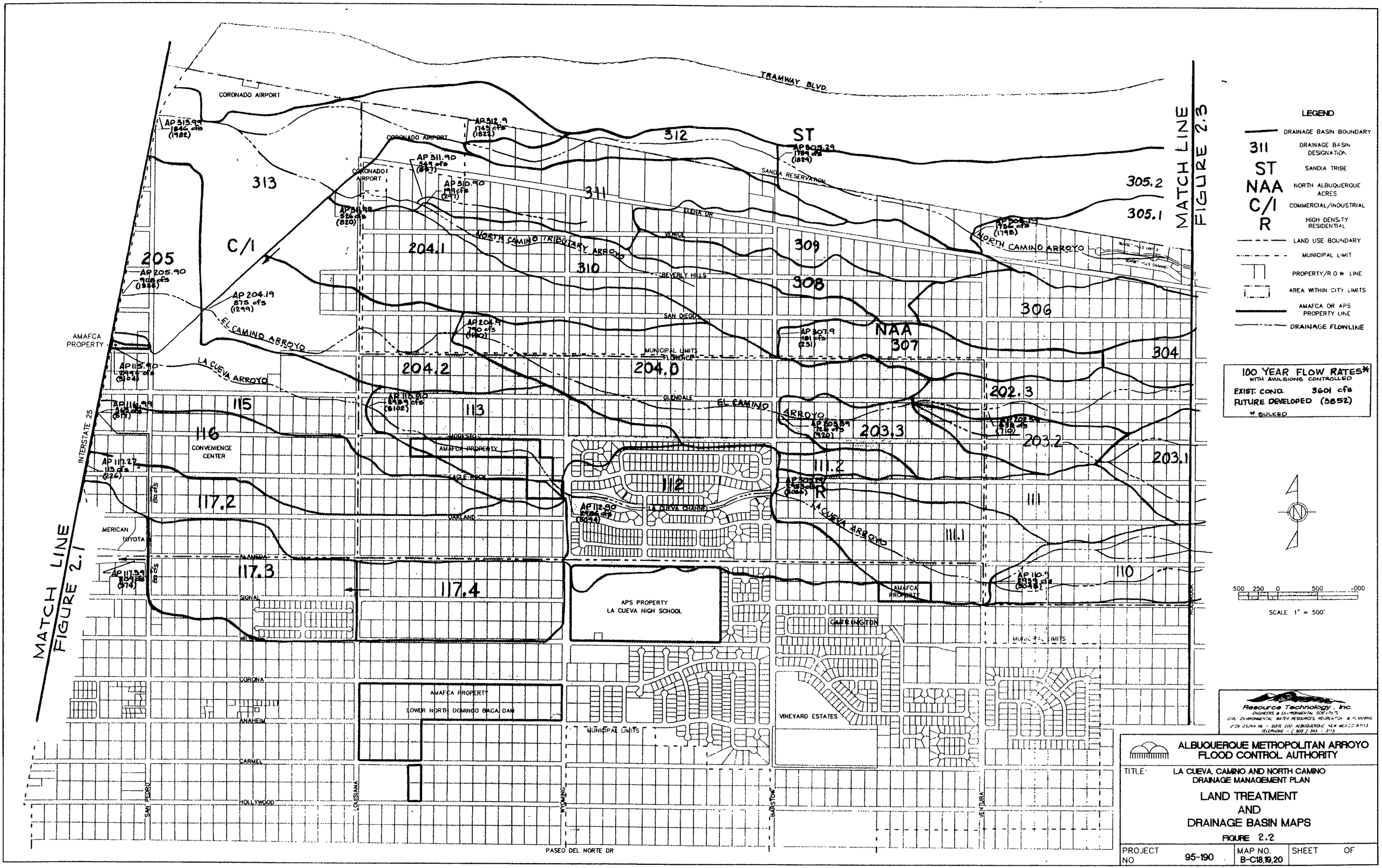
ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

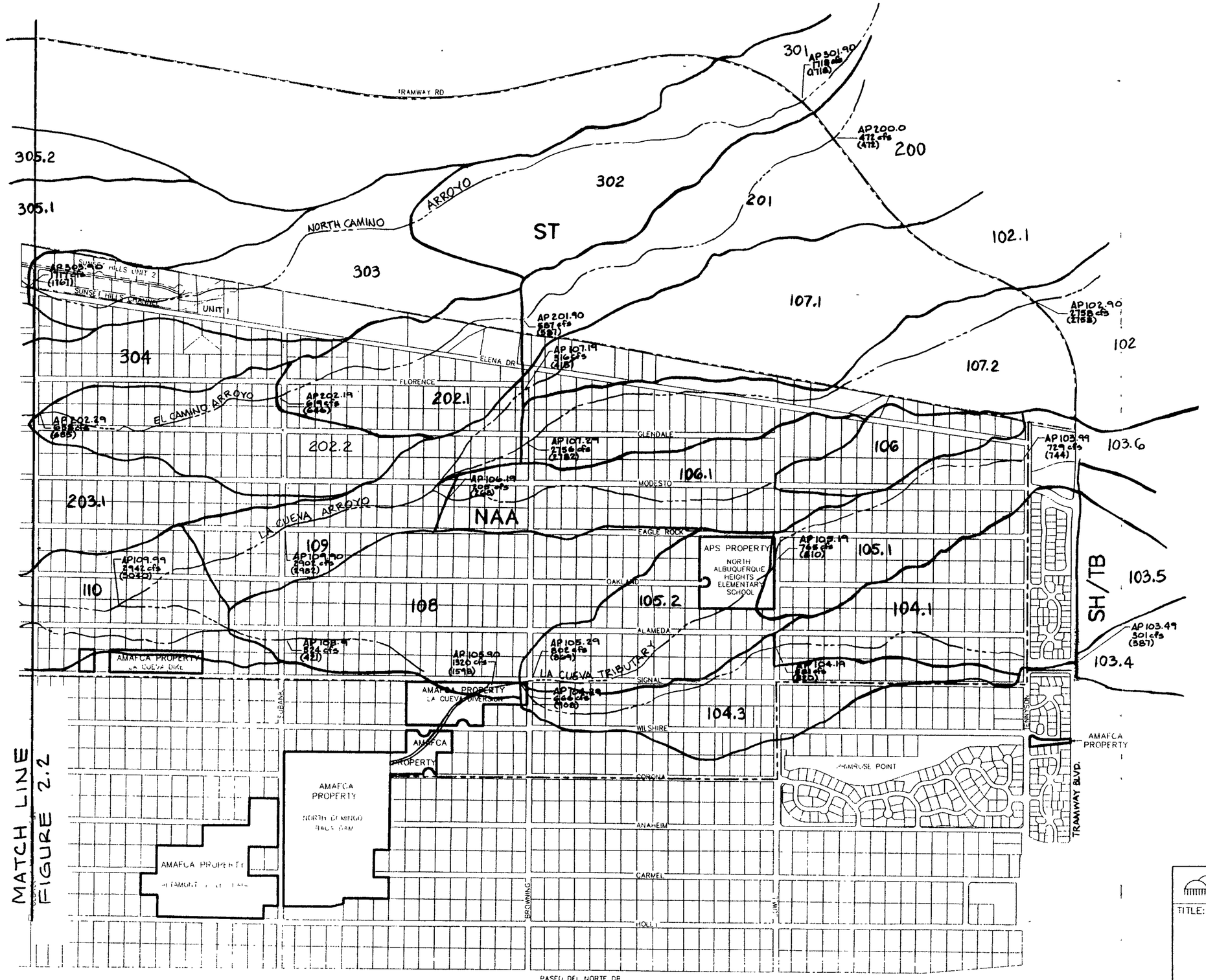
TITLE: LA CUEVA, CAMINO AND NORTH CAMINO DRAINAGE MANAGEMENT PLAN

LAND TREATMENT AND DRAINAGE BASIN MAPS

FIGURE 2.1

PROJECT NO	95-190	MAP NO.	B-C18,19,20	SHEET	OF


TRAMWAY BLVD.
CORONADO AIRPORT
SANDIA RESERVATION
NORTH CAMINO TRIBUTARY ARROYO
NORTH CAMINO ARROYO
EL CAMINO ARROYO
LA CUEVA ARROYO
ELENA DR.
VENICE
BEVERLY HILLS
SAN DIEGO
MUNICIPAL LIMITS
FLORENCE
GLENDALE
MODESTO
EAGLE ROCK
OAKLAND
ALAMEDA
SIGNAL
WILSON
CORONA
ANAHEIM
CARMEL
HOLLYWOOD
PASEO DEL NORTE DR
INTERSTATE 25
SAN PEDRO
LOUISIANA
WYOMING
BARSTOW
VENTURA
AMAFCA PROPERTY
CONVENIENCE CENTER
MERICAN TOYOTA
APS PROPERTY
LA CUEVA HIGH SCHOOL
LA CUEVA CHANNEL
LOWER NORTH DOMINGO BACA DAM
VINEYARD ESTATES
CARRINGTON
MATCH LINE FIGURE 2.1
MATCH LINE FIGURE 2.3
LEGEND
DRAINAGE BASIN BOUNDARY
311 DRAINAGE BASIN DESIGNATION
ST SANDIA TRIBE
NAA NORTH ALBUQUERQUE ACRES
C/I COMMERCIAL/INDUSTRIAL
R HIGH DENSITY RESIDENTIAL
LAND USE BOUNDARY
MUNICIPAL LIMIT
PROPERTY/R.O.W. LINE
AREA WITHIN CITY LIMITS
AMAFCA OR APS PROPERTY LINE
DRAINAGE FLOWLINE
100 YEAR FLOW RATES*
WITH AVULSIONS CONTROLLED
EXIST. COND. 3601 cfs
FUTURE DEVELOPED (3852)
* BULKED
SCALE 1" = 500'
Resource Technology, Inc.
ENGINEERS & ENVIRONMENTAL SCIENTISTS
CIVIL, ENVIRONMENTAL, WATER RESOURCES, RECREATION & PLANNING
7129 OSUNA NE - SUITE 200 ALBUQUERQUE NEW MEXICO 87113
TELEPHONE - (505) 345 - 3115
ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY
TITLE: LA CUEVA, CAMINO AND NORTH CAMINO DRAINAGE MANAGEMENT PLAN
LAND TREATMENT AND DRAINAGE BASIN MAPS
FIGURE 2.2
PROJECT NO 95-190
MAP NO. B-C18,19,20
SHEET OF



LEGEND

———	DRAINAGE FLOWLINE
═══	DRAINAGE BASIN BOUNDARY
201	DRAINAGE BASIN DESIGNATION
ST	SANDIA TRIBE
NAA	NORTH ALBUQUERQUE ACRES
SH/TB	SANDIA HEIGHTS/ TRAMWAY BLVD
— — —	LAND USE BOUNDARY
┬┬	PROPERTY/R O W LINE
═══	AMAFCA OR APS PROPERTY LINE

100 YEAR FLOW RATES *
WITH AVULSIONS CONTROLLED

EXIST. COND.	5601 cfs
FUTURE DEVELOPED	(3852)

* BULKED

N

500 250 0 500 1000

SCALE 1" = 500'

Resource Technology, Inc
ENGINEERS & ENVIRONMENTAL SCIENTISTS
CIVIL, ENVIRONMENTAL, WATER RESOURCES, RECREATION & PLANNING
2128 LOUISIANA NE - SUITE 200, ALBUQUERQUE, NEW MEXICO 87110
TELEPHONE - (505) 345 - 3115

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

TITLE: LA CUEVA, CAMINO AND NORTH CAMINO DRAINAGE MANAGEMENT PLAN

LAND TREATMENT AND DRAINAGE BASIN MAPS

FIGURE 2.3

PROJECT NO	95-190	MAP NO	B-C21,22,23	SHEET	OF

3. HYDROLOGY MODEL

A. General

The term "existing condition," as used in this report, refers to drainage infrastructure rather than levels of development. Thus, there are existing conditions with current levels of development and existing conditions with future full development. The modeling of new drainage infrastructure as proposed is Section 8 of this report under fully developed conditions is referred to as "proposed conditions" (for worst case flow rates, assuming no avulsion control, see Section 6).

B. Current Development Model

The existing conditions, current development, model results are summarized in Table 3.1 as "existing" conditions. Flow rates have been adjusted to reflect sediment bulking by the factors shown in Section 4. ***All avulsions are assumed to be controlled so as to prevent interbasin transfers of storm water.*** Because of the overriding influence of the Sandia Mountain drainage basins on the La Cueva and North Camino Arroyos, there is little variation in flow from Tramway Boulevard to I-25. It appears that local inflows merely replace the reduction in peak flows due to routing. The El Camino Arroyo, which is less dependent on mountain flows, shows a gradual increase in flow as it progresses from east to west. Output summary files and hydrology schematic maps are located in Appendix B. Figures 2.1, 2.2 and 2.3 show the location of selected analysis points.

C. Future Full Development Model

The existing condition, future full development, model results are also shown in Table 3.1 as "Future Conditions." Again, due to the influence of the mountain basins, there is little apparent increase in peak runoff rates due to development in the North Camino and La Cueva Arroyo basins. The El Camino basin, which is less influenced by the mountain areas, shows a correspondingly greater impact due to development. Selected flow rates for both existing and future conditions are shown on Figures 2.1, 2.2 and 2.3.

The proposed improvements to the Balloon Fiesta Park have only been reflected in land treatments and not in terms of any impact proposed facilities may have on runoff routing. In general, this model only reflects changes in land treatments and does not model any other proposed improvements other than avulsion control.

D. Proposed Conditions Model

The Proposed Condition Model has been taken from the City's **Draft North Albuquerque Acres Master Drainage Plan.** This model, based on the original AMAFCA full development model, includes all of the proposed facilities within the municipal limits. There are also some

minor changes to land treatments reflecting proposals currently under consideration by the **Sector Development Plan** for the recently annexed areas of North Albuquerque Acres. The City's **NAA Master Drainage Plan** and **Sector Development Plan** are discussed more fully in Section 7 of this report. Summary output files are in Appendix B.

TABLE 3.1

EXISTING AND FUTURE 100-YEAR FLOW RATES*

Location	North Camino Arroyo (cfs)	El Camino Arroyo (cfs)	La Cueva Arroyo (cfs)
Tramway	AP 301.90	AP 200.0	AP 102.90
Existing	1718	472	2758
Future	1718	472	2758
Browning		AP 201.90	AP 107.29
Existing	-	587	2756
Future	-	587	2782
Eubank		AP 202.19	AP 109.99
Existing	-	619	2942
Future	-	646	3040
Holbrook	AP 303.90	AP 202.29	
Existing	1717	638	-
Future	1767	685	-
Ventura	AP 305.19	AP 202.39	AP 110.9
Existing	1736	638	2939
Future	1798	710	3048
Barstow	AP 305.29	AP 203.39	AP 111.99
Existing	1739	726	2953
Future	1829	920	3066
Proposed	1829	924	3094
Wyoming		AP 204.9	AP 112.90
Existing	1743	790	2986
Future	1822	1130	3094
Proposed	1822	967	3128
Louisiana			AP 113.90
Existing	-	-	2989
Future	-	-	3106
Proposed		324	3908
I-25	AP 313.99	AP 205.90	AP 115.90
Existing	1846	908	2994
Future	1982	1335	3108
Proposed	2043	873	3923
North Diversion Channel	AP 402.90		AP 128.90
Existing	1863	-	3898
Future	2422	-	4591
Proposed	2540		5551

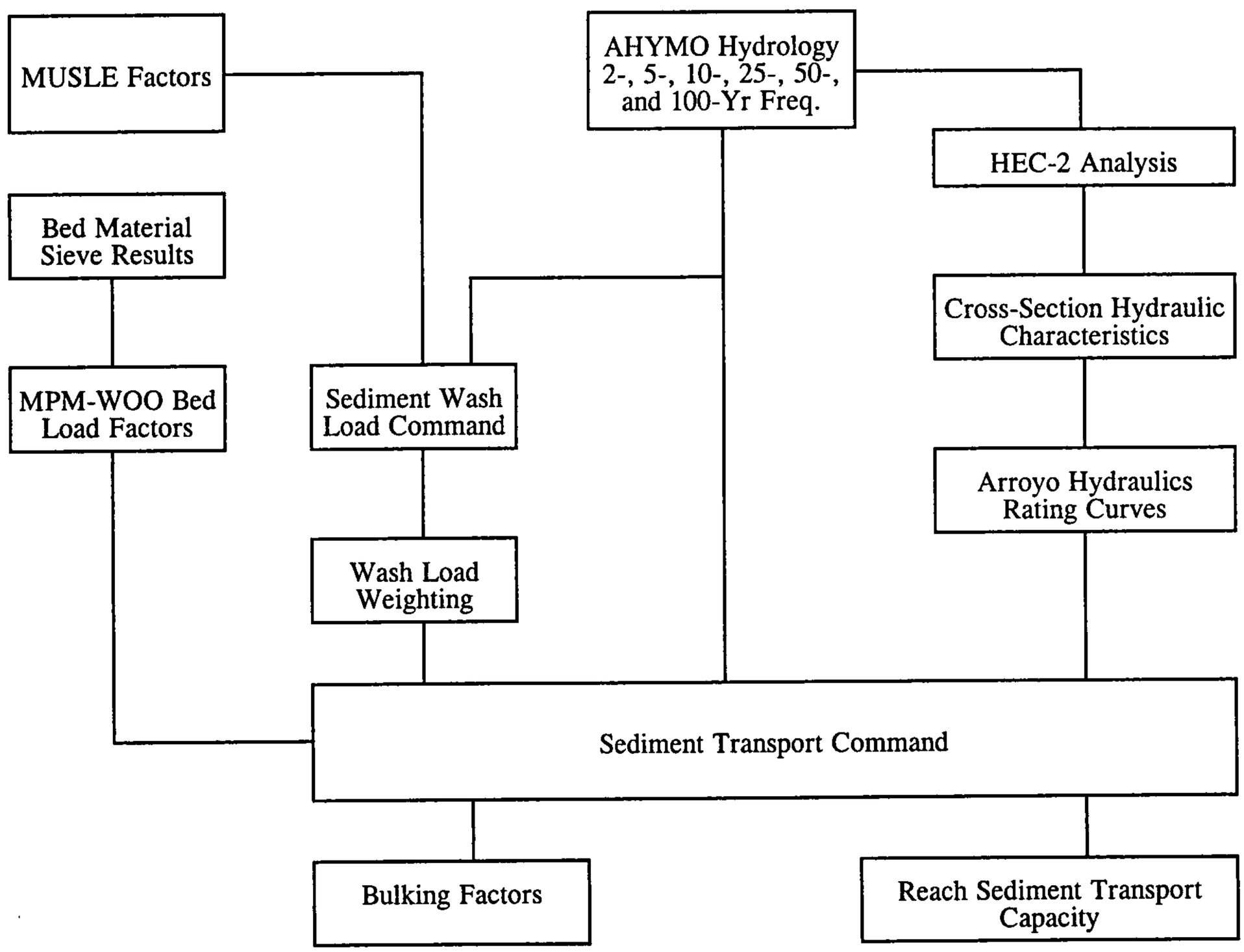
*Bulked for sediment and assuming avulsion control.

4. SEDIMENT TRANSPORT ANALYSIS

A. General

The primary purpose of the sediment transport analysis was to determine bulking factors for the arroyos in the study area and to identify reaches as being either aggradational or degradational. The methodology involves the use of the methodology presented in the AMAFCA **Sediment and Erosion Design Guide** (March 1994) and the AHYMO Sediment Transport command. A flow chart of the various inputs for the Sediment Transport Command is shown below. A description of each of the inputs, including assumptions and other important information is also given. Input and Summary files are in the Technical Appendix.

Flow-Chart of Sediment Transport Analysis



B. Input Parameters

Hydrographs

Existing condition 100-year hydrographs were used as the basis for analysis for both bed load and wash load. Where other frequencies were required, they were estimated as a fraction of the 100-year frequency using data from an earlier analysis of portions of the North Camino Arroyo for the Sunset Hills CLOMR, approved by FEMA in February of 1996. The estimated fraction of the 100-year hydrograph is shown in Table 4.1.

Bed Material

Bed samples were taken at several locations in all three arroyos. A high degree of variability existed in the mean grain sizes (D-50). For this reason, all samples taken east of Browning Street were averaged together to obtain a single representative D-50 for the area. Similarly, results for samples taken west of Browning Street were averaged together. Locations of all sediment samples are shown in Figures 4.1 and 4.2.

The average D-50 was used to find factors **a** through **d** according to Figure 3.20 in AMAFCA's **Sediment and Erosion Design Guide**, Mussetter, 1994. Factors **a** through **d** are used in the MPM-WOO Bed Load Formula and are inputs to the Sediment Transport Command.

Wash Load

Wash load calculations were completed using the AHYMO Sed Wash Load command. This command uses the Modified Universal Soil Loss Equation (MUSLE) to compute wash load concentration. The results are multiplied by 3.0 as recommended in AMAFCA's **Sediment and Erosion Design Guide**. Since several basins contribute runoff to a particular reach of an arroyo, the wash load results for each basin were weighted corresponding to basin area. Factors for each basin are contained in the Technical Appendix. Inputs for the MUSLE equation are described as follows:

<u>Soil Erodibility Factor, K</u>

K-values were determined from the **Prudent Line Analysis, La Cueva Arroyo and Watershed Between Tennyson Street and Modesto Avenue**, RCE (1992) and **Albuquerque Arroyos Sedimentation Study Numerical Model Investigation**, Corps of Engineers (1995) K-values of the Camino and La Cueva Basins. The Corps, using SCS soil surveys, determined a weighted K-value for each subbasin based on the percentage of a given soil type in that area. RCE (1992) used K=0.02 to K=0.05 for Sandia Mountain Basins. In this study, a K factor of 0.05 was selected for use in the mountain basins and a K-value of 0.20 was used for all basins west of Tramway Boulevard.

Cover and Management Factor, C

The C-values used were determined from Table B.2 of the AMAFCA **Sediment and Erosion Design Guide**. A 25% canopy area of grasses and shrubs was assumed with no appreciable mulch for the non-mountain basins. For this condition Table B.2 gives a C-value of 0.36 which compares well with the C-value of 0.40 used by the Corps of Engineers (1995).

The mountain basins contain trees, brush, and more ground cover. A 50% canopy cover with 6' height was assumed in the upland basins, with a ground cover of 20%. Table B.2 gives a C-value of 0.19 for this condition.

Erosion Control Practice Factor, P

A P-value of 1.0 was used, assuming that undeveloped land will not be graded or ploughed to control erosion.

Topographic Factor, LS

LS values were determined from Equation B.3 of the AMAFCA **Sediment and Erosion Design Guide**:

$$LS = \left(\frac{\lambda}{72.6}\right)^n * (0.065 + 0.0454 * S + 0.0065 * S^2)$$

λ = overland slope length
S = slope in percent

n = 0.3 for slope $\leq$ 3%
n = 0.4 for slope = 4%
n = 0.5 for slope $\geq$ 5%

LS values corresponding to upland (mountain) basins, developed basins east of Tramway Boulevard, and developed basins west of Tramway Boulevard were used. LS values for mountain basins were computed individually, depending on topography. Other LS values are as follows:

	λ (ft)	S (%)	LS
East of Eubank Boulevard	240	5	0.83
West of Eubank Boulevard	240	4	0.57

The overland slope lengths were determined based on site visits and topographic maps. The overland flow length in North Albuquerque Acres was chosen as 240 feet since this is the approximate typical lot length. The slopes shown are average values for the specified areas.

C. HEC-2 Modeling and Arroyo Rating Curves

Discharges corresponding to 10%, 20%, 40%, 60%, 80%, 100%, and 120% of the 100-year discharge were input to the HEC-2 analyses to obtain rating curves for individual reaches. Arroyo cross-sections were taken at 100-foot intervals for the HEC-2 analysis. GR cards were created using a program that converts distance-elevation information for each cross-section.

Cross-section geometry was examined to determine channel vs. overbank areas. In cases where there was no clear division between channel and overbank, the overbank was assumed to be where the 100-year flow depth was 6-inches or less. This criteria of a 6-inch flow depth was determined based on an overbank flow velocity of 3 fps or less, as recommended by the HEC-2 User's Manual for Floodway Determination. A normal depth of 6-inches corresponds to a velocity of 3 fps in wide channels with slope and roughness characteristics found in the study area. Cross-sections where more than one flow path was evident (braided streams) were considered as a whole channel, again as suggested in the HEC-2 User's Manual for Floodway Determination.

Mannings "n" values of 0.030 for channel and 0.045 for overbank were used in the models. The "NH Card" option was used for labeling n-values so that n-values could be fixed independently of the position chosen for the overbanks, and also so that multiple-channel conditions could be modeled.

Top width and mean velocity data for each cross-section were examined to select reaches with similar hydraulic characteristics. Once reaches were selected, the top width and velocity were averaged for each of the seven discharges to obtain a rating curve for that reach. A total of thirty-eight reaches on the three main arroyos and twenty reaches on two tributary arroyos were studied in detail.

D. Sediment Transport Capacity

The Rating Curves were used as input in the Sediment Transport Command to relate top width and velocity with discharge for each reach shown in Figures 4.1 and 4.2. To this the weighted results from the wash load computations and the MPM-Woo coefficients were added. In this manner, with the input hydrographs for the 100-year, 50-year, 25-year, 10-year, 5-year and 2-year storms as described in Section 4.B, the sediment transport capacity for each reach was determined as reported in Tables 4.2 through 4.6.

Utilizing the sediment transport capacity as determined above, the potential for aggradation or degradation in each reach was determined by applying the principal of continuity. If each natural arroyo reach was assumed to transport sediment up to its full capacity, and that if this capacity exceeded the supply from the upstream reach, then arroyo degradation (erosion) would occur. Conversely, if the supply of sediment exceeded the transport capacity then aggradation would take place. To further aid in this analysis Equation 1.1 of the "Erosion and Sediment Design Guide" was utilized to determine mean annual sediment loadings. In this manner both short term (average annual) sediment aggradation/degradation potential and long

term (30 times the average annual plus the 100-year) aggradation/degradation potential could be examined. These are also reported in Tables 4.2 through 4.6 for each arroyo.

A comparison of the average annual sediment loadings for the Camino and North Camino Arroyos reveals relative channel stability east of Coronado Airport. At the airport itself there seems to be a major depositional zone that may be related to the gradual decrease in the prevailing east to west arroyo bed slopes. However, a comparison of the long term trends for each arroyo reach reveals a pattern for alternating degredational and aggradational zones that could have a major impact on long term arroyo channel stability.

The La Cueva arroyo demonstrates a somewhat different pattern. East of Eubank there is a pattern of major arroyo bed degradation followed by aggradation in the vicinity of one of the previously identified avulsion areas just east of Eubank even at the average annual level. This is followed by a series of reaches from Eubank west to Ventura where there is relative short term channel stability. West of Ventura the model indicates an area of channel degradation that coincides with an area observed in the field to be characterized by arroyo channel head cuts. These tendencies are even more pronounced when a comparison is made of the long term trends. Immediately downstream from the hard lined channel through Nor Este Subdivision there is a zone of channel degradation followed by an aggradational zone at Coronado Airport under both short term and long term conditions.

E. Bulking Factors

In addition to reporting the sediment transport capacity for each reach, both volumetrically and by weight, the AHYMO output also calculates the average bulking factor for each hydrograph. The average bulking factors for the 10- and 100-year flows for the thirty-eight main arroyo reaches from this study plus an additional three reaches from similar studies in the project area with similar soils and bed slopes were statistically analyzed to determine a relationship between flow rate and bulking factor. The following equation was found to provide a reasonably good fit for the data:

$$BF \text{ (in \%)} = 3.622 + .001875Q \text{ (in cfs)}$$

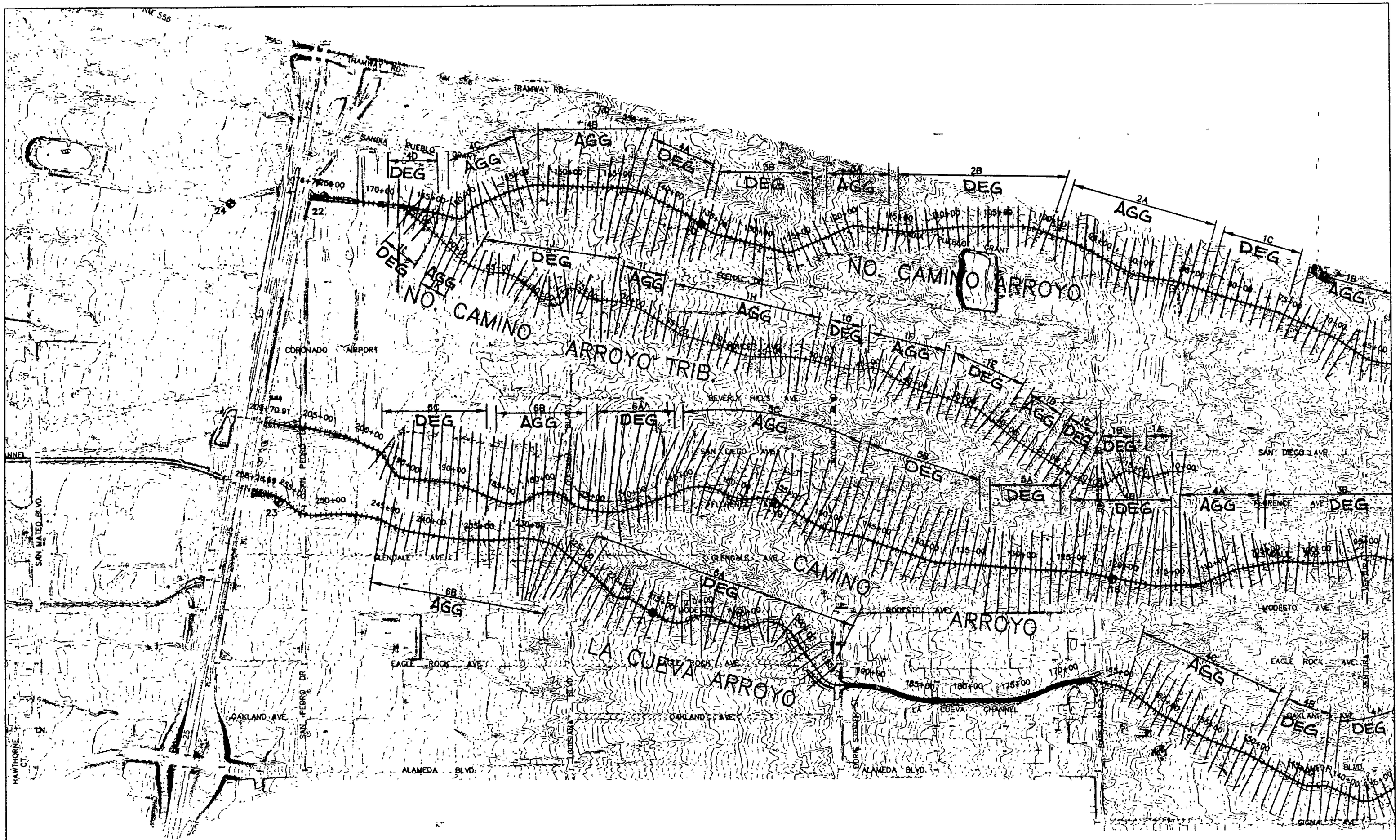
Bulking factors (rounded to the nearest whole percent) were then calculated as a function of flow rate as shown in Table 4.7. A more complete discussion of the statistical analysis is contained in Appendix A.

Bulking factors, determined in this manner, could then be applied externally to the hydrology model results to determine peak flow rates at various points, prior to any reservoir routings or to approximate sediment storage requirements for ponds and dams. *It was felt that applying bulking factors as a function of flow rate gave a reasonable representation of the effects of sediment in these limited situations but should not be used where a higher degree of accuracy is required, such as for prudent line analysis or for determining sediment aggradation/degradation zones.*

TABLE 4.1

HYDROGRAPH FREQUENCY FACTORS

Frequency	Fraction of Q-100
2-Year	.22
5-Year	.35
10-Year	.53
25-Year	.71
50-Year	.87



LEGEND

1A — REACH DESIGNATION

ARROYO FLOWLINE

1 — SEDIMENT SAMPLE LOCATION

AGG — AGGRADATIONAL

DEG — DEGRADATIONAL

NOTE:

SEDIMENT LOCATIONS 5–10 ARE NOT SHOWN. THEY ARE LOCATED OUTSIDE THE LIMITS OF THIS MAPPING.

500 250 0 500 1000

SCALE: 1" = 500'

Resource Technology, Inc.
ENGINEERS & ENVIRONMENTAL SCIENTISTS
CIVIL, ENVIRONMENTAL, WATER RESOURCES, RECREATION, & PLANNING
2129 OSUNA NE – SUITE 208, ALBUQUERQUE, NEW MEXICO 87113
TELEPHONE – (505) 345 – 3115

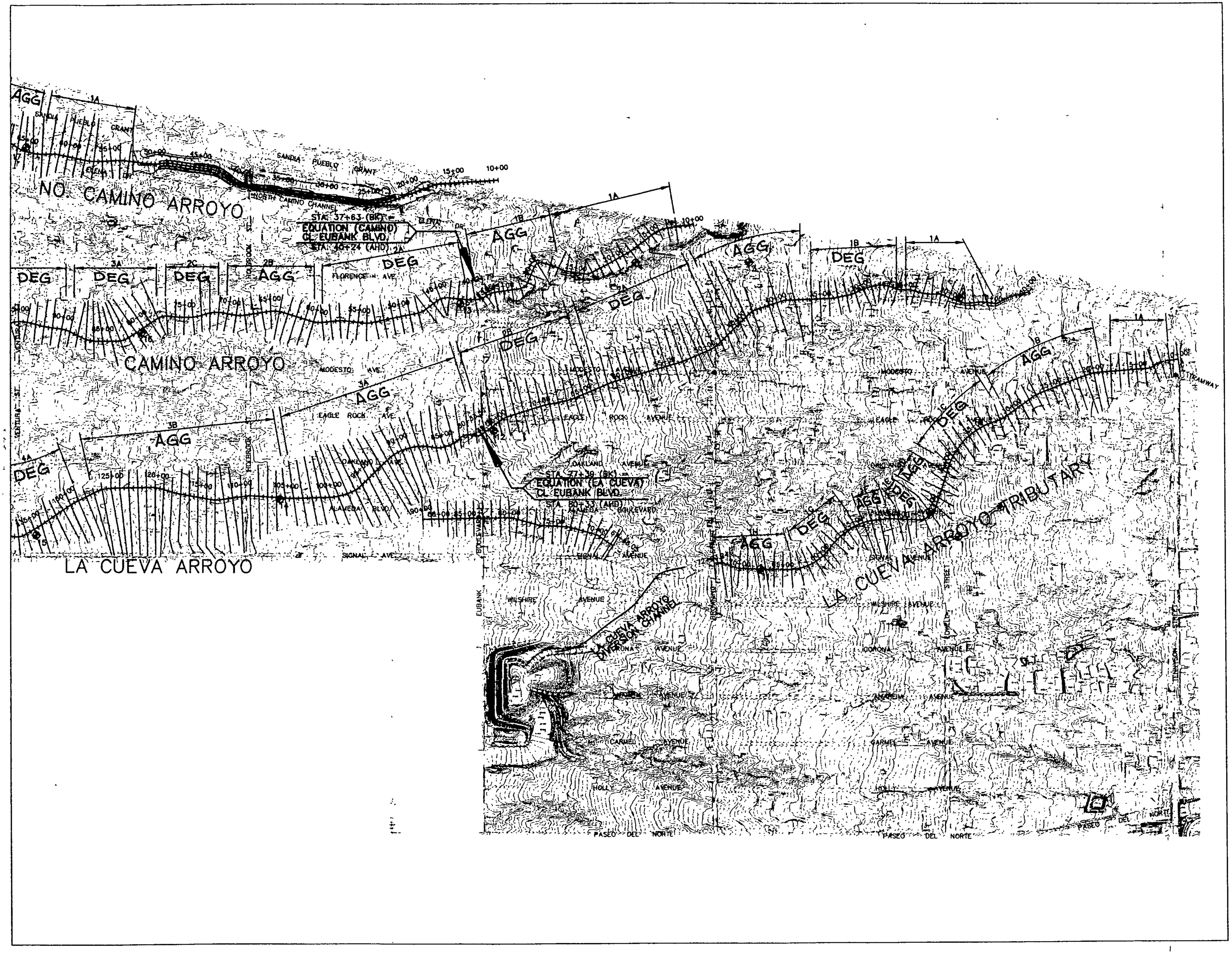
ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

TITLE: LA CUEVA, CAMINO AND NORTH CAMINO ARROYOS DRAINAGE MANAGEMENT PLAN

SEDIMENT AND EROSION MAP

FIGURE 4.1

PROJECT NO.	95-190	MAP NO.	B-C18,19,20	SHEET	OF



LEGEND

1A	REACH DESIGNATION
———	ARROYO FLOWLINE
◆ 1	SEDIMENT SAMPLE LOCATION
AGG	AGGRADATIONAL
DEG	DEGRADATIONAL

NOTE:

SEDIMENT LOCATIONS 5-10 ARE NOT SHOWN. THEY ARE LOCATED OUTSIDE THE LIMITS OF THIS MAPPING.

500 250 0 500 1000

SCALE: 1" = 500'

Resource Technology, Inc.
ENGINEERS & ENVIRONMENTAL SCIENTISTS
CIVIL, ENVIRONMENTAL, WATER RESOURCES, RECREATION, & PLANNING
2129 OSUNA NE - SUITE 200, ALBUQUERQUE, NEW MEXICO 87113
TELEPHONE - (505) 345 - 3115

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

TITLE: LA CUEVA, CAMINO AND NORTH CAMINO ARROYOS DRAINAGE MANAGEMENT PLAN

SEDIMENT AND EROSION MAP

FIGURE 4.2

PROJECT NO.	95-190	MAP NO. B-C18,19,20	SHEET	OF

TABLE 4.2

SUMMARY OF EXISTING CONDITIONS
NORTH CAMINO ARROYO

Reach*	Sediment Transport Capacity in Tons by Frequency							Average Annual Aggradation (+) Degradation (-) Tons	100-Year Aggradation (+) Degradation (-) Tons	30-Year Cumulative Plus 100-Year Tons
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Average Annual			
1A	5479	9777	16865	23718	29704	36898	7372	-	-	-
1B	4409	7827	13104	18556	23613	28861	5907	+1465	+8037	+51987
1C	4515	8702	15158	22601	29849	35684	6646	-739	-6823	-28993
2A	4456	7627	12439	17691	22648	26694	5751	+895	+8990	+35840
2B	4594	8310	15613	24122	32537	39837	6799	-1048	-13143	-44583
3A	4639	7530	12040	17242	22526	27132	5759	+1040	+12705	+43905
3B	5801	9407	14736	20721	26524	30948	7072	-1313	-3816	-43206
4A	6734	10404	15266	20469	25487	30059	7648	-576	+889	-16391
4B	4708	7660	12127	17739	23862	29141	5900	+1748	+918	+53358
4C	4432	7437	11945	16716	21224	25236	5581	+319	+3905	+13475
4D	7690	13662	23346	34784	46100	54061	10569	-4988	-28825	-178465

*Reach locations are shown on Figures 4.1 and 4.2

TABLE 4.3

SUMMARY OF EXISTING CONDITIONS
NORTH CAMINO ARROYO TRIBUTARY

Reach*	Sediment Transport Capacity in Tons by Frequency							Average Annual Aggradation (+) Degradation (-) Tons	100-Year Aggradation (+) Degradation (-) Tons	30-Year Cumulative Plus 100-Year Tons
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Average Annual			
1A	119	199	326	467	601	714	152			
1B	154	267	470	693	884	1039	209	-57	-325	-2035
1C	199	337	514	714	926	1113	247	-38	-74	-1214
1D	110	180	283	390	488	570	134	+113	+543	+3933
1E	163	282	497	734	942	1113	222	-88	-543	-3183
1F	117	193	302	415	517	600	143	+79	+513	+2883
1G	216	368	610	875	1125	1138	278	-135	-538	-4588
1H	173	285	448	625	792	932	213	+65	+206	+2126
1I	170	278	430	583	718	829	205	+8	+103	+343
1J	640	1166	1955	2811	3735	4479	893	-688	-3650	-24290
1K	445	730	1145	1588	1999	2341	544	+349	+2138	+12608
1L	827	1386	2192	2964	3650	4242	1020	-476	-1901	-16181

*Reach locations are shown on Figures 4.1 and 4.2

TABLE 4.4

SUMMARY OF EXISTING CONDITIONS
EL CAMINO ARROYO

Reach*	Sediment Transport Capacity in Tons by Frequency							Average Annual Aggradation (+) Degradation (-) Tons	100-Year Aggradation (+) Degradation (-) Tons	30-Year Cumulative Plus 100-Year Tons
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Average Annual			
1A	779	1515	2830	4525	6283	7851	1234	-	-	-
1B	762	1359	2273	3282	4264	5110	1030	+204	+2741	+8861
2A	1005	1865	3213	4770	6388	7847	1436	-406	-2737	-14917
2B	970	1690	2700	3766	4881	5881	1254	+182	+1966	+7426
2C	1011	1810	3220	5118	6990	8587	1462	-208	-2706	-8946
3A	1092	1953	3405	5115	6522	7656	1517	-55	+931	-719
3B	1130	2081	3677	5763	7499	8769	1610	-93	-1113	-3903
4A	1028	1872	2918	4045	5216	6401	1377	+233	+2368	+9358
4B	975	1762	3069	4515	5864	7071	1363	+14	-670	-250
5A	1488	2423	3800	5234	6586	7724	1808	-445	-653	-14003
5B	1775	2922	4449	6110	7568	8761	2140	-332	-1037	-10997
5C	1683	2813	4389	6065	7720	9224	2084	+56	-463	+1217
6A	3454	6287	11234	14439	17528	20279	4682	-2598	-11055	-88995
6B	1684	2961	4796	6692	8398	9794	2190	+2492	+10485	+85245
6C	2224	4123	6944	10249	13496	16350	3127	-937	-6556	-34666

*Reach locations are shown on Figures 4.1 and 4.2

TABLE 4.5

SUMMARY OF EXISTING CONDITIONS
LA CUEVA ARROYO

Reach*	Sediment Transport Capacity in Tons by Frequency							Average Annual Aggradation (+) Degradation (-) Tons	100-Year Aggradation (+) Degradation (-) Tons	30-Year Cumulative Plus 100-Year Ton
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Average Annual			
1A	9679	19751	36471	57934	80862	101926	15599	-	-	-
1B	11171	22942	45824	74322	106044	139271	19375	-3776	-37345	-150625
1C	7699	14395	26721	42104	58562	74455	11473	+7902	+64816	+301876
2A	8402	15999	28533	42679	56436	69690	12442	-969	+4765	-24305
2B	8098	16098	30027	47267	66135	83010	12989	-547	-13320	-29730
3A	8850	15626	25786	37222	48940	60423	11857	+1132	+22587	+23719
3B	7617	13329	23150	34453	45437	54992	10449	+1408	+5431	+47671
4A	7730	14986	27889	43606	59745	73322	12061	-1612	-18330	-66690
4B	14578	29226	53690	84653	119144	151733	23421	-11360	-78411	-419211
4C	11233	21689	35445	49832	64502	75893	15766	+7655	+75840	+305490
5 (Nor Este Channel)										
6A	14481	25850	42897	61000	77897	93882	19411	-3645	-17989	-127329
6B	13801	21251	33843	48297	62099	73112	16438	+2973	+20770	+109960

*Reach locations are shown on Figures 4.1 and 4.2

TABLE 4.6

SUMMARY OF EXISTING CONDITIONS
LA CUEVA DIVERSION CHANNEL

Reach*	Sediment Transport Capacity in Tons by Frequency							Average Annual Aggradation (+) Degradation (-) Tons	100-Year Aggradation (+) Degradation (-) Tons	30-Year Cumulative Plus 100-Year Tons
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	Average Annual			
1A	1431	2603	4706	6986	9305	11511	2061	-	-	-
1B	1146	2068	3277	4332	5372	6229	1481	+580	+5282	+22682
1C	1420	2437	3792	5210	6713	8248	1792	-311	-2019	-11349
1D	875	1644	3048	4391	5350	6157	1271	+521	+2091	+17721
1E	1199	2036	3546	5589	7508	9189	1644	-373	-3032	-14222
1F	997	1794	3121	4765	6564	8143	1418	+226	+1046	+7826
1G	986	1933	3856	6396	8783	10878	1640	-222	-2735	-9395
1H	1164	1899	2968	4139	5337	6363	1424	+216	+4515	+10995

*Reach locations are shown on Figure 4.1

TABLE 4.7

BULKING FACTORS FOR SEDIMENT AS A FUNCTION OF FLOW RATE

Clean Water Flow Rate, Q (cfs)	Bulking Factor* (%)
0 - 500	4
501 - 1000	5
1001 - 1600	6
1601 - 2100	7
2101 - 2600	8
2601 - 3200	9
3201 - 3700	10
3701 - 4200	11

* Valid for NAA and Sandia Heights natural channels west of USFS Boundary only, D_{50} 1.5mm - 3.0mm

5. HYDRAULIC ANALYSIS OF EXISTING ARROYO FACILITIES

A. General

The La Cueva Arroyo system is partially channelized west of Barstow Street. The major elements consist of the Nor Este Channel on the main branch from Barstow to Wyoming, the North La Cueva Channel from I-25 to the North Diversion Channel, and the South La Cueva Channel from I-25 to the confluence with the North La Cueva west of Jefferson. The North Camino Arroyo is channelized at Sunset Hills from 1600 feet east of Holbrook to 1000 feet west of Holbrook. Channelizing the North Camino west of I-25 is currently under study. In addition, there are five major I-25 crossing structures conveying the main branches of the North Camino, El Camino and La Cueva Arroyos under I-25, including two tributaries of the La Cueva Arroyo. All structures are shown on Figure 1. Each will be discussed more fully below.

