Samuel Andrade, President

Andrade Homes inc.

H23-D5b

October 9,1979

Mr. Richard S. Heller
City Engineer
P.O.Box 1293
Albuquerque,New Mexico 87103

Re: Lot 22,Kachina Hills 2

Dear Mr. Heller:

In response to your letter of September 20,1979 to Mr. Jim Haynes,owner of the above named lot, this is to advise you that the ponding area has been restored.

Very truly yours,

Sam Andrade
Samuel Andrade
President

SA/jg

4001 Ellison Northeast • Albuquerque, New Mexico 87109 • (505) 345-9986

RECEIVED BWH DEC 3 1976

City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

MAYOR
Harry E. Kinney

CHIEF ADMINISTRATIVE OFFICER
Frank A. Kleinhenz

CFQ

December 2, 1976

Mr. Allan Whitesel
Bohannan, Westman, Huston
4125 Carlisle Blvd. N.E.
Albuquerque, New Mexico 87107

RE: DRAINAGE REPORT, UNIT 3
CRESTVIEW HEIGHTS

Dear Mr. Whitesel:

The proposed report is acceptable in concept. Since Malcolm drains to Piedra Lisa Channel higher than before the development made the diversion, the Piedra Lisa Channel will need to be part of the construction plans and development.

Very truly yours,

Kleston H Laws

Kleston H. Laws
Assistant City Engineer-Hydrology

KHL/fs

Public Works Department

Director – Erwin F. Hensch, P. E. 766-7467
Engineering 766-7441 – V. M. Kimmick, P. E.
Street Maint. 766-7755 – G. E. Par[illegible] P. E.
Ass't. Director – Harold R. Orr, Jr. P. E.
Liquid Waste 766-7535 – R. P. Lowe, P. E.
Water 766-7437 – W. H. Otto, P. E.

ENGINEERS & PHOTOGRAMMETRISTS

BOHANNAN WESTMAN HUSTON & ASSOCIATES INC.

4 25 CARLISLE BLVD. N.E.
ALBUQUERQUE, NEW MEXICO 87107
PHONE 505 881-2000

Received

November 5, 1976

Mr. Kleston Laws
Assistant City Engineer
City of Albuquerque
P.O. Box 1293
Albuquerque, New Mexico 87103

Dear Mr. Laws:

Enclosed are three copies of the drainage report for Unit 3 in Crestview Heights Subdivision.

If you have any questions, please feel free to contact me at this office.

Sincerely,

Allan L. Whitesel

Allan L. Whitesel, P.E.

Enclosures

ALW/ku
Job No. 76-073

DRAINAGE REPORT

UNIT 3, CRESTVIEW HEIGHTS

ALBUQUERQUE, NEW MEXICO

DRAINAGE REPORT
UNIT 3, CRESTVIEW HEIGHTS
ALBUQUERQUE, NEW MEXICO

NOVEMBER 1976

PREPARED FOR

HOME PLANNING DEVELOPMENT COMPANY
AFFLIATED MORTGAGE AND DEVELOPMENT COMPANY
JOINT VENTURE
2900 LOUISIANA BLVD., N.E.
ALBUQUERQUE, NEW MEXICO 87110

PREPARED BY

BOHANNAN WESTMAN HUSTON & ASSOCIATES, INC.
4125 CARLISLE BLVD., N.E.
ALBUQUERQUE, NEW MEXICO 87107

REGISTERED PROFESSIONAL ENGINEER
STATE OF NEW MEXICO
No. 5354
ALLAN L. WHITESEL

ALLAN L. WHITESEL
N.M.P.E. NO. 5354

TABLE OF CONTENTS

APPENDIX

LIST OF PLATES

PURPOSE AND SCOPE

The purpose and scope of this report is to determine an acceptable method for controlling the rate of runoff resulting from a 100-year frequency storm falling on all contributing areas, as well as the parcel itself. Upland flows coming onto this property are considered, and surface runoff drainage improvements to the Piedra Lisa Drainage Easement north of Unit 3 have been provided.