B. Nor Este Channel

The Nor Este Channel was constructed by Presley Homes in 1987 as part of the Nor Este subdivision infrastructure. The AMAFCA maintained structure consists of a 10-foot bottom width, concrete lined channel with a minimum depth of 8.25-feet (with up to an additional 3.67-feet of additional freeboard in super elevated sections). It has a soil cement inlet structure and discharges to a dip-section and dike at Eagle Rock and Wyoming. The soil cement dike was constructed by AMAFCA in 1985. The design flow rate was reported to be 4870 cfs. Based on our analysis, using a Manning's "n" value of 0.015, we determined the limiting reach to have a capacity of 5829 cfs. See Figure 5.1 for typical section details.

C. North La Cueva Channel

The North La Cueva Channel was constructed in phases between 1983 and 1989 with 75% private and 25% AMAFCA funds. The AMAFCA maintained channel extends from I-25 to the North Diversion Channel. The El Camino Arroyo has been diverted by a subsequent AMAFCA project to the channel just west of I-25 and the South La Cueva Channel is intercepted just west of Jefferson. The typical section has a 15-foot bottom width and a minimum depth of 9.5-feet. The design flow rate was reported to vary from 5500 cfs at the upstream end (at I-25) to 7000 cfs at the downstream North Diversion Channel inlet. Based on our analysis, using a Manning's "n" of 0.015, we determined the limiting reach to be immediately west of Jefferson Boulevard with a hydraulic capacity of 6329 cfs. The proposed condition flow rate is 5551 cfs. See Figure 5.1 for typical section details.

D. South La Cueva Channel

The South La Cueva Channel was constructed in phases concurrent with the North La Cueva Channel with 75% private and 25% AMAFCA funding. The AMAFCA maintained facility consists of a 600-foot earth and riprap section immediately west of I-25 that receives the discharge from two I-25 crossing structures; one located at I-25 north of Modesto and the other

located at I-25 and Eagle Rock (sometimes called the Wildflower Diversion). A concrete lined section begins 1000-feet east of San Mateo and continues to Jefferson Boulevard, where the channel is intercepted by a 96-inch RCP that conveys the arroyo to the confluence with the North La Cueva Channel. The concrete lined South La Cueva Channel is located in a park area and the typical section consists of a 10-foot bottom width channel 3-feet deep that utilizes grassy bank areas for freeboard. The design flow rate was 1100 cfs. Our analysis indicated that bank full capacity for the limiting concrete lined section was 1000 cfs, using a Manning's "n" of 0.015. The transition to the 96-inch RCP was designed to prevent inlet control at a flow rate of 1100 cfs. As a "worst case" scenario we calculated the capacity of this transition with inlet control for the 96-inch pipe and determined it to be approximately 940 cfs.

The limiting situation on the Wildflower Diversion just west of I-25 was determined to be the 88" x 54" RCP at Modesto (old Alameda). Here the hydraulics are clearly inlet control which gives the culvert a capacity of 260 cfs before the minimum road elevation is reached. Currently this culvert is partially blocked with sediment. The I-25 structure has a capacity almost twice that of the downstream culvert at Modesto and the "proposed condition" flow rate of 368 cfs exceeds the culvert capacity by approximately 100 cfs.

E. North Camino Channel at Sunset Hills

The North Camino Arroyo was channelized by Taylor-Graham Development through the Sunset Hills subdivision in 1996-97 and turned over to AMAFCA for maintenance upon completion. It is concrete-lined with supplemental gabion spur dikes. It was designed by RTI for 2500 cfs. The capacity was recently verified by FEMA when a LOMR was approved in January of 1998. See Figure 5.2 for typical section details.

F. I-25 Crossing Structures

Concurrent with this study the New Mexico State Highway and Transportation Department is evaluating the I-25 crossing structures as part of an I-25 improvement program. Their consultant, Bohannan-Huston, Inc. has determined the crossing capacities for the specific structures to be as shown in Table 5.1.

Upon completion of a proposed 3 - 14' x 8' concrete box culvert at the North Camino Arroyo/I-25 crossing structure all of the major arroyo crossings at I-25 will have 100-year capacity, assuming avulsion control upstream. Without avulsion control upstream the El Camino crossing will have the capacity for less than half of the 100-year "worst case" flow rates discussed in Section 6.

TABLE 5.1

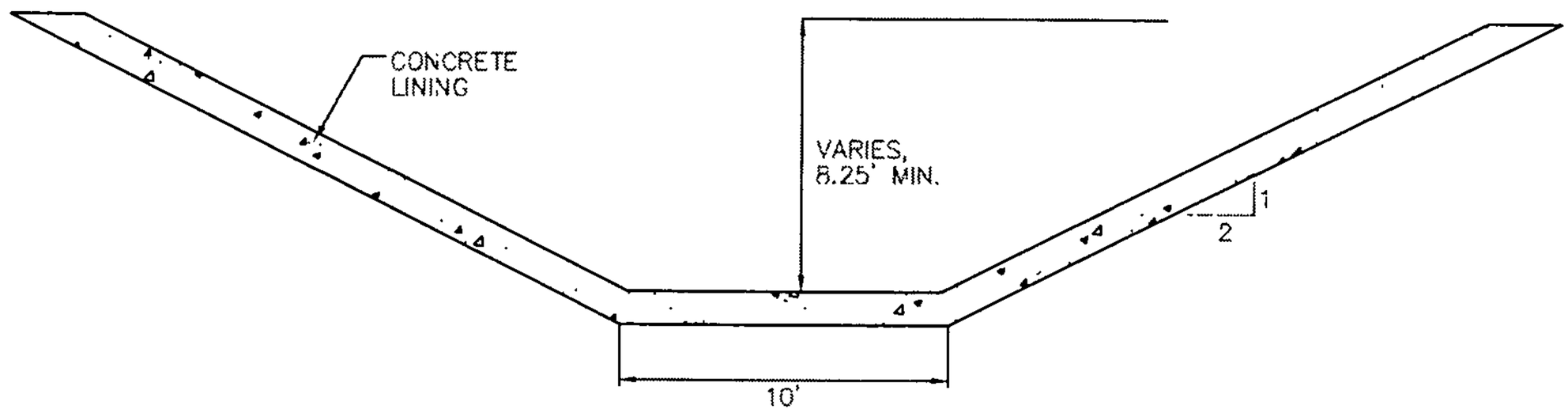
I-25 STRUCTURE CROSSING CAPACITIES

Structure Name	Size	Existing Flow Rate	Proposed** Flow Rate	Maximum Capacity	*Worst Case Flow Rates*
North Camino*	12-48" CMP	1846 cfs	2043 cfs	1020 cfs	*2399 cfs*
El Camino	12-48" CMP	908 cfs	1306 cfs	1536 cfs	*3438 cfs*
La Cueva	3-10'x10' CBC	2994 cfs	3170 cfs	4500 cfs	*3830 cfs*
South La Cueva	8-36" CMP	222 cfs	418cfs	552 cfs	-
Wildflower	5-36" CMP	94 cfs	368 cfs	410 cfs	-

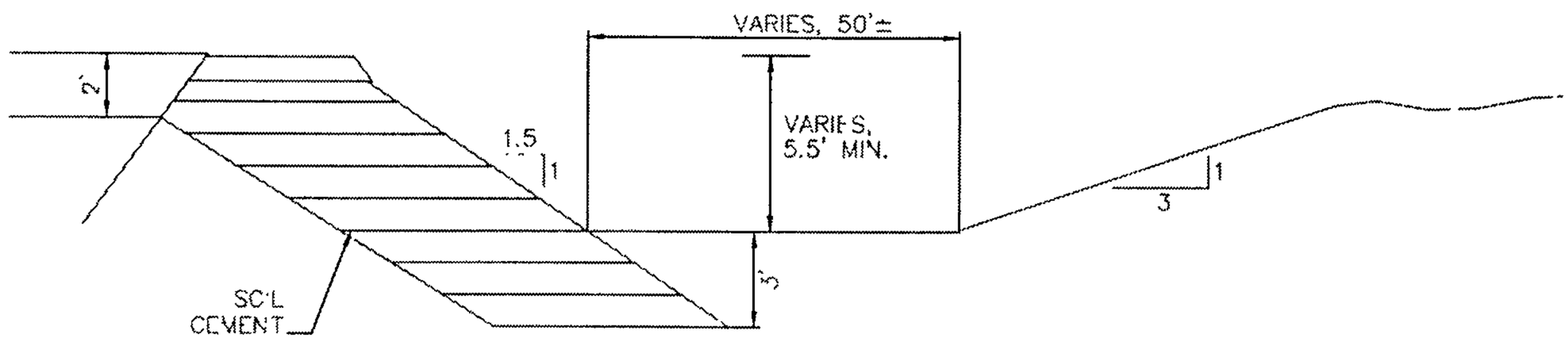
*NMSHTD proposes to build 3 - 12' x 8' CBC's as part of future I-25 project. New capacity will be 3500 cfs.

**Proposed future condition 100-year flow rates with Avulsion Control.

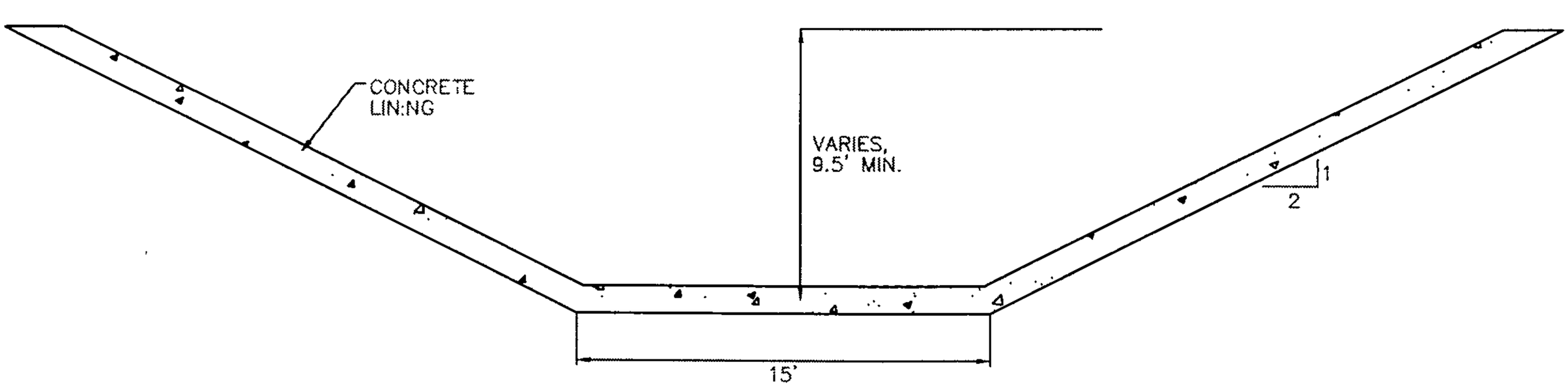
FIGURE 5.1 TYPICAL SECTION DETAIL



(A) NOR ESTE CHANNEL

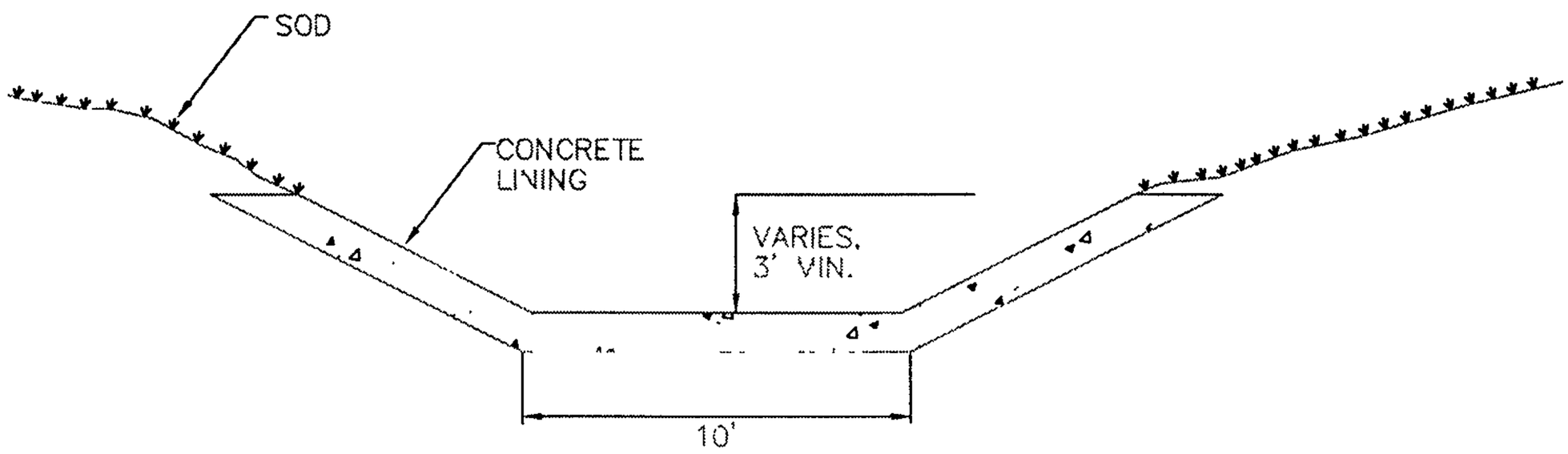


(B) EAGLE ROCK DIKE

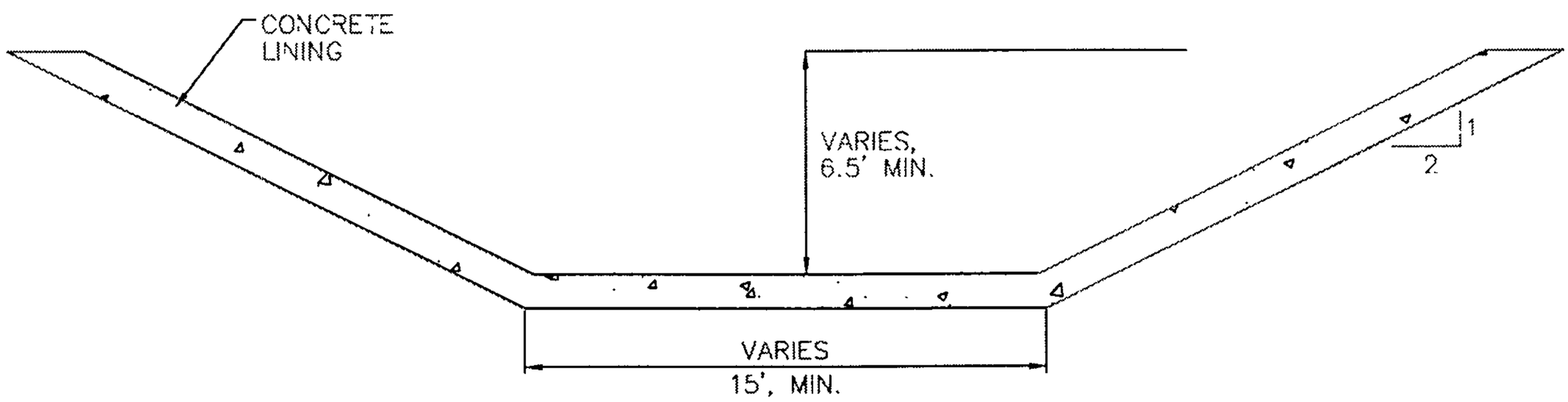


(C) NORTH LA CUEVA CHANNEL

FIGURE 5.2 TYPICAL SECTION DETAIL



(D) SOUTH LA CUEVA CHANNEL



(E) NORTH CAMINO CHANNEL
AT SUNSET HILLS

5.1

6. AVULSIONS

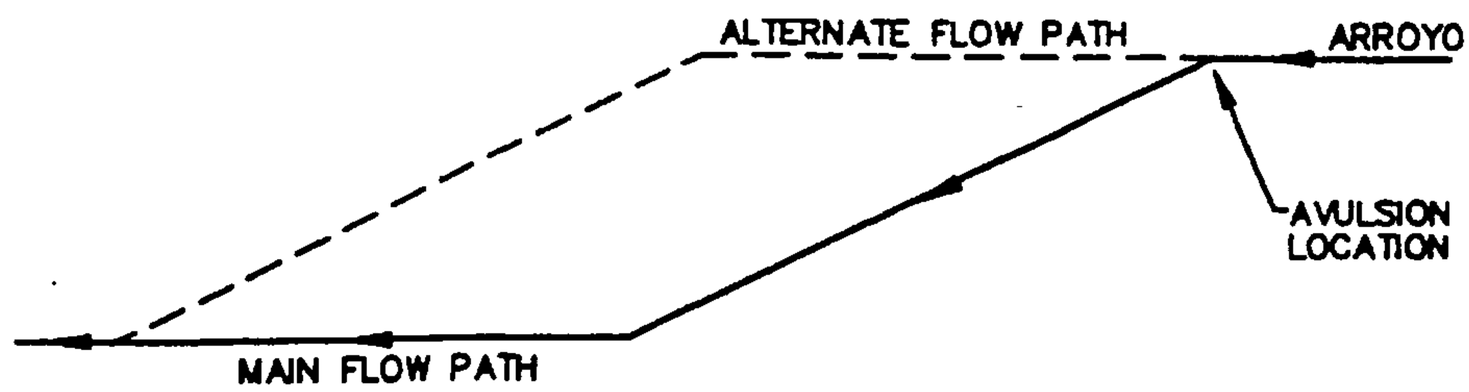
A. General

An arroyo avulsion can be defined as a location where the flow path of an arroyo may change course, either totally or partially. An avulsion may be the result of natural forces, such as wind or water or due to some human activity such as road building or site grading. An avulsion may occur over time as the historic arroyo bed is altered by natural sediment and erosion processes, or quickly, if caused by human activity.

Indications of natural avulsions are apparent in an examination of historic aerial photographs of the North Camino, El Camino and La Cueva arroyo drainage basins, especially in the area from the base of the Sandia Mountains through North Albuquerque Acres. Additional potential avulsion sites, some caused by human activity, can be identified through a careful examination of existing topographic maps. The eight most significant avulsion sites, as judged by their impact on this study, are identified in Figures 6.1 and 6.2 as sites Number 1 through Number 8. *(It should be noted that similar potential avulsions elsewhere in North Albuquerque Acres have been controlled or eliminated by manmade structures such as the AMAFCA dikes on Signal and Wilshire Avenues which prevent the La Cueva Arroyo from avulsing south to the North Domingo Baca Arroyo. Other avulsions have been controlled by arroyo crossing structures on Tramway Boulevard).* Certain avulsions have been recognized since 1983 (AMAFCA Board Resolutions 83-11 and 93-10 in the Appendix), but have not yet been controlled.

B. Consequences

Engineers, planners, local officials, and developers are faced with a high degree of uncertainty as to the peak flow rates at critical locations throughout the area. Because of the uncertainty, a worst case situation has to be evaluated and infrastructure designed accordingly. This could result in multiple parallel structures designed to convey the same storm water as shown below.



BOTH MAIN FLOW PATH AND ALTERNATE FLOW PATH DRAINAGE FACILITIES MUST BE DESIGNED FOR FULL FLOW IN THE ARROYO.

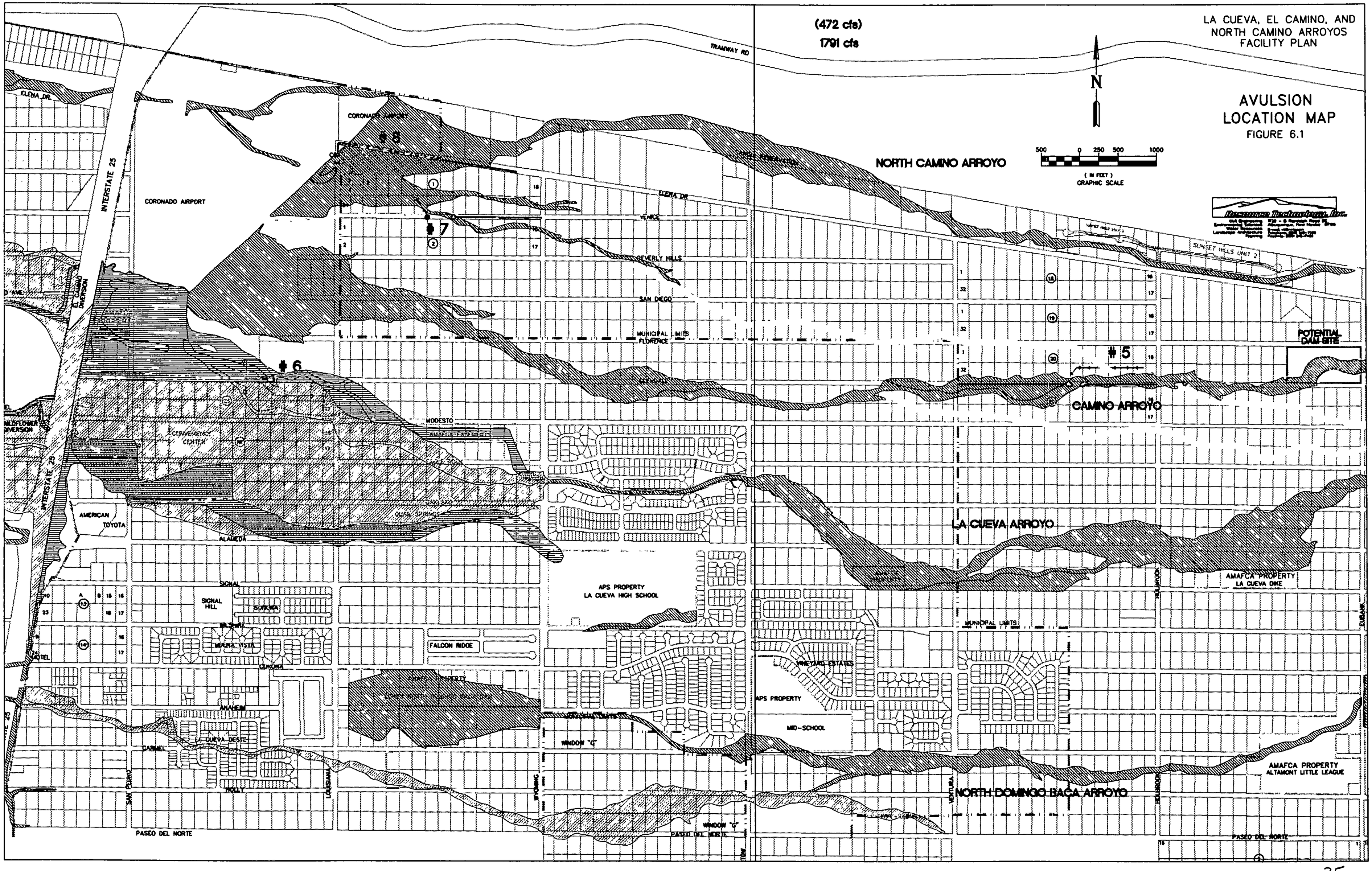
The effective FEMA Flood Insurance Study, dating from 1983, displays the main arroyo floodplains, including some avulsion locations on the La Cueva and North Domingo Baca

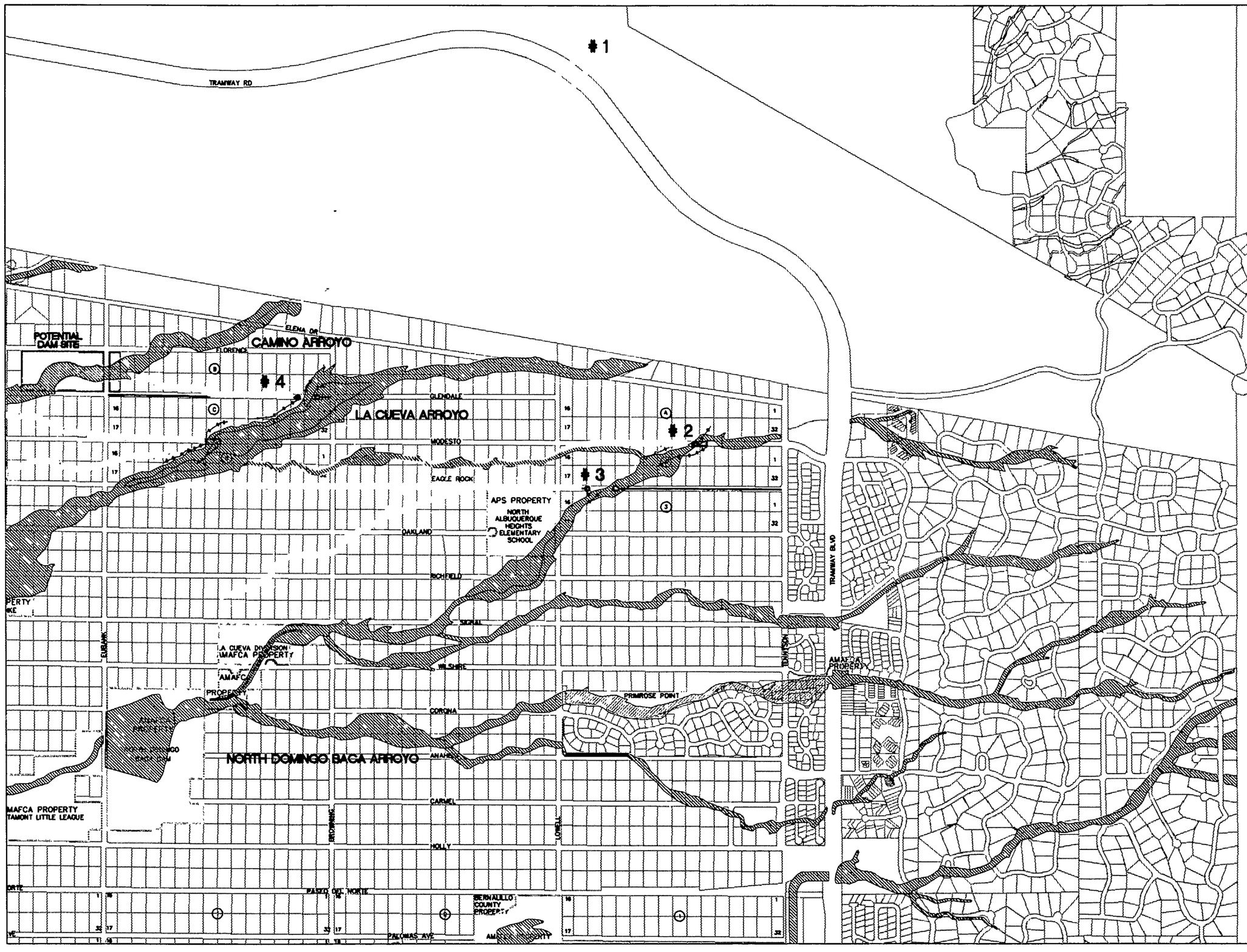
Arroyos. However, the 1983 FIS provided no guidance for avulsion evaluation. A 1993 re-study of the La Cueva and El Camino systems and several subsequent LOMR's have become entangled in questions concerning peak flow rates because of potential avulsions in distant upstream areas. Frequently a "worst case" scenario has had to be evaluated in order to obtain FEMA approval for floodplain revisions.

C. Avulsion Control

As one of the tasks of the **North Camino, El Camino and La Cueva Arroyo Drainage Management Plan**, RTI prepared a **Report on North Albuquerque Acres Arroyo Avulsion Problems, March 1997.** It contained conceptual plans for controlling the major avulsions along with cost estimates for the proposed work. Schematic drawings showing the various options evaluated are presented as Figures 6.3 and 6.4. In addition, a "no control" option was evaluated and a potential "worst case" hydrology for no avulsion control was developed. These "worst case" flow rates are reported in Table 6.1 through 6.3. *As can be seen from the Tables, Avulsions 1 and 4 have the most significant downstream impact.* The **March 1997 Avulsion Report** concluded that "the long term cost of 'no control' is estimated to be approximately twice that of implementing the control measures" based on the conceptual designs. The total cost of controlling the major avulsions at locations 1 through 8 was estimated to range from $4.8 to $6.1 million while the infrastructure cost of the 'no control' option was estimated at $10.3 million. Both estimates include right-of-way costs. A more recent evaluation by RTI for the City of Albuquerque **North Albuquerque Acres Master Drainage Plan (Revised Draft), March 1998**, concluded that the increased infrastructure costs within the municipal limits of not controlling Avulsions 1, 4, 5, 7, and 8 would come to approximately $2.48 million.

The **Avulsion Report** was presented to the AMAFCA Board and the avulsion control issue was discussed at several AMAFCA Board meetings during 1997 and early 1998. Bernalillo County and City of Albuquerque officials have also been briefed on the situation and several discussions on strategy for avulsion control have taken place. This has resulted in a more refined set of avulsion control options that will be discussed in detail in the Facilities Master Plan section of this Report.


LA CUEVA, EL CAMINO, AND
NORTH CAMINO ARROYOS
FACILITY PLAN
AVULSION
LOCATION MAP
FIGURE 6.1
N
500 0 250 500 1000
(IN FEET)
GRAPHIC SCALE
(472 cfs)
1791 cfs
TRAMWAY RD
ELENA DR.
CORONADO AIRPORT
INTERSTATE 25
EL CAMINO DIVERSION
WILDFLOWER DIVERSION
NORTH CAMINO ARROYO
#8
#7
#6
#5
ELENA DR
VENICE
BEVERLY HILLS
SAN DIEGO
MUNICIPAL LIMITS
FLORENCE
MODESTO
CAMINO ARROYO
POTENTIAL DAM SITE
SUNSET HILLS UNIT 2
AMERICAN TOYOTA
ALAMEDA
LA CUEVA ARROYO
APS PROPERTY
LA CUEVA HIGH SCHOOL
AMAFCA PROPERTY
LA CUEVA DIKE
SIGNAL
SIGNAL HILL
SONOMA
MONTE VISTA
CORONA
FALCON RIDGE
MUNICIPAL LIMITS
VINEYARD ESTATES
APS PROPERTY
MID-SCHOOL
ANAHEIM
LA CUEVA DESIG
CARMEL
HOLLY
WINDOW "G"
AMAFCA PROPERTY
ALTAMONT LITTLE LEAGUE
NORTH DOMINGO BACA ARROYO
PASEO DEL NORTE
SAN PEDRO
LOUISIANA
WYOMING
VENTURA
HOLLYBROOK
EUBANK



LEGEND

- MUNICIPAL LIMITS
- FEMA ACTION PENDING ON REMOVAL FROM FLOODPLAIN
- FEMA FLOODPLAIN
- REVISED FLOODPLAIN
- #2
- (472 cfs)
- 1791 cfs

N

500 0 250 500 1000

(IN FEET)
GRAPHIC SCALE

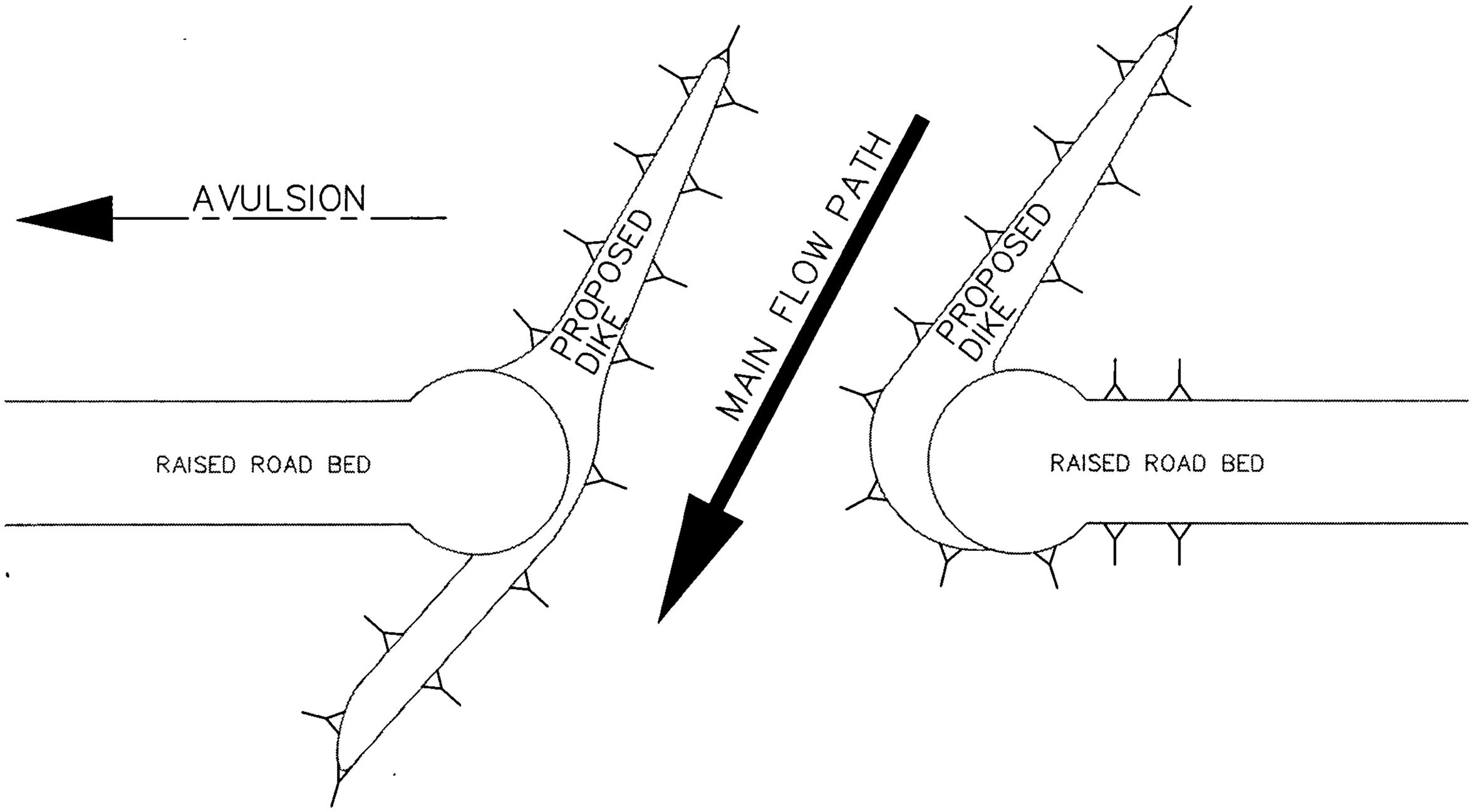
LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

AVULSION LOCATION MAP

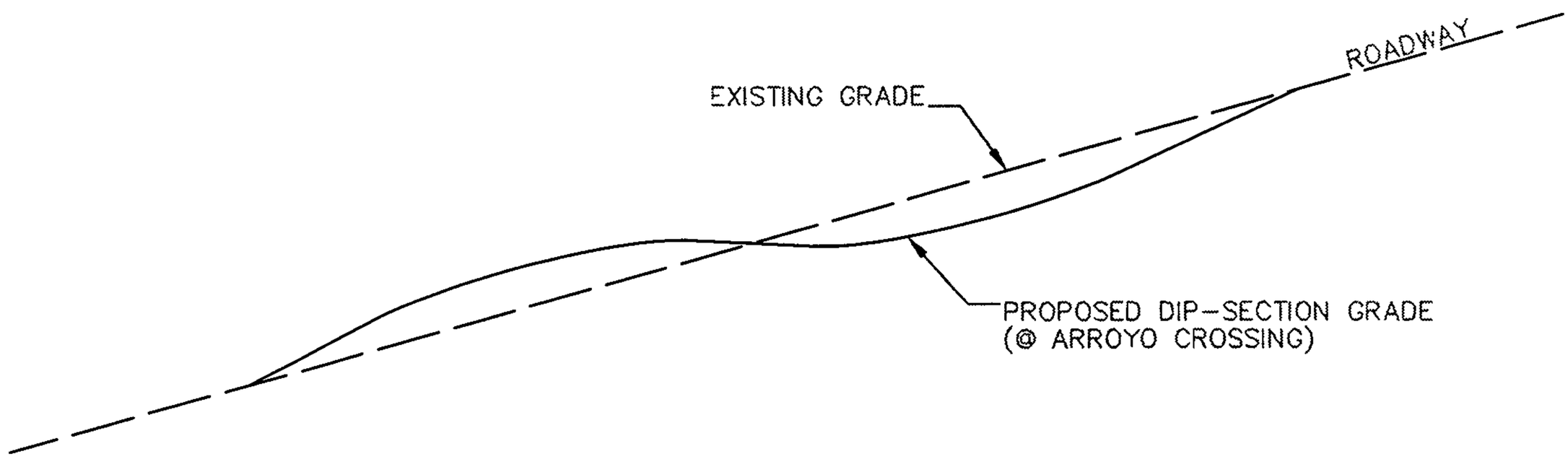
FIGURE 6.2

Resource Technology, Inc.

FIGURE 6.3 AVULSION CONTROL
SCHEMATIC DRAWINGS

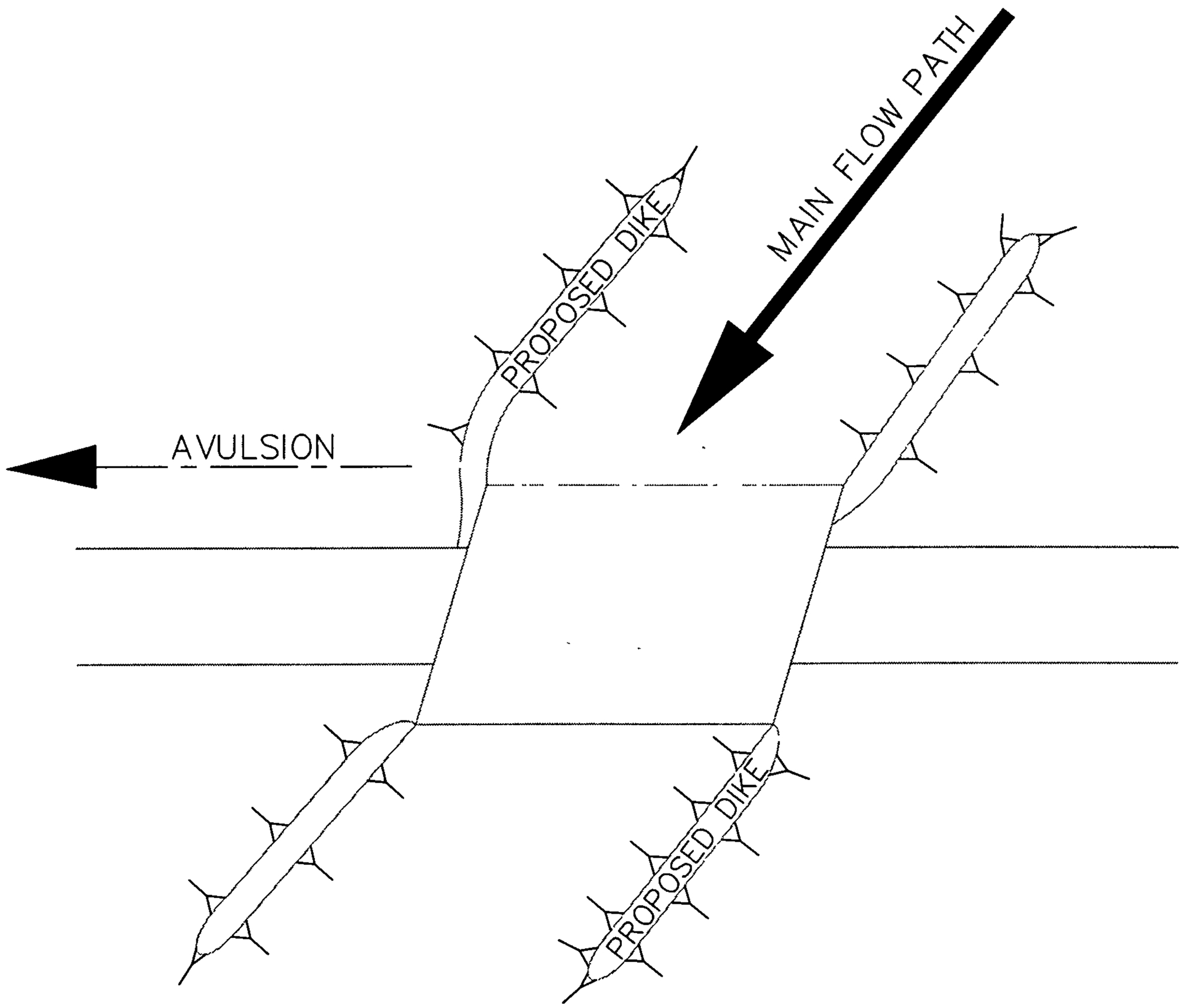


(A) CUL-DE-SAC / DIKE (PLAN VIEW)
AVULSION CONTROL



(B) DIP-SECTION (PROFILE VIEW)
AVULSION CONTROL

FIGURE 6.4 AVULSION CONTROL
SCHEMATIC DRAWINGS



(C) BRIDGE / DIKE (PLAN VIEW)
AVULSION CONTROL

TABLE 6.1

WORST CASE FLOW RATES NORTH CAMINO ARROYO

	Avulsion Control Q_{100} (cfs)	No Avulsion Control, Primary Avulsion Q_{100} (cfs)		No Avulsion Control, Secondary Avulsion Q_{100} (cfs)
I-25 (AP 313.99)				
Existing	1846	#5	2127	NA
Future	1982	#5	2399	NA
North Diversion Channel (AP 402.9)				
Existing	1863	#5	2167	NA
Future	2422	#5	2883	NA

NORTH CAMINO TRIBUTARY ARROYO

Barstow (AP 307.9)				
Existing	181	#5	660	NA
Future	232	#5	744	NA
Wyoming (AP310.9)				
Existing	199	#5	672	NA
Future	296	#5	766	NA
Coronado Airport (AP311.99)				
Existing	527	#5	875	NA
Future	820	#5	1290	NA

TABLE 6.2

WORST CASE FLOW RATES EL CAMINO ARROYO

	Avulsion Control Q_{100} (cfs)	No Avulsion Control, Primary Avulsion Q_{100} (cfs)	No Avulsion Control, Secondary Avulsion Q_{100} (cfs)
Tramway (AP 200.0)			
Existing	472	#1 1791	NA
Future	472	#1 1791	NA
Browning (AP 201.9)			
Existing	587	#1 1782	NA
Future	587	#1 1796	NA
Eubank (AP 202.19)			
Existing	619	#1 1790	NA
Future	646	#1 1806	NA
Holbrook (AP 202.29)			
Existing	638	#4 3161	#1 1803
Future	685	#4 3243	#1 1816
Ventura (AP 202.39)			
Existing	638	#4 3165	#1 1810
Future	710	#4 3247	#1 1826
Barstow (AP 203.39)			
Existing	726	#4 3213	#1 1841
Future	920	#4 3310	#1 1883
Wyoming (AP 204.9)			
Existing	790	#4 3243	#1 1852
Future	1130	#4 3380	#1 1926
I-25 (AP 205.9)			
Existing	908	#4 3286	#1 1876
Future	1335	#4 3438	#1 1975

TABLE 6.3 WORST CASE FLOW RATES LA CUEVA ARROYO					
	Avulsion Control Q_{100} (cfs)	No Avulsion Control, Primary Avulsion Q_{100} (cfs)		No Avulsion Control, Secondary Avulsion Q_{100} (cfs)	
Eubank (AP 109.99)					
Existing	2942	#2	3535	NA	
Future	3040	#2	3647	NA	
Ventura (AP 110.90)					
Existing	2939	#3	3545	#2	3537
Future	3048	#3	3709	#2	3693
Barstow (AP 111.99)					
Existing	2953	#3	3560	#2	3530
Future	3066	#3	3744	#2	3727
Wyoming (AP 112.90)					
Existing	2986	#3	3597	#2	3562
Future	3094	#3	3795	#2	3774
Louisiana (AP 113.90)					
Existing	2989	#3	3589	#2	3548
Future	3106	#3	3820	#2	3799
I-25 (AP 115.90)					
Existing	2994	#3	3587	#2	3546
Future	3108	#3	3830	#2	3809
North Diversion Channel					
Existing	3898	#3	4545	#2	4440
Future	4591	#3	5290	#2	5251

7. FACILITIES PLANNING

A. General

The three major arroyo systems are located in both unincorporated areas and within the municipal limits of the City of Albuquerque. Therefore, both the City and Bernalillo County have an interest in drainage issues within the project area. While AMAFCA's interest is primarily with the major arroyo systems, the City and County have additional concerns with development and transportation related issues that overlap with drainage considerations. For these reasons both the Bernalillo County Public Works Division and the City of Albuquerque Public Works Department Hydrology Division have initiated additional planning studies that include portions of the AMAFCA study area. See Figure 7.1. These studies and their current status are discussed below.

B. North Albuquerque Acres/Sandia Heights Drainage Plan, Phase I
Bernalillo County

The study area is the unincorporated area west of the U.S. Forest Service boundary to Eubank Boulevard and north of San Antonio Avenue to the Sandia Reservation. The area is traversed by the El Camino, La Cueva, North Domingo Baca, South Domingo Baca and Pino Arroyos. The goal of the study is to provide an integrated hydrological analysis, identify critical roadway drainage structures and alignments, develop arroyo management criteria and establish areas where development can take place utilizing the existing platting without the current requirement for a detailed site grading and drainage plan. The Drainage Plan was initiated in June of 1997 with RTI chosen as the engineering consultant. RTI to date has issued a Hydrology Report, identified erosion setbacks and energy grade line elevations for the major and minor arroyos, and made recommendations for drainage structure improvements in Sandia Heights.

Currently in progress is the effort to establish drainage structure requirements and road vertical alignments in the North Albuquerque Acres area to Eubank Boulevard. The original road grid established for North Albuquerque Acres ignored drainage patterns and over time some of these unimproved streets contributed to the avulsion problems in the area. One of the goals in this effort is to reestablish historic drainage patterns by providing adequate arroyo crossing structures and adjusting vertical alignments to prevent avulsions from occurring where natural flow lines cross road beds. In addition, public safety issues are being addressed by limiting flows crossing roads to traversable depths and velocities.

Avulsions 2, 3 and 4 are located within the County Phase I Drainage Plan area. Among the contributing factors to each of these potential avulsions is the roadway vertical alignment where the arroyo crosses the right-of-way and the conceptual designs put forward as possible solutions frequently depend on changes in road vertical alignments and/or arroyo crossing structures.

One major concern is that if these major avulsions are not controlled, there may well be additional drainage structure requirements at other locations in order to meet County road crossing criteria as well as the impact that they could have on private homeowners.

While the Phase I Drainage Master Plan is still in the draft phase, preliminary data from this effort and conceptual designs from the AMAFCA **Avulsion Report** have been combined to prepare preliminary plans for the control of Avulsions Number 2 and 3. These preliminary plans have been used to generate more detailed cost estimates to be used in placing these proposed projects on the November 1998 County Capital Improvements bond election ballot. These proposed structures, shown as Figures 7.2 and 7.3, are as follows:

- Avulsion Number 2 at Modesto, Construct bridge with training dike and 600-feet of downstream channel. Total estimated cost, including right-of-way: $463,400.00

- Avulsion Number 3 at Eagle Rock, Construct dip-section sufficient to pass 100-year flow while maintaining access to all currently developed lots. Total estimated cost: $111,200.00

C. Alameda Boulevard East Corridor Study
Bernalillo County

Bernalillo County is the lead agency on this transportation corridor study of the Alameda corridor by Avid Engineering from I-25 to Eubank and then south to Paseo del Norte. The La Cueva Arroyo meanders through the proposed corridor at several locations east of Barstow. Among the alternatives chosen for study, the apparent preferred option (B2) is to contain the arroyo on the north side of the future transportation facility in a "naturally appearing drainage way." This is currently shown as an earth lined channel with soil cement bank protection. Roadway drainage is to be conveyed in storm drains but discharge points are not identified.

D. North Albuquerque Acres Transportation Plan
Bernalillo County

Bernalillo County is the lead agency on this neighborhood transportation study being prepared by Avid Engineering with the assistance of the North Albuquerque Acres Community Association Transportation Committee. The goals of the study are to decrease traffic speed through residential areas, achieve an even distribution of traffic volume on east-west roads and eliminate or reduce cut-through traffic through the neighborhood. A variety of traffic calming devices are proposed as streets and roads are paved in the area. In some locations where major arroyos cross roads, cul-de sacs are allowed for as an alternative to bridges and/or dip-sections, although the consensus seemed to be that they should be avoided where possible. Proposed future cul-du-sac locations in the northern portion of this study area generally reflect those shown in the AMAFCA **Avulsion Report.**

E. North Albuquerque Acres Master Drainage Plan
City of Albuquerque

In conjunction with a Sector Development Plan for recently annexed lands north of Paseo del Norte, the City of Albuquerque Public Works Department Hydrology Division has initiated a drainage planning effort for the incorporated portion of NAA east of I-25 and north of Paseo del Norte, see Figure 7.1. Resource Technology, Inc., as the City's consultant, is currently preparing the Final Report for this project which identifies all major storm drainage infrastructure in their planning area. This consists of six channelization projects, thirty-three storm drain projects, and five avulsion control projects with a total estimated construction cost of $23.68 million.

The recommendations concerning the La Cueva, El Camino and North Camino Arroyos in the Draft Report include the following:

- **La Cueva Arroyo**: Continue the channelization of the arroyo from the Alameda facility proposed by Bernalillo County from its divergence from the Alameda alignment to the Nor Este Channel and from the outfall of the existing Nor Este Channel to I-25. This project would control Avulsion Number 6.
- **El Camino Arroyo**: Capture the El Camino arroyo where it enters the City limits in a closed conduit and convey to the future La Cueva Channel west of Wyoming Boulevard.
- **North Camino Arroyo**: Capture the North Camino and its major tributary where they cross into the municipal limits and convey their combined flows to the future I-25 crossing structure proposed by NMSHTD.

At each major north-south street crossing these lined arroyos will receive discharges from major storm drains. There are additional facilities which drain either to the Lower North Domingo Baca Dam or to other portions of the North Domingo Baca system.

All of the above drainage facilities were sized based on the assumption that major upstream avulsions were controlled. To accomplish avulsion control, four projects are proposed in unincorporated areas which would implement the recommendations for Avulsion Numbers 1, 4, 5, and 7 of the March 1997 **Avulsion Control Report.** The extra cost of constructing facilities within the municipal limits for the the "worst case" flow rates was estimated to be $2.5 million above the cost of facilities designed for the lower flow rates, including the cost of the avulsion control projects (also $2.5 million). This indicated a benefit/cost ratio of 2.0 within the City limits alone.

The adoption by the City of Albuquerque of the **NAA Master Drainage Plan** would place all of the above projects on the City's Capital Improvements Projects list. Funding for projects would come from future bond monies. In the interim, individual developers would be required to build portions of these systems adjacent to their proposed projects and others might be constructed in whole or in part as part of SAD projects. Because some of the downstream facilities may not yet be constructed inevitably some of the interim facilities will require

temporary retention ponds similar to those built on the North Domingo Baca system at Vineyard Estates, La Cueva Oesta and Buena Vista subdivision.

The following description of proposed facilities on the North Camino, El Camino and La Cueva Arroyos is taken from the Revised Draft of the City's **North Albuquerque Acres Master Drainage Plan** July, 1998.

"2. **La Cueva Arroyo**

a. An alignment study for the extension of Alameda from Barstow to Eubank as a major arterial is currently underway. The options have been narrowed down to one of three that are all within the current Signal/Alameda corridor. These alignments would all intersect the La Cueva Arroyo at Holbrook. From this point on the arroyo is assumed to be confined to an improved conveyance to the point of connection with the existing concrete lined reach from Barstow to Wyoming. The conceptual design for this improved conveyance indicates soil cement bank protection with an open bottom for a channel confined by the new Alameda facility on the south and the old Alameda alignment on the north.

b. For the reach of the La Cueva Arroyo west of Wyoming to I-25 where relatively high density commercial and residential development is proposed by the **Sector Development Plan**, beside the need to meet City drainage criteria for arterial crossings and previously proposed plans for a Louisiana Boulevard storm drain outfall to the arroyo near Glendale, there are also the problems associated with a potential avulsion (Number 6) at Glendale between San Pedro and Louisiana. In addition, the half mile of arroyo upstream from this reach is concrete lined as is the one and three quarter mile reach downstream to the North Diversion Channel. For these reasons this reach was also assumed to be lined (C-3) for future conditions. For very little additional expense this reach could be designed to convey a future diversion of the El Camino Arroyo to the La Cueva Channel at Wyoming. See the discussion of this proposal in Section 3.e.

c. As the arroyo is lined from Holbrook to I-25 it is proposed that connecting storm drains be constructed at all major north-south street crossings. These connecting systems at Ventura (SD-30), Barstow (SD-25), Louisiana (SD-5) and San Pedro (SD-3) have been incorporated into the future condition model.

d. The existing condition analysis indicated problems with the capacity of the existing storm drain facility at Alameda and Wyoming. There were two options, either replace the existing 36"-54" storm drain flowing north to the La Cueva Channel at Eagle Rock or to take part of the flow at this intersection south in a 42" pipe to the recently constructed storm drain at Wyoming and Wilshire that outfalls to the North Domingo Baca Arroyo.

Since the length of pipe was close to the same with either option the southern option (SD-21) was chosen for economic reasons. Under pressure the Wyoming storm drain to the North Domingo Baca Arroyo has the capacity for an additional 48 cfs.

e. From the existing condition hydrology model it was apparent that there was a problem with the Alameda/I-25 intersection. Between Signal and Modesto flows from the east are currently intercepted by the San Pedro storm drain, sized by NMSHTD for the existing condition 50-year storm, in the mid 1980's. The current existing condition 100-year hydrology model, which includes several upstream detention ponds, results in over 300 cfs reaching the Alameda/I-25 intersection. At the same time there are two NMSHTD I-25 crossing structures at Modesto and Eagle Rock just north of the intersection which have considerable excess capacity. There is also additional capacity available in the North Domingo Baca Arroyo crossing structure at Corona but there are conveyance problems west of I-25 where an unlined ditch crosses through the Coronado Mobile Home Village. Several options were examined but they either involved an expensive parallel storm drain in Alameda from I-25 to the North Diversion Channel or the acquisition of additional right-of-way, therefore, a parallel storm drain in San Pedro (SD-9), with a new storm drain connection (SD-10) to the Eagle Rock I-25 structure, is proposed. This proposed system will have the capacity to divert all the 100-year flows from east of San Pedro to one or the other of the two NMSHTD crossing structures. In conjunction with this system, an Alameda storm drain (SD-13) is proposed that extends to Louisiana. These combined systems reduces the 100-year flow to the Alameda/I-25 intersection to 150 cfs by increasing the combined flow to the structures to the north from 302 cfs to 781 cfs.

3. El Camino Arroyo

a. To date development in the El Camino basin east of I-25 has not yet proceeded as far as that for the La Cueva and North Domingo Baca basins and the area east of Wyoming to the municipal limits is being planned for low density residential development. These facts led to some consideration being given to leaving the arroyo in its natural state. With this scenario limited road crossing structures would be provided and north-south streets would have grade set so that they discharged roadway runoff into the arroyo with only limited use made of storm drains. Residential construction would be permitted on existing platted lots only if the building foot print was outside the designated Federal Emergency

Management Agency (FEMA) floodplain and the calculated erosion setback. Construction within the designated erosion setback area would only be permitted with appropriate arroyo stabilization measures (bank protection, berms, grade control structures, spur dikes, etc.) subject to City of Albuquerque approval.

The advantages of this approach are:

- Preservation of natural aesthetic qualities of the area.
- Low capital cost from a public agency point of view since most arroyo stabilization measures would be the responsibility of individual home owners.

The disadvantage of this approach are as follows:

- There is really no such thing as a stable "natural arroyo" within a developing area. Increased runoff, both the frequency of low flow events and the magnitude of peak flows, leads to either increased sediment transported to the arroyo or increased erosion from clean water. Either will result in arroyo disequilibrium leading to incision and/or widening of the "natural" channel.
- The FEMA floodplain would not be revised so it would not be practical to develop numerous lots.
- The erosion setback requirements will be on the order of 120-feet on either side of the arroyo flow line (double that if the upstream avulsions are not controlled) which will cause many other property owners considerable additional expense for bank stabilization measures to develop their lots, ranging from $10,000 to $30,000 per lot.
- The installation of disconnected and intermittent bank stabilization measures could result in threats to private home owners from long term arroyo migration out flanking their attempts at erosion control. Maintenance of these privately owned facilities even if they are in drainage easements could be problematic.
- Discharging road/street runoff into "natural" arroyos could lead to public liability for damage caused by erosion.
- Where the existing road/street right-of-way is within the FEMA floodplain either relocating the "natural" arroyo or the roadway may be required to comply with City ordinances. Either approach will require the acquisition of additional right-of-way and possibly obtaining a LOMR (Letter of Map Revision) from FEMA. The

additional expense will provide very little net benefit for the public other than maintaining 100-year access to some property owners.

- Bridge construction is complicated by the fact that either long span structures over the natural arroyo or extensive training dikes for shorter span structures are required. Additional footing and/or pier protection may be required.

In summary, leaving the arroyo in its natural state is not a viable option. It would result in higher development costs for most property owners due to extensive erosion setback restrictions and high long term public and private maintenance costs associated with arroyo evolution over time as the natural channel reacted to increased runoff.

b. An improved channel, constructed of concrete, soil cement or riprap, would reduce the extent of the floodplain and eliminate the need for erosions setbacks. It would also reduce the cost associated with providing transportation infrastructure to the area as well as long term maintenance costs. To minimize the amount of land required for channel construction the facility could be located adjacent to the existing 60-foot Glendale right-of-way, where possible. Since the minimum residential street right-of-way is 42-feet, the remaining 18-feet could be combined with an additional 60-feet of drainage easement to create a 78-foot channel easement. The chief disadvantages of an improved channel are

- High initial construction costs.
- Aesthetic considerations
- Given the limited potential for major subdivision development in the El Camino Basin if the La Cueva Sector Plan is adopted, either private property owners would be required to provide a 60-foot drainage easement or the City would be required to buy the 60-foot wide right-of-way adjacent to Glendale.

c. If Avulsions 1 and 4 are controlled and the 100-year flow rate can be kept at 1000 cfs or less a closed conduit (large diameter pipe) is a viable option. A facility that included a sediment basin at Ventura, where the arroyo would be captured, can be routed down the Glendale right-of-way and diverted to the proposed La Cueva Channel west of Wyoming Avenue. The pipe diameter would range from 84 " to 96" and require special consideration in the design and construction of other underground utilities. Additional storm drains west of Wyoming would collect local drainage and convey it to the existing El Camino crossing at I-25 where it would join the La Cueva Channel at the existing diversion.

d. A summary of the estimated cost of the channel and closed conduit options is as follows:

- Concrete Channel from Ventura to I-25 (without avulsion control): $7,298,468
- Concrete Channel from Ventura to I-25 (with avulsion control): $5,432,688
- Pipe from Ventura to La Cueva Channel, west of Wyoming: $3,014.415

Even with the $1.9 million for the cost of controlling Avulsions Number 1 and 4, discussed in more detail in the Avulsion Control section, the economic advantages of the pipe option are obvious. Additional data is contained in the Appendix.

e. Based on the above discussion it is proposed that the El Camino Arroyo be intercepted near Glendale and Ventura and routed down Glendale in a 84" storm drain (SD-6) to Wyoming. At Wyoming a 96" storm drain can convey the runoff to the future La Cueva Channel (C-3). The downstream I-25 box culvert and the existing channel facilities west of I-25 currently have the capacity for the anticipated 100-year flow rates.

f. At each of the existing major north-south streets local storm drain interceptors will bring runoff to the proposed pipe in Glendale. These connecting systems are at Ventura (SD-8) and Barstow (SD-7). West of the proposed diversion a major storm drain in Florence (SD-4) will pick up local drainage and take it to the existing I-25 El Camino crossing structure. A tributary of the El Camino will be conveyed by another storm drain (SD-1) from Louisiana and Venice to SD-4 near the current Coronado Airport runway and additional local drainage will be intercepted at San Pedro (SD-2).

4. North Camino Arroyo

a. The main branch of the North Camino Arroyo does not cross any currently dedicated streets within the municipal limits east of I-25. Since the owners of Coronado Airport, Sandia Pueblo, may choose to make alterations to the natural channel at some point in the future to reclaim land from floodplain, a lined channel (C-1) is proposed from I-25 to the City limits. A training dike is proposed to extend farther to the east to control Avulsion Number 8. While the existing I-25 crossing structure is

inadequate a replacement structure is currently under design (3 - 12' x 8' CBC with a 3500 cfs capacity).

b. A major tributary of the North Camino Arroyo crosses Louisiana Boulevard between Elena Drive and Beverly Hills. The 100-year flow in this tributary of 803 cfs could be conveyed to the main North Camino Channel in either a closed conduit (84" RCP) or an open channel. The open channel option is proposed and this is shown on Figure 5B as C-1a.

5. Avulsion Control Measures East of City Limits

a. Controlling upstream avulsions has a major impact on flow rates on most of the arroyos crossing the planning area. While it is possible to design facilities for the "worst case" flow rates the increased construction costs within the city limits alone would be several million dollars higher than the cost of controlling the avulsions. A comparison of the total cost for drainage facilities required for "worst case" flow rates with that for avulsion control resulted in a benefit to cost ratio of 2.0 for facilities within the City limits alone. There are additional savings resulting from avulsion control in the unincorporated areas. Therefore, conceptual plans for the control of avulsions having a major impact within the City are discussed below.

b. Avulsion Number 1, which results in the North Camino Arroyo joining the El Camino Arroyo east of Tramway Road, can be controlled by the construction of a dike on USFS and Sandia Pueblo land. A conceptual design for this project, developed for AMAFCA, is shown in the Appendix. AMAFCA has been engaged in discussions with Sandia Pueblo and the USFS concerning this matter but no action has been taken to date.

c. Avulsion Number 4, which consists of a series of problem areas between Eubank and Browning which could result in all or part of the La Cueva Arroyo joining the El Camino Arroyo, can be controlled in a number of ways. These potential solutions, ranging from a detention dam at Browning, full channelization of the La Cueva from Browning to Eubank, to a series of dip sections, bridges and dikes at critical points, have been developed for AMAFCA but not yet acted on by that agency. From the perspective of drainage control within the City Limits controlling this avulsion at the critical points would eliminate the problem and be the most economical. A conceptual layout of this solution is contained in the appendix.

From COA MDP Draft July, 1998

d. Avulsion Number 5, which could result in the El Camino Arroyo leaving its historic flow path and joining a tributary of the North Camino Arroyo, can be controlled by a ditch and dike along the north side of Glendale, just west of Holbrook, and a dip-section on Glendale. A conceptual layout is shown in the Appendix .

e. Avulsion Number 6 is addressed by channelizing the La Cueva Arroyo from Wyoming to I-25 as previously discussed in the La Cueva section.

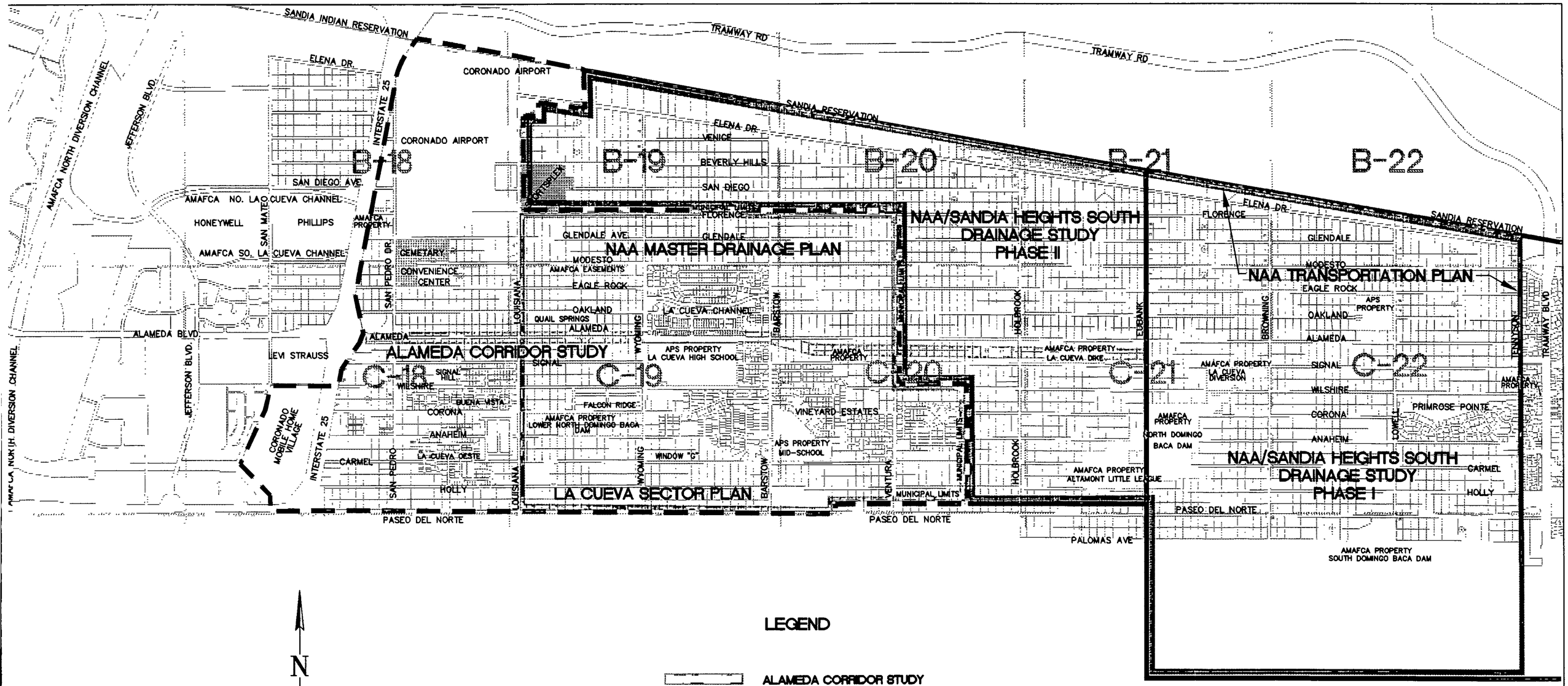
f. Avulsion Number 7, located on a tributary to the North Camino Arroyo which would result in this tributary joining the El Camino Arroyo at Coronado Airport, can be addressed by a paved dip section or bridge on Venice, east of Louisiana, and a relatively short section dike on the north side of Venice. A conceptual layout for this proposal is shown in the Appendix.

g. Avulsion Number 8, located east of Louisiana along Elena Drive which would result in the North Camino Arroyo joining the North Camino Tributary at Louisiana, can be controlled either by raising the grade on Elena or by the design of the inlet for the North Camino Channel, (C-1). Since there may be some future interest in redeveloping the southern portion of the Coronado Airport site prior to construction of the North Camino Channel, a conceptual Elena vertical alignment is shown in the Appendix.

h. Avulsions 2 and 3, both located on a tributary of the La Cueva Arroyo east of Lowell, have little impact within the city limits. However, both of these avulsions do cause considerable local concern and control measures have been proposed by Bernalillo County Public Works Division for inclusion on the 1998 CIP bond election."

Cost estimates for the proposed City projects are given below as Table 7.1 from the **NAA Master Drainage Plan**. (July 1998 Draft)

TABLE 7.1 (from COA MDP Table 9) COST ESTIMATES				
PROJECT NO.	PROJECT DESCRIPTION	CONSTRUCTION COST	R\W COST	TOTAL COST
SD-1	VENICE TO EL CAMINO CHANNEL	$303,833.00	$2,500.00	$306,333.00
SD-2	SAN PEDRO TO EL CAMINO CHANNEL	$130,648.00	$0.00	$130,648.00
SD-3	SAN PEDRO TO LA CUEVA CHANNEL	$200,273.00	$0.00	$200,273.00
SD-4	FLORENCE-LOUISIANA-SAN DIEGO	$1,084,378.00	$0.00	$1,084,378.00
SD-5	LOUISIANA TO LA CUEVA CHANNEL	$158,935.00	$0.00	$158,935.00
SD-6	GLENDALE-EL CAMINO ARROYO PIPE	$2,100,622.00	$80,000.00	$2,180,622.00
SD-7	BARSTOW TO EL CAMINO CHANNEL	$286,452.00	$0.00	$286,452.00
SD-8	VENTURA TO EL CAMINO CHANNEL	$173,826.00	$2,500.00	$176,326.00
SD-9	UP-GRADE SAN PEDRO STORM DRAIN	$692,295.00	$0.00	$692,295.00
SD-10	EAGLE ROCK/WILDFLOWER SD	$189,344.00	$15,000.00	$204,344.00
SD-11	EAGLE ROCK-SAN PEDRO SD	$390,431.00	$47,000.00	$437,431.00
SD-12	OAKLAND-SAN PEDRO SD	$189,407.00	$0.00	$189,407.00
SD-13	ALAMEDA-SAN PEDRO SD	$310,266.00	$0.00	$310,266.00
SD-14	CORONADO MH PARK SD	$621,028.00	$0.00	$621,028.00
SD-15	HOLLY-I-25 SD	$114,228.00	$45,000.00	$159,228.00
SD-16	CORONA-I-25 SD	$269,623.00	$0.00	$269,623.00
SD-17	LOUISIANA-CORONA SD	$97,083.00	$0.00	$97,083.00
SD-18	HOLLY TO AMAFCA POND SD	$69,064.00	$0.00	$69,064.00
SD-19	MURRELET SD EXTENSION	$236,678.00	$94,000.00	$330,678.00
SD-20	CORONA-WYOMING SD	$66,347.00	$0.00	$66,347.00
SD-21	ALAMEDA-WYOMING SD	$210,026.00	$0.00	$210,026.00
SD-22	BARTOW-NDB SD (SOUTH)	$129,633.00	$0.00	$129,633.00
SD-23	UP-GRADE BARSTOW SD (NORTH)	$279,985.00	$0.00	$279,985.00
SD-24	BARSTOW SD EXTENSION TO SIGNAL	$56,314.00	$0.00	$56,314.00
SD-25	BARSTOW TO LA CUEVA CHANNEL	$226,558.00	$0.00	$226,558.00
SD-26	MID SCHOOL POND	$53,881.00	$0.00	$53,881.00
SD-27	ALMADEN VALLEY TO LA CUEVA CHAN	$200,695.00	$23,500.00	$224,195.00
SD-28	OAKLAND TO LA CUEVA CHANNEL	$425,575.00	$5,000.00	$430,575.00
SD-29	VENTURA SD EXTENSION TO WILSHIRE	$89,138.00	$2,500.00	$91,638.00
SD-30	VENTURA TO LA CUEVA CHANNEL	$99,594.00	$2,500.00	$102,094.00
SD-31	WILSHIRE-VENTURA SD	$104,879.00	$2,500.00	$107,379.00
SD-32	VINYARD IV POND	$55,279.00	$0.00	$55,279.00
SD-33	HOLBROOK TO NDB CHANNEL	$543,081.00	$7,500.00	$550,581.00
C-1, AV-8	NORTH CAMINO CHANNEL & DIKE	$1,583,325.00	$150,000.00	$1,733,325.00
C-1A	NO. CAMINO TRIB CHANNEL	$392,097.00	$0.00	$392,097.00
C-3, AV-6	LA CUEVA CHANNEL (WYO TO I-25)	$3,775,168.00	$155,100.00	$3,930,268.00
C-4	LA CUEVA CHAN (VENTURA TO BARST)	$1,705,335.00	$155,100.00	$1,860,435.00
C-5	NDB CHANNEL AT LNDB DAM	$746,104.00	$0.00	$746,104.00
C-6	NDB CHANNEL(HOLBRK TO BARST)	$2,073,353.00	$0.00	$2,073,353.00
AV-1	JUAN TABO PICNIC RD DIKE	$447,287.00	$0.00	$447,287.00
AV-4	EUBANK-GLENDALE DIKES & BRDG	$740,039.00	$720,000.00	$1,460,039.00
AV-5	GLENDALE CHANNEL & ROAD	$256,666.00	$168,750.00	$425,416.00
AV-7	VENICE DIP-SECT AND DIKE	$78,479.00	$48,469.00	$126,948.00
TOTAL		**$21,957,252.00**	**$1,726,919.00**	**$23,684,171.00**
SD - Storm Drain Project; C - Channel Project; AV - Avulsion Control Project				



N

2000 0 2000

1000

GRAPHIC SCALE

LEGEND

- ALAMEDA CORRIDOR STUDY
- LA CUEVA SECTOR PLAN
- NAA MASTER DRAINAGE PLAN
- NAA/SANDIA HEIGHTS SOUTH DRAINAGE STUDY - PHASE I AND II
- NAA TRANSPORTATION PLAN

LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

FIGURE 7.1

PLANNING/STUDY BOUNDARIES

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 - B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@rmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400

pinbnd.dwg 5-22-98 2:14:00 pm EST

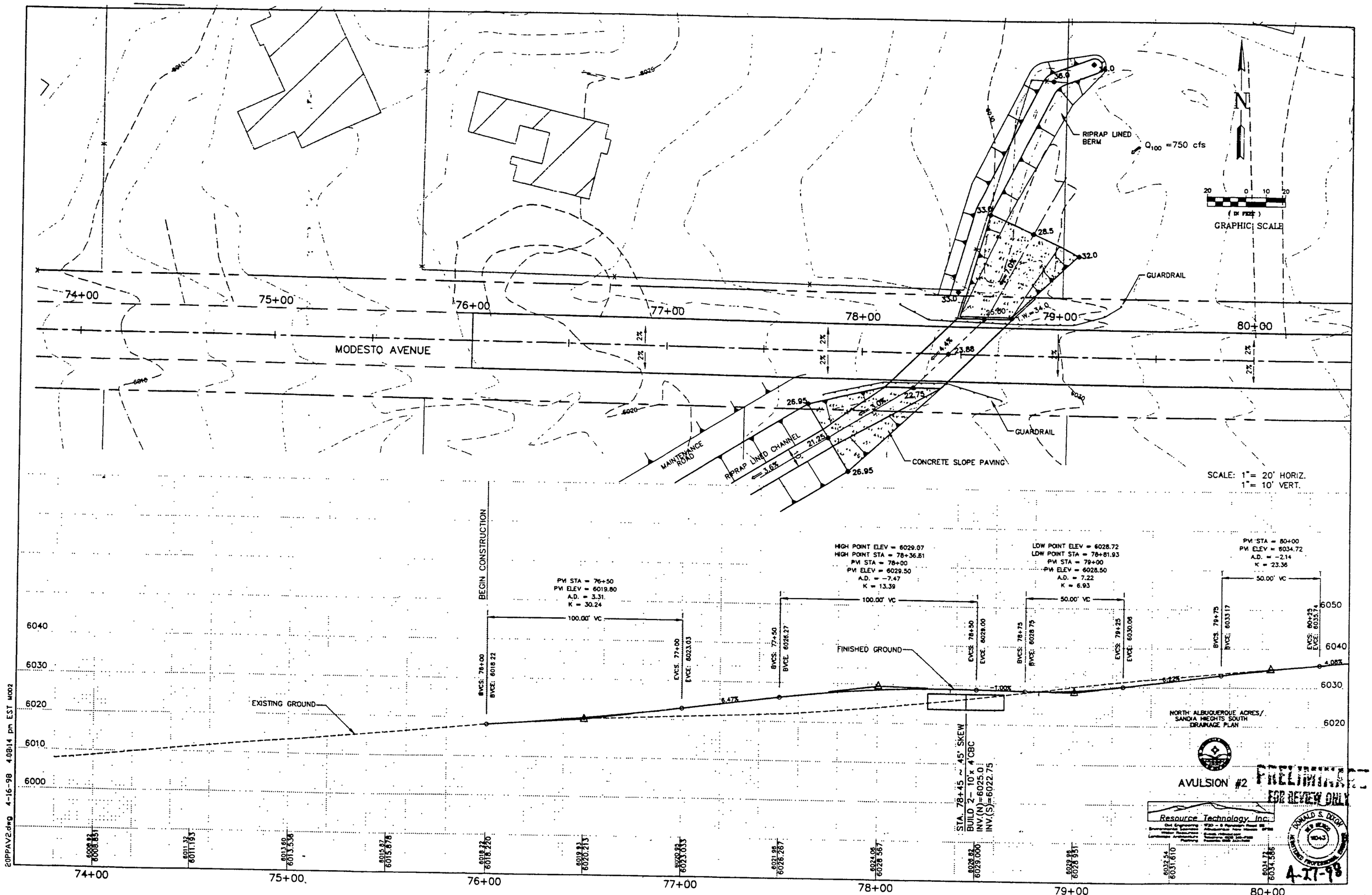
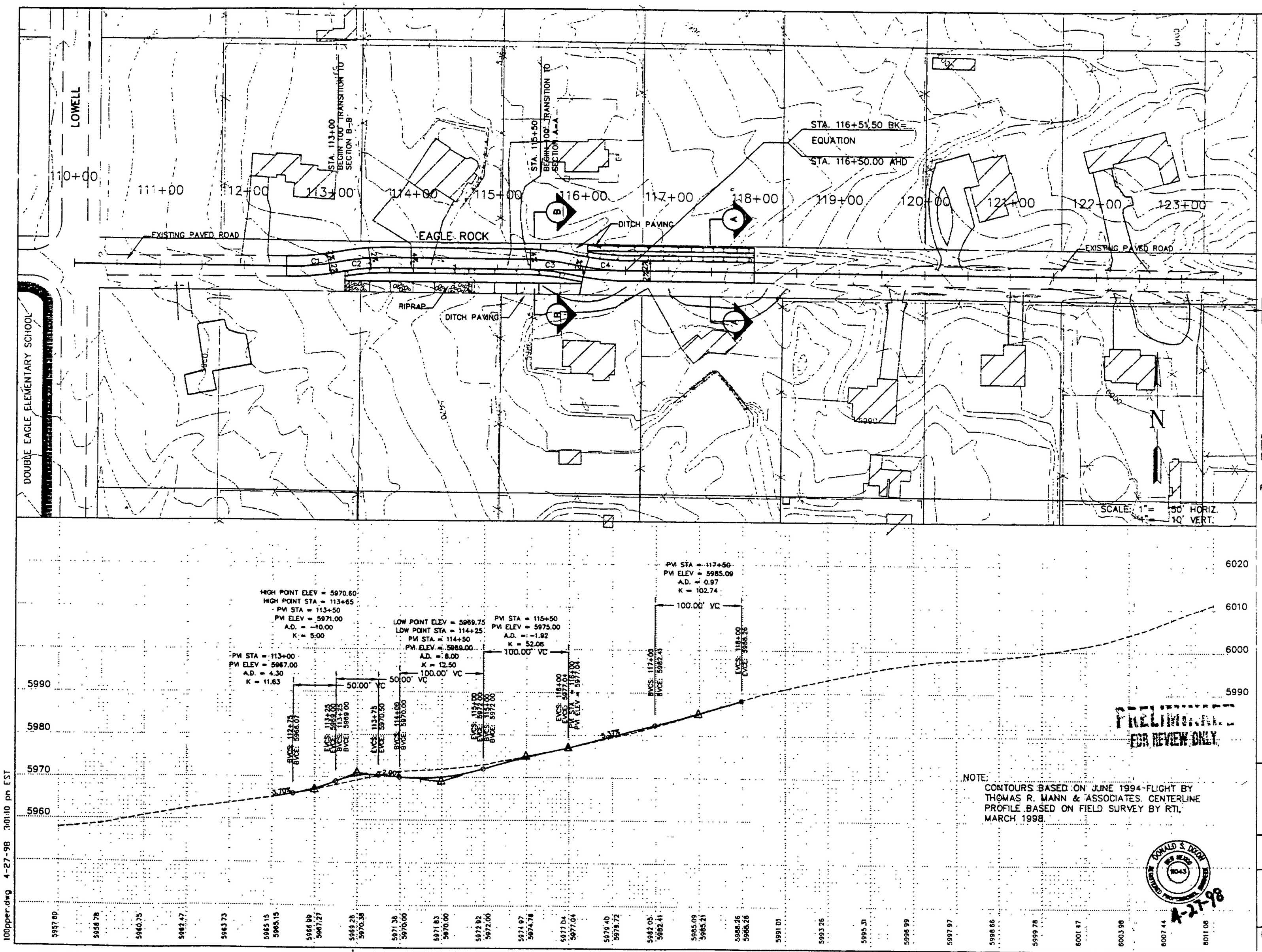
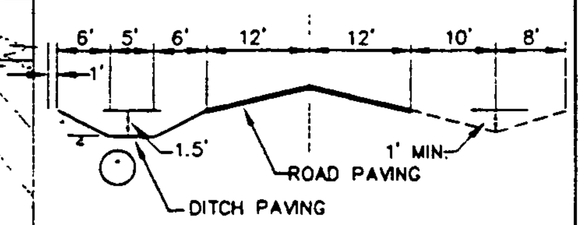

MODESTO AVENUE
74+00
75+00
76+00
77+00
78+00
79+00
80+00
RIPRAP LINED BERM
Q_{100} =750 cfs
GUARDRAIL
GRAPHIC SCALE
MAINTENANCE ROAD
RIPRAP LINED CHANNEL
CONCRETE SLOPE PAVING
SCALE: 1"= 20' HORIZ.
1"= 10' VERT.
BEGIN CONSTRUCTION
PVI STA = 76+50
PVI ELEV = 6019.80
A.D. = 3.31
K = 30.24
100.00' VC
HIGH POINT ELEV = 6029.07
HIGH POINT STA = 78+36.81
PVI STA = 78+00
PVI ELEV = 6029.50
A.D. = -7.47
K = 13.39
LOW POINT ELEV = 6028.72
LOW POINT STA = 78+81.93
PVI STA = 79+00
PVI ELEV = 6028.50
A.D. = 7.22
K = 6.93
50.00' VC
PVI STA = 80+00
PVI ELEV = 6034.72
A.D. = -2.14
K = 23.36
FINISHED GROUND
EXISTING GROUND
STA. 78+45 ~ 45° SKEW
BUILD 2- 10'x 4' CBC
INV.(N)=6025.0
INV.(S)=6022.75
NORTH ALBUQUERQUE ACRES/
SANDIA HEIGHTS SOUTH
DRAINAGE PLAN
AVULSION #2
PRELIMINARY
FOR REVIEW ONLY
Resource Technology, Inc.
DONALD S. DIXON
4-27-98
20PPAV2.dwg 4-16-98 4:08:14 pm EST MOD2

FIGURE 7.2

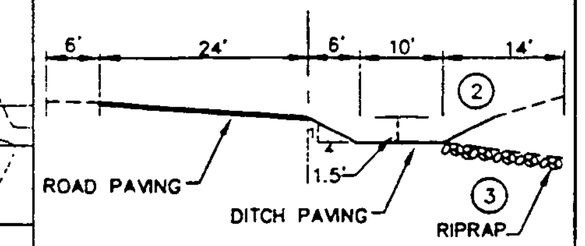


LEGEND

- CONTOURS
- EXISTING GROUND
- DESIGN PROFILE



SECTION A-A
NOT TO SCALE



SECTION B-B
NOT TO SCALE

① 16+25 – 18+00
② 14+75 – 16+00
③ 13+25 – 14+75

HORIZONTAL CURVE DATA

CURVE	PC	PT	LEN	DELTA	RAD.
C1	112+51.11	113+08.71	57.6	11° 00' 00"	300.0
C2	113+13.83	113+71.42	57.6	11° 00' 00"	300.0
C3	115+31.29	115+88.88	57.6	11° 00' 00"	300.0
C4	115+94.00	116+51.60	57.6	11° 00' 00"	300.0

50 0 25 50 100
(IN FEET)
GRAPHIC SCALE

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
7720 – B Renaissance Road SE
Albuquerque New Mexico 87108
Phone: (505) 265-7200
Facsimile: (505) 265-7400

BERNALILLO COUNTY
PUBLIC WORKS DIVISION

NORTH ALBUQUERQUE ACRES/
SANDIA HEIGHTS SOUTH
DRAINAGE PLAN

AVULSION #3

EAGLE ROCK DR. – STA. 112+50 TO 118+00

PROJECT NO.	ZONE MAP NO.	SHEET NO.
95-050	C-22	

FIGURE 7.3

8. ARROYO FACILITIES PLAN

A. General

The following discussion is confined to the major proposed facilities on each of the major arroyo systems that are part of the study area. As noted in the previous section the City and the County have both initiated studies addressing local drainage issues and storm drain systems that feed the major arroyos that have relied on the previously submitted AMAFCA **Hydrology Report: La Cueva, El Camino and North Camino Arroyos Drainage Management Plan, September 1996** for identification of basic hydrological data. In addition the City's Revised Draft for the **North Albuquerque Acres Master Drainage Plan, March 1998**, has identified recommendations for the treatment of the major arroyos within their study area complying with the City's Drainage Ordinance. Likewise, both the City and County studies have recognized the problems posed by the avulsions identified in the AMAFCA work and are in the process of adopting strategies to deal with those they feel have a major impact within their respective jurisdictions. The draft recommendations from the City and County studies have been incorporated into the recommendations for this report.