LOCATION AND TERRAIN

The location of this parcel of land is shown on Plate I. It is bounded on the north by the Piedra Lisa Drainage Easement, on the east by Monte Largo Drive, on the south by Rover Avenue, and on the west by Tramway Boulevard. The mesa east of Tramway in this area has natural slopes that vary between 5.0% and 10% and the soils are mainly granular decomposed granite.

DRAINAGE BEFORE DEVELOPMENT

The land slopes across Unit 3 from east to west at 5 to 10%. The grass cover is poor in the present undeveloped state. The undeveloped drainage areas, flow patterns, and runoff rates are shown on Plate II. Existing runoff is generally concentrated in existing natural channels.

DRAINAGE AFTER DEVELOPMENT

If the recommendation of this report are incorporated into the final design of Unit 3, internal runoff will be conveyed through this subdivision in the streets and backyard ponding will be provided to insure that this development does not increase the runoff rate. The upland storm runoff will be intercepted by Monte Largo Drive and conveyed to the Embudo Arroyo Drainage Easement in a standard street section.

A cattle guard inlet and a 36" storm sewer will be provided in Malcolm Avenue just south of Menaul to convey local runoff into the Piedra Lisa Drainage Easement, and 10' drainage easement structures will be provided in areas B and C to convey surface runoff out of the subdivision. This approach will necessitate approximately 470 feet of channel improvements in the Piedra Lisa Drainage Easement to provide adequate drainage, erosion control, and headroom for construction of the 36" storm sewer from Malcolm Avenue. Internal drainage areas, flow patterns, and drainage improvement locations are shown on Plate III. Plate IV shows drainage improvement details, and Plate V shows proposed drainage improvements to the Piedra Lisa Channel.

HYDROLOGIC ANALYSIS

A 100-year frequency storm falling on all contributing areas in conjunction with the rational method of computing the flow rate was used to determine the flows contained in this report. To implement the use of the rational formula, data was obtained from Plates I, II, and III contained in the back of this report. A table of the results of the hydrologic analysis is provided in the appendix, as well as sample calculations.

RECOMMENDATIONS

Based upon the analysis performed for this report, the following recommendations which should be included in the final design of Unit 3 are made:

1. Backyard ponds should be constructed for every lot and the grading should insure all storm water falling behind setback lines drain toward these ponds.

2. A 32' by 4' cattle guard inlet should be constructed in Malcolm Avenue just south of Menaul Boulevard. (See Plate III)

3. A 36" RCP storm sewer line should be constructed from the cattle guard inlet in Malcolm to the Piedra Lisa Drainage Easement. (Plate III)

4. Slope paving should be constructed in the improved Piedra Lisa Channel at the outlet of the 36" RCP from Malcolm Avenue. (Plate V)

5. The Piedra Lisa drainage channel should be improved to its final grade and sections (as shown in "Study of the Embudo Arroyo System and Its Tributaries, 1976", City of Albuquerque) for approximately 190 feet east of Malcolm Avenue and 280 feet west of Malcolm Avenue. (Plate V) definition of downstream channel

6. The drainage and utility easements in areas B and C (Plate III) should have 10' wide standard drainage easement lining constructed within them. where do flows go & what happens.

7. Waterblocks should be constructed at location shown on Plate III.

CONCLUSIONS

If the information in this report is incorporated into the final design of Unit 3, Crestview Heights, storm water resulting from a 100-year frequency storm falling on all areas contributing runoff to this parcel of land can satisfactorily be controlled and this development will not increase surface runoff.