All proposed facilities for the La Cueva, El Camino and North Camino Arroyos along with the locations of the major avulsions are shown on Figures 8.7a through 8.7k at the end of this section. Also shown are the supplemental storm drainage facilities identified in the City's Revised Draft **NAA Master Drainage Plan**. Not shown are the miscellaneous street crossing facilities that are being proposed by the County's **Phase I North Albuquerque Acres Drainage Study**. Additional information on the various options considered is contained in the Technical Appendix.

B. North Camino Arroyo

The northern most arroyo in the study area is the North Camino. It originates in the Sandia Mountains and after passing through U.S. Forest Service and Sandia Pueblo land it enters North Albuquerque Acres near the intersection of Elena Drive and Eubank Boulevard. Soon thereafter it is intercepted by the North Camino Channel at Sunset Hills which conveys it to a point approximately one quarter mile west of Holbrook. The natural channel then conveys it another one half mile parallel to Elena Drive until it passes back into Sandia Pueblo land west of Ventura Boulevard. It re-enters the study area near Wyoming Boulevard and Elena Drive where the floodplain broadens as the flow path becomes less well defined and the Coronado Airport runway blocks its path to the crossing structure at I-25. Several major tributaries combine just east of Louisiana Boulevard which in turn join the main branch of the arroyo west of Louisiana.

There are three major avulsions of concern on the North Camino system. These are:

1. Avulsion Number 1, west of Tramway Road near the entrance to the Juan Tabo Picnic area. Here the main arroyo could avulse to the El Camino Arroyo system. *Avulsions 1 and 4 have the most significant down stream consequences.*

2. Avulsion Number 7, on Venice just east of Louisiana. The southern tributary of the North Camino could alter its historic path and end up in the El Camino system.
3. Avulsion Number 8, along Elena Drive just east of Louisiana. The main branch of the arroyo could potentially join the combined tributaries at Louisiana.

With the exception of the avulsion on U.S. Forest Service/Sandia Pueblo lands east of the study area the North Camino Arroyo poses few problems until it reaches the Coronado Airport vicinity. Therefore our discussion of options will be divided between control of Avulsion Number 1 and arroyo management from its re-entry into North Albuquerque Acres near Wyoming and Elena to the North Diversion Channel west of I-25.

Avulsion Number 1

Three general strategies have been examined for control of Avulsion Number 1. These are:

1. Constructing a training dike on Sandia Pueblo and U.S. Forest Service lands at the point where the avulsion could occur. This would consist of a 800-1000 foot long riprap armored revegetated earthen dike ranging from 3 to 8 feet in height. (See Figures 8.0a and 8.0b)
2. Construction of a detention dam on the Camino Arroyo downstream from the potential avulsion near Eubank and Glendale (the proposed Hamilton Dam site as proposed by Rice in 1974). This 90 acre-foot detention dam could be designed to limit avulsion flows from the North Camino to approximately current 100-year flow levels.
3. Construction of a diversion channel for both the North Camino and El Camino arroyos to the northwest along the Tramway Road alignment that would swing back to the south through Coronado Airport to the North Camino/I-25 crossing structure.

By inspection the first option, building a dike near the Juan Tabo Picnic Area access road, would be the most economical and satisfactory solution if permission from Sandia Pueblo and the U.S. Forest Service can be obtained. However, given the complexity of negotiations with two other separate entities it was decided to pursue other options as well in the event that problems developed with this strategy. Initially attention was focused on the dam option as an alternative to the dike. While the AMAFCA Board had approved the recommendation to build a dam at this general location in 1975, plans to go to design and construction with this facility were put on hold in the early 1980's. The new proposed dam would require approximately 12 acres of land for the site. As of this writing there is still vacant land available to accommodate this facility but this area continues to experience rapid development and this may not be the case for much longer. Preliminary cost estimates confirmed the initial estimate as to the most economical solution with the estimated cost of the dike at $450,000, assuming no additional cost for easements, and the dam at $1,900,000, including right-of-way. (See Figure 8.1)

At the direction of the AMAFCA Board a third option was examined. This consisted of a diversion of the El Camino and North Camino flows along Tramway Road. This diversion structure, sized for approximately 2200 cfs, would follow the Tramway right-of-way to the west through Sandia Tribal land for about four miles and then cut back to the south through the

Sandia owned Coronado Airport to the I-25 crossing structure and would require Pueblo of Sandia approval. The total length would be approximately 4.4 miles and the construction cost, *exclusive of right-of-way*, was estimated to be about $6,556,000.

Based on economic considerations the control of Avulsion Number 1 would be best accomplished by the construction of a training dike on Sandia/U.S. Forest Service lands near the Juan Tabo Access road. The **Draft North Albuquerque Acres Master Drainage Plan** has selected this option as a recommendation for adoption by the City of Albuquerque. As a contingency enough land near Glendale and Eubank should be acquired to keep the dam option open until negotiations with the Pueblo and the Forest Service are complete and financing for the project is in place. However, in the fall of 1998 the Sandia Tribal council formally rejected the dike proposal and attempts by some members of the Tribal government to get them to reconsider have been unsuccessful to date. For these reasons it is recommended that AMAFCA pursue the Hamilton Dam option.

North Camino Arroyo Facilities West of Wyoming

AMAFCA currently has under study the feasibility of channelizing the North Camino Arroyo west of I-25 to the North Diversion Channel as public/private cost share project. The New Mexico State Highway and Transportation Department currently has plans to upgrade the North Camino I-25 crossing structure. From I-25 to just east of Louisiana Boulevard the **COA Draft North Albuquerque Acres Master Drainage Plan** has recommended the channelization of the main branch of the North Camino when the Coronado Airport site is developed (project C-1) as well as the combined tributaries from Louisiana to the confluence with the main branch (project C-1a). Taken together these combined efforts of the City, NMSHTD and AMAFCA would provide for the management of the North Camino Arroyo except on Sandia Tribal lands and two remaining avulsions at locations 7 and 8.

If the recommendations of the City's **Draft North Albuquerque Acres Master Drainage Plan** are adopted Avulsion Number 7 would be controlled by a dip-section and dike on Venice Avenue just east of the current municipal limits by proposed project AV-7. Avulsion 8 would be controlled by the previously mentioned channelization of the North Camino east of Louisiana but in the interim it could be eliminated by the construction of a slightly raised portion of Elena Drive between Louisiana and Wyoming. This interim proposal has been incorporated in the recommendations by project AV-8. All of the above recommendations are incorporated into the Arroyo Facility Plan.

C. El Camino Arroyo

The El Camino Arroyo originates east of Tramway Road immediately south of the North Camino and follows a parallel path as far as I-25 where it has been diverted into the La Cueva Channel. East of Louisiana Boulevard to Tramway Road there are no channel improvements or crossing structures. At Louisiana Boulevard the Sportsplex recreation development has diverted the natural channel around their facilities and west of Louisiana the runway at Coronado Airport causes the floodplain to spread out due to backwater effects.

There are two major potential avulsions into the El Camino system and one major potential avulsion out of the El Camino system. Avulsion Number 1 from the North Camino system could potentially join the El Camino east of Tramway Road. The options to control this avulsion and recommendations were discussed above with the North Camino Arroyo Facilities Plan. Avulsion Number 4 from the La Cueva system, which could enter the El Camino system at any one of several different locations, will be discussed in more detail with the La Cueva Arroyo Facilities Plan. Therefore, only Avulsion Number 5 where the El Camino could leave its historic flow path and join the south tributary of the North Camino Arroyo will be discussed below.

El Camino Arroyo Facilities Plan

From its entry into the study area immediately west of Browning near Elena Drive to the municipal limits at Ventura the El Camino Arroyo poses few problems other than Avulsion Number 5. The options for the control of this avulsion all consist of a dike on the north side of Glendale immediately west of Holbrook combined with one of the following:

1. A dip-section on Glendale to bring the arroyo back to the south side of the road.
2. A bridge on Glendale to bring the arroyo back to the south side of the road.
3. Creating a cul-de-sac on either side of the arroyo on Glendale to eliminate the need for either a bridge or a dip-section and to provide some traffic calming benefits per the Bernalillo County **North Albuquerque Acres Transportation Plan**.
4. Construction of a riprap lined channel on the north side of Glendale with a dip-section similar to 1 above but with a local access road to serve the lots cut-off by the channel.

Options 1-3 above would all solve the problem with the avulsion but could result in the necessity to acquire up to six full lots for the north side dike since there would be little left of these lots that was not either part of the dike or in floodplain and access could be a problem. The fourth option would address these problems by providing a channel adjacent to Glendale with a private access road on the north side of the channel to serve the remainder of each lot. This would reduce right-of-way costs substantially. Option 4 was the recommended option (project AV-5) in the City's **Draft North Albuquerque Acres Master Drainage Plan.** Either at a later date or as part of a joint project with the County the dip-section could be replaced with a bridge if depth and/or velocity exceed County drainage criteria. The total cost of this project with dip-section was estimated to be $425,400 including right-of-way. See Figures 8.2a and 8.2b.

Other than the control of Avulsion Number 5 and crossing structures at major streets and roads the El Camino can be left in its natural state to the municipal limits subject only to the designs of private land owners who may desire to build within the floodplain or erosion setback areas.

After the arroyo enters the city limits at Ventura, as discussed in Section 7.E, it will be captured and conveyed in a pipe to a diversion to the La Cueva Channel west of Wyoming Boulevard. This proposal has the obvious merit of eliminating over one mile of parallel channel which will result in savings not only in construction costs but long term maintenance as well. There is sufficient capacity in the existing facilities from I-25 to the North Diversion Channel for the increased flow. A substantial amount of local drainage (approximately 800cfs) originating west of Wyoming will continue to discharge to the existing El Camino diversion at I-25. However, this project depends upon the successful implementation of avulsion control measures for avulsions Number 1 and 4.

D. La Cueva Arroyo

The La Cueva Arroyo is by far the largest of the three major arroyos in the study area. Like the other two arroyo systems it originates in the Sandia Mountains and traverses North Albuquerque Acres prior to crossing I-25 and thence to the North Diversion Channel. This system formerly consisted of the main branch that enters the study area just east of Lowell and Elena and two major tributaries to the south that have recently been diverted by AMAFCA's La Cueva Diversion Channel to the North Domingo Baca Dam at Browning. The two tributaries up to the point of the diversion remained in the study area. The main branch is partially channelized with concrete lined reaches from Barstow to Wyoming and from I-25 to the North Diversion Channel. Other improvements consist of the Eagle Rock diversion dike west of Wyoming that contain the arroyo in one of several former flow paths and raised portions of Signal Avenue that serve as a dike to prevent avulsions from the La Cueva system south to the North Domingo Baca system. See Figure 1.

There are four major avulsions on the La Cueva system. These are:

1. Avulsion Number 2, at Modesto west of Tennyson. Here the northern most tributary can avulse from its primary flow path to flow down or along Modesto to the main branch nearly a mile to the west.
2. Avulsion Number 3, at Eagle Rock east of Lowell. At this location the same northern tributary can avulse down Eagle Rock, passing by Double Eagle Elementary School to join the main branch at one or more locations farther to the west.
3. Avulsion Number 4, on Glendale and Modesto east of Eubank. Avulsion Number 4 is actually a series of potential avulsions where all or part of the main branch can leave its historic flow paths and join the El Camino system a mile or more to the west. This avulsion, which along with Avulsion Number 1 has the most significant impact in the region, would more than double the flow rate west of Holbrook in the El Camino system.
4. Avulsion Number 6, on Glendale between Louisiana and San Pedro. This avulsion has resulted in the flooding of the I-25 north bound frontage road and adjacent areas, most

recently in June of 1996. City of Albuquerque forces have recently constructed a dip-section on Glendale that provides for an interim "fix" to control low flows.

La Cueva Arroyo Facilities Plan

Avulsion Number 4

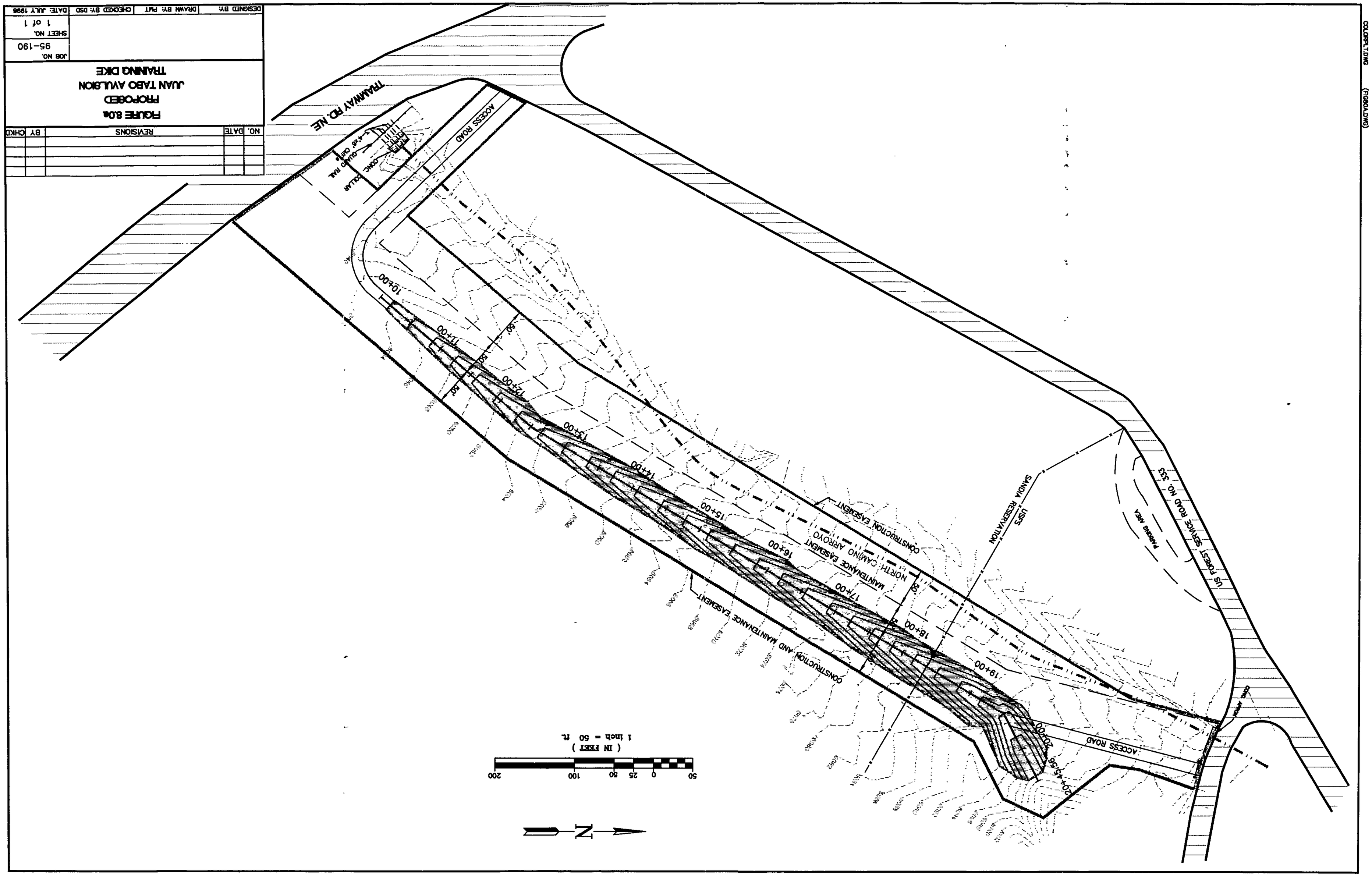
Because of the downstream impacts control of Avulsion Number 4 is seen as one of the major goals of the La Cueva Arroyo management effort. Among the options examined during the course of this study are the following:

1. Training dikes and a dip-section at Glendale in conjunction with training dikes and a bridge at Modesto, both improvements between Browning and Eubank. See Figure 8.3.
2. Training dikes and a cul-de-sac on Glendale either on both sides of Browning or providing a bridge on one side and a cul-du-sac on the other. This would also be in conjunction with training dikes and a bridge on Modesto as in 1 above. See Figure 8.4.
3. A 135 Ac-ft detention dam at Browning and Glendale that would route flows to the southern most flow line and reduce 100-year flows to the capacity of the natural channel. This option would also require re-routing a portion of Browning and possibly Glendale near the proposed dam. See Figure 8.5.
4. Channelizing the La Cueva Arroyo from Browning to west of Eubank where it would join the future improved conveyance for the La Cueva as part of the Alameda project. The west end of Glendale at Browning and the west end of Eagle Rock at Eubank would also be re-routed to eliminate additional crossing structures. See Figure 8.6.

Options 1 and 2 are very similar, the primary difference being the substitution with option 2 of a cul-du-sac for a dip-section. Given the high 100-year flow rates on the order of 3000 cfs at this location dip-sections could pose a major safety hazard. Therefore, Option 2 was given more thorough evaluation and was proposed as a quick and efficient solution in the **Avulsion Report**. The cost of this project, including right-of-way, was estimated to be $1,460,039. However, an additional $2,020,000 would be needed for additional drainage structures at road crossings between Browning and the proposed Alameda facility west of Eubank for a combined total of $3,480,039. The primary disadvantage of this approach is that while it provides adequate control of the avulsions it does not remove any other land from floodplain. Its only function would be to prevent the La Cueva Arroyo from avulsing to the El Camino.

Option 3 was evaluated at the request of the AMAFCA Board. A detention dam at Browning would certainly eliminate the need for additional downstream avulsion control measures on the La Cueva by lowering the maximum flow to a point well below the capacity of the natural channel. A 133-Ac-ft facility would have a 100-year discharge of 685 cfs. However, there would still be enough contributing area to the arroyo system that when combined with the dam outflow would require significant downstream drainage structures. For example the estimated 100-year flow in the main branch of the La Cueva Arroyo at Eubank after the construction of a dam would be 737 cfs and 975 cfs where it enters the municipal limits at Ventura.

62



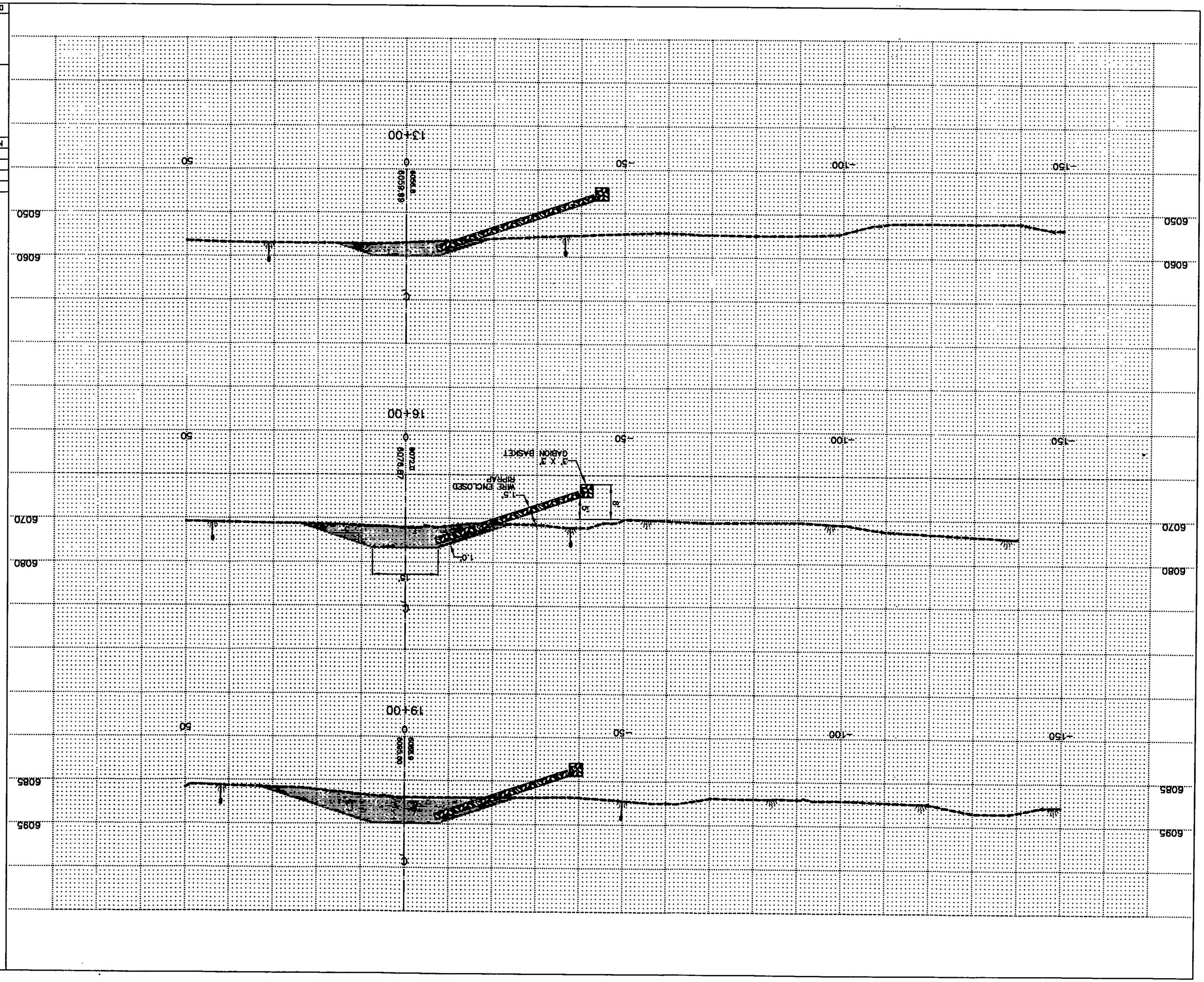
NO.	DATE	REVISIONS	BY	CHKD

FIGURE 8.0a
PROPOSED
JUAN TABO AVULSION
TRAINING DIKE

JOB NO. 95-190
SHEET NO. 1 of 1

DESIGNED BY: | DRAWN BY: PMT | CHECKED BY: DSD | DATE: JULY 1996

COLORPLT.DWG (FIGRDA.DWG)



(IN FEET)
1 inch = 10 ft.

10 0 5 10 20

SCALE: 1"= 10' HORIZ.
1"= 10' VERT.

NO.	DATE	REVISIONS	BY	CHKD

FIGURE 8.0b
PROPOSED
JUAN TABO AVULSION
TRAINING DIKE CROSS SECTIONS

JOB NO.
95-190

SHEET NO.
1 of 1

DESIGNED BY: | DRAWN BY: PMT | CHECKED BY: DSD | DATE: AUG 1996

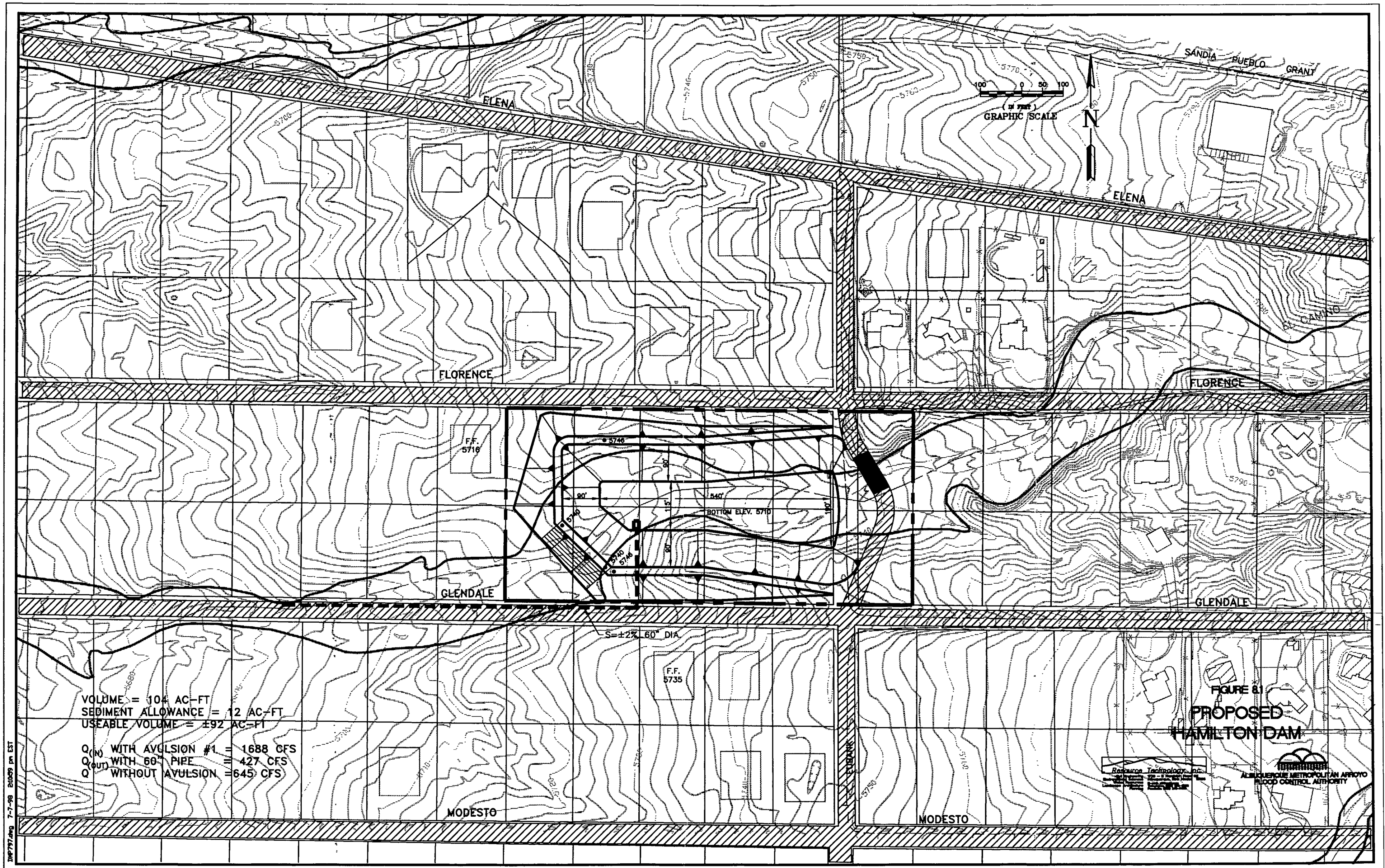


FIGURE 8.1
PROPOSED
HAMILTON DAM

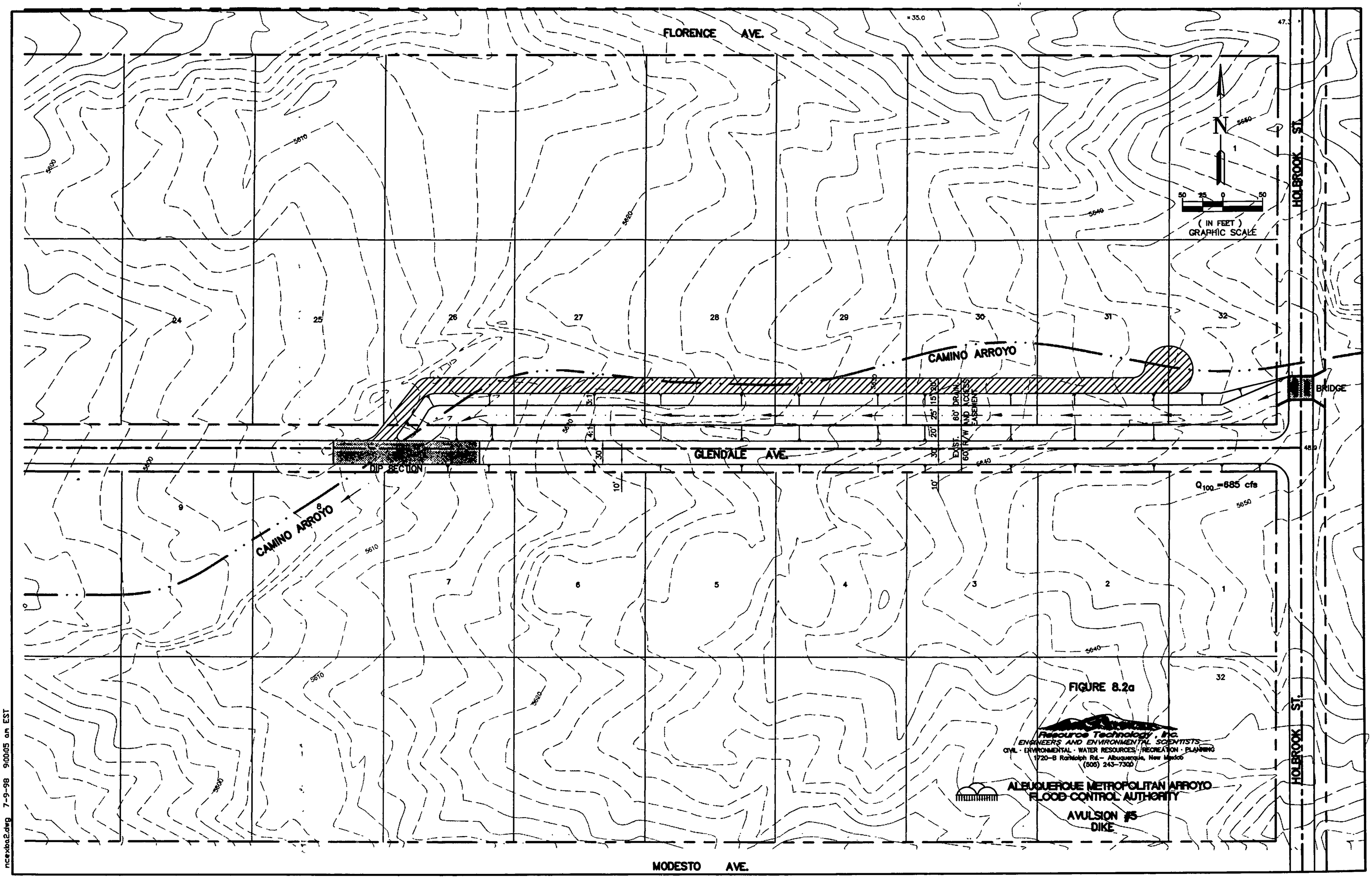
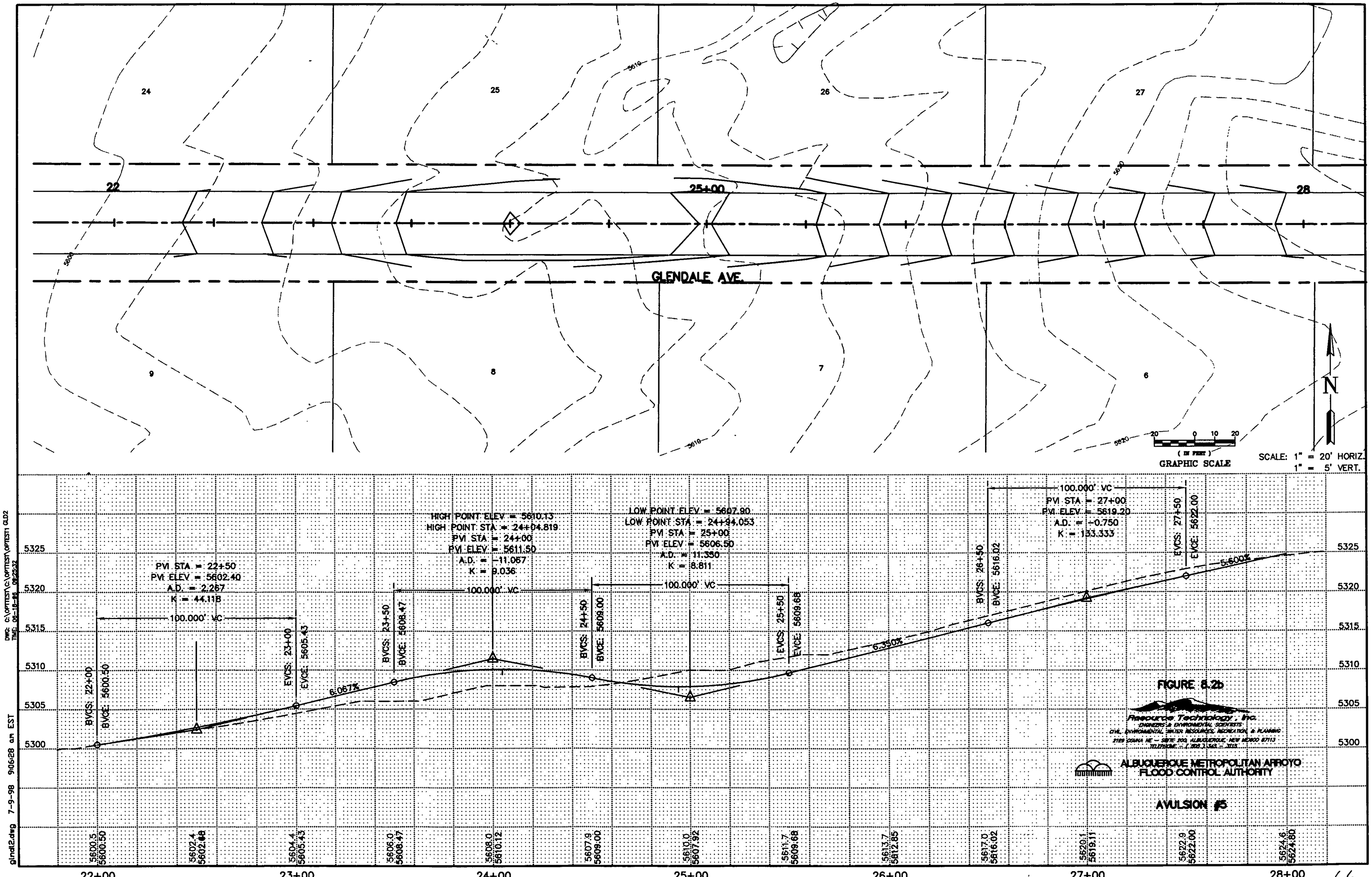

FLORENCE AVE.
HOLBROOK ST.
N
(IN FEET)
GRAPHIC SCALE
CAMINO ARROYO
BRIDGE
GLENDALE AVE.
DIP SECTION
60' DRAIN. AND ACCESS EASEMENT
EXIST. 60' R/W
Q_{100} =685 cfs
CAMINO ARROYO
MODESTO AVE.
Resource Technology, Inc.
ENGINEERS AND ENVIRONMENTAL SCIENTISTS
CIVIL · ENVIRONMENTAL · WATER RESOURCES · RECREATION · PLANNING
1720-B Randolph Rd.– Albuquerque, New Mexico
(505) 243-7300
ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY
AVULSION #5
DIKE
nicexba2.dwg 7-9-98 9:00:05 am EST

FIGURE 8.2a


24
25
26
27
22
25+00
28
GLENDALE AVE.
9
8
7
6
5610
5600
5620
N
20 0 10 20
(IN FEET)
GRAPHIC SCALE
SCALE: 1" = 20' HORIZ.
1" = 5' VERT.
HIGH POINT ELEV = 5610.13
HIGH POINT STA = 24+04.819
PVI STA = 24+00
PVI ELEV = 5611.50
A.D. = -11.067
K = 9.036
LOW POINT ELEV = 5607.90
LOW POINT STA = 24+94.053
PVI STA = 25+00
PVI ELEV = 5606.50
A.D. = 11.350
K = 8.811
PVI STA = 22+50
PVI ELEV = 5602.40
A.D. = 2.267
K = 44.118
100.000' VC
PVI STA = 27+00
PVI ELEV = 5619.20
A.D. = -0.750
K = 133.333
BVCS: 22+00
BVCE: 5600.50
EVCS: 23+00
EVCE: 5605.43
BVCS: 23+50
BVCE: 5608.47
BVCS: 24+50
BVCE: 5609.00
EVCS: 25+50
EVCE: 5609.68
BVCS: 26+50
BVCE: 5616.02
EVCS: 27+50
EVCE: 5622.00
6.067%
6.350%
5.600%
5325
5320
5315
5310
5305
5300
5600.5 5600.50
5602.4 5602.40
5604.4 5605.43
5606.0 5608.47
5608.0 5610.12
5607.9 5609.00
5610.0 5607.92
5611.7 5609.68
5613.7 5612.85
5617.0 5616.02
5620.1 5619.11
5622.9 5622.00
5624.6 5624.80
22+00
23+00
24+00
25+00
26+00
27+00
28+00
FIGURE 8.2b
Resource Technology, Inc.
ENGINEERS & ENVIRONMENTAL SCIENTISTS
CIVIL, ENVIRONMENTAL, WATER RESOURCES, RECREATION, & PLANNING
2109 OSUNA NE – SUITE 200, ALBUQUERQUE, NEW MEXICO 87113
TELEPHONE: (505) 345-9115
ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY
AVULSION #5
DWG: C:\OPTEST\C:\OPTEST\OPTEST1 GLD2
TIME: 06-18-98 09:25:32
glndl2.dwg 7-9-98 906:28 am EST

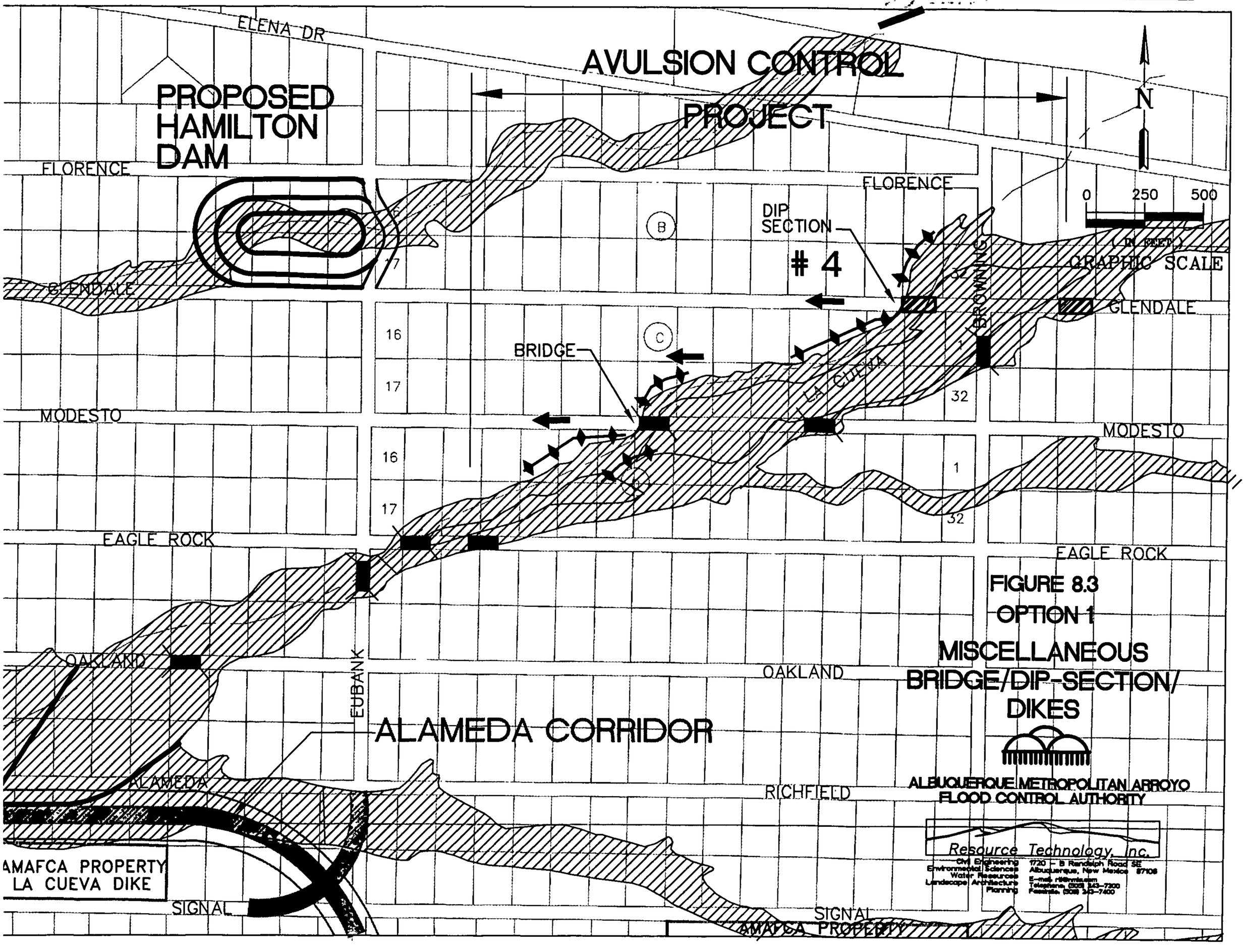


FIGURE 8.3
OPTION 1
MISCELLANEOUS
BRIDGE/DIP-SECTION/
DIKES

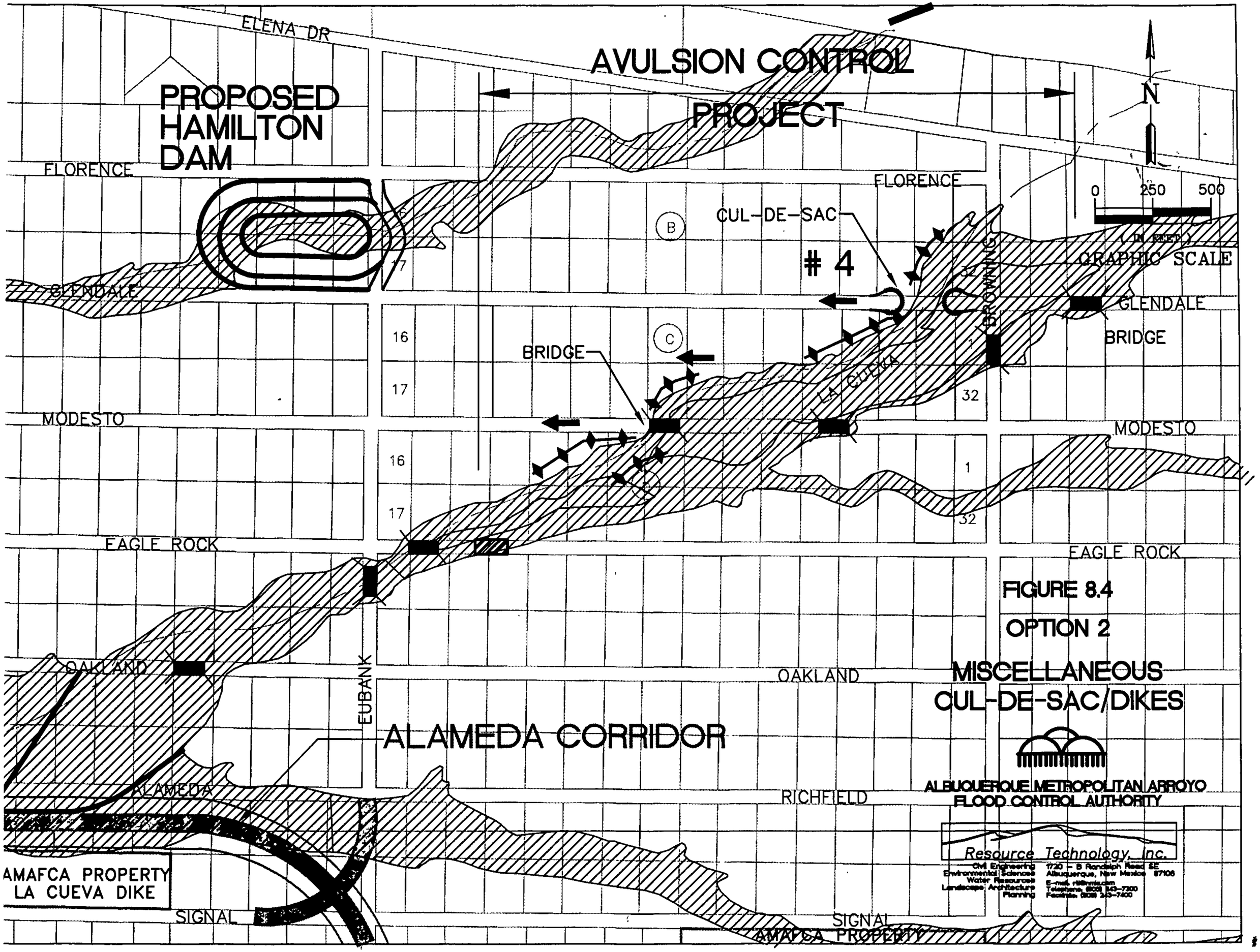


FIGURE 8.4

OPTION 2

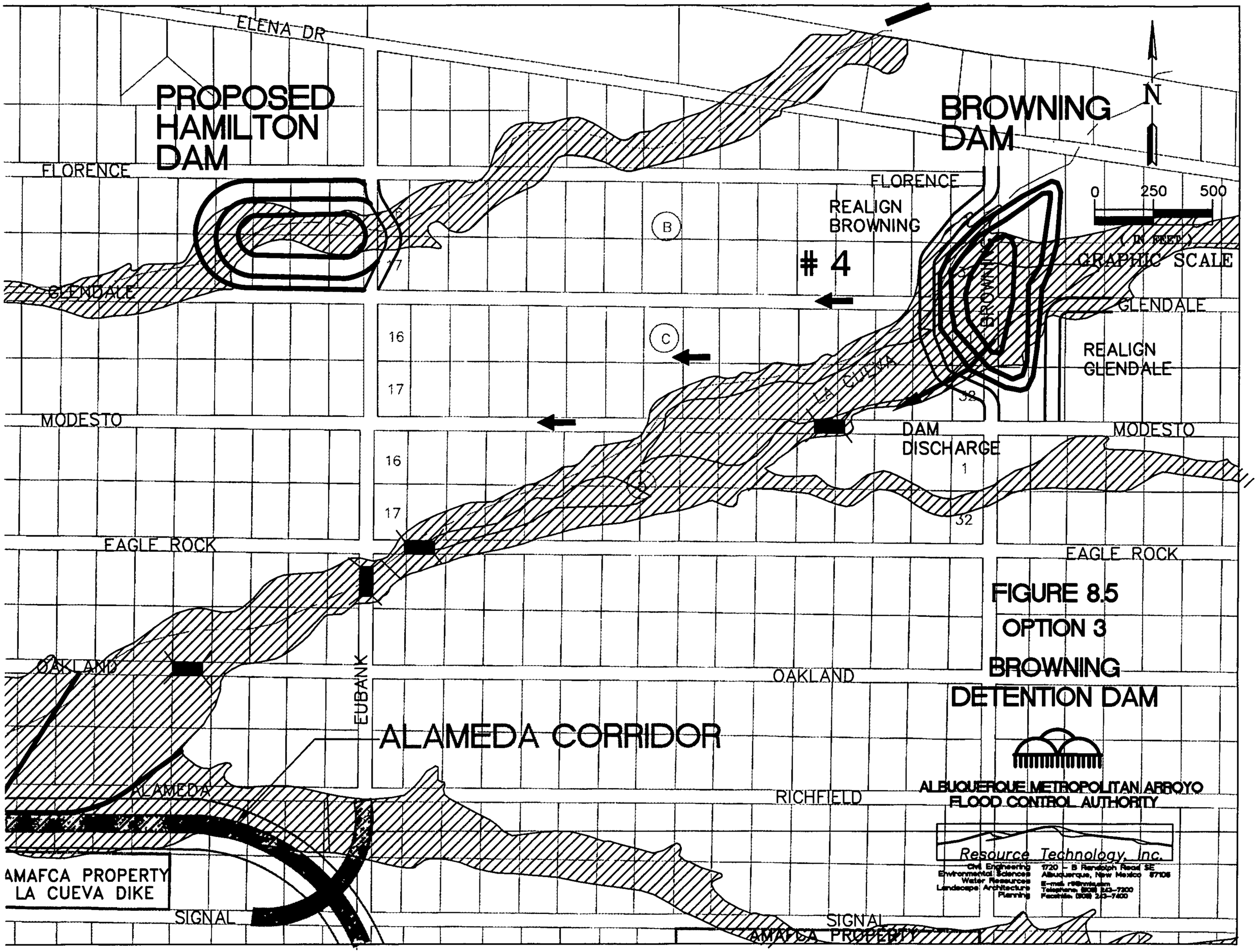


FIGURE 8.5

OPTION 3

BROWNING DETENTION DAM

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.

Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning

1720 - B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@rmtg.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400

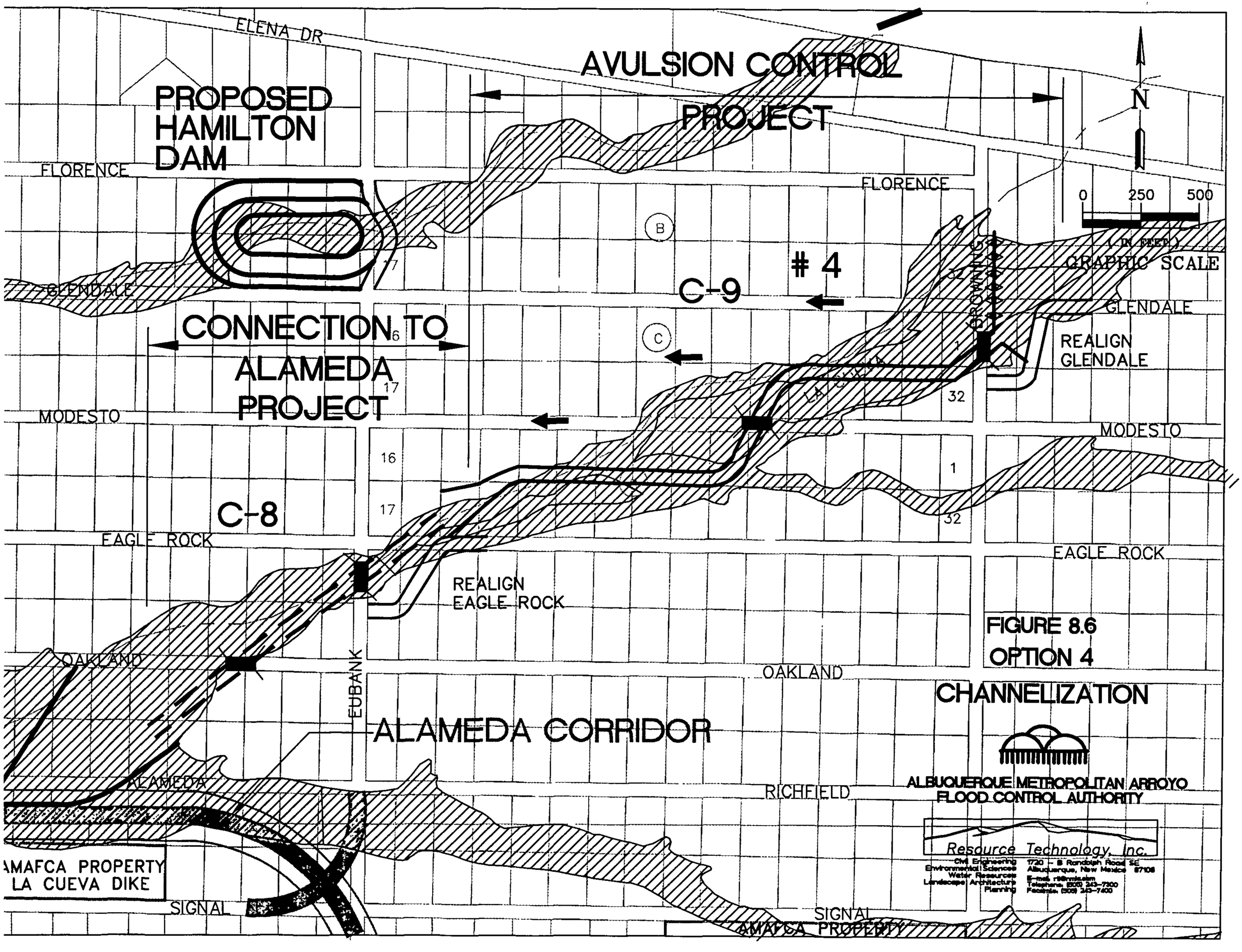


FIGURE 8.6
OPTION 4
CHANNELIZATION

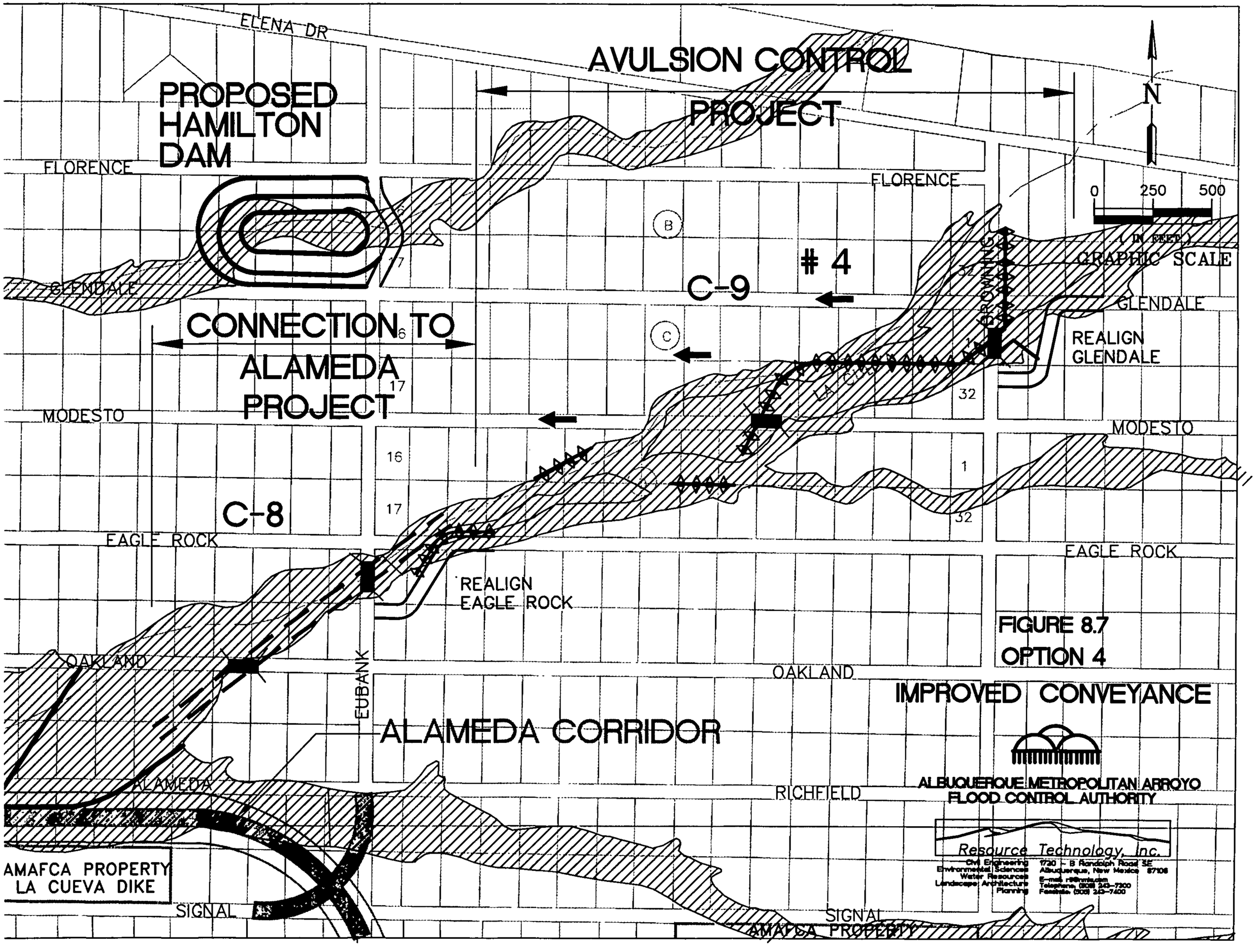


FIGURE 8.7
OPTION 4

The estimated cost of $3.3 million did not include the cost of any of the downstream facilities at Modesto, Eagle Rock, Eubank and Oakland. When the estimated $800,000 for these downstream facilities is added in, the combined total for Option 3 comes to over $4.1 million. Another potential drawback for the dam option is the aesthetic impact of a 30-foot embankment in an area where "view" is highly sought after.

Option 4, the channelization option, has proved to be a competitive alternative. While there are several possible alignments, the one presented to the AMAFCA Board and shown on Figure 8.6 confines the arroyo in a channel that follows one of the multiple possible flow paths of the main arroyo. This eliminates the need of at least four major road crossing structures. The estimated cost of the entire facility from Browning to the Alameda corridor was $3,707,700 including 10 full lots acquired for right-of-way. Additional easements would be required from property owners where the channel "take" was less than 35% of the .89 acre lot. It was assumed that these easements could be acquired for little or no cost since the channel would reclaim the remainder of the lot from floodplain. The possibility of total lot acquisition could also be considered. Option 4 has several advantages. These are:

- The total cost of arroyo management, including bridges, from Browning to the Alameda facility is comparable with Option 2.
- Unlike Option 2 the channelization option will remove approximately 20 acres from floodplain.
- As discussed below a lined or improved conveyance will be more consistent with downstream facilities.
- Lower long term maintenance costs (i.e., silt removal, riprap repair due to head cutting, etc.).
- Elimination of cul-du-sacs on Glendale will maintain better traffic circulation while the revised alignment will help to slow down traffic.

For the above reasons it was determined that the channelization option, shown as projects C-8 and C-9, would provide for the best long term arroyo management alternative for the reach between Browning and Eubank as well as providing avulsion control. The remainder of the main branch of the La Cueva Arroyo east of Browning would remain in its natural state unless modified by individual land owners or at road and street crossings. Cost comparisons of the various options are contained in Table 8.1.

Based on response at public meetings there is opposition on the part of some land owners to constructing a concrete or soil cement channel in this area. While the alternatives proposed by the land owners (either construction of a dam on Sandia Pueblo land or the construction of a dozen or more infiltration/detention dams) are not practical for various reasons, other options could be explored. If this opposition is representative of the general community feeling an improved naturalistic conveyance along an alignment similar to that shown for the C-9 channel could be considered. This would consist of the same general configuration at the Glendale/ Browning intersection but west of there the arroyo could be confined to the southern flow path with constructed berms as far as the Modesto crossing and then allowed to find its own path from there to the Eubank crossing. West of the Modesto crossing a berm along the southern

floodplain limits would be required as well as at several locations along the northern floodplain limits to prevent secondary avulsions or protect existing developed properties. See Figure 8.7.

The primary disadvantages of the improved conveyance approach are:

- The Eubank and Modesto crossings would require structures with a greater span (and expense) for an unconfined arroyo than for a channelized one.
- More right-of-way may have to be acquired since there would be less land removed from floodplain and consequentially less incentive for landowners to grant easements without monetary compensation.

However, the improved conveyance concept lends itself better to phased construction than does the full channelization concept. Temporary improved dip sections could be constructed to be replaced by bridges or multi-box culverts at a later date and berm construction could be built in phases based on priorities reflecting the probability of a major avulsion occurring at a particular location. However, overall construction costs are essentially the same as for concrete channel construction. If there is interest in property in this area for recreation and/or open space purposes some of the excess right-of-way acquired could be sold to other public agencies to reduce overall project cost. A similar approach could be adopted for the proposed facility C-8.

The alignment shown and related cost estimates for proposed projects C-8 and C-9 above are based on a tinted concrete or stepped soil cement lined channel. As discussed above, a more naturalistic channel treatment is also possible but would involve additional right-of-way and possible increased construction and maintenance costs. However, recreation, open space and/or aesthetic considerations could make a more naturalistic option viable with corresponding adjustments in total project costs.

TABLE 8.1

Avulsion Number 4
Cost Estimates of Various Options

OPTION	COST OF AVULSION CONTROL ONLY	COST OF CONVEYANCE TO ALAMEDA	TOTAL COST: BROWNING TO ALAMEDA
Option No. 2 **Misc. Dikes/Bridges, Cul-du-Sacs**	$1,460,039.00	$2,020,000.00	$3,480,039.00
Option No. 3 **Browning Detention Dam**	$3,320.647.00	$800,000.00	$4,120,647.00
Option No. 4 **Channelization** (Figure 8.6)	$2,241,400.00 (Phase I) C9	$1,466,300.00 (Phase II) C8	$3,707,700.00

Avulsions Number 2 and 3

As mentioned above these two avulsions are on the northern tributary to the La Cueva Arroyo outside of the City Limits. See Figure 6.2. The impact of either of these avulsions is chiefly related to floodplain issues immediately to the west and increasing the flow rate in the main branch of the La Cueva Arroyo by approximately 20%.

While the same basic options of dip-sections, bridges and cul-du-sacs were examined at these locations, Bernalillo County has utilized AMAFCA's **Avulsion Report** data to create a partial "fix" of Avulsion Number 3 and, as mentioned in Section 7.B, is currently planning to seek funding in the fall 1998 bond election to construct permanent avulsion control facilities at Modesto and Eagle Rock. Preliminary plans indicate a bridge and 600-feet of downstream channel for Avulsion Number 2 and a concrete lined dip-section and road vertical alignment adjustment for Avulsion Number 3. Based on these preliminary plans a cost estimate has been prepared which totals $574,600 for both projects, including right-of-way. The remainder of the tributary will remain in its natural condition except as modified by private land owners and at bridge crossings.

La Cueva Arroyo Facilities West of Eubank

As discussed in Section 6.E, the City anticipates that the La Cueva Arroyo will be completely channelized within the municipal limits, shown as projects C-3 and C-4. Prior to final design of proposed project C-3 a determination of the advisability of the El Camino diversion at Wyoming must be made. Incidental to this channelization Avulsion Number 6, on Glendale west of Louisiana, will be controlled. In addition, channelization or some sort of improved conveyance will be extended east almost to Eubank by Bernalillo County's Alameda project as discussed in Section 6.C and shown as project C-11 on Figure 8.7j. When all of the above facilities are constructed (including the proposed channel to control Avulsion Number 4) the La Cueva Arroyo will be improved from Browning to the North Diversion Channel. At periodic intervals within the municipal limits, including at all major north-south street crossings, storm drains will discharge into this channel.

East of I-25 improvements to the South La Cueva Arroyo system consist entirely of storm drains to convey runoff to one of the two I-25 crossing structures. West of I-25 all required infrastructure is in place with the exception of improvements to the Wildflower Diversion at the Modesto culvert.

E. Summary of Proposed Recommendations for Arroyo Facilities and Avulsion Control Measures

The following are the major elements by reach of the proposed recommendations for an Arroyo Facilities Plan for the La Cueva, El Camino and North Camino Arroyos. Not included are numerous additional road crossing structures for arroyos to be left in their "natural" state in the unincorporated areas.

North Camino Arroyo

• From North Diversion Channel to I-25 - see North Camino Study by AMAFCA

1. From I-25 to Louisiana - Concrete lined channel. (C-1)
2. From Louisiana east to Municipal Limits - Concrete lined channel with Training Dike. This will also control Avulsion No. 8. (C-1)
3. Municipal Limits east to mountains - Natural Channel, except as modified by 4 below.
4. Avulsion Number 1 - Controlled by a detention dam at Eubank and Glendale or a dike on U.S.F.S./Sandia Pueblo land near Juan Tabo Picnic Area access road. (AV-1)

North Camino Tributary

5. From confluence with North Camino to Louisiana - Concrete lined channel. (C1-a)
6. From Louisiana, east - Natural channel, except as modified by 7 below.
7. Avulsion Number 7 - Controlled by dip-section and dike on Venice. (AV-7)

El Camino Arroyo

• From North Diversion channel to I-25 diverted to La Cueva. Local drainage addressed by existing storm drains.

8. I-25 to Wyoming - Local drainage conveyed to existing El Camino diversion at I-25 by miscellaneous storm drains.
9. From La Cueva Channel to Wyoming and Glendale - Closed conduit diversion. (SD-6)
10. Wyoming to Barstow - Closed conduit. (SD-6)
11. Barstow to Ventura - Closed conduit with de-silting basin at Ventura. (SD-6)
12. Ventura, east - Natural channel, except as modified by 13 below.
13. Avulsion Number 5 - Controlled by riprap channel and dip-section west of Holbrook. (AV-5)

La Cueva Arroyo

• From North Diversion Channel to I-25, existing concrete channels.

14. From I-25 to Wyoming - Concrete lined channel. This will also control Avulsion Number 6. (C-3, AV-6)
15. From Barstow to Holbrook - Concrete lined channel and/or improved conveyance along Alameda. (C-4)
16. From Barstow to 1000-feet west of Eubank - Improved conveyance. (C-11)
17. From 1000-feet west of Eubank 500-feet east of Eubank at Eagle Rock - lined channel or improved conveyance. (C-8)
18. From 500-feet east of Eubank at Eagle Rock to Browning and Glendale -lined channel or improved conveyance. (C-9, AV-4)
19. From Browning east to U.S. Forest Service land - Natural channel.

La Cueva Tributary

20. Avulsion Number 2 - Controlled by bridge and channel at Modesto. (C-10, AV-2)
21. Avulsion Number 3 - Controlled by dip-section at Eagle Rock. (AV-3)

F. Cost Estimates

Cost Estimates for each of the major elements in the Arroyo Facilities Plan are shown in Table 8.2. It should be noted that many of the projects rely on donated right-of-way or easements. Some of this property may be obtained as part of the City's development process. In other cases negotiations with individual property owners may be required. The benefit to property owners will be a usable remanent that has been removed from floodplain. The cost of Letters of Map Revision (LOMR's), the North Camino Arroyo west of I-25, currently being studied under separate contract, and possible improvements to the Wildflower diversion to the South La Cueva Channel (see section 5.D) have not been included in the cost estimates.

The proper functioning of the above major elements depend, especially within the City limits, on the construction of numerous "feeder" storm drains. These have been included in the City's **North Albuquerque Acres Master Drainage Plan**. Table 8.3 shows the overlap of the City and AMAFCA planning efforts for the La Cueva, El Camino and North Camino basins as well as the additional upstream work anticipated by this study. All proposed facilities in both the City MDP and this study have been sized for flows assuming that upstream avulsions have been controlled. If avulsions are not controlled costs will increase. As stated in section 8.B, Avulsions 1 and 4 have the most significant impact.

TABLE 8.2

LA CUEVA, EL CAMINO AND NORTH CAMINO ARROYO FACILITIES PLAN* COST ESTIMATES

FACILITY	DESCRIPTION	CONSTRUCTION COST	R/W COST	TOTAL COST
North Camino C-1, AV-8	Channel Crossing Coronado Airport	$1,583,325.00	$150,000.00 See Note 3	$1,733,325.00
North Camino C-1a	Channel to pick up Tributary Flows	$392,097.00	See Note 1	$392,097.00
North Camino Trib. AV-7	Dip-Section and Dike on Venice Avenue	$78,479.00	$48,469.00	$126,948.00
Hamilton Dam AV-1	Detention Dam at Glendale, west of Eubank	$940,000.00	$960,000.00	$1,900,000.00
El Camino Pipe SD-6	Pipe from Ventura to La Cueva at Wyoming	$2,100,622.00	$80,000.00 See Note 3	$2,180,622.00
El Camino C-7, AV-5	Riprap Channel and Dip-Section on Glendale west of Holbrook	$256,666.00	$168,750.00	$425,416.00
La Cueva C-3, AV-6	Channel from Wyoming to I-25	$3,775,168.00	$155,100.00 See Note 1	$3,930,268.00
La Cueva C-4	Improved conveyance and/or channel from Ventura to Barstow	$1,705,335.00	$155,100.00 See Note 2	$1,860,435.00
La Cueva C-11	Improved conveyance and/or channel from west of Eubank to Ventura	$2,028,506.00	See Note 2 $80,000.00	$2,108,506.00
La Cueva C-8	Improved conveyance and/or channel from west of Eubank to C-9	$1,226,287.00	$240,000.00 See Note 3	$1,466,287.00
La Cueva C-9, AV-4	Channel and/or improved conveyance from Browning to east of Eubank at Eagle Rock	$1,681,422.00	$560,000.00 See Note 3	$2,241,422.00
La Cueva Tributary C-10, AV-2	Riprap channel from bridge at Modesto 600-feet west	$319,434.00	$144,000.00 See Note 3	$463,434.00
La Cueva Tributary AV-3	Dip-section on Eagle Rock, east of Lowell	$111,150.00	na	$111,150.00
TOTAL		**$16,198,491.00**	**$2,741,419.00**	**$18,939,910.00**

*See Table 8.3 for required connecting storm drain improvements within municipal limits per COA MDP.
**Should approval for easement for dike on Pueblo/USFS land not be granted, Hamilton Dam would be required at cost of $1.9 million. See Figure 8.1

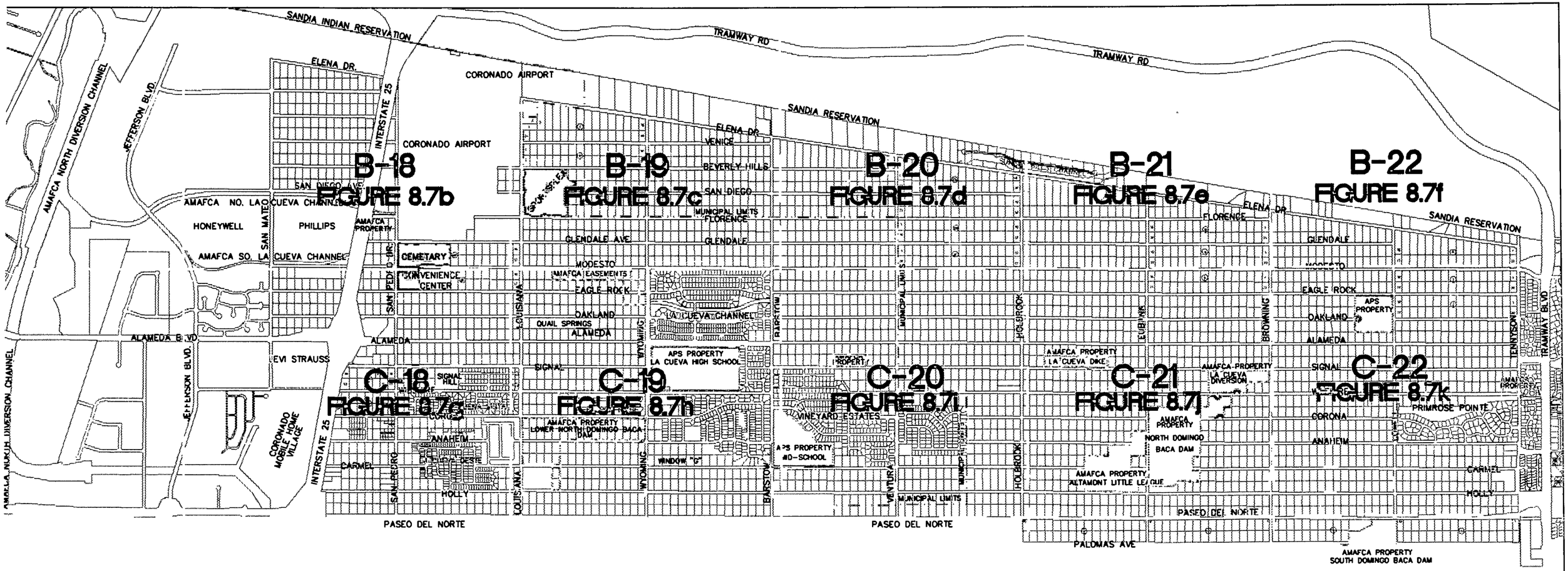
1. Assumes R/W provided by property owners at time of re-plat for future development.
2. Assumes R/W provided by County as part of Road Project.
3. Assumes some R/W provided by easement.

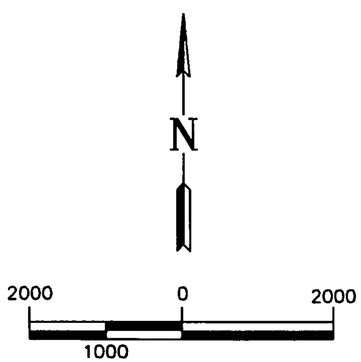
TABLE 8.3

COST ESTIMATES
LA CUEVA, EL CAMINO AND NORTH CAMINO DMP AREA

PROJECT NUMBER	CONSTRUCTION COST	R\W COST	TOTAL COST
SD-1	$303,833.00	$2,500.00	$306,333.00
SD-2	$130,648.00	$0.00	$130,648.00
SD-3	$200,273.00	$0.00	$200,273.00
SD-4	$1,084,378.00	$0.00	$1,084,378.00
SD-5	$158,935.00	$0.00	$158,935.00
SD-6*	$2,100,622.00	$80,000.00	$2,180,622.00
SD-7	$286,452.00	$0.00	$286,452.00
SD-8	$173,826.00	$2,500.00	$176,326.00
SD-9	$692,295.00	$0.00	$692,295.00
SD-10	$189,344.00	$15,000.00	$204,344.00
SD-11	$390,431.00	$47,000.00	$437,431.00
SD-12	$189,407.00	$0.00	$189,407.00
SD-13	$310,266.00	$0.00	$310,266.00
SD-25	$226,558.00	$0.00	$226,558.00
SD-27	$200,695.00	$23,500.00	$224,195.00
SD-28	$425,575.00	$5,000.00	$430,575.00
SD-30	$99,594.00	$2,500.00	$102,094.00
C-1,AV-8*	$1,583,325.00	$150,000.00	$1,733,325.00
C-1A*	$392,097.00	$0.00	$392,097.00
C-3,AV-6*	$3,775,168.00	$155,100.00	$3,930,268.00
C-4*	$1,705,335.00	$155,100.00	$1,860,435.00
AV-1**	$940,000.00	$960,000.00	$1,900,000.00
AV-4**	$740,039.00	$720,000.00	$1,460,039.00
C7,AV-5*	$256,666.00	$168,750.00	$425,416.00
AV-7*	$78,479.00	$48,469.00	$126,948.00
TOTAL COA MDP			
SUBTOTAL	**$16,634,241.00**	**$2,535,419.00**	**$19,169,660.00**
C-8	$1,226,287.00	$240,000.00	$1,466,287.00
C-9,AV-4**	$1,681,422.00	$560,000.00	$2,241,422.00
C-11	$2,028,506.00	$80,000.00	$2,108,506.00
C-10,AV-2	$319,434.00	$144,000.00	$463,434.00
AV-3	$111,150.00	$0.00	$111,150.00
TOTAL ADDITIONAL AMAFCA DMP			
SUBTOTAL	**$4,626,760.00**	**$304,000.00**	**$4,930,760.00**
TOTAL DMP AREA	**$21,261,001.00**	**$2,839,419.00**	**$24,100,420.00**

* Project Recommended by both COA MDP and AMAFCA DMP
** COA and AMAFCA have selected different options.
Total additional AMAFCA reflects only the increased cost.
SD - Storm Drain Project, C - Channel Project, AV - Avulsion Control Project





LA CUEVA, EL CAMINO, AND
NORTH CAMINO ARROYOS
FACILITY PLAN

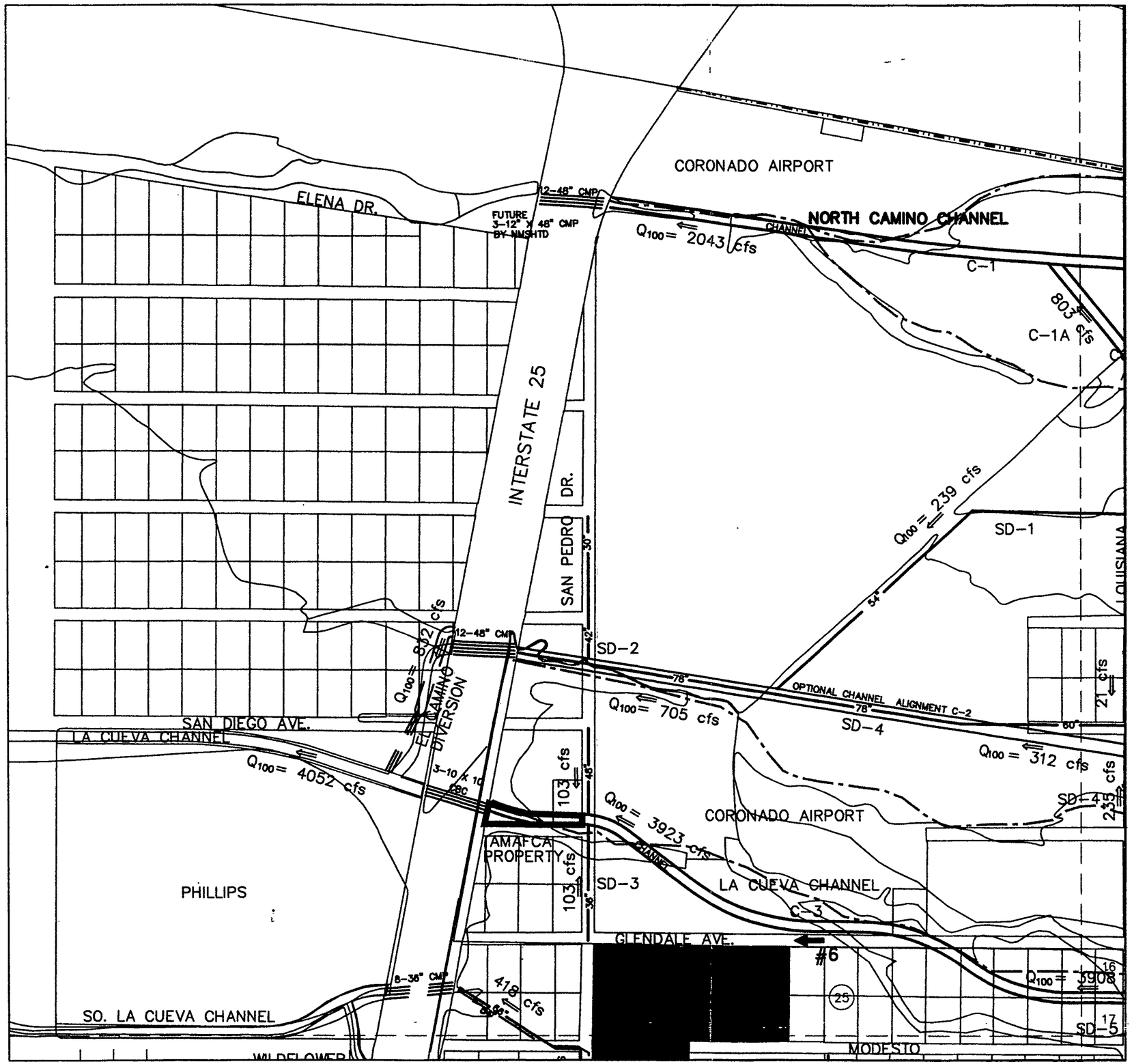
FIGURE 8.7a

VICINITY MAP

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning

1720 – B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rt@rmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

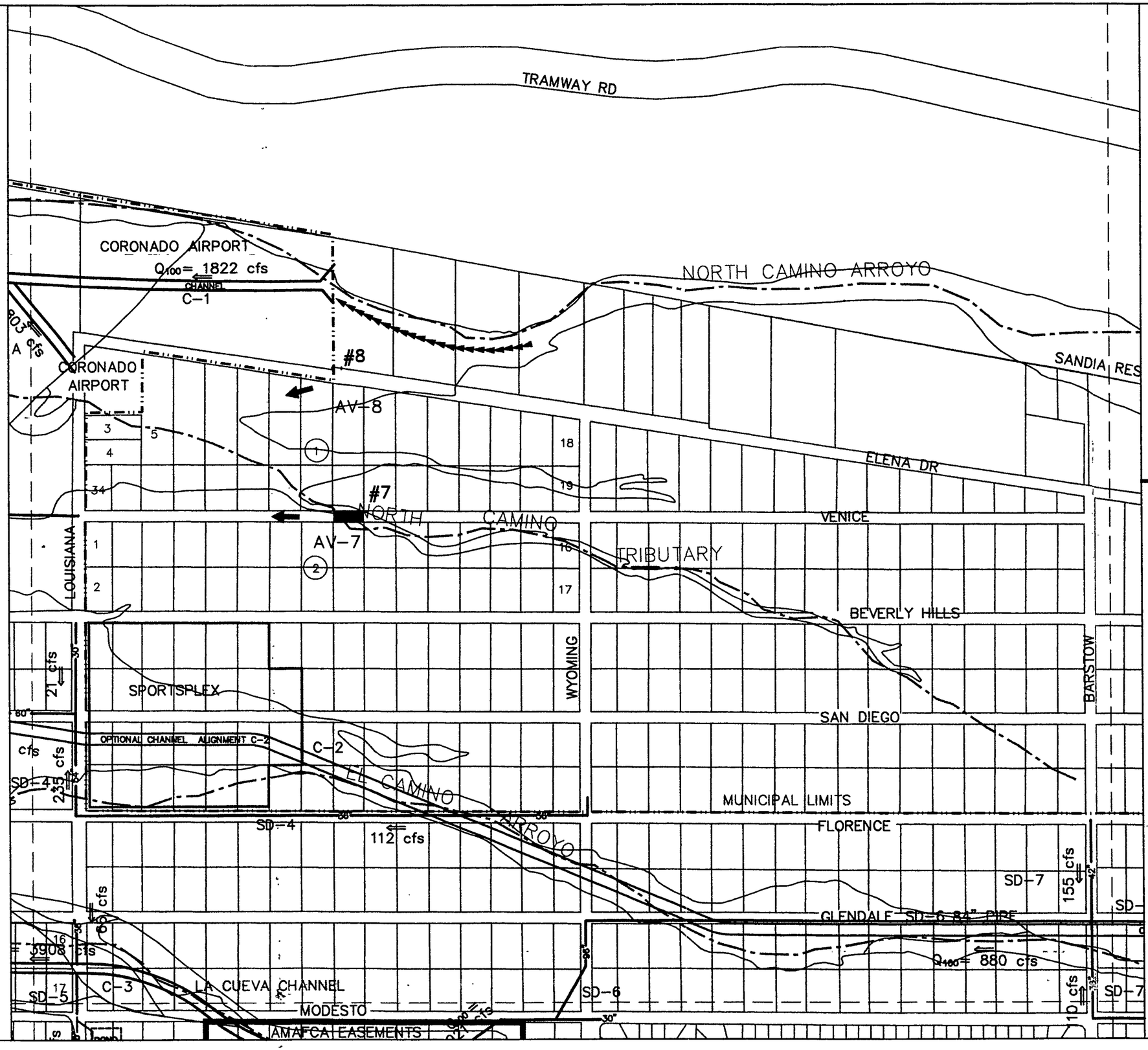
STORM DRAIN FACILITIES B-18

FIGURE 8.7b

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 - B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400