APPENDIX

SUMMARY OF HYDROLOGIC DATA
SAMPLE CALCULATIONS
COST ESTIMATE – DRAINAGE IMPROVEMENTS

SUMMARY OF HYDROLOGIC DATA

UNDEVELOPED

Area	Acres	QCFS
1	15.5	24.7
2	21.5	31.3
3	7.2	11.9
4	19.6	28.6
5A	2.6	5.1
6	15.7	23.2
7	14.2	22.2
Total	96.3	147.0[1]

DEVELOPED

Area	Effective Acres[2]	QCFS
A	12.7	43.4
B	9.4	31.6
C	1.7	7.0
D	1.4	4.8
5A	2.6	5.1
6	15.7	23.2
7	14.2	22.2
Total	N/A	137.3[1]

1. Indicates the development as planned will not increase the runoff rate. This is due to backyard ponding.

2. Does not include the area behind setback line, because this will be ponded in backyard ponds and will not contribute to runoff.

SAMPLE CALCULATIONS

Runoff Computations

The runoff calculations were made using the rational formula. The time of concentration (Tc) used in the calculations was found by following the empirical formula.

$$Tc = Log^{-1}[.3641(B) + .3854\ Log(L) - .197\ Log(S) - .3613]$$

Where:

- S = Average Slope of Basin in Percent
- B = Ground Factor
  - Paved = 0.77
  - Bare Soil = 1.52
  - Poor Vegetation Cover = 1.80
  - Average Grass = 2.16
  - Dense Grass = 2.57
- L = Distance to Furthest Point in the Basin in Feet
- Tc = Time of Concentration

I. UNDEVELOPED AREAS: Example Area 1 (Plate III)

Area (A)	= 15.48 Ac.
Length of Area (L)	= 1340 ft.
Average Slope (S)	= 5.7%
Ground Factor (B)	= 1.80
Time of Concentration (Tc)	= 22.4 min.

$$Tc = Log^{-1}[.3641\ (1.80) + .3854\ Log(1340) - .197\ Log(5.7) - .3613]$$
$$= Log^{-1}[1.35036] = 22.4$$

Intensity (I)[1]	= 3.98 in./hr.
Runoff Coefficient (C)	= 0.4
Q = CIA = (.4) (3.98) (15.48)	= 24.6 cfs

---

[1]Master Plan of Drainage, City of Albuquerque, 1963

II. DEVELOPED AREAS: Example Area A

For developed conditions, it was assumed all area behind the setback lines will drain toward the back yard pond. Therefore, the contributing area was considered as only the street, sidewalks, drivepads, and front lawns between the setback line and the sidewalk.

Effective Area (A_e)	= 12.68 Ac.
Length of Area (L)	= 2100 ft.
Average Slope (S)	= 3.3%
Ground Factor (B)[2]	= 0.77
Time of Concentration (Tc)	= 12.5 min.

$$TC = Log^{-1}[.3641\ (0.77) + .3854\ Log(2100) - .197\ Log(3.3) - .3613]$$
$$= Log^{-1}[1.09729] = 12.5 \text{ min.}$$

Intensity (I)[1]	= 5.0 in./hr.
Runoff Coefficient (Cn)[3]	= 0.685
$Q = CIA_e = (.685)\ (5.0)\ (12.68)$	= 43.4 cfs

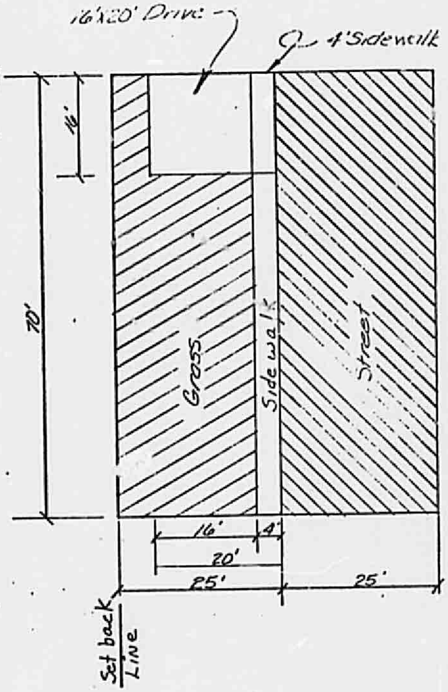
---

[1] Master Plan of Drainage, City of Albuquerque, 1963.

[2] Ground factor for pavement was used because the flow path is almost entirely in the streets.