BASPRP2.dwg 7-7-99 8:43:11 am EST



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

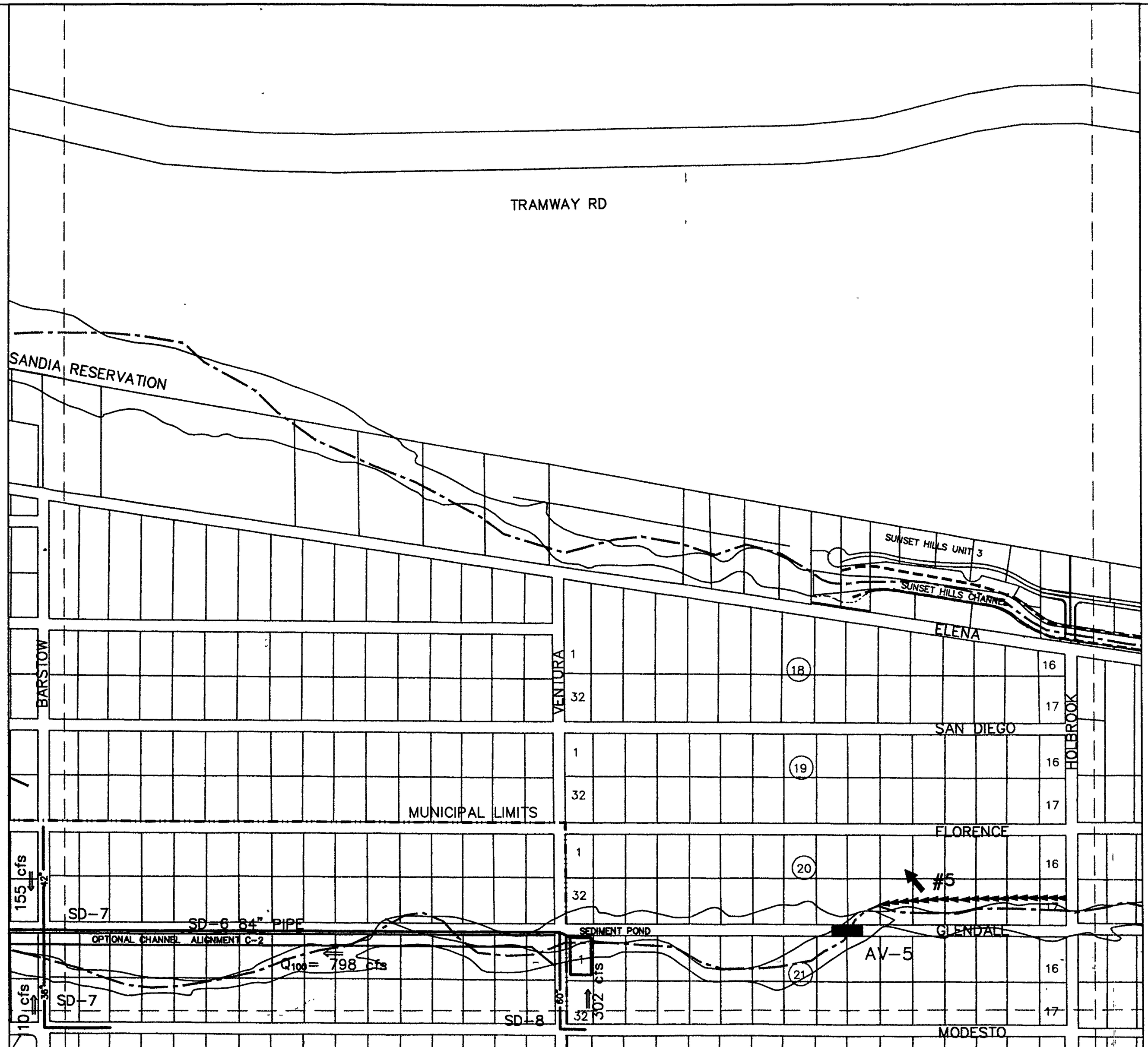
LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

STORM DRAIN FACILITIES B-19

FIGURE 8.7c

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 - B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

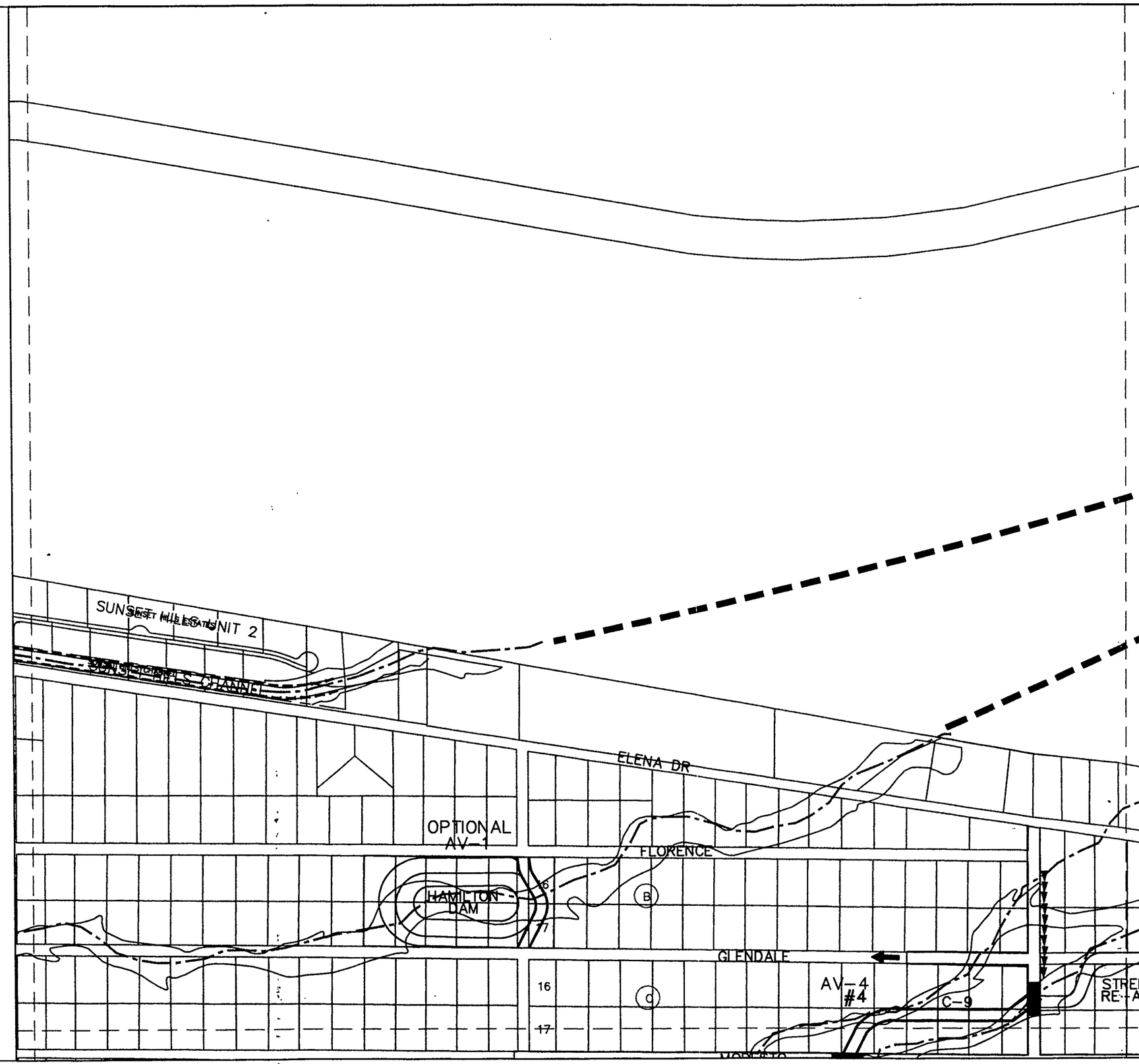
LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

STORM DRAIN FACILITIES B-20

FIGURE 8.7d

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 - B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

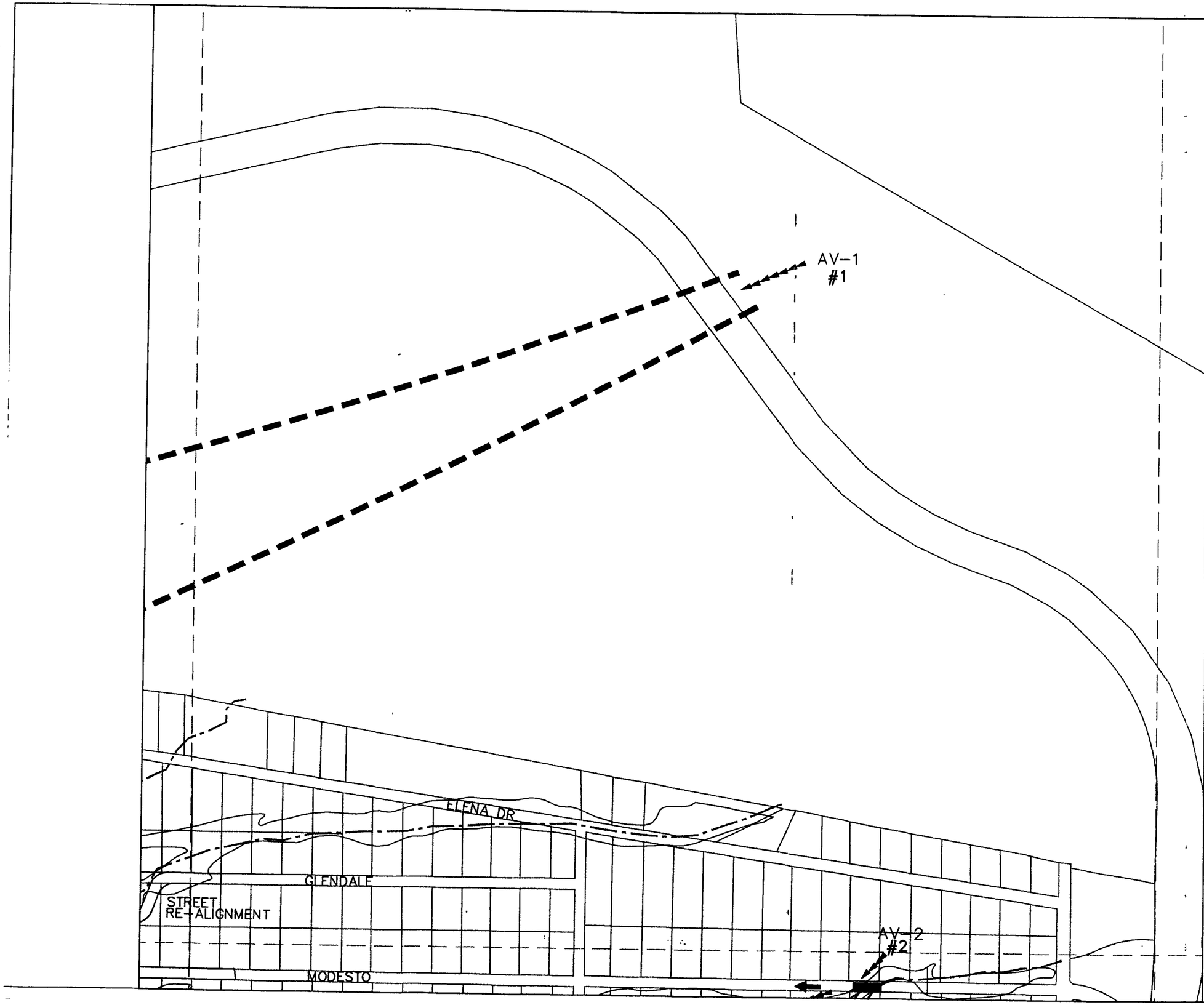
LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

STORM DRAIN FACILITIES B-21

FIGURE 8.7e

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 – B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are
future condition 100-year.

LA CUEVA, EL CAMINO, AND
NORTH CAMINO ARROYOS
FACILITY PLAN

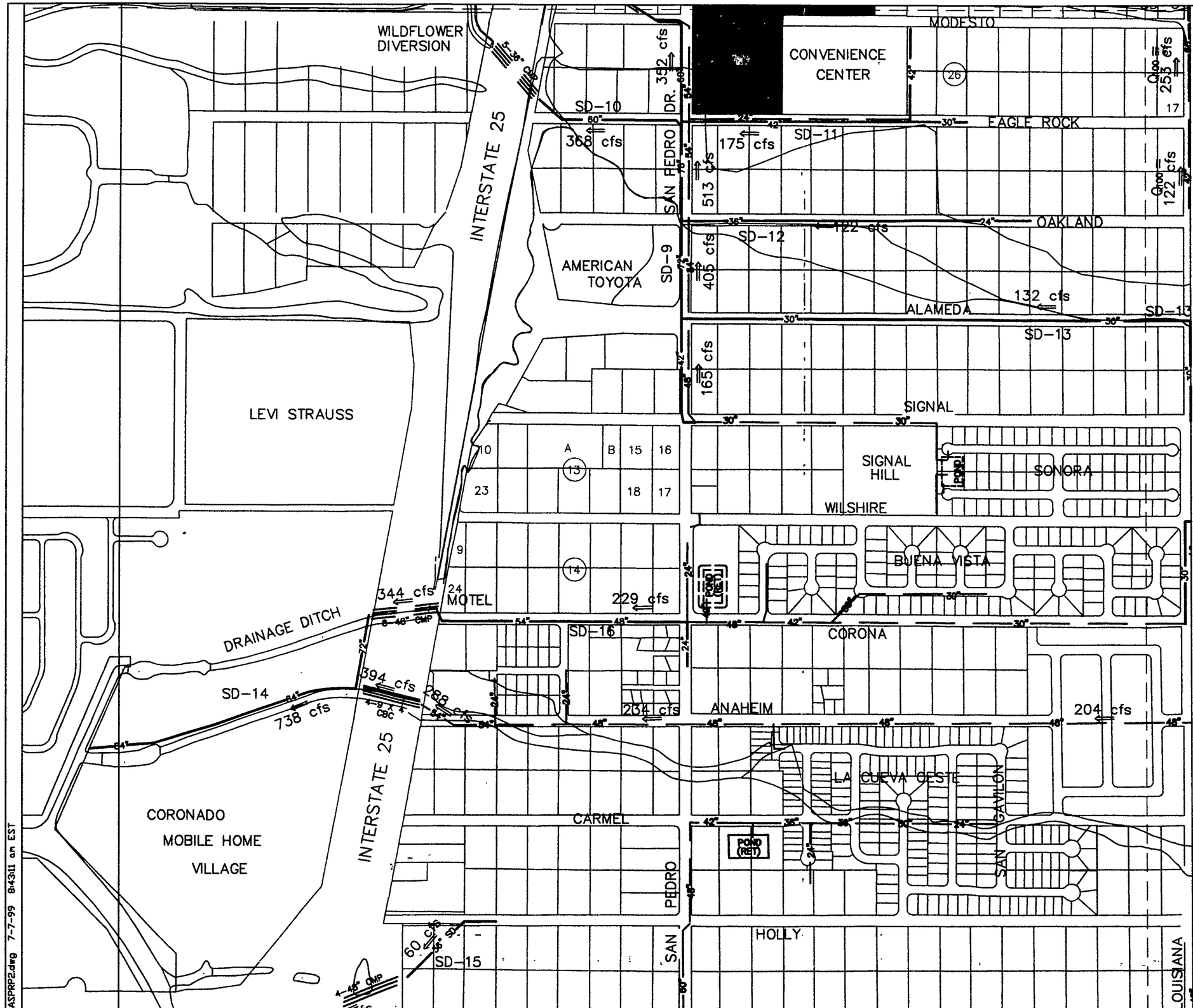
STORM DRAIN FACILITIES
B-22

FIGURE 8.7f

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 – B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400

84



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

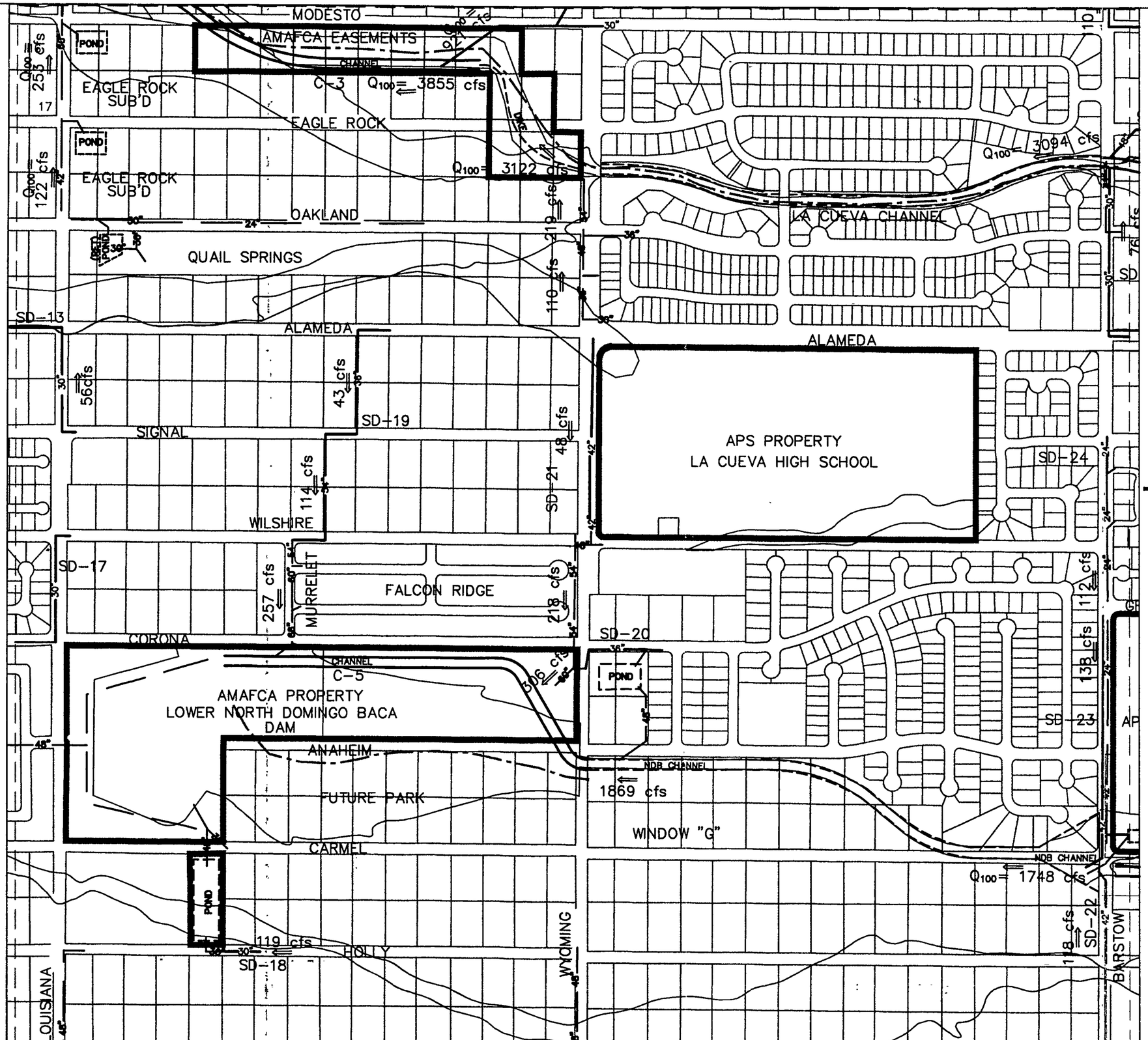
LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

STORM DRAIN FACILITIES
C-18

FIGURE 8.7g

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
1720 - B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

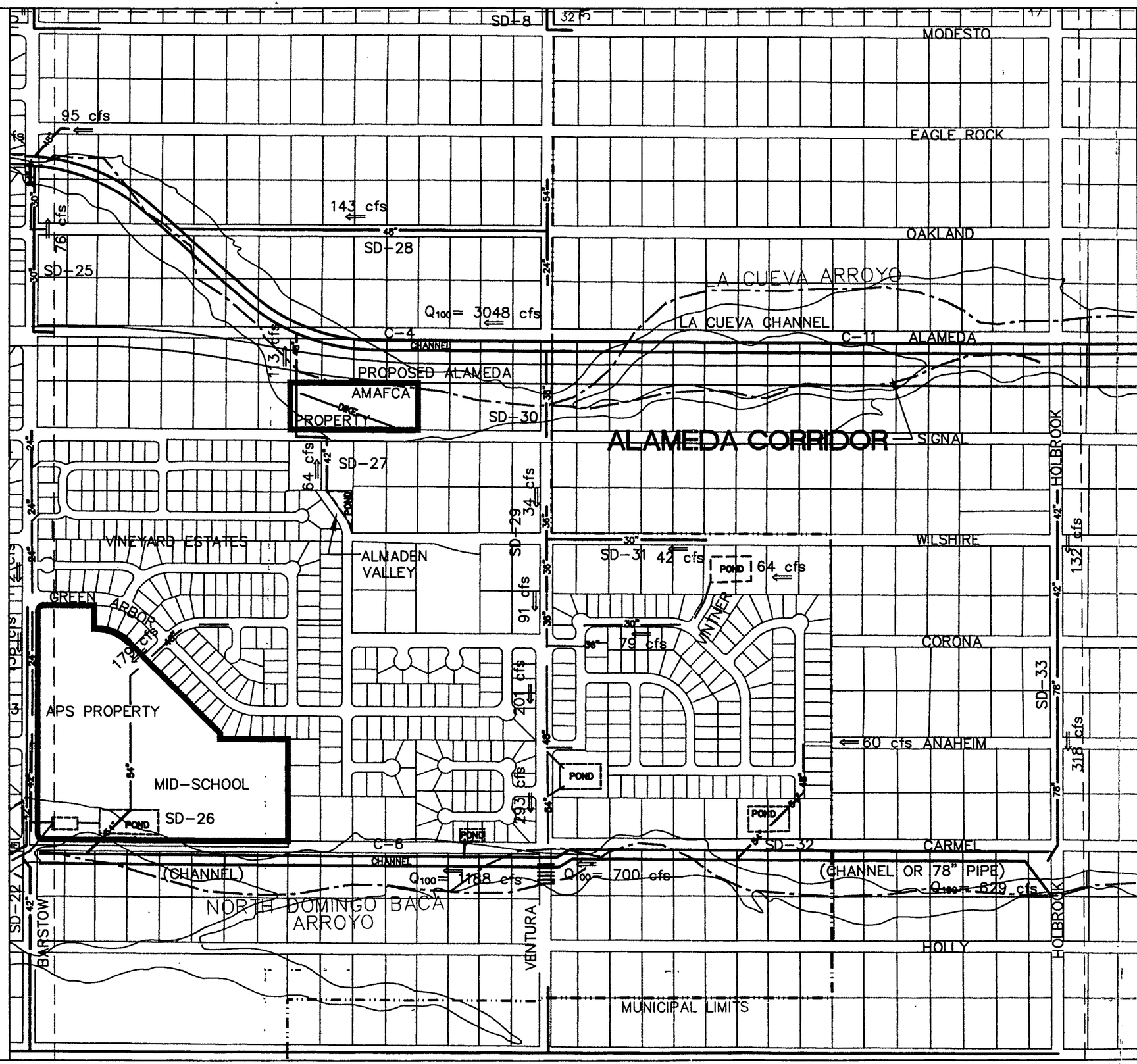
LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

STORM DRAIN FACILITIES C-19

FIGURE 8.7h

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 – B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

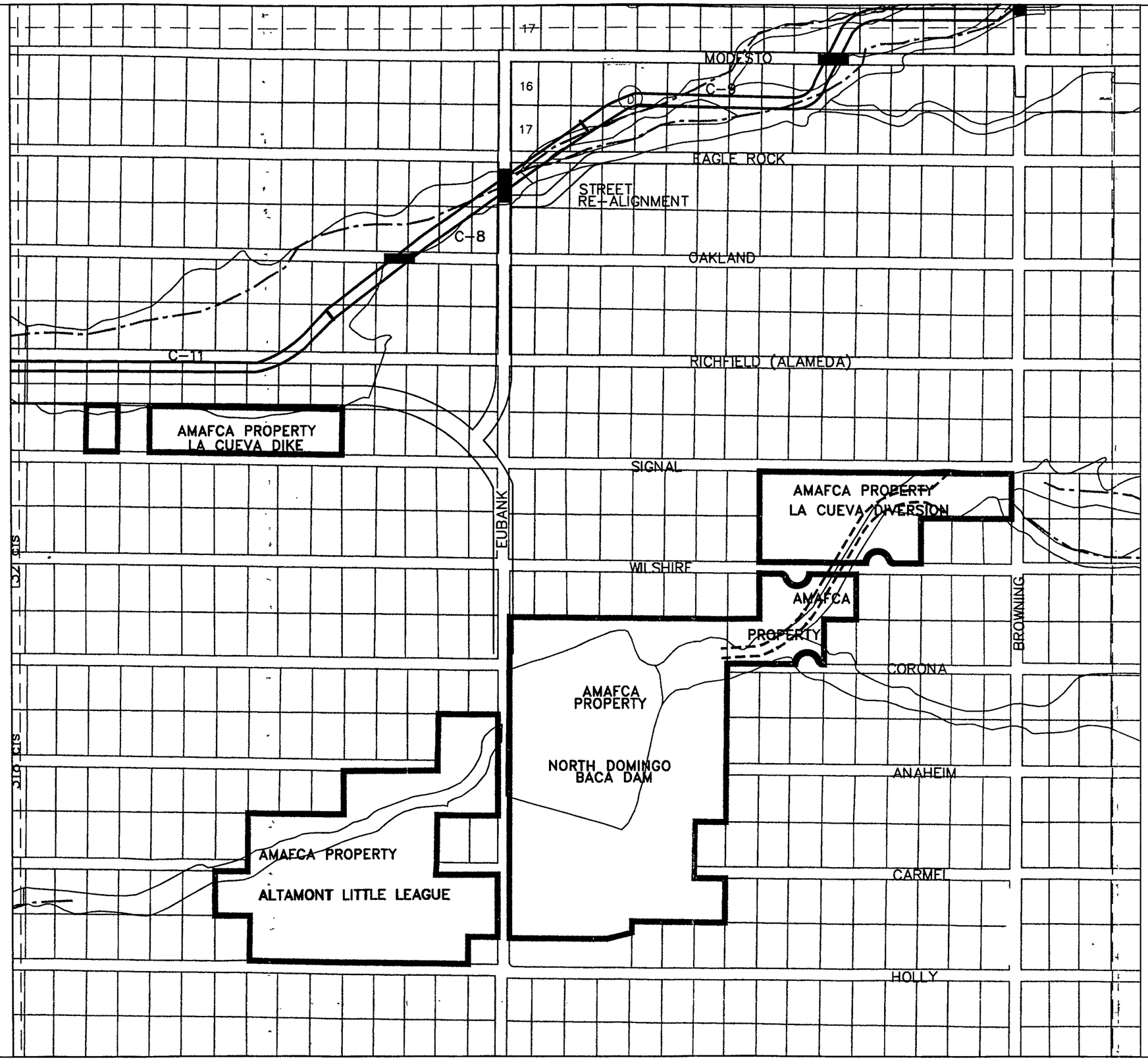
LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

STORM DRAIN FACILITIES C-20

FIGURE 8.7i

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 – B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

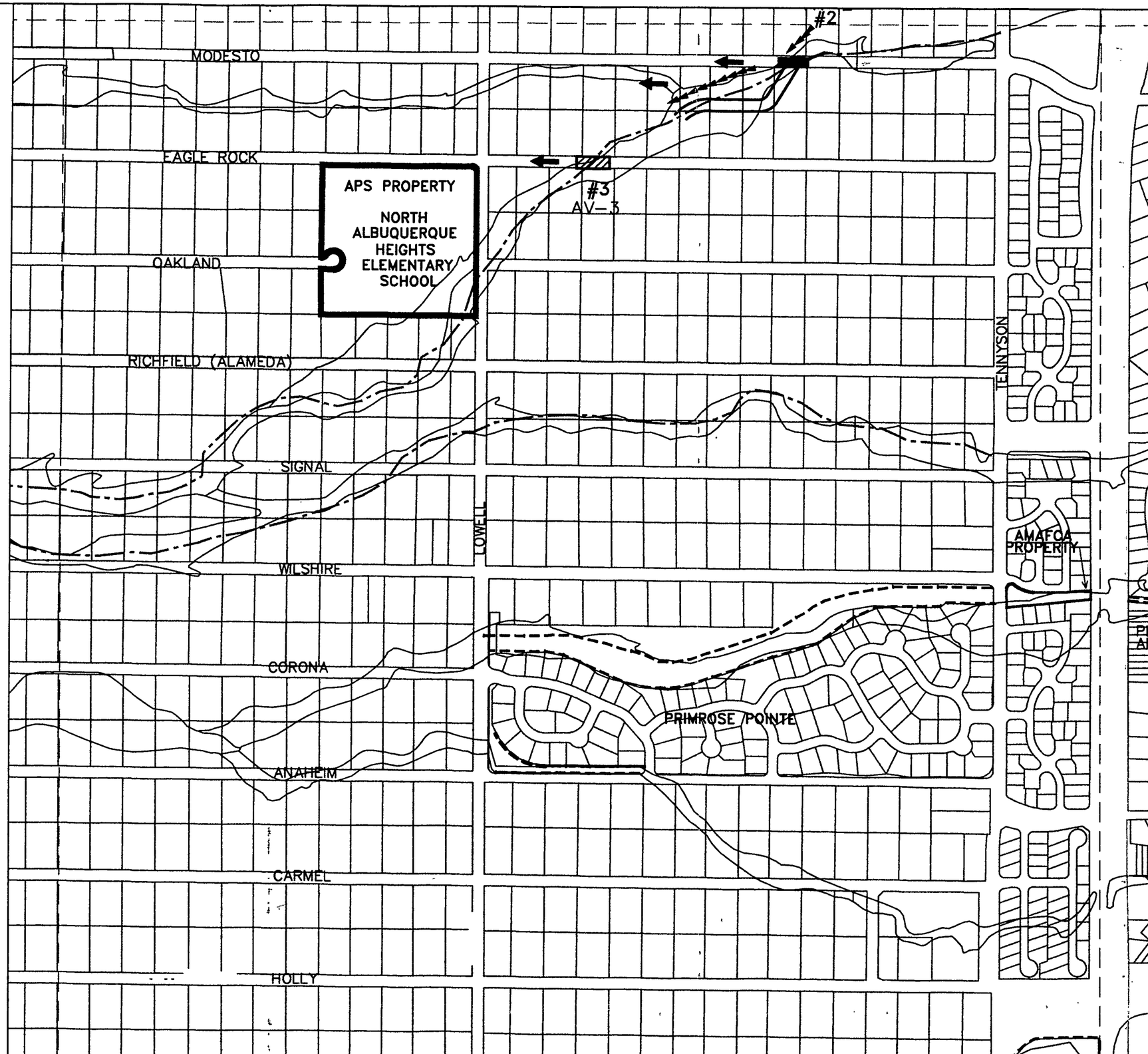
LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

STORM DRAIN FACILITIES C-21

FIGURE 8.7j

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 – B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400



N

500 0 250 500

(IN FEET)

LEGEND

- MUNICIPAL LIMITS
- EXISTING PLATTING
- EXISTING ARROYO FLOW PATH
- EXISTING STORM DRAIN
- EXISTING CHANNEL
- PROPOSED STORM DRAIN
- PROPOSED CHANNEL
- PROPOSED STRUCTURE
- PROPOSED ROAD
- PROPOSED DIP SECTION
- PROPOSED DIKE
- #5 AV-5 POTENTIAL AVULSION

NOTE:
All flow rates shown are future condition 100-year.

LA CUEVA, EL CAMINO, AND NORTH CAMINO ARROYOS FACILITY PLAN

STORM DRAIN FACILITIES C-22

FIGURE 8.7k

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

Resource Technology, Inc.
Civil Engineering
Environmental Sciences
Water Resources
Landscape Architecture
Planning
1720 - B Randolph Road SE
Albuquerque, New Mexico 87106
E-mail: rti@nmia.com
Telephone: (505) 243-7300
Facsimile: (505) 243-7400

ADDENDUM NUMBER ONE

Table of Contents

Minutes from August 18, 1998 Public Meeting	92
Response to Concern/Comments Survey	97
Additional Comments by Perry Wilkes	106
Response to Perry Wilkes Comments	121
Minutes from September 15, 1998 Briefing for Public Officials	127
Response form Public Officials	131
Minutes from October 28, 1998 Briefing for Elected Officials	136

Resource Technology, Inc.
1720 - B Randolph Rd. SE Albuquerque, NM 87106
Telephone: (505) 243-7300
FAX: (505) 243-7400

MINUTES

AMAFCA FACILITY PLAN AND BCPW NORTH ALBUQUERQUE ACRES/SANDIA HEIGHTS SOUTH DRAINAGE INFRASTRUCTURE PLAN
PUBLIC MEETING
19 AUGUST 1998

TIME: 6:30 - 9:00 PM

LOCATION: 8901 Lowell St. NE

PRESENTERS: Kurt Browning, AMAFCA; Don Dixon and Chuck Thompson, Resource Technology, Inc.

ATTENDEES: See Attached List

RECORDER: Chuck Thompson CNT

Introduction given by Kurt Browning -- presenters, AMAFCA and BCPW personnel present were introduced. Mr. Browning provided an overview of the overlapping plans to introduce the presentations: the 1995 AMAFCA Drainage Management Plan (DMP), the City of Albuquerque (COA) Master Drainage Plan for North Albuquerque Acres, and the BCPW Drainage Infrastructure Plan (Phase I) for North Albuquerque Acres (NAA) and Sandia Heights South (SHS). Mr. Browning discussed the nature of the problem of potential major arroyo flows in the SHS/NAA area and AMAFCA's role in controlling them. He described the major avulsions that have been identified in the area and discussed their impacts.

Don Dixon of Resource Technology, Inc. (RTI) gave a more detailed presentation on the integration of the work on the various plans. He emphasized that the various plans are planning documents and are subject to revision based on public comment and the needs of the community. Mr. Dixon provided an overview of existing major facilities and discussed proposed plans to channelize or place in storm drains portions of the La Cueva, Camino, and El Camino arroyos. Right-of-way issues and the potential for private construction of some structures was discussed. The total cost of the projects in the AMAFCA Facilities Plan is estimated to be $17.5 million.

Chuck Thompson of RTI discussed work to date on Phase I of the BCPW DMP. Phase I of the plan includes assessment and planning of drainage infrastructure in Sandia Heights South and

NAA from Eubank Blvd. east to San Antonio Dr. north. Mr. Thompson stated that the major objective of the plan is to bring existing NAA and SHS drainage structures up to current county standards. The Phase I portion of the NAA/SHS area has the potential for 4700 home sites and that the BCPW DMP will be used as a guidance document for future infrastructure improvements as the area develops. Mr. Thompson reiterated that existing drainage patterns will not be changed with the exception of potential avulsions. The proposed infrastructure improvements for the Phase I portion of NAA includes 1 major channel on the La Cueva Arroyo, 4 storm drains (not inlcuding those in the Paseo del Norte system), 14 concrete box culverts, 96 culvert pipes (48 of which are larger than 24"), 1 cul-de-sac termination of an alignment, 9 lined dip sections, and two sediment/detention ponds. Total costs for the NAA portion of Phase I are $7.54 million (not including Paseo del Norte storm drains, certain road improvement costs, and some right-of-way acquisition costs). $2.87 million of these costs overlap with the AMAFCA facility plan. The total cost for the Phase I portion of the NAA/SHS work including the previously presented Sandia Heights South facilities is $9.83 million.

Presenters responded to questions and comments from attendees during and following the presentations. These are summarized as follows:

- **When will the these plans be implemented?**
  AMAFCA will be finalizing their plan this fall and possible Board action on it may be by the end of the year. After that they may consider proposed facilities on a case by case basis. BCPWD project is on a somewhat later schedule. Final Phase I plan for County Commission consideration should be ready by the end of this year or early next year. Implementation will be through subdivision process, in conjunction with street/road projects, or as part of County CIP process.

- **How will they be paid for?**
  Funding sources will vary. Some projects could be on a cost share basis between multiple governmental entities and/or private parties. Special Assessment Districts are a possibility. Some will be funded through transportation projects. CIP Bond projects and state funds are other possibilities.

- **Were alternatives to concrete channels considered?**
  For planning purposes and developing cost estimates traditional concrete or soil cement linings were assumed since they are the most economical conveyances. However, other options are possible. These would have to be considered in the specific channel planning and design process once a commitment to a project has been made.

- **Will floodplains be removed?**
  The purpose of these various proposed facilities is to control potential flood damage and provide for public safety. This will frequently remove some properties from floodplain. However, this is incidental to the other flood control functions of the projects.

- **Will the County provide culvert crossings for access to private property?** No. Access from the public R/W to private property is the property owners responsibility.

- **If Elena is raised at Lowell won't it impact property owners to the north?** One of the design constraints for this proposed project is to avoid negative impact on adjacent property owners. This may result in alterations to the alignment as shown if further analysis indicates that it could cause problems.

- **Will the new Alameda alignment and "improved conveyance" along the north side cut off access to private property along the existing Richfield/Alameda R/W?** Design details for Alameda are not part of this project but it is our understanding that the County has to either provide access or buy the property. They may be considering using the existing Richfield alignment as a frontage road to provide access in the future.

- **What are box culverts?** Concrete Box Culverts were described and examples in the area (on Lowell, west of Primrose Pointe and on Tramway) were given.

- Many attendees had questions about specific locations which were addressed to various AMAFCA, BCPWD and RTI staff for consideration. A Mr. Perry Wilkes wanted to encourage an alternate approach and passed out a position paper to various public agency representatives. A copy is attached. All were encouraged to fill out a questionnaire either before leaving or to return to RTI by mail.

Attendance Roster

Public Meeting

Albuquerque Metropolitan Arroyo and Flood Control Authority (AMAFCA) & Bernalillo County Public Works Division (BCPW)

AMAFCA Facility Plan and BCPW North Albuquerque Acres/Sandia Heights South Drainage Infrastructure Plan

August 19, 1998

Name	Affiliation	Telephone No.
Chris Lackmann	AMAFCA	
Bette + Perry Wilkes	Modesto property owners	873-3239
John P. Curtin	C.O.A./PWD/Hyd	768-2727
Jude Thorler		828-1875
Jim Duncan		856-0081
Scott Clark	Double Eagle Realty	294-4595
Don W. Grady		884-8493
JERRY JANICKE	North ABQ Acres	856-1136
BILL FOX	Fox Realty	356.1794
ROGER PAUL	BC PUBLIC WORKS DIV.	848-1515
Ted Reddinger	Bern. Co. Planning	924-3721
Gilbert Sanchez	Prop. owner	792-4037
JOHN R NELSON	owner	884 2210
STEPHANIE GRANTORS	REBROKER	821-1309
Bob Foglesong	BCPWD	848-1511
JOHN REILY	AMAFCA	
Barbara Rosnagle	Sandia Heights Assn.	856-7162
Bonnie Harkey	North Albuq. Acres Neighborhood Assn	856-1258
JAMES D. SMITH	Albuquerque	821-1465
Kurt		
Chuck		
Dixon		

9 of 22

Attendance Roster

Public Meeting

Albuquerque Metropolitan Arroyo and Flood Control Authority (AMAFCA) & Bernalillo County Public Works Division (BCPW)

AMAFCA Facility Plan and BCPW North Albuquerque Acres/Sandia Heights South Drainage Infrastructure Plan

August 19, 1998

Name	Affiliation	Telephone No.
Michelle & Knute Northrup		831-8826
Lena Eddings		872-0095/875-1851
BRAD CATANACH	BCPWD	848-1583
CHARLES THOMPSON	RTI	243-7300

PUBLIC MEETING
AMAFCA FACILITIES PLAN FOR LA CUEVA, EL CAMINO AND NORTH CAMINO ARROYOS
and
BCPWD NORTH ALBUQUERQUE ACRES/SANDIA HEIGHTS (SOUTH) DRAINAGE STUDY

CONCERNS/COMMENTS

1. Are you a property owner in one of the study areas?

☒ Yes
☐ No

2. Which area?

☐ Sandia Heights
☒ North Albuquerque Acres, east of Eubank
☐ North Albuquerque Acres, west of Eubank, north of Paseo del Norte, but outside the City Limits
☐ Within the City Limits, north of Signal Avenue
☐ Other_____

3. Are you a home owner in one of the study areas?

☒ Yes
☐ No

4. Which area?

☐ Sandia Heights
☒ North Albuquerque Acres, east of Eubank
☐ North Albuquerque Acres, west of Eubank, north of Paseo del Norte, but outside the City Limits
☐ Within the City Limits, north of Signal Avenue
☐ Other_____

5. How long have you lived at your current residence?

☒ 3 years or less
☐ More than 3 years

6. Do you work in the area?

☐ Yes
☒ No

7. Rank your drainage concerns in order of importance (1 being most important).

4 Safety
1 ✓ Reduction and/or control of floodplains and arroyos
5 Preservation of Open Space
___ Minimize Public Cost
3 Minimize Private Cost
___ Increase developable area
2 Other Review Process by Co + AMAFCA

8. Would you support a Special Assessment District for drainage infrastructure?

☑ Yes
☐ No

9. What would be a reasonable assessment per lot?

☐ Up to $500
☑ $500-$1000
☐ $1000-$1500
☐ $1500-$2000

10. How did you here about this meeting?

☐ Newspaper
☐ Community Organization
☐ From a friend or associate
☑ Direct contact with AMAFCA, BCPWD or RTI staff
☐ Other_____

11. Which roads/streets do you use most regularly?

Elena + Lowell

12. Which part of the presentation was of most interest to you?

☐ AMAFCA La Cueva, El Camino and North Camino Facilities Plan
☒ BCPWD North Albuquerque Acres/Sandia Heights (South) Drainage Study
☐ Both
☐ Other_____

13. What additional information would you like to see concerning drainage issues?

14. Other comments. Proposal to raise Elena at Lowell would give me problems by forcing Arroyo more to North

15. If you would like to be notified directly of future meetings on drainage issues, please provide us with your name, address and phone number.

PLEASE RETURN QUESTIONNAIRE TO ONE OF THE STAFF MEMBERS PRESENT OR SEND TO:

RESOURCE TECHNOLOGY, INC.
1720-B RANDOLPH RD., NE
ALBUQUERQUE, N.M.. 87106
(Attn: Dixon)

FAX: 243-7400

1998

PUBLIC MEETING
AMAFCA FACILITIES PLAN FOR LA CUEVA, EL CAMINO AND NORTH CAMINO ARROYOS
and
BCPWD NORTH ALBUQUERQUE ACRES/SANDIA HEIGHTS (SOUTH) DRAINAGE STUDY

CONCERNS/COMMENTS

1. Are you a property owner in one of the study areas?

- [x] Yes
- [ ] No

2. Which area?

- [ ] Sandia Heights
- [x] North Albuquerque Acres, east of Eubank
- [ ] North Albuquerque Acres, west of Eubank, north of Paseo del Norte, but outside the City Limits
- [ ] Within the City Limits, north of Signal Avenue
- [ ] Other_____

3. Are you a home owner in one of the study areas?

- [x] Yes
- [ ] No

4. Which area?

- [ ] Sandia Heights
- [x] North Albuquerque Acres, east of Eubank
- [ ] North Albuquerque Acres, west of Eubank, north of Paseo del Norte, but outside the City Limits
- [ ] Within the City Limits, north of Signal Avenue
- [ ] Other_____

5. How long have you lived at your current residence?

- [ ] 3 years or less
- [x] More than 3 years

6. Do you work in the area?

☒ Yes
☐ No

7. Rank your drainage concerns in order of importance (1 being most important).

1 Safety
2 Reduction and/or control of floodplains and arroyos
4 Preservation of Open Space
3 Minimize Public Cost
3 Minimize Private Cost
2 Increase developable area
____Other_____

8. Would you support a Special Assessment District for drainage infrastructure?

☒ Yes
☐ No

9. What would be a reasonable assessment per lot?

☐ Up to $500
☒ $500-$1000
☐ $1000-$1500
☐ $1500-$2000

perhaps a different scale based on benefit
non floodzone lot w/ house lower
heavily impacted floodzone lot higher

10. How did you here about this meeting?

☐ Newspaper
☐ Community Organization
☐ From a friend or associate
☒ Direct contact with AMAFCA, BCPWD or RTI staff
☐ Other_____

11. Which roads/streets do you use most regularly?
Richfield, Browning, Jewell, Eubank, Arakiem

12. Which part of the presentation was of most interest to you?

☐ AMAFCA La Cueva, El Camino and North Camino Facilities Plan
☐ BCPWD North Albuquerque Acres/Sandia Heights (South) Drainage Study
☐ Both
☐ Other_____

13. What additional information would you like to see concerning drainage issues?

14. Other comments. I BELIEVE WE NEED MORE SOLUTIONS TO SOLVE THE FLOOD ZONE ISSUES. THERE SEEMS TO BE AN ATTITUDE OF LEAVING FLOODZONES ALONE AND IN PRIVATE OWNERSHIP A FORCING OF "OPEN SPACE". AS GROWTH CONTINUES, DEMAND AND DESIRE FOR THESE LOTS WILL INCREASE, PEOPLE WILL DEVELOP THEM, EVEN WITH EXPENSIVE SITE BY SITE IMPROVEMENTS. WE NEED BETTER PLANS FOR REMOVING LOTS FROM THE FLOOD AREAS, MINIMIZING IMPACTS TO CREATE BAD SITES + SO FORTH. THERE IS NO DEVELOPER TO SOLVE THESE PROBLEMS - WE NEED OUR TAX DOLLARS GOVERNMENT TO TAKE THAT LEAD. IT WON'T END, PEOPLE WILL BUILD ON THESE FLOOD LOTS. THIS AREA HAS BEEN IN DEMAND AND WILL REMAIN SO. GOVERNMENT AGENCIES DID NOT STEP IN DURING THE '70'S + '80'S BUT IT MUST SOONER OR LATER. AS YOU CAN SEE, THE LONGER IT GOES, THE HARDER IT GETS!

15. If you would like to be notified directly of future meetings on drainage issues, please provide us with your name, address and phone number.

STEPHANIE GRANFORS
P.O BOX 90009
ALBUQUERQUE, NM 87199
821-1309

PLEASE RETURN QUESTIONNAIRE TO ONE OF THE STAFF MEMBERS PRESENT OR SEND TO:

RESOURCE TECHNOLOGY, INC.
1720-B RANDOLPH RD., NE
ALBUQUERQUE, N.M.. 87106
(Attn: Dixon)

FAX: 243-7400

WE ALSO NEED MORE PUBLIC INVOLVED. THE MEETING ATTENDEES WERE MOSTLY STAFF. BETTER NOTIFICATION ESSENTIAL.

PUBLIC MEETING
AMAFCA FACILITIES PLAN FOR LA CUEVA, EL CAMINO AND NORTH CAMINO ARROYOS
and
BCPWD NORTH ALBUQUERQUE ACRES/SANDIA HEIGHTS (SOUTH) DRAINAGE STUDY

CONCERNS/COMMENTS

1. Are you a property owner in one of the study areas?

☒ Yes
☐ No

2. Which area?

☐ Sandia Heights
☒ North Albuquerque Acres, east of Eubank
☐ North Albuquerque Acres, west of Eubank, north of Paseo del Norte, but outside the City Limits
☐ Within the City Limits, north of Signal Avenue
☐ Other_____

3. Are you a home owner in one of the study areas?

☐ Yes
☒ No

4. Which area?

☐ Sandia Heights
☐ North Albuquerque Acres, east of Eubank
☐ North Albuquerque Acres, west of Eubank, north of Paseo del Norte, but outside the City Limits
☐ Within the City Limits, north of Signal Avenue
☐ Other_____

5. How long have you lived at your current residence?

☐ 3 years or less
☐ More than 3 years

6. Do you work in the area?

☐ Yes
☒ No

7. Rank your drainage concerns in order of importance (1 being most important).

____Safety
____Reduction and/or control of floodplains and arroyos
____Preservation of Open Space
____Minimize Public Cost
____Minimize Private Cost
____Increase developable area
____Other See Ltrs to Kurt Browning, Mar 24 + Aug 19 98

8. Would you support a Special Assessment District for drainage infrastructure?

☐ Yes
☒ No

9. What would be a reasonable assessment per lot?

☐ Up to $500
☐ $500-$1000
☐ $1000-$1500
☐ $1500-$2000

10. How did you here about this meeting?

☐ Newspaper
☐ Community Organization
☐ From a friend or associate
☒ Direct contact with AMAFCA, BCPWD or RTI staff
☐ Other_____

11. Which roads/streets do you use most regularly?
Modesto + Eubank

12. Which part of the presentation was of most interest to you?

☐ AMAFCA La Cueva, El Camino and North Camino Facilities Plan
☐ BCPWD North Albuquerque Acres/Sandia Heights (South) Drainage Study
☒ Both
☐ Other_____

13. What additional information would you like to see concerning drainage issues?

see Ltrs to Kurt Browning
see ltr to NAACA

14. Other comments.

Please see ltr to Senator DeDe Feldman attached

15. If you would like to be notified directly of future meetings on drainage issues, please provide us with your name, address and phone number.

Perry R. Wilkes Jr
5147 Tennie Rd SW
Albuquerque, NM 87121

PLEASE RETURN QUESTIONNAIRE TO ONE OF THE STAFF MEMBERS PRESENT OR SEND TO:

RESOURCE TECHNOLOGY, INC.
1720-B RANDOLPH RD., NE
ALBUQUERQUE, N.M.. 87106
(Attn: Dixon)

FAX: 243-7400

Perry Robert Wilkes

June 10, 1998

Dede Feldman
State Senator
1821 Meadow View Drive NW
Alburquerque, NM 87104

Dear Dede,

My father asked me to forward this information to you. It concerns the very important subject of the Alburquerque aquifer. I hope it will be of interest to you.

Briefly, the aquifer is recharged by meltwater from the winter snows. This water runs down through the tilted geography which created the Rio Grande Valley eons ago. In the springtime we can watch this process as the many streams which run down the western face of the Sandias disappear into the vast alluvial fan at the foot of the mountains. There are also a number of small arroyos on the east mesa which largely handle the runoff generated by summer thunderstorms. The great majority of this water sinks into the very porous decomposed granite soil of the area and quickly disappears without a trace. I have seen this happen myself through countless hours spent exploring the east mesa when I was younger. As the area becomes more highly developed and roads are paved, this area will become less naturally absorptive, and problems will develop.

The AMAFCA approach has always been to construct a vast network of concrete-lined channels which reduce the natural absorptivity of the soil and accumulate floodwaters which are dangerous for anyone unlucky enough to be caught in one of these channels during an upstream storm. Because of this irresponsible design approach, we have seen many people perish over the years in these publicly-funded death traps. This swift water is often sent roaring into the Rio Grande, and away from the Alburquerque aquifer where it could be of great benefit. The result is a net loss to the Alburquerque area. Sometimes this runoff water is collected in huge, expensive, and unsightly, dams.

The main reason for this "concrete channel with storage dam" approach is probably job creation. There's nothing wrong with the goal of creating decent jobs. Indeed, it's a laudable goal but there is a far better way to accomplish the dual goals of runoff control and job creation.

A more responsible approach would be to develop a series of small check-dams from which an unlucky person could easily extricate himself and live to see another day. These small dams could provide a string of wildlife habitat and recreational areas which would blend unobtrusively into neighbor and small business communities. Instead of taking large tracts of expensive land off the tax roles and depressing neighborhood property values, such a project could actually increase property values and boost the tax roles. As a side benefit, there would be plenty of private-sector jobs generated during the construction period to spur the economy.

There are many people who believe there must be a better way to invest public funds for the betterment of the community as a whole, and this approach would go a long way toward making that goal a reality. I know you will give these thoughts your attention, and I thank you for that.

Sincerely,

Perry Robert Wilkes

718 Mountain Road Northwest | Alburquerque, New Mexico | 87102 | Tel 505-842-8626

PROBLEMS W/ WILKES PLAN – • FEMA FLOODPLAIN (HIS LOTS ARE ALL FP)
• FEMA APPROVAL (NOT REALISTIC)
• AVULSION #4 STILL NEEDS TO BE ADDRESSE DUE TO SAFETY DOWNSTREAM
• MESA DEL SOL IS FLAT ONTOP – WILKES LOT 3-1%

* COMMUNITY MUST DESIGN FOR 100YR EVENT

Barbara Seward : member

Board of County Commissioners:

District 4

Re: North Albuquerque Acres Rural Community

August 22, 1996

• ARROYO 3300 cfs +
• steep slopes
• alluvial fan area/sediment issues/proble.
• W/HIS PLAN – WIDE AREA OF LOTS WOULD NEVER B ABLE TO DEVELOP PER EXISTING ORD. (HE SHO NEW HOMES
• DAM PROPOSED ON PUEBLO?
• PROPOSED SMALL PONDS WOULD BE DESTROYED IN 100YR EVENT

Dear Commissioner Seward:

First, let me compliment you on your dedication and excellent work toward a better County. It is truly appreciated.

Next, let me present my approach for a better County in the form of a development plan which I have prepared for our five lots in NAA. This plan is the result of considerable investigation, observations and research over a 30 year period and I believe it has merit in dealing effectively with Albuquerque's water concerns in particular. Please note that in this approach toward improving the situation I have emphasized water conservation, water reuse and water retention. Constructed wetlands wastewater treatment is employed as added protection against possible ground water contamination due to septic tank leach fields and to create treated water for irrigation.

Over the years arroyo flow through the lots has increased dramatically primarily due to development with very poor surface water management. In this regard I find that there is very little effort made to retain run off on NAA developed property. In fact it would appear that most building permits issued by the County are taken as a license to flood out down stream neighbors. In 1970 I could step across the west arroyo on our property, now it is 40 feet wide and four feet deep due to this increased runoff.

The plan calls for beneficial retention of all water that falls on the property, reuse of water generated on site, and biologically sound management of arroyos running across the property, all aimed at reducing the demand on the aquifer (which is being depleted). Management intensive (controlled) grazing based on a biological plan designed to enhance the native grasses and other vegetation is proposed to ensure functioning water and mineral cycles as well as enhancing energy flow and plant succession. It is my observation that practically all the developed land and much of the undeveloped land in NAA has dysfunctional water and mineral cycles resulting in very little recharge of the water table and depletion of the mineral and organic content of the soil. As a result, energy flow and vegetation succession are also observed to be very poor in most cases.

The plan addresses these very important keys to the sustainability of the community and shows how it can be done without taxpayer expense. Over all this approach may even result in saving taxpayer cost in many ways i.e. cleaner air, reduced pumping of ground water and smaller (fewer) AMAFCA structures.

A longer arroyo path through the property is used to reduce the exit flow velocity of the west arroyo, with a corresponding reduction of the impact on our downstream neighbors property.

The approach outlined herein is also very effective in managing tumble weeds as many grazing animals find them to be good forage especially when they are very young.. Incidentally, I have not burnt a tumble weed in over 10 years as they are good mulch and soil binders. Burning them would not only pollute the air but would destroy a valuable resource.

The County could be helpful by grading Modesto in such a way that would work with the plan i.e. by directing the arroyo flow down the arroyo instead of across our property. Each road grading operation on Modesto results in an adverse impact on the plan and places our property at risk, not to mention the high cost of replacing lost soil and repairing erosion damage. Grading both sides of Modesto shoulders in a balanced symmetrical manner without under-cutting the part next to our property (and dumping it in the arroyo) would be very beneficial i.e. using excess dirt from the north shoulder to build up that part of the south shoulder which blends with the 5 lots. (see drawing).

I'm sure you recognize the general educational value of this approach in that it lays a solid foundation on which a better understanding of our environment can be built. Our teachers in turn need this support in furthering the learning process if we are to avoid and solve community (and other) problems for future generations. (Each lot a learning site)

I believe we all can work together to ensure a quality, productive and sustainable community at a lower overall cost. I'm willing to give it a try for a much better County.

Please excuse this rambling letter where I have sacrificed style for content and expediency

Enclosed please find a reduced size copy of my plan and other information.

Your comments would be greatly appreciated.

Sincerely yours, for a much better County,

Perry R. Wilkes Jr.
5147 Jennie Rd. SW
Albuquerque, NM 87121

P. S. please refer to these excellent books which can be found in the Public Library. Nos. 1 and 2 document the wrong road taken by the West and later by Albuquerque. No 2 also documents the much better road taken by Portland, OR. Nos. 3 and 4 complement the Portland story with a local perspective.

1- Cadillac Desert, By Marc Reisner

2-Planning Americas Communities, By Herb Smith

3-Rural Environmental Planning for a Sustainable Community, By Paul Lusk et al

4-Holistic Resource Management, By Allan Savory

Both Paul Lusk and Allan Savory live in the Rio Grande Valley. Herb Smith is a former Planning Director for Albuquerque.

1

Kirt Browning, P. E. AMAFCA
2600 Prospect Ave. NE
Albuquerque, NM 87107

March 24, 1998

RECEIVED
MAR 25 1998
AMAFCA

Re: La Cueva/Camino Arroyos

Dear Mr. Browning;

In response to La Cueva/ Camino DMP Avulsion #4 proposed Hamilton Dam, considered at the February Board of directors meeting, I am proposing a regional approach for managing La Cueva/ Camino Arroyos that would provide quality, productive and sustainable water courses and in turn ensure protection of the health, safety and welfare of the regional community at a reduced over all and long term cost. (See overlay on RTI drawing.)

Using Natural Engineering and Holistic Management principles, this plan would enhance the water cycle, recharge the aquifer, create a pleasing educational setting and provide a foundation for an "Adopt an Arroyo Program" to mention just a few of the benefits. This plan involves handling the runoff (flood water from the Sandia Mountains) at or near its major source and then using human scale structures to handle any release flow and local flow from other sources along the route to the Rio Grande.

I understand that previous research by others (ref. Ken O' Brien and Associates report, Oct. 1971) has shown that geologic formation characteristics of the head water areas of the arroyo systems running through Albuquerque provide an efficient, effective and natural way to recharge the regional aquifer. Increasing the capture of runoff water into the aquifer in this way and making up the difference with San Juan-Chama Diversion water

under the water compact with Texas. could result in a tremendous cost saving from not having to build a purification plant or significantly reducing its scale to process the San Juan-Chama water as is being planned.

The plan I propose would be an opportunity to demonstrate the feasibility of the concept while reducing the need for costly, complicated and dangerous fast flow channels through the Albuquerque area and most importantly it would be a step toward restoring the former livability of the region. With a recharged aquifer the region and its people would benefit in many ways.

The plan I propose is consistent with the ever growing need to pursue long range regional planning views of water and how its handled. The arroyos, which are basic and fundamental elements of the region, would not only be a focus of the community but would also be a productive member of the community. This is a sharp contrast to the arroyo being converted to a dangerous, unpleasant and unproductive conveyance relegated to the back of the "lot" with an ongoing tax payer burden for concrete lining replacement.

This plan is heavily weighted and highly dependent on community education (enlightenment) and involvement for its success. An education program tailored for the community and patterned after the very enlightening and recent Drainage Management work shop (sponsored under the leadership of the State Land Office.), on March 12th and 13th, I believe, would be a very worth while and productive way to for AMAFCA to spend taxpayers' money.

///

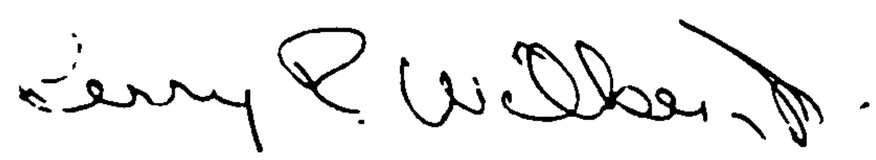
This regional plan involves the U.S. Forest Service, the Sandia Pueblo, the state of New Mexico, the County of Bernalillo, Sandoval County, the City of Albuquerque, the AMAFCA the RGCOG, the MRGCD, APS, and individual property owners.

Calling on Resource Technology Inc. and others, with tremendous capabilities and knowledge, to join AMACFA in taking a leadership role in the refinement and implementation of this conceptual plan would, I believe, result in benefits for all at less cost than the plan being considered.

Our property, (Our Places, Arroyo Alegre runs through them) is based on having a healthy, productive and sustainable arroyo system in order to achieve the goal we have set for the land. (A copy of our goal and our core values are attached.) I believe that achievement of this goal will also benefit the community as an important element in the regional plan here-in described. Our Places plan is in the design development phase and will be available to you at a later date. In the mean time please refer to a copy of the earlier conceptual plan which is attached along with a copy of my letter to County Commissioner Barbara Seward in which the plan is explained.

The plan presented here is based on ideas and information I have gathered in my association with many learned and thoughtful individuals, I believe it deserves your most considerate attention.

Respectfully yours;



Perry R. Wilkes, Jr. P. E. Retired
5147 Jennie Rd. SW
Albuquerque, NM 87121

DISTRIBUTION LIST

Albuquerque Mayor Jim Baca

N.M. Land Commissioner Ray Powell

N.M. State Engineer, (Attn. Frank Titus)

U.S. Bureau of Reclamation, Steve Hanson

MRGCOG

MRGCD (Attn. Sterling Grogan)

Bernalillo County Commissioner, Barbara Seward

Sandia Pueblo Governor

1000 Friends of New Mexico

Sierra Club, Attn. Susan Gorman (Sustainability Campaign)

MRWPAC

UNM Architectural & Planning School, Attn. Paul Lusk

NAANA

N.M. State Senator, Dede Feldman

N.M. State Representative

Jim Lewis, Organic Land Planner

Allan Savory, Center for Holistic Management

Bernalillo County Planner, Nano Chavez

Larry Blair, Bernalillo County Public Works

N.M. Environmental Law Center

U.S. Corps of Engineers

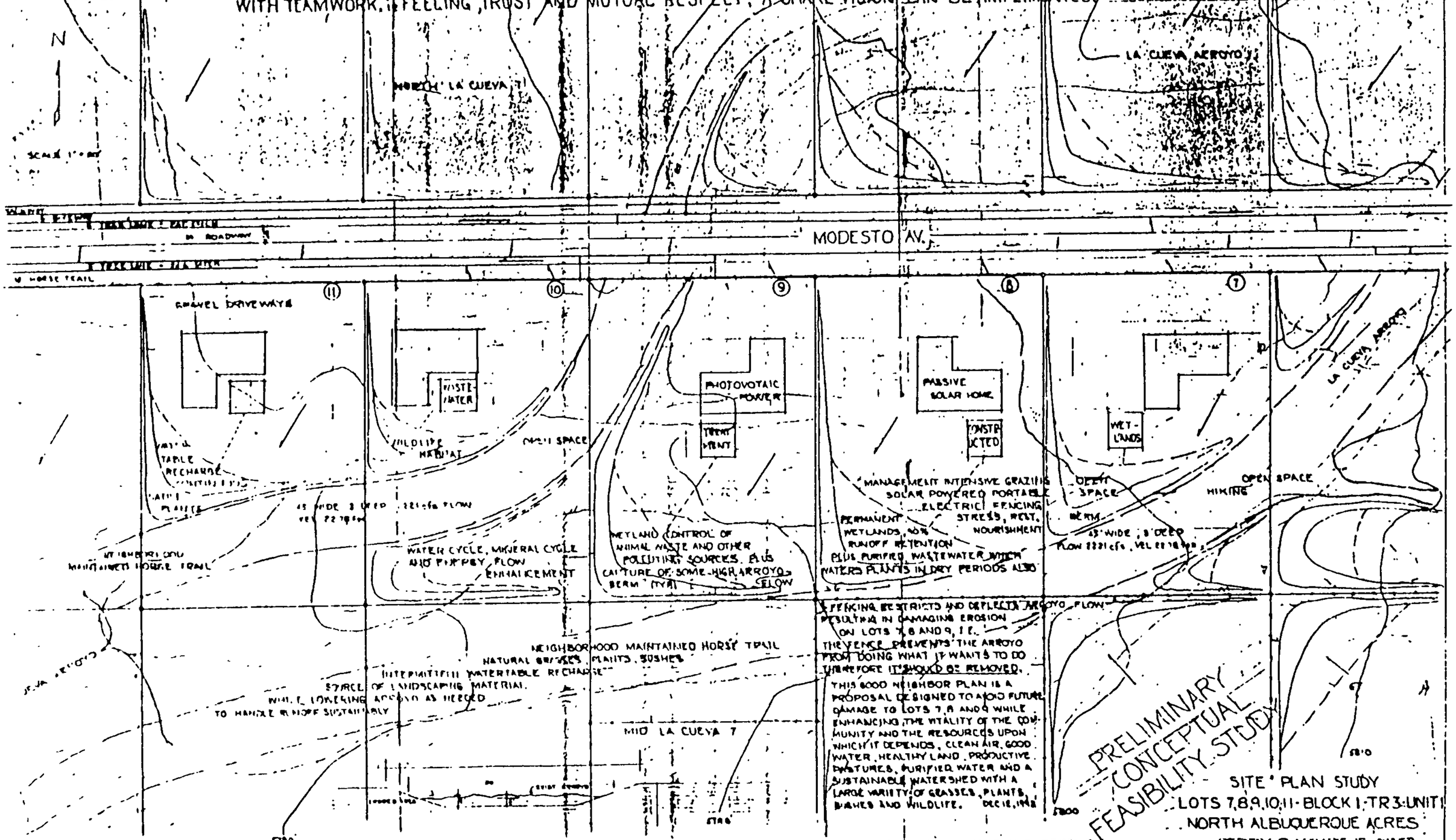
A GOOD NEIGHBOR PLAN FOR QUALITY, PRODUCTIVE, SUSTAINABLE COUNTRY LIVING IN NORTH ALBUQUERQUE ACRES — LOW COST AND HEALTHY — FUN TOO!

GOALS: CLEAN AIR, GOOD WATER, HEALTHY LAND IN A SECURE, ENJOYABLE, EDUCATION SETTING — A COMMUNITY WORKING TO IMPROVE QUALITY OF LIFE

WATER CONSERVATION AND RETENTION, WASTEWATER PURIFICATION USING CONSTRUCTED WETLANDS, HEALTHY HORSES, ORGANIC GROWN FOOD, SOLAR HEAT-POWER

SUSTAINABLE, STABLE WATERSHED CATCHMENT WITH WATERTABLE RECHARGE AND A LARGE VARIETY OF GRASSES, PLANTS, BUSHES, TREES AND WILDLIFE.

WITH TEAMWORK, FEELING, TRUST AND MUTUAL RESPECT, A SHARE VISION CAN BE IMPLEMENTED. LETS DO IT! — JAN. 1994



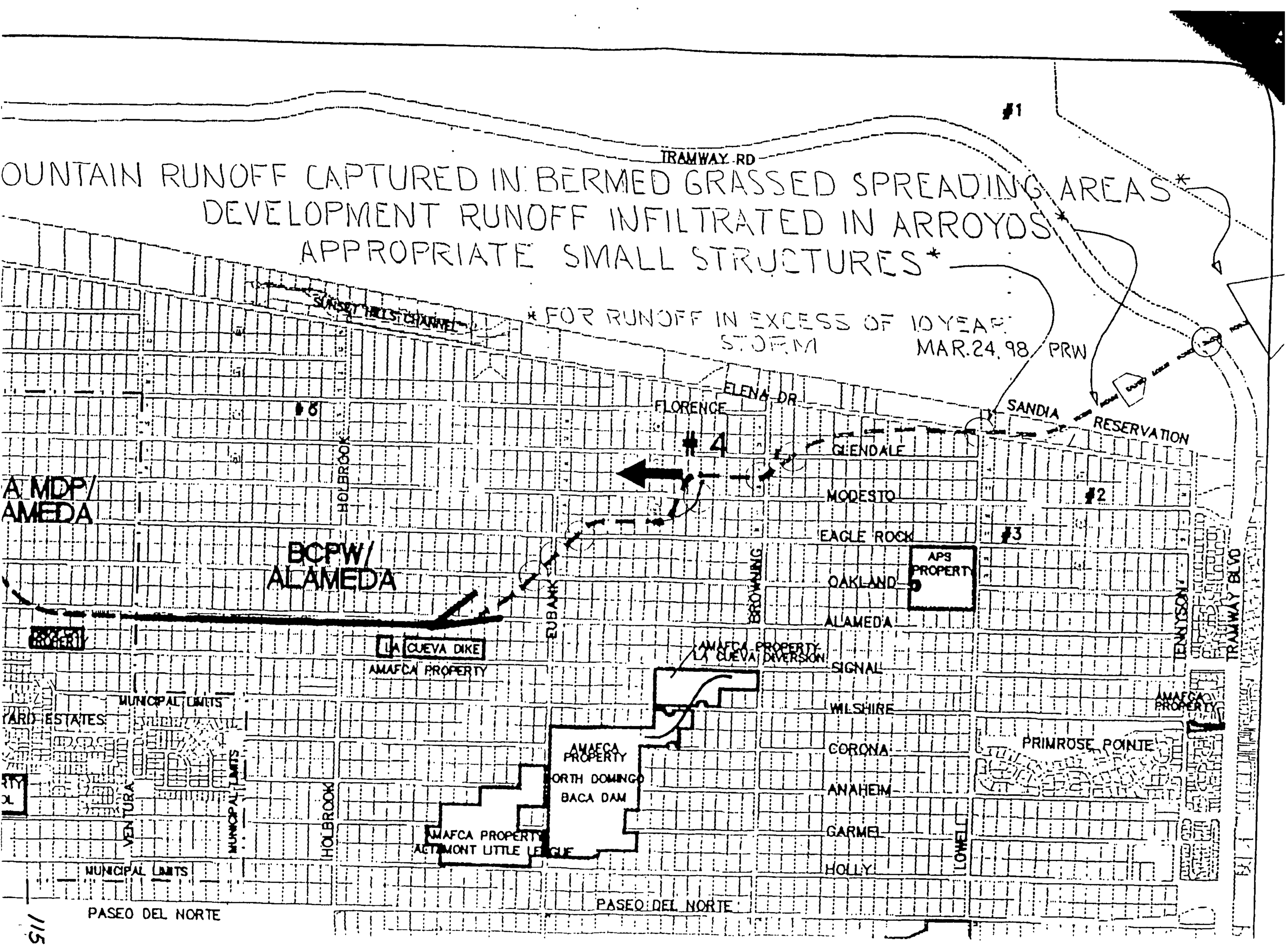
SEEKING RESTRICTS AND DEFLECTS ARROYO FLOW RESULTING IN DAMAGING EROSION ON LOTS 7, 8 AND 9, I.E. THE FENCE PREVENTS THE ARROYO FROM DOING WHAT IT WANTS TO DO THEREFORE IT SHOULD BE REMOVED.

THIS GOOD NEIGHBOR PLAN IS A PROPOSAL DESIGNED TO AVOID FUTURE DAMAGE TO LOTS 7, 8 AND 9 WHILE ENHANCING THE VITALITY OF THE COMMUNITY AND THE RESOURCES UPON WHICH IT DEPENDS, CLEAN AIR, GOOD WATER, HEALTHY LAND, PRODUCTIVE PASTURES, PURIFIED WATER AND A SUSTAINABLE WATERSHED WITH A LARGE VARIETY OF GRASSES, PLANTS, BUSHES AND WILDLIFE. DEC 18, 1993

PRELIMINARY CONCEPTUAL FEASIBILITY STUDY

SITE PLAN STUDY
LOTS 7,8,9,10,11 - BLOCK 1 - TR 3 - UNIT 1
NORTH ALBUQUERQUE ACRES
PERRY R. WILKES JR. OWNER
PERRY R. WILKES, JR. ENGINEER
NM 2439 (REVISED) JAN. 30 1981 (NOV 30 9

DEVELOPMENT OF THIS PROPERTY SHALL BE BASED ON AN EQUAL RESPECT FOR EACH MEMBER OF THE COMMUNITY I.E. SOIL, WATER, PLANTS, ANIMALS AND PEOPLE (CULTURE MONETARY) PLANTS AND ANIMALS HAVE LITTLE OR NO VALUE, THE BASIS FOR DEVELOPMENT MUST BE HOLISTICALLY FOCUSED IN ORDER TO PRESERVE THE INTEGRITY, STABILITY AND BEAUTY OF THE LAND, I.E. AN ECONOMICALLY SUSTAINABLE, HIGH QUALITY OF LIFE, PRODUCTIVE SITE.


OUNTAIN RUNOFF CAPTURED IN BERMED GRASSED SPREADING AREAS*
DEVELOPMENT RUNOFF INFILTRATED IN ARROYOS*
APPROPRIATE SMALL STRUCTURES*
* FOR RUNOFF IN EXCESS OF 10 YEAR STORM
MAR.24, 98 PRW
TRAMWAY RD
SUNSET HILLS CHANNEL
#1
#2
#3
#4
#5
#6
ELENA DR
FLORENCE
GLENDALE
SANDIA RESERVATION
MODESTO
EAGLE ROCK
OAKLAND
ALAMEDA
SIGNAL
WILSHIRE
CORONA
ANAHEIM
GARMEL
HOLLY
PASEO DEL NORTE
HOLBROOK
EUBANK
BROADWAY
LOWELL
TENNYSON
TRAMWAY BLVD
VENTURA
A MDP/
AMEDA
BCPW/
ALAMEDA
APS PROPERTY
LA CUEVA DIKE
AMAFCA PROPERTY
AMAFCA PROPERTY
LA CUEVA DIVERSION
AMAFCA PROPERTY
NORTH DOMINGO BACA DAM
AMAFCA PROPERTY
ACTIMONT LITTLE LEAGUE
PRIMROSE POINTE
MUNICIPAL LIMITS
MUNICIPAL LIMITS
MUNICIPAL LIMITS
YARD ESTATES

115

Perry Robert Wilkes

June 10, 1998

Dede Feldman
State Senator
1821 Meadow View Drive NW
Alburquerque, NM 87104

Dear Dede,

My father asked me to forward this information to you. It concerns the very important subject of the Alburquerque aquifer. I hope it will be of interest to you.

Briefly, the aquifer is recharged by meltwater from the winter snows. This water runs down through the tilted geography which created the Rio Grande Valley eons ago. In the springtime we can watch this process as the many streams which run down the western face of the Sandias disappear into the vast alluvial fan at the foot of the mountains. There are also a number of small arroyos on the east mesa which largely handle the runoff generated by summer thunderstorms. The great majority of this water sinks into the very porous decomposed granite soil of the area and quickly disappears without a trace. I have seen this happen myself through countless hours spent exploring the east mesa when I was younger. As the area becomes more highly developed and roads are paved, this area will become less naturally absorptive, and problems will develop.

The AMAFCA approach has always been to construct a vast network of concrete-lined channels which reduce the natural absorptivity of the soil and accumulate floodwaters which are dangerous for anyone unlucky enough to be caught in one of these channels during an upstream storm. Because of this irresponsible design approach, we have seen many people perish over the years in these publicly-funded death traps. This swift water is often sent roaring into the Rio Grande, and away from the Alburquerque aquifer where it could be of great benefit. The result is a net loss to the Alburquerque area. Sometimes this runoff water is collected in huge, expensive, and unsightly, dams.

The main reason for this "concrete channel with storage dam" approach is probably job creation. There's nothing wrong with the goal of creating decent jobs. Indeed, it's a laudable goal but there is a far better way to accomplish the dual goals of runoff control and job creation.

A more responsible approach would be to develop a series of small check-dams from which an unlucky person could easily extricate himself and live to see another day. These small dams could provide a string of wildlife habitat and recreational areas which would blend unobtrusively into neighbor and small business communities. Instead of taking large tracts of expensive land off the tax roles and depressing neighborhood property values, such a project could actually increase property values and boost the tax roles. As a side benefit, there would be plenty of private-sector jobs generated during the construction period to spur the economy.

There are many people who believe there must be a better way to invest public funds for the betterment of the community as a whole, and this approach would go a long way toward making that goal a reality. I know you will give these thoughts your attention, and I thank you for that.

Sincerely,

Perry Robert Wilkes

718 Mountain Road Northwest Alburquerque New Mexico 87102 Tel 505 [illegible]

OUR PLACES ON MODESTO NE
Bette J. & Perry R. Wilkes Jr., P. E. Retired

NATURAL ENGINEERING

August 19, 1998

Kurt Browning, P. E. AMAFCA Project Engineer
2600 Prospect Ave. NE
Albuquerque, NM 87107

Re; Community response for August 19, 1998 public meeting.

Dear Mr. Browning;

I have reviewed a July 8, 1998 draft of La Cueva, El Camino, and North Camino Arroyos Drainage Plan by AMAFCA / RTI.

I feel that the North Albuquerque Acres area would be better served at a lower cost with greater environmental benefits by following the course of action suggestions that I outlined in my letter to you dated March 24, 1998.

Briefly, geologic information indicates that relatively high infiltration rate areas exist at the upper portion of the alluvial fan of each arroyo before it passes through NAA. These areas coincide with the mouth of the respective Sandia Mountain canyons that feed these arroyos. The existence of these very high rate infiltration areas is both logical and observable. * They were formed over millions of years by storm water from each canyon as it spread out and slowed down dropping the larger gravel first. With more spreading and slowing on the alluvial fan the next size gravel was dropped and so on down the slope.

Enhancing these high infiltration rate spreading areas along the Sandia foothills with grassed berms, allowing the water additional time to percolate would not only increase the aquifer recharge and reduce flood risk but would also reduce the amount and velocity of water flowing through the existing NAA arroyos.** This Natural Engineering which would all but eliminate major avulsion threats and goes hand in hand with regional planning . The cost saving with this approach could be very significant.

NAA is located in a region defined by the Sandia Mountain and multiple agencies including the Forest Service, Sandia Pueblo, Bernalillo County and Sandoval County.

Since both the aquifer and surface water know no boundaries, all AMAFCA, City, County plans should reflect a regional approach incorporating Natural Engineering methods or we will soon run out of water, tax payer money and lose our rural setting.

I sincerely hope that I will have your support in urging AMAFCA , Bernalillo County and the City of Albuquerque to take this Regional approach for Storm Water Management and work with the other members of the Region in achieving the many lasting benefits.

Sincerely yours for a quality, productive and sustainable place to live and enjoy.

Perry R. Wilkes, Jr.

Perry R. Wilkes, Jr.

* For information on detailed soil data and infiltration rates, see Ken O'Brian & Associates , Sandia Foothills Drainage Study. Dated Oct. 1971

** Sandia foothills Drainage and Development Policies, A/BC Planning Department dated (Nov. 1971)

xc Frank Martinez , AMAFCA Executive Director

zc Barbara Sewart, Bernalillo County Commissioner

xc Bill Reinhart, President, NAACA

ECOLOGY UNLIMITED NATURAL ENGINEERING THE WHOLE ENCHILADA
Bette & Perry R. Wilkes, Jr., P. E. Retired 5147 Jennie Rd. SW Albuquerque, NM 87121

September 21, 1998

Professor Denise D. Fort
UNM School of Law
1117 Stanford Dr. NE
Albuquerque, New Mexico 87131-1431

Dear Professor Fort,

I would like to thank you for sending me a copy of the June 1998 Report of the Western Water Policy Review Advisory Commission (WWPRAC) entitled "Water in the West: The Challenge for the next Century."

The arrival of this report was very timely and supportive of my efforts to convince the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFACA) to reconsider its present Proposal for handling storm water runoff in La Cueva Arroyo. I believe tha AMACFA Proposal is deeply flawed in its assumptions and would result in an unnecessarily expensive project which would actually decrease public safety, harm the existing natural process and natural beauty of the area and ultimately lead to an overall reduction in property values.

I have been working with other area property owners to develope an Alternative Proposal which meets the intent and purpose of the Report issued by the WWPRAC and is consistent with the tenets of past area planning efforts. Our approach envisions dealing with the problem in small inclemental steps to check the flow at its point of generation and not create an extremely hazardous channelizied flow, the likes of which has cost many lives over the years in other areas of the City. A series of small check-dams constructed on a neighborhood scale would, I believe, represent a far more effective way of dealing with the problem and could actually be a visual asset to the community.

I commend you, and other members of the Commission on the intelligent and insightful work you have accomplished with this Report and I look forward to being of assistance in its implementation.

Sincerely,

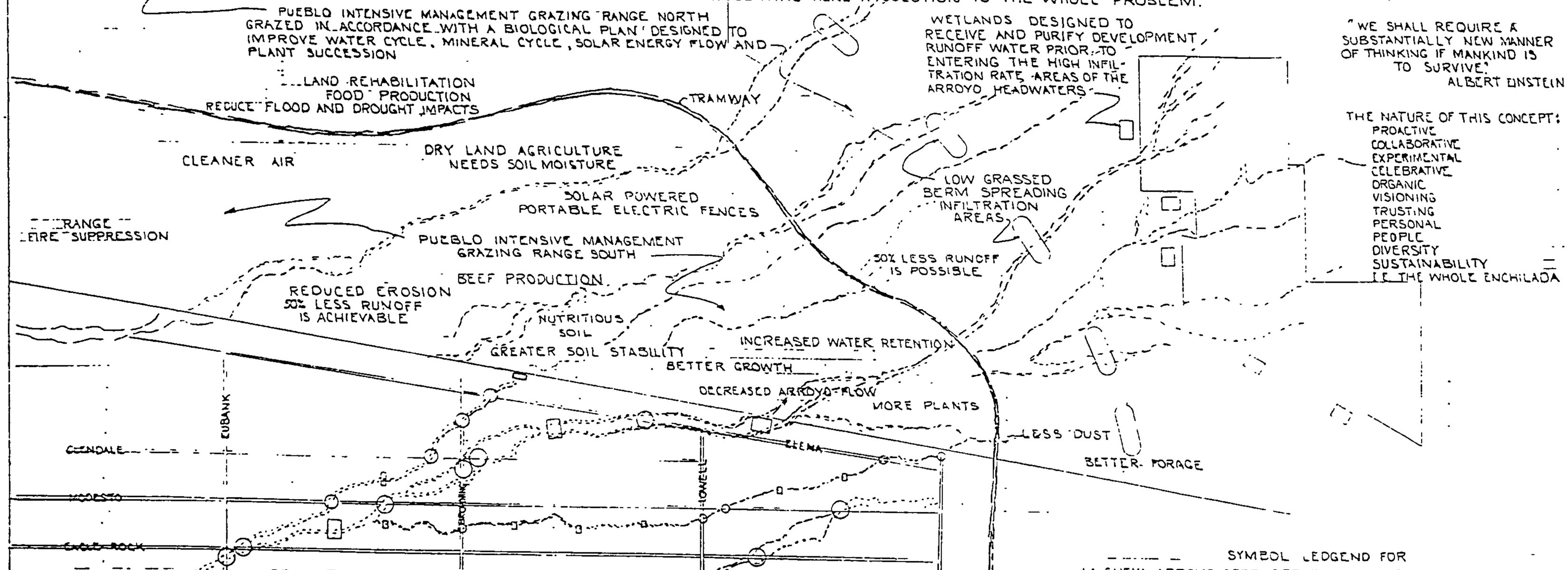
Perry R. Wilkes, Jr.

THIS IS A LAYMAN'S CONCEPT OF A REGIONAL HOLISTIC STORMWATER AND DROUGHT MANAGEMENT PLAN
PROTECTING OUR WATER BY REPLENISHING THE AQUIFER AND PRESERVING LA CUEVA ARROYO IN NAA

THIS PLAN UTILIZES EDUCATION, ENHANCED NATURAL ENGINEERING, PERMACULTURE PRINCIPLES, XERISCAPING, PROVEN RANGE MANAGEMENT PRACTICES, ETC.
FOCUSING ON QUALITY, PRODUCTIVITY, SUSTAINABILITY, LOW COST AND RESPECT FOR MOTHER EARTH

"THE WHOLE PROBLEM MUST BE SOLVED NOT JUST SOME HANDILY IDENTIFIABLE AND SIMPLIFIABLE ASPECT OF IT" WENDELL BERRY 1981 BOOK THE GIFT OF GOOD LAND

THE PLAN GUIDELINE: SINCE STORMWATER IS SIMPLY A RESOURCE OUT OF PLACE, WHAT CAN BE DONE TO USE THIS RESOURCE BENEFICIALLY?
THE QUESTION IS ANSWERED BY PRESENTING HERE A SOLUTION TO THE "WHOLE" PROBLEM.



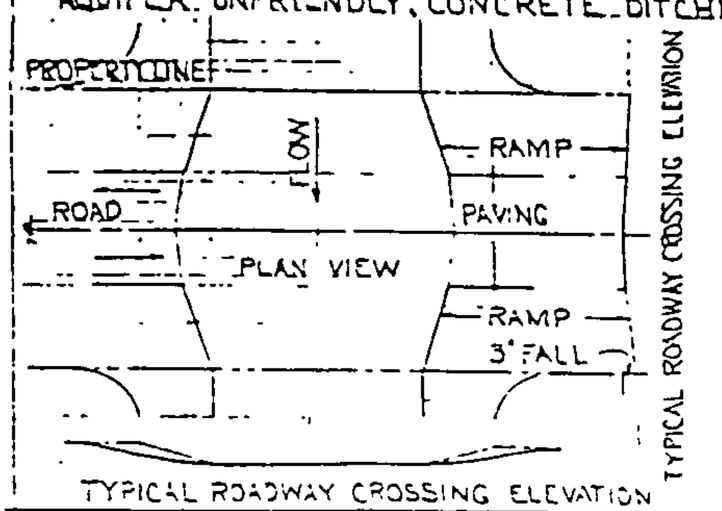
"WE SHALL REQUIRE A SUBSTANTIALLY NEW MANNER OF THINKING IF MANKIND IS TO SURVIVE."
ALBERT EINSTEIN

THE NATURE OF THIS CONCEPT:
PROACTIVE
COLLABORATIVE
EXPERIMENTAL
CELEBRATIVE
ORGANIC
VISIONING
TRUSTING
PERSONAL
PEOPLE
DIVERSITY
SUSTAINABILITY
I.E. THE WHOLE ENCHILADA

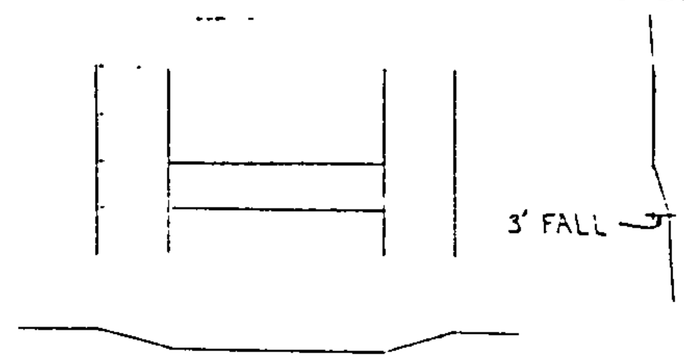
DROUGHT AND STORMWATER MANAGEMENT IN NORTH ALBUQUERQUE ACRES INVOLVES LANDSCAPE ARCHITECTS WORKING WITH PUBLIC AND PRIVATE PROPERTY OWNERS TO CAPTURE AND USE RAINWATER BENEFICIALLY, WHICH IN TURN WOULD VIRTURALLY ELIMINATE EROSION CAUSING RUNOFF AND PREPARE THE COMMUNITY FOR INEVITABLE DROUGHTS. ENHANCED ARROYO CORRIDORS, AS SHOWN, COULD THEN SAFELY HANDLE THE REDUCED FLOW TO BECOME THE COMMUNITY LANDSCAPE CENTERPIECE. THIS AQUIFER FRIENDLY APPROACH COST COULD BE CONSIDERABLY LESS THAN CONSTRUCTING LARGE, DIVISIVE AQUIFER UNFRIENDLY, CONCRETE DITCHES AND WOULD SERVE TO UNITE THE COMMUNITY TO PROTECT ITS WATER SUPPLY.