[3] See next sheet for Cn computation.

SAMPLE CALCULATIONS
RUNOFF COMPUTATIONS



Pavement
- Drive 20'x16' = 320 ft²
- Sidewalk 4'x54' = 216 ft²
- Street 25'x70' = 1750 ft²
- 2310 ft² = .053 Acres 64.6%

Lawn
- 21'x54' = 1134 ft²
- 5'x16' = 80 ft²
- 1214 ft² = .029 Acres 35.4%
- Total Area = .082 Acres 100%

Cn.
- Pavement .646 @ .95
- Grass .354 @ .20

Cn = (.646)(.95) + (.354)(.20)

Cn = .685

CATTLE GUARD INLET AND 36" STORM SEWER LINE COMPUTATIONS

1. 32' x 4' cattle guard inlet in Malcolm Avenue from face of curb to face of curb. Design method adjusted from method on page 18–27, Design, ELWYN E. SEELYE – 1966.

$$Q = cA\sqrt{2gh} \times 2/3 \text{ and } h = \frac{\left(\frac{1.5Q}{0.6A}\right)^2}{64.4}$$

Where Q = Quantity of runoff (cfs)

C = Orifice coefficient (0.6 for square openings and 0.8 for round openings)

A = Net area (ft.^{2})

g = 32.2

h = Allowable head

Q = Flow from Area A (Plate III) = 48.6 cfs

C = 0.6

$$A = \frac{32}{3.625} \times \frac{800 \text{ in.}^2}{144 \text{ in.}^2/\text{ft.}^2} = 49.04 \text{ ft.}^2$$

$$h = \frac{\left(\frac{1.5Q}{0.6A}\right)^2}{64.4} = \frac{\left(\frac{1.5\,(48.6)}{(0.6)\,(49.04)}\right)^2}{64.4} = 0.095' = 1.1''$$

2. 36" storm sewer line from cattle guard inlet in Malcolm Avenue to Piedra Lisa Channel.

Q = 48.6 cfs (required capacity)

$$\frac{HW}{D} = \frac{4.5'}{3.0'} = 1.5$$

HW is the available headwater between the assumed top of curb at the cattle guard inlet and the flow line of the 36" storm sewer line from the inlet to the Piedra Lisa Drainage Easement.

Using chart 2, page 5–22, in the Bureau of Public Roads' Hydraulic Engineering Circular No. 5, April 1964, the actual capacity of the 36" storm sewer line with 4.5' of head is 54 cfs. This assumes inlet control.

Using chart 43, page 56, in the Bureau of Public Roads' publication entitled "Design Charts for Open–Channel Flow," 1961, the capacity of the 36" storm sewer on a 1% slope was found to be 58 cfs.

The required capacity of this line is 48.6 cfs; therefore, the 36" storm sewer will adequately carry the required flow, as well as provide some safety factor.

It was determined that a 30" storm sewer line would be inadequate at this location.

COST ESTIMATE
DRAINAGE IMPROVEMENTS

I.	Piedra Lisa Channel Improvements	$18,300.00
II.	Cattle Guard Inlet and 36" RCP Storm Sewer Line	8,300.00
III.	Unit 3 Drainage Easement Lining	9,000.00
	TOTAL	$35,000.00

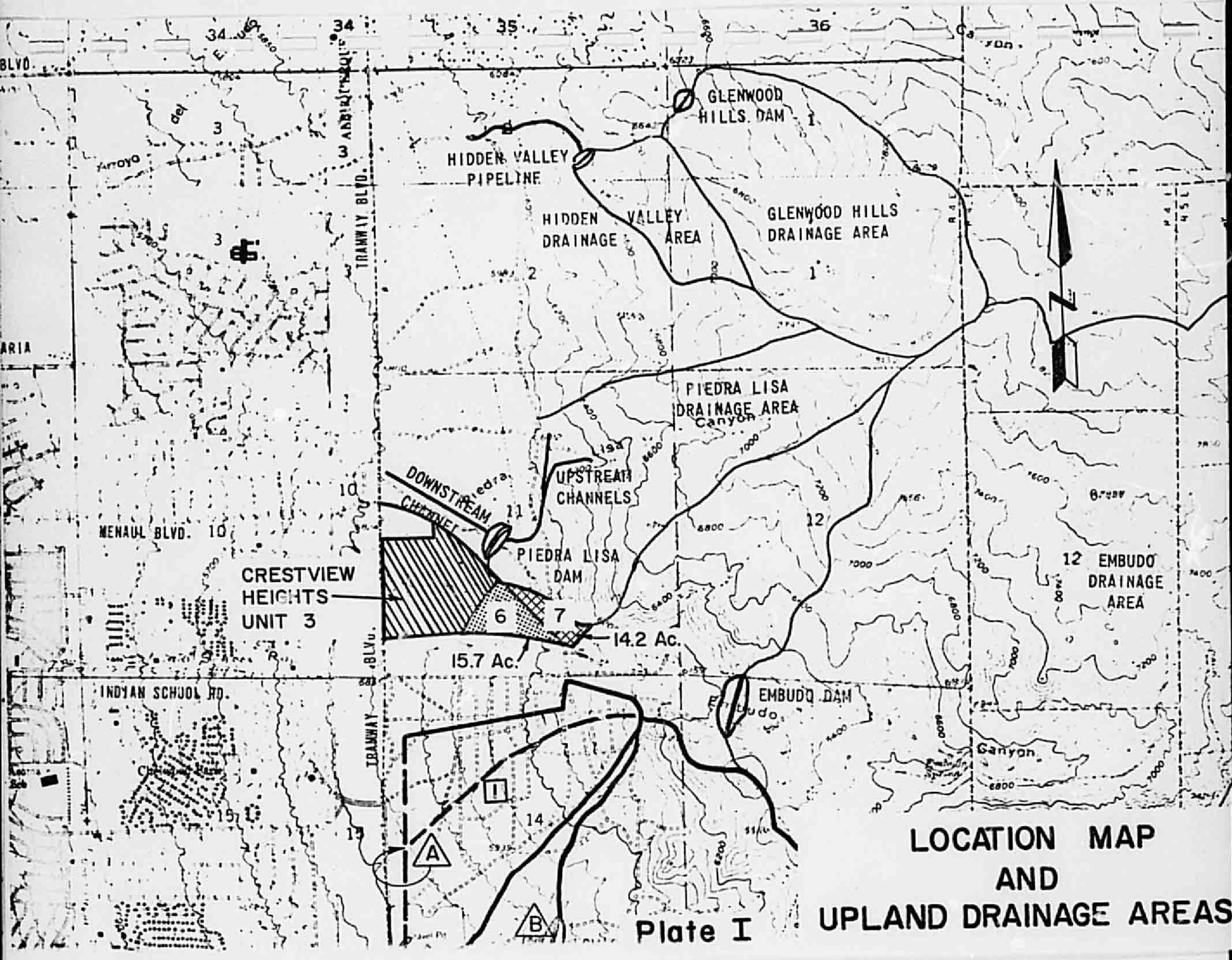
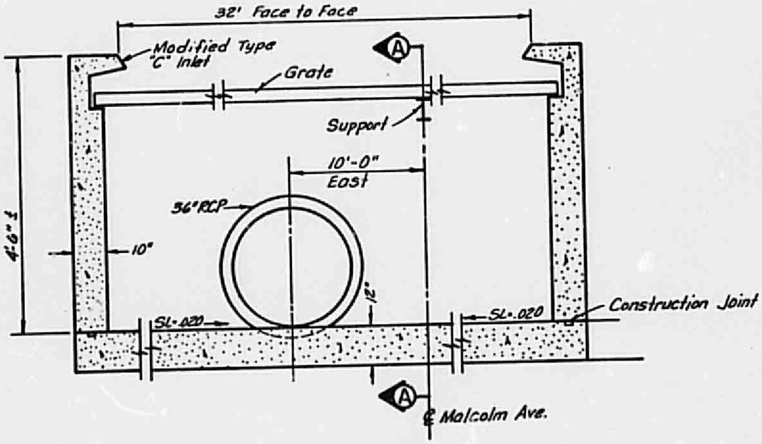
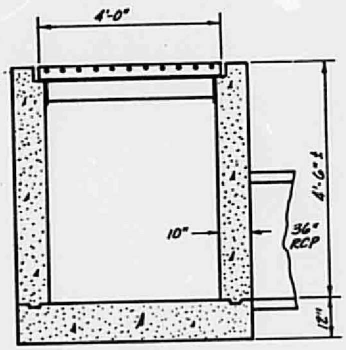


Plate I

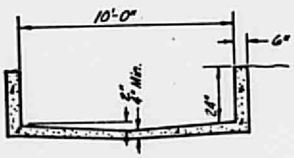
LOCATION MAP AND UPLAND DRAINAGE AREAS



CATTLEGUARD INLET



SECTION A-A



TYPE B
DRAINAGE EASEMENT
LINING DETAIL

DRAINAGE IMPROVEMENT DETAILS

Plate IV

CRESTVIEW HEIGHTS
UNIT 3

Albuquerque,
Bernalillo County, New Mexico

DRAINAGE REPORT
FOR
CRESTVIEW HEIGHTS INC.

JULY 1973

BOHANNAN WESTMAN HUSTON

ENGINEERS & PHOTOGRAMMETRISTS

BOHANNAN WESTMAN HUSTON & ASSOCIATES INC.

4125 CARLISLE BLVD., N.E.
ALBUQUERQUE, NEW MEXICO 87107
PHONE 505 345-2681

July 30, 1973

Crestview Heights, Inc.
1000 San Mateo Blvd SE
Albuquerque, New Mexico 87108

Gentlemen:

We are submitting this Drainage Report to you on Crestview Heights Subdivision covering the development of Unit 3. The control of the runoff shall comply with the requirements of the Albuquerque Metropolitan Arroyo Flood Control Authority and with present City of Albuquerque policies.

We appreciate this opportunity to serve you. If any questions arise, we will be available to assist in your response.

Very truly yours,

Michial M. Emery

Michial M. Emery, PE
Chief Engineer

MME/teg

Enclosure

DRAINAGE REPORT

FOR

UNIT 3

CRESTVIEW HEIGHTS
BERNALILLO COUNTY, NEW MEXICO

JULY 1973

PREPARED FOR:

CRESTVIEW HEIGHTS, INC.
1000 SAN MATEO BLVD. SE
ALBUQUERQUE, NEW MEXICO 87108

BY

BOHANNAN WESTMAN HUSTON & ASSOCIATES, INC.
4125 CARLISLE BLVD NE
ALBUQUERQUE, NEW MEXICO 87107

STATE OF NEW MEXICO
MICHIAL M. EMERY
No. 5194
REGISTERED PROFESSIONAL ENGINEER

Michial M. Emery, P.E.
Chief Engineer

DRAINAGE REPORT
FOR
UNIT 3
CRESTVIEW HEIGHTS SUBDIVISION

DRAINAGE REPORT
CRESTVIEW HEIGHTS SUBDIVISION
UNIT 3

LOCATION

Unit 3 of the Crestview Heights Subdivision is located in the City of Albuquerque along the eastern right of way of Tramway Boulevard immediately east of Indian School Road. It covers an area of approximately 56 acres and is presently undeveloped. Plans call for developing Unit 3 exclusively as R-1 single family lots of approximately one fifth acre each.

Unit 3 lies on the alluvial fan that extends from the throat of the Embudo Canyon westward into the valley. The land slopes at approximately 6% from east to west and has a poor to moderate grass cover. (See Plate I, Location Map)

DRAINAGE BEFORE DEVELOPMENT

Runoff from the Embudo Canyon formed the alluvial fan on which Unit 3 is located. Plate #3, Flood Plain Layout, along with the Cross Section Sheets, Plates 5 and 6, indicate that the flows remain well confined in the throat of Embudo Canyon, but have a tendency to spread out upon descending onto the alluvial fan. The quantity of flow generated in the Embudo Canyon for the Standard Project Flood design storm was taken from the booklet entitled "Flood Plain Information - Albuquerque Arroyos - Part II." A portion of this booklet has been reproduced as Plate II of this report. Plate #3, Flood Plain Layout, shows that these flows divide into two major natural arroyos as they approach the eastern property line of the subject parcel. One arroyo skirts the southern boundary of the parcel while the other goes virtually through the center of the property.

DRAINAGE AFTER DEVELOPMENT - METHODS OF ANALYSIS AND RECOMMENDATIONS

In order to prevent the Embudo Canyon flood waters from ever reaching the subject property after development, the concept of a diversion berm and channel was introduced and analyzed. After the feasibility of this concept was established, the internal drainage of the development itself was examined and appropriate recommendations formulated. (Refer to Plate 4, Drainage Improvements After Development and Plate 7, Plat Plan).

A) Diversion Berm and Channels

In analyzing the hydraulics of diverting the flows from Embudo Canyon around the subject property, the following assumptions were made:

1) Flows rushing down channels and arroyos in a supercritical state of flow and subjected to a sudden change of direction would, in the worst case, convert all velocity head to depth of water. Therefore, any diversion berm must be at least as high as the value of the total specific energy plus appropriate freeboard (freeboard assumed to be 1').

2) Assuming that all energy at the berm is in the form of potential energy, any diversion berm must be at least as

high as the normal depth of the downstream channel, plus the energy in feet of water necessary to accelerate still water to the normal velocity of the downstream channel, plus appropriate freeboard.

Table 1, Miscellaneous Calculations for Diversion Berm and Channel, indicates that the maximum height of berm needed is 12.25' above the floor of the existing arroyos. Calculations also indicate that the slope of the downstream east-west channel should be reduced below those naturally available to reduce eroding velocities. To accomplish this, a concrete lined spill trough is recommended to dissipate energy and lower the upper invert of this channel. (See Plate 4).

It is also recommended that all berm faces exposed to flowing water be concrete lined and that a 3' deep concrete cut-off wall be installed along the toe of these berms to minimize the dangers of undercutting.

Since the purpose of this report is to examine the idea of a diversion berm and channel as an engineering concept, the dimensions and technical data indicated on Plate 4 are rough approximations only and not intended to be used for construction. Earth cut and fill calculations can undoubtedly be refined, but at this point it appears that as much as 30,000 cubic yards of earth fill in excess of that available from earth cut may be necessary in order to construct the diversion facilities.

B) Internal Drainage for the Development

The Plat and surrounding vicinity were broken up into 13 subdrainage areas so that the rational runoff formula could be applied. Since a drainage easement has been provided running east-west through the property, all drainage was assumed to be directed into this easement where feasible. Such a drainage pattern will entail local regrading and earth moving operations in order to fill the existing arroyo and to provide the necessary 0.5% slope on streets running north-south. (Refer to Plate 4).

A natural coefficient of runoff of 0.3 was assumed for areas not presently to be developed. For developed areas, a "weighted" coefficient of runoff was calculated using estimated values of roof, street, lawn, and gravelled areas. These calculations resulted in a developed coefficient of runoff equal to 0.5. Subsection areas and Runoff Calculations for the 100 Year Design Storm have been tabulated in Table 2.

Flows for subsection areas #1, 5, 6, 7, 10, and 13 were assumed to remain natural since development of these areas is not under present consideration. Those areas which will be developed sometime in the future will be designed in accordance with Albuquerque Metropolitan Arroyo Flood Control Authority Standards.

Once flows to various points were established, appropriate channels, catch basins, storm pipes, and culverts were sized to accept the design flows (see Table 3, Miscellaneous

Calculations for Internal Drainage, and the various sections included on Plate 4). In particular