SYMBOL LEDGEND FOR LA CUEVA ARROYO SPREADER FALLS IN NORTH ALBUQUERQUE ACRES

FALLS SYMBOL	STREET CROSSING AV WIDTH	FALLS SYMBOL	PROPERTY LINE AV WIDTH	EST FLOW QUANTITY CU.FT/SEC	EST FLOW VELOCITY FT/SEC	ARROYO DEPTH FT
	50'		50'	1500	10	4'
	25'		25'	800	10	4'
	10'		10'	400	10	3'



TYPICAL ROADWAY CROSSING ELEVATION



SCALE 1" = 20'

TYPICAL ARROYO CONTOUR

CREATING MINI WETLANDS-ROCK-MARSHES TO HELP PUT SOMETHING IN THE "BANK" FOR THOSE NON-RAINY DAYS A 50% RUNOFF REDUCTION IS POSSIBLE

PRELIMINARY

BOTTOM LINE: THE AQUIFER HAS DROPPED 140 FEET AS STATED IN THE 1998 WATER IN THE WEST REPORT

SCALE 1" = 500'

LA CUEVA ARROYO:
OUR LIFE LINE-CENTERPIECE
DRAWN BY PERRY R WILKES JR
PROPERTY OWNER- NAA
NOV. 16 1998 REV

120

Resource Technology, Inc.
1720 - B Randolph Rd. SE Albuquerque, NM 87106
Telephone: (505) 243-7300
FAX: (505) 243-7400

10 September, 1998

Kurt Browning, PE
AMAFCA
2600 Prospect NE
Albuquerque, N.M.

Re: Perry Wilkes Proposal and Sandia Pueblo

Dear Kurt;

Pueblo of Sandia officials requested a meeting with John Curtin to discuss the City's Master Drainage Plan for North Albuquerque Acres. The meeting took place on August 21, 1998. John requested that I attend to assist with technical details. Besides John and I, Matthew Foster and Rhea Graham (Water Resource Manager) were in attendance. Several other parties attended for brief periods.

During the course of the discussion the proposed dike on Pueblo land was brought up. Matthew stated that while the Pueblo still regarded the proposal favorably they were aware that other proposals were circulating that involved the use of Pueblo tribal lands to solve City and County drainage problems. He stated in the strongest possible terms that tribal officials had no interest in such proposals. While he did not mention any specific details I had the impression he was referring the Perry Wilkes "regional approach" outlined in his March 24, 1998 letter to you and copied to the Pueblo of Sandia Governor's office. I think their opposition needs to be considered if the Wilkes proposals are to be pursued any further.

Resource Technology, Inc.

Donald S. Dixon

Donald S. Dixon, P.E.

16 September, 1998

Resource Technology, Inc.
1720 - B Randolph Rd. SE Albuquerque, NM 87106
Telephone: (505) 243-7300
FAX: (505) 243-7400

John Kelly, P.E.
AMAFCA
2600 Prospect, N.E.
Albuquerque, N.M.

Re: Perry Wilkes Drainage Concept
La Cueva, Camino and North Camino DMP
RTI No. 95-190

Dear John;

In my previous comments on the concepts presented by Mr. Wilkes I have concentrated on the practicality of the proposal with regards to use of Pueblo of Sandia land for a major detention dam. However, there are some technical issues related to his proposal that need to be addressed as well. These are discussed below.

Assuming a retention dam on the La Cueva Arroyo was built near Tramway it would certainly reduce flows in the general area where Mr. Wilkes owns property. While the following discussion utilizes the Tramway location the same arguments would apply to the Browning location in the Draft Facilities Plan with minor modifications to some of the numbers. The following table shows the unbulked flow rates for future condition development at selected locations, assuming 100% retention.

FLOW RATES AT SELECTED LOCATIONS ON LA CUEVA ARROYO		
LOCATION	**NO DAM**	**WITH RETENTION DAM**
Browning	2575 cfs	326 cfs (14 ac-ft)
Ventura	2796 cfs	1554 cfs (79 ac-ft)
Wyoming	2870 cfs	1995 cfs (115 ac-ft)
I-25	3566 cfs	3126 cfs (201 ac-ft)

While a 10-50% reduction in 100-year flow rates through the incorporated portion of North Albuquerque Acres would be of benefit, major flood control facilities (channels or additional dams) would still be required. Mr. Wilkes seems to recognize this and proposes to control runoff from areas downstream of the Tramway Dam with individual lot storm water detention and/or "small check dams".

There are several problems with individual lot storm water detention systems. First of all nearly 50 % of the available NAA lots east of Eubank and approximately 20% of those west of Eubank in unincorporated areas are already built on. It would be virtually impossible to force these property owners to "retrofit" detention ponds on their homes sites. In addition, long term maintenance and operation of these systems would depend on the actions of individual property owners. The City of Albuquerque formerly had a on-site storm water detention policy that proved to be unreliable and difficult to enforce. That policy was replaced by the current City Drainage Ordinance.

If the emphasis were shifted to the check dam concept (by which I assume he intends that they function as detention or retention ponds) a workable plan could certainly be developed that would supplement the operation of the proposed Tramway Dam (or Browning Dam). If we assume that at least 50% of the 100-year storm water volume would need to be detained in ponds in order to achieve meaningful downstream reduction in runoff flow rates and that the individual ponds had an average storage capacity of 6 acre-feet then approximately 16 "check dams" would be required. Six of these would need to be located east of Ventura and an additional ten between Ventura and I-25. Each would cover between 1 and 2 acres of land and have a depth of between 5 and 10 feet. A storm drain system would still be required to capture flows and route them to the ponds and to receive discharge from the ponds and take it to existing facilities at I-25. (If they were designed to permanently retain storm water runoff it would raise water rights issues that would require State Engineer Office approval and would require changes to the City Drainage Ordinance). While this is all technically feasible and could result in some "open space" benefits, I doubt if there would be any economic benefit resulting from such an approach.

The possible benefit of groundwater recharge from another major dam and additional shallow ponds or check dams would have to be demonstrated. It is my understanding that the primary recharge zones are at the base of the Sandia Mountains. Personal observation of existing detention dams in the NAA area leads me to believe that there is very little recharge. Water in minor depressions that does not drain through the principal spillway seems to evaporate rather than infiltrate. I bring this issue up more to point out that there is no necessary connection between impounding water on the surface and recharge of an aquifer hundreds of feet (and in some cases over 1000-ft.) below the surface than to dismiss entirely the question of benefits due to recharge.

In summary, while a dam upstream of Mr. Wilkes' property would enable him to develop it, the overall benefit to the community of his concept is less clear. While I have not performed a

detailed cost estimate of his proposal, my feeling is that there would be little economic benefit. The recharge issues needs more investigation and the open space benefit of check dams scattered throughout the area is highly subjective. If you would like me to pursue any of these issues further please let me know.

Resource Technology, Inc.

Donald S. Dixon, P.E.

Resource Technology, Inc.
1720 - B Randolph Rd. SE Albuquerque, NM 87106
Telephone: (505) 243-7300
FAX: (505) 243-7400

11 November. 1998

John Kelly, P.E.
Albuquerque Metropolitan Arroyo Flood Control Authority
2600 Prospect NE
Albuquerque, N.M. 87106

Re: Comments on Perry Wilkes Revised Drainage Concept (11/9/98)
La Cueva, Camino and North Camino DMP
RTI No. 95-190

On November 9,1998 Mr. Wilkes presented me with a revised concept for North Albuquerque Acres consisting of a 11x17 sheet with various facilities, comments and detailed sketches of his latest thoughts (see attached). The new system seems to rely on "low berms" in the foothills to spread arroyo flows out so as to encourage additional infiltration, various "constructed wetland" areas to "purify" runoff from developed areas, "arroyo spreader falls" along some of the major arroyo flow paths (presumably to enhance infiltration), and providing paved dip sections in NAA for arroyo crossings. West of his property, located between Browning and Eubank on Modesto, I presume Mr. Wilkes still proposes to utilize check dams and on-site detention ponds.

While in theory many of Mr. Wilkes's proposals would reduce flow rates for downstream property owners there are several practical problems with their implementation.

1. Not the least of these problems is that numerous critical elements in his plan require construction on Pueblo of Sandia and U.S. Forest Service land. Given that there are alternative approaches to flood control and water resource management it is hard to see why the Pueblo and U.S.F.S. would be willing to give up control and use of significant tracts of their land in order for Mr. Wilkes and a few other property owners to benefit.

2. Secondly, Mr. Wilkes assumes that the major mechanism for infiltration is surface area exposed to runoff. This is an over simplification of the infiltration process. During a major storm runoff is generated by the fact that the ground surface infiltration capacity has been exceeded by rainfall. Therefore, spreading water over a larger area that is already saturated beyond its infiltration capacity would be pointless. The only practical way to increase the amount of infiltration that will take place is to increase the depth of the water to create static head and/or to increase the time over which infiltration can take place. This indicates that some sort of ponding is required to increase infiltration by any significant amount.

3. The structures required to accomplish the goal stated by Mr. Wilkes of a 50 % reduction

in runoff would be far larger or more numerous than shown on his conceptual plan. It can shown that in order to reduce runoff rates during a 100-year event by a meaningful amount that the stored volume of one or more detention or infiltration basins would have to be on the order of 50% of the total runoff volume. This means that for Mr. Wilkes to benefit, regardless of where they are placed east of his property, the total volume stored by the berms, check dams and spreader falls would have to be approximately 95 acre-feet. (The total existing condition 100-year volume of runoff at Browning for the main branch of the La Cueva Arroyo is 187 Acre-feet, after subtracting various losses including infiltration.) If each berm or check-dam stored 6 acre-feet of water, 16 structures would be required.

4. Finally, for safety reasons Bernalillo County limits the 100-year flow allowed over a roadway by the following:

- Maximum allowable flow depth is 8-inches
- Maximum product of velocity and depth must be less than 6.5.

Normally these restrictions limit the maximum allowable flow in a dip-section to less than 200 cfs. There are dozens of places in North Albuquerque Acres and Sandia Heights road crossings that do not meet these criteria but BCPW is currently trying to develop a plan to address this issue.

In summary, while the goals of reducing overall storm water runoff and maximizing basin recharge presented by Mr. Wilkes are hard to fault, I do not think the plan he has presented will accomplish them. For the La Cueva, El Camino and North Camino Arroyos the issue of recharge east of Browning is probably best left to nature by leaving the natural arroyos alone whenever possible. West of Browning some form of human intervention for flood control is inevitable given the density of existing as well as future development. In this area a program of basin recharge may well be warranted to replace any loss of natural infiltration capacity by human activity but the nature of these facilities would have to be determined by further investigation.

Resource Technology, Inc.

Donald S. Dixon, P.E.

La Cueva, Camino and North Camino Arroyos
Facilities Plan
Public Agency Briefing

Meeting Minutes

Location: **AMAFCA Conference Room**

Date: **Tuesday, September 15,1998**

Time: **8:30 AM**

Attendees: **See Attached List**

Recorder: **D. Dixon**

John Kelly opened the meeting at 8:35 by asking Dixon to update the parties present on the recent Public Meeting held to discuss the AMAFCA Facilities Plan and the BCPW NAA/SH Drainage Infrastructure plan on 8/19/98.

Dixon reported that the meeting was sparsely attended with 9 of the 22 present being either AMAFCA, BCPW, City employees or their Consultants. The major concerns expressed were when would the facilities proposed be built and by who. Most comments expressed concerns about specific properties and local drainage problems. The written comments (from 3 responses to questionnaires) concerned private property access, wanting more lots removed from flood plain and concern about channel/dam construction instead of more naturalistic approaches. The channel issue was raised by Perry Wilkes who advocates a combination of a large dam on Pueblo land along with smaller ponding facilities located in NAA.

Dixon went on to report that based on a separate meeting with John Curtin and the Pueblo that the dam on Pueblo land would not meet with their approval. In his opinion there were numerous other problems with the Wilkes proposal as well.

John Kelly reported that AMAFCA staff has had recent discussions with Pueblo officials that have resulted in some progress toward resolving the dike issue. The Pueblo of Sandia council may authorize their representatives to negotiate an agreement with AMAFCA on design and construction of the dike. The AMAFCA Board would like to resolve this issue prior to the January election.

Dixon offered to go over any aspects of the draft AMAFCA facilities plan if desired but recommended that more discussion of the La Cueva Arroyo/Avulsion #4 was probably in order.

The main issues were whether to propose a traditional concrete channel or a more naturalistic approach similar to the original avulsion control recommendation. This approach could be worked into an Open Space Plan for the area.

Dan Hogan (COA Hydrology) reported that the plan to control avulsion #4 in the City's draft MDP for NAA may be hard to implement by the City since it is outside of the City limits.

Matt Schmader (Open Space) stated that they only have a very limited land acquisition budget ($100,000). In addition they need to do a thorough review of the area to determine if any of the property is appropriate for open space.

Dixon pointed out that all of the options had an estimated cost of $3 to $4 million with the channelization option being the most economical because it reduced substantially the number and required span for bridges at arroyo crossings. Open space land acquisition would be additional to this.

Roger Paul brought up the fact that the County Transportation plan for the area only recognized the need for a limited number of cul-de-sacs. In this area they were on Elena and Glendale. Any proposal to put cul-de-sacs on Modesto would probably not have their support. He also proposed setting up a meeting with Commissioner Seward and Councilmen Bregman to discuss these issues and obtain their support for the plan.

John Kelly suggested that more concern be given to the overall needs of the community in North Albuquerque Acres. Which was the most pressing need - more developable lots or more open space? He felt that we needed more input from planners.

Matt Schmader indicated that Open Space was not interested in acquiring flood plain lots for the costs being indicated ($75000-$80000). Their primary concern was to maintain trail access.

John Kelly suggested that joint acquisition by AMAFCA and Open Space might be a possibility.

The meeting concluded that more discussion of the open space approach with avulsion control dikes was needed in the report. The AMAFCA Board would decide if they wanted to have minor revisions made and then adopt the report or to make revisions and hold another public meeting prior to any Board action. He stated that he needed any comments to be presented to the Board by Wednesday, September 23.

distribution: Attendees

Invited but not in attendance:

Bob Foglesong
Carmen Chavez
Ray Van Hoven
Howard Stone
Carlos Padilla

NAME	ORGANIZATION	PHONE/FAX
Donald Dixon	RTI	243-7300/243-7400
Ted Reddinger	Bern. Co. BZ&P	924-3721/924-3780
John Curtin	C.O.A./PWD/Hyd	768-2727/768-2765
DAN HOGAN	" " "	768-2729 768-2765
ROGER PAUL	BCPWD	848-1515/848-1510
BRAD CATANACH	BCPWD	848-1583/848-1510
JOHN KELLY	AMAFCA	884-2215/884-0214
Susan Calongne	CITY/COUNTY FPA	924-3982
Matthew Foster	Pueblo of Sandia	867-3317 | 867-9255
Matt Schmader	Open Space	873-6620/873-6628

CITY OF Albuquerque

September 24, 1998

Mr. John Kelly, AMAFCA
2600 Prospect NE
Albuquerque, NM 87107

RE: La Cueva, El Camino and North Camino Arroyos Drainage Facility Plan

Dear John,

I think the draft plan does an excellent job identifying the drainage issues throughout North Albuquerque Acres. As you know, the City is currently preparing the La Cueva Sector Development Plan for the area between Louisiana and Ventura, north of Paseo del Norte. The purpose of the Sector Plan is to institute land uses and zoning and provide capital infrastructure priorities for vacant properties in the plan area. In conjunction with the Sector Plan, the City is also drafting a Master Drainage Plan which identifies all major storm drainage infrastructure in the Sector Plan area. All of the drainage structure improvements were based on the assumption that major upstream avulsions were controlled. The economic advantages of controlling the avulsions in the short-term would result in a benefit to cost ratio of 2.0 for facilities within the City limits. This information is stated in your draft Drainage Facility Plan, but I feel the need to stress the importance of avulsion control. Controlling the avulsions is critical to the implementation of the La Cueva Sector Development Plan. It will require a coordinated effort between the City, County, and AMAFCA.

If I may, I would like to recommend avulsions 4 and 6 as priorities. Both of these avulsions involve the La Cueva Arroyo which is identified as a Major Open Space Arroyo in the *Facility Plan for Arroyos*. This arroyo has been designated as one of the facilities that will benefit from the 1/4 cent Open Space Tax. It is also identified as a major trail corridor on the *Trails and Bikeways Facility Plan*. Also, the La Cueva Sector Plan proposes a future park along this arroyo, immediately east of Louisiana. Please take these avulsions into consideration when you prioritize expenditures.

Thank you for the opportunity to comment on this plan. If you have any questions regarding my comments, please call me at 924-3814.

Yours truly,

Carmen Chavez

Carmen Chavez, North Albuquerque Community Planner

cc: John Curtin, COA, Hydrology Division
Phyllis Taylor, Sites Southwest

County of Bernalillo
Zoning, Building & Planning Department
600 Second Street NW • Suite 400 • Albuquerque, NM 87102 • (505) 924-3700 • Fax (505) 924-3750

TO: John Kelley, P.E. Chief Engineer, AMAFCA

FROM: Ted Reddinger, Program Planner, NAA

SUBJECT: La Cueva, El Camino, and North Camino Arroyos Drainage Facility Plan

DATE: September 23, 1998

The North Albuquerque Acres (NAA) and Sandia Heights (SH) area is within the unincorporated portion of Bernalillo County. This area offers many unique and challenging planning and engineering opportunities.

These opportunities were mainly created because the original platting action for NAA consisted of a uniform grid pattern that ignored topographic and drainage features. Presently the problem is compounded by the fact that most of the lots are in individual ownership, making it difficult to amass portions for necessary drainage easements.

There are approximately 1700 lots in NAA with about 725 currently developed. The portion of NAA that lies within Bernalillo County maintains a rural character; is zoned A-1 which requires a one acre minimum lot size and the home owners to supply their own water and waste water systems, as compared to the City portion that is serviced by municipal water and sewer.

Bernalillo County is experiencing moderate levels of single family home construction on the originally platted lots. The western portion of the area, within the City, is being developed either as commercial/industrial or replatted for higher density residential development.

Historical drainage patterns should be emphasized, provided that the arroyo (drainage) crossings can be properly addressed from a transportation standpoint.

The health, safety, and general welfare of the area residents should be of utmost importance concerning the development and implementation of this Drainage Facility Plan.

Xc: Don Dixon, P.E, V.P., Resource Technology, Inc.

City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

September 18, 1998

John Kelly
AMAFCA
2600 Prospect NE
Albuquerque, NM 87107

RE: La Cueva, El Camino and North Camino Arroyos Drainage Facility Plan

Dear Mr. Kelly:

This the first time I've ever known the City consultant, the County consultant and the AMAFCA consultant to agree with each other. Seriously, the City appreciates your cooperation and coordination with the City's North Albuquerque Acres Master Drainage Plan. You have done an excellent job of incorporating our work into your report. The Drainage Facility Plan combines the efforts of the City, the County and AMAFCA into a unified plan for these arroyos.

If I can be of further assistance, You may contact me at 768-2727.

Sincerely,

John P. Curtin

John P. Curtin, P.E.
Project Manager, PWD/Hyd

c: Don Dixon, Resource Technologies, Inc.
Dan Hogan, Manager, Hydrology Div.

United States Department of Agriculture
Forest Service
Cibola National Forest
Sandia Ranger District
11776 Hwy. 337
Tijeras, NM 87059
(505) 281-3304 FAX: 281-1176

File Code: 2720

Date: August 10, 1998

Mr. Kurt Browning
AMAFCA
2600 Prospect NE
Albuquerque, NM 87107

Dear Mr. Browning:

The Forest Service is in the environmental analysis process for the AMAFCA training dike propsal with all interested parties. To enable us to complete the necessary analysis requirements as they pertain to Forest Service lands, we are requiring you to provide written concurrence from Sandia Pueblo whom you have been working with. This will enable us to proceed with a decision.

Should there be any questions, contact Donald Hall at 847-2990.

Sincerely,

CLIFFORD J. DILS
District Ranger

RECEIVED
AUG 12 1998
AMAFCA

United States
Department of
Agriculture

Forest
Service

Cibola
National
Forest

Sandia Ranger District
11776 Hwy. 337
Tijeras, NM 87059
(505) 281-3304 FAX: 281-1176

File Code: 2720

Date: October 26, 1998

Mr. Kurt Browning
AMAFCA
2600 Prospect NE
Albuquerque, NM 87107

Dear Mr. Browning:

In reviewing our files as they pertain to the AMAFCA training dike proposal, we find that we are still in need of written concurrence from Sandia Pueblo whom you have been working with. We again request that you provide this information to enable us to proceed with a decision.

Should there be any questions, please contact Donald Hall at 847-2990.

Sincerely,

CLIFFORD J. DILS
District Ranger

RECEIVED
OCT 29 1998
AMAFCA

Resource Technology, Inc.
1720 - B Randolph Rd. SE Albuquerque, NM 87106
Telephone: (505) 243-7300
FAX: (505) 243-7400

La Cueva, Camino and North Camino Arroyos Facilities Plan Elected Officials Briefing

Meeting Minutes

Location: Bernalillo County Commission Conference Room

Date: Wednesday, October 28, 1998

Time: 9:00 AM

Attendees:
Commissioner Barbara Seward
Councilor Vincent Griego
Councilor Sam Bregman
Larry Blair, COA Dir. Of Public Works
John Curtin, COA Hydrology
Roger Paul, BCPW
John Kelly, AMAFCA
Donald Dixon, RTI

Recorder: D. Dixon

The meeting was opened at 9:15 am with an introduction by John Kelly. The purpose of the meeting was to inform elected officials of the nature and scope of the planning efforts underway by AMAFCA and the related projects by the City and County.

Kelly and Dixon gave a brief overview of the AMAFCA Facilities Plan and how it related to the City and County studies. The critical necessity from an cost standpoint of avulsion control was presented and the benefit of cooperation with the Pueblo of Sandia discussed. John Kelly reviewed AMAFCA Board attempts, unsuccessful to date, to control what is called Avulsion No. 1 by cooperative efforts with Sandia Pueblo and the US Forest Service.

The overall cost of implementing the plan was estimated to be on the order of $20,000,000, not including connecting storm drains in the City and numerous arroyo road crossings in the County. John Kelly pointed out that this was more than the current AMAFCA Board felt it could commit to given other pressing drainage needs in other locations. Roger Paul stated that while the County study was not complete, BCPW had already placed several avulsion control projects on its CIP list although they were not on the current Bond cycle. John Curtin indicated that with the

hoped for approval of the City's NAA Master Drainage Plan and related La Cueva Sector Plan some related projects within the municipal limits would be placed on the City's CIP program. Don Dixon pointed out that each of the planning efforts by the City, County and AMAFCA had its own cost estimates but, due to the overlap in projects, the overall cost of the required drainage improvements was not the sum of the estimated cost of each of the three studies.

After addressing questions for clarification of some of the technical issues each of the elected officials expressed support for attempting to solve drainage problems in an integrated manner and hoped that cooperative efforts would continue.

The meeting adjourned at 10:30 am.

Additional Explanations for Form 3
Hydrologic Analysis Form
North La Cueva, South La Cueva, and South El Camino Arroyos

3.1. Changed Physical Conditions of Watershed

Since the acceptance of the effective FEMA floodplain maps several physical changes controlling flooding have occurred to the N. La Cueva, S. La Cueva, and S. El Camino arroyos.

North La Cueva Arroyo

The area studied for this revision request for the N. La Cueva begins on the upstream side at Wyoming Blvd. The N. La Cueva Arroyo crosses Wyoming Blvd. just south of Eagle Rock Ave.

Two previously accepted LOMRs, dated June 3, 1988 and June 29, 1990, for Nor Este Estates revised the North and South La Cueva floodplain just east of Wyoming Blvd. This revision request begins where the Nor Este Estates LOMRs ended. The accepted LOMRs for Nor Este Estates are provided in Appendix A.

The physical flood control measures that have occurred on the N. La Cueva Arroyo are described briefly below. Further details for each control measure are provided later in this LOMR.

1. La Cueva Training Dike at Eagle Rock Ave. - A training dike was built at Wyoming Blvd. and Eagle Rock Ave. by AMAFCA. This functions to collect the upstream flow and direct it to its historic path north of Eagle Rock Ave.

2. 3-10'x10' Concrete Box Culverts Under I-25 - The structure that passes the N. La Cueva flow under I-25 (referred to as Structure 11) consists of 3-10'x10' CBC's. This structure also carries some excess flow from the S. El Camino Arroyo, under I-25. Figure 1.1 shows the I-25 drainage structure locations.

3. Concrete Lined Channel on the West Side of I-25 - The N. La Cueva Arroyo was channelized in a trapezoidal, concrete lined channel from I-25 to the arroyo's confluence with the North Diversion Channel, by AMAFCA.

South La Cueva Arroyo

The area studied for the S. La Cueva begins just east of Wyoming Blvd., on the La Cueva High School property, and continues to the confluence of the S. La Cueva with the N. La Cueva.

Physical changes that have occurred on the S. La Cueva Arroyo area are briefly described below:

1. San Pedro Storm Drain- The storm drain begins at Signal Ave. and continues north along San Pedro Drive to Modesto Ave. (Old Alameda Ave.). At Modesto Ave. the storm sewer turns northwest, continuing underground, and outlets on the east side of I-25, just in front of Structure 12. Structure 12 consists of 8-36" reinforced concrete pipes (RCP) which pass flow under I-25. Currently, there are two branch

storm drains that direct flow to the main San Pedro Storm Drain. A 30" storm drain is located in Signal Ave. and a 24" storm drain is in Eagle Rock Ave. Refer to Figure 1.1 and Figure 3A for reference on the location of the storm drain system.

The main storm drain in San Pedro Drive is a 54" RCP. The as-built plans for the storm drain are provided in Volume 3 of the LOMR. The design capacity for the San Pedro Storm Drain is 160 cfs. Currently, with the existing inlets and the unpaved conditions of many of the area streets, the system does not collect the flow capacity.

- *Diversion of Flow Into South La Cueva Watershed*
  The southern portion of the storm drain system, south of Oakland Ave., collects and diverts flow from the southern adjacent watershed into the South La Cueva Watershed being studied in this LOMR. Without the storm drain system, the flow originally traveled along Alameda Ave. and under I-25.

  A branch of the southern part of the system runs along the west side of Sonora Subdivision, from Wilshire Ave. to Signal Ave., and then west along Signal Ave. to connect with the San Pedro Storm Drain. 30" RCP is used in the branch storm drain. With the current inlets and 100-yr storm flow conditions, it is estimated that this branch storm drain collects approximately 25 cfs, which is contributed to the San Pedro Storm Drain.

  Also, there are two inlets at Alameda Ave. and San Pedro, which connect directly to the San Pedro Storm Drain, directing flow into the South La Cueva Watershed. These two inlets are estimated to collect approximately 10 cfs each. Refer to Appendix A for estimations of flows into existing inlets.

  Therefore, a total of approximately 45 cfs, for the 100-yr storm, is estimated as currently being diverted into the South La Cueva Watershed via the San Pedro Storm Drain.

- *Collection of South La Cueva Flow*
  Some flow in the South La Cueva Watershed that originally reached I-25 at Structure 13 is collected by the San Pedro Storm Drain and diverted to Structure 12. There are currently three inlets that function to collect this flow. One is at San Pedro and Oakland Ave., one just north of San Pedro and Oakland Ave., and one at San Pedro and Eagle Rock Ave. Together these three inlets collect approximately 30 cfs for the 100-yr storm event.

  The San Pedro Storm Drain flow passes under I-25 at Structure 12. On the west side of I-25, the flow from Structure 12 combines with the flow from Structure 13 in the South La Cueva Channel. Since the South La Cueva flows combine on the west side of I-25, the diversion of the 30 cfs on the east side of I-25 from Structure 12 to Structure 13 is not a significant change.

  The San Pedro Storm Drain also collects flow in the South La Cueva Basin that contributes flow directly to Structure 12. This flow would originally reach Structure 12, even if the San Pedro Storm Drain was not in place. Therefore,

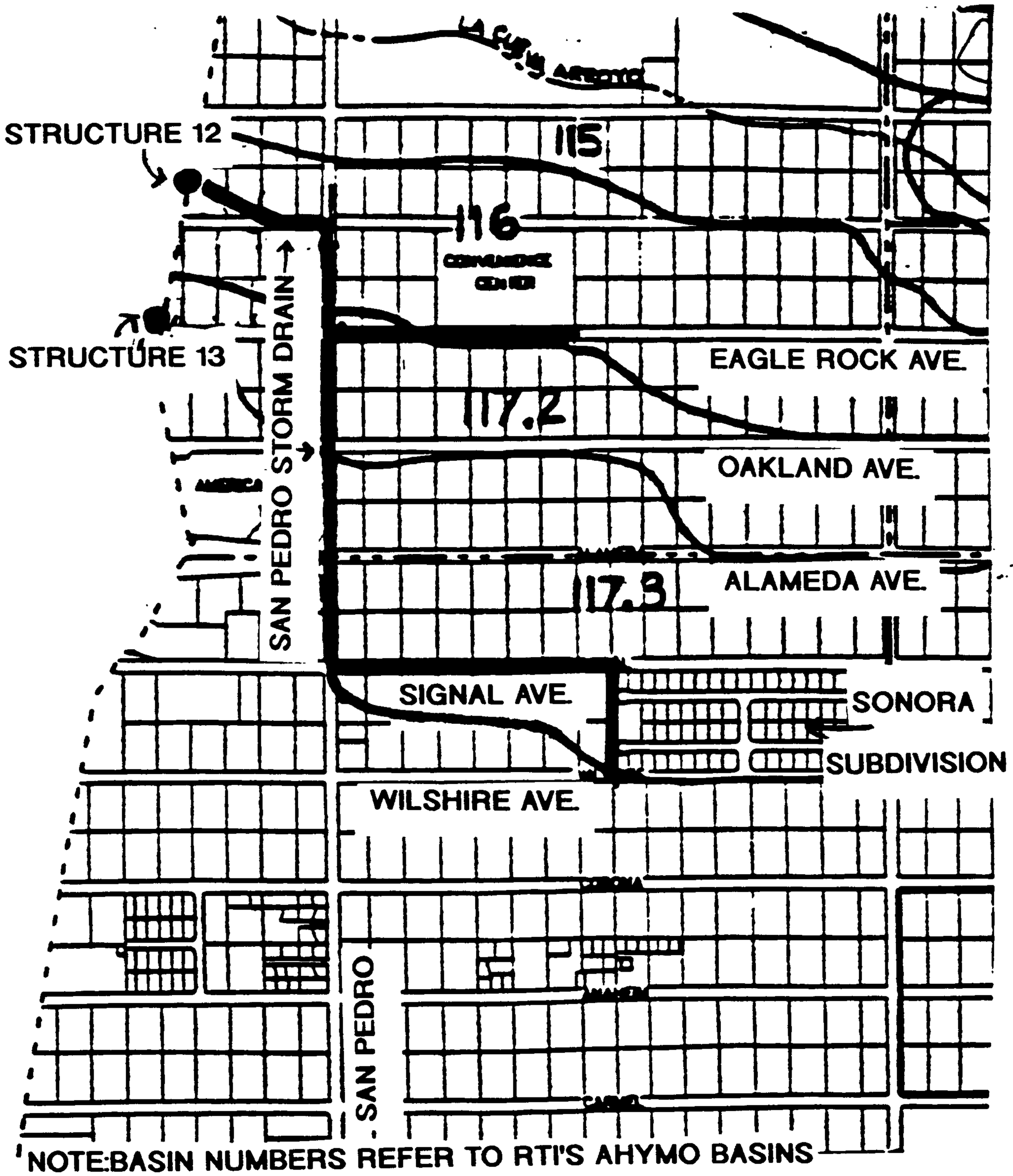


FIGURE 3A

SCHEMATIC OF SAN PEDRO STORM DRAIN SYSTEM

the hydrology is not changing significantly in this basin due to the storm drain system.

- *Summary*
  As a result of the San Pedro Storm Drain, approximately 45 cfs is added to the South La Cueva Watershed from the southern adjacent watershed. Also, the storm drain system adds approximately 75 cfs to Structure 12, some from the southern adjacent watershed, and some South La Cueva flow diverted from its flow path to Structure 13.

2. Wildflower Training Dike - A portion of the runoff from the S. La Cueva watershed, east of I-25, flows under I-25 through Structure 13. Structure 13 consists of 5-36" RCP which pass flow under I-25.

   The flow under I-25, through Structure 13, enters the Wildflower Diversion. This diverts the flow north, through an earthen channel, into the S. La Cueva Channel.

3. Concrete Lined Channel on the West Side of I-25 - The channel on the west side of I-25 is a trapezoidal, concrete lined channel. The flow is contained in the improved channel to its confluence with the N. La Cueva Channel.

South El Camino Arroyo

The floodplain area requested for revision for the S. El Camino is only the area west of I-25.

Description of Hydrology for the El Camino Arroyo
The El Camino Arroyo originates east of Albuquerque in the Sandia Mountains. It is the most northern arroyo in the area referred to as the Northeast Heights area of Albuquerque. The arroyo, near Tramway Blvd., separates into two distinct branches, the North El Camino and the South El Camino. Under existing conditions, the runoff from the basins located east of Tramway Blvd. can potentially all travel to the North El Camino, all travel to the South El Camino, or be distributed between both branches. For the LOMR study, it was assumed that all of the flow from the eastern basins entered the South El Camino Arroyo at the point near Tramway Boulevard.

The flows, with and without the eastern basins included, for the South El Camino Arroyo at I-25 are compared in Table 3.1. Dividing the flow from the eastern basins between the North and South El Camino branches was not attempted. It would be difficult to determine and justify what fraction of flow enters each branch. For the task of determining floodplain boundaries for the LOMR area, it was determined that the flow from the eastern basins should be included in the South El Camino Arroyo to insure that the floodplain boundaries are not underestimated.

Table 3.1: Comparison of the South El Camino Flow at I-25

	S. El Camino Flow at I-25	
	N. El Camino Basins east of Tramway entering the S. El Camino	N. El Camino Basins east of Tramway, not entering the S. El Camino
S. El Camino Flow at I-25	2218 cfs	908 cfs
Total Basin Area at I-25	3.22 sq. mi.	1.49 sq. mi.

Physical changes that have occurred on the S. El Camino Arroyo are briefly described below:

1. El Camino Diversion - The majority of the S. El Camino Arroyo flow passes under I-25 through 12-48" RCP (Structure 8). Some flow travels south on the east side of I-25 and passes under I-25 through Structures 9, 10, and 11.

   All of the flow through Structures 8, 9 and 10 enters the S. El Camino Diversion on the west side of I-25. This directs all of the flow south through a concrete box culvert, to the concrete lined N. La Cueva channel.

3.2. Alternative Methodology

The hydrology of this report was obtained from the Hydrology Report for the La Cueva, El Camino and North Camino Arroyos Drainage Management Plan by Resource Technology, Inc. (RTI) September, 1996. The hydrologic model used was the AHYMO computer model used in accordance with the City of Albuquerque Development Process Manual.

The effective FIS hydrologic study was done in 1975 by Leonard Rice using the MIT Catchment Model (MITCA). The AHYMO model is a more current and widely accepted hydrologic model, and is approved by FEMA for use in the Albuquerque area. The model was developed specifically by AMAFCA for use in modeling storms in the Albuquerque area.

The hydrology used in this LOMR analysis is slightly different from the September 1996 RTI Hydrology Report. The difference is that, for the LOMR study, the flow from the El Camino Arroyo basins located east of Tramway Boulevard was all assumed to enter the South El Camino Arroyo. The Hydrology Report from RTI assumed that this avulsion is controlled and the flow from the eastern basins of the El Camino Arroyo remains in the

North El Camino Arroyo. This difference in hydrology explains the higher flow rates reported in the LOMR, as compared to the RTI Hydrology Report, for the South El Camino Arroyo.

Sept. 1990

3.3. Approval of the Hydrologic Analysis

FEMA has accepted the City of Albuquerque Development Process Manual in a letter dated November 14, 1991 to Mr. Gilbert Aldaz, City/County Floodplain Administrator. In addition, the AHYMO hydrologic models used in this LOMR has been approved by AMAFCA. See Appendix A for a copy of the AMAFCA letter of approval.

3.4. Comparison of 100-yr. Discharges

The effective FIS lists discharges for the Camino Arroyo and the La Cueva Arroyo, while the revised hydrologic model separates the flow between the North and South El Camino Arroyo and the North and South La Cueva Arroyo. The differences in the setup of the models makes a direct comparison of the 100-yr discharges difficult.

The source for the FIS discharges for the Camino and La Cueva arroyos is the Northeast Heights Drainage Management Plan, Leonard Rice, April 1975 (provided in Appendix A). Using the information provided in the Leonard Rice basin boundary map, the Camino Arroyo reported in the FIS corresponds closely to the South El Camino Arroyo as described by the revised hydrologic model. The La Cueva Arroyo in the FIS is separated into the North and South La Cueva arroyos in the revised hydrologic model.

The discharges and drainage areas from the FIS and the revised hydrology for the LOMR are summarized and compared in Table 3.2.

Table 3.2: Comparison of 100-yr Discharges

Flooding Source and Location	FIS Drainage Area (sq. mi.)	FIS 100-yr Peak Discharge (cfs)	Revised Drainage Area (sq. mi.)	Revised 100-yr Peak Discharge (cfs)
S. El Camino Arroyo				
at Wyoming Blvd.	N/A	N/A	2.90	2199
at I-25	3.36	3033	3.22	2218
at North Diversion Channel	3.52	2721	N/A	N/A

Table 3.2: Comparison of 100-yr Discharges (continued)

Flooding Source and Location	FIS Drainage Area (sq. mi.)	FIS 100-yr Peak Discharge (cfs)	Revised Drainage Area (sq. mi.)	Revised 100-yr Peak Discharge (cfs)
N. La Cueva Arroyo*				
at Wyoming Blvd.	N/A	N/A	4.12	2986
at I-25	6.40	3302	4.36	2994**
at North Diversion Channel	7.10	2975	8.52	5503
S. La Cueva Arroyo*				
at Confluence West of I-25	N/A	N/A	0.39	425
at Confluence With N. La Cueva	N/A	N/A	0.57	788

RTI worst case = 3500±

* *The FIS reports discharges for the La Cueva Arroyo and does not differentiate between the North and South La Cueva. The FIS areas and flows reported in Table 3.2 for the North La Cueva represent the La Cueva as defined by the Leonard Rice basin boundaries, which combines the North and South La Cueva.*

** *This flow does not include the weir flow from the South El Camino, along the east side of I-25. Refer to additional explanation 7.1.1.*

A comparison of the 100-yr. discharges is possible for the La Cueva Arroyo at the North Diversion Channel. For the La Cueva Arroyo at the North Diversion Channel, the effective FIS reports a 100-yr. peak flow of 2975 cfs for a 7.10 sq. mi. drainage area. The revised hydrology reports this location as the North La Cueva at the North Diversion Channel. This location includes the flow from the North and South La Cueva and the South El Camino. The revised hydrology produces a 100-yr. peak flow of 5503 cfs for an 8.52 sq. mi. drainage area. The hydrology and hydraulics of the La Cueva have changed since the effective FIS to include a larger drainage area contributing to La Cueva Channel and a higher 100-yr. storm peak flow.

3.5. Transitions to Unrevised Portions of the Floodplain in LOMR Area

This LOMR addresses three flooding sources: the North La Cueva, the South La Cueva, and the South El Camino arroyos. The three flooding sources are being approached together due to their hydrologic and hydraulic connections. This combined approach helps assure an accurate and complete transition for the area, from the effective discharges to the proposed discharges.

Additional Explanations for Form 3
Hydrologic Analysis Form
North La Cueva, South La Cueva, and South El Camino Arroyos

The area for the North and South La Cueva arroyos ties into the boundary of two previously accepted LOMRs for the Nor Este Estates Subdivision. The Nor Este Estates Subdivision LOMRs have downstream boundaries at Wyoming Blvd. The upstream boundary for this current LOMR is at Wyoming Blvd. The accepted LOMRs for the Nor Este Estates Subdivision are provided in Appendix A for reference.

The downstream boundary of the floodplain revision in this LOMR, for the North and South La Cueva arroyos, is at the confluence with AMAFCA's North Diversion Channel. At this point the revised floodplain ties into the existing floodplain defined for the North Diversion Channel. The transition between the revised and existing floodplains for the North and South La Cueva arroyos is shown in Figure 5.11 (Volume 1 of the LOMR).

The South El Camino floodplain, on the east side of I-25, is not being revised from the effective NFIP maps with this LOMR. This LOMR proposes the revision of the floodplain on the west side of I-25, due to the construction of the South El Camino Diversion. The upstream boundary for this LOMR is located just west of the South El Camino Diversion. The South El Camino Diversion directs the arroyo flow to the North La Cueva Channel, eliminating the South El Camino Arroyo floodplain downstream of the Diversion. The floodplain for the South El Camino is removed to where the historic arroyo path, before the construction of the diversion, ties into the North Diversion Channel and the North El Camino Arroyo floodplains. The transition between the revised and existing floodplain for the South El Camino Arroyo is shown in Figure 5.11 (Volume 1 of the LOMR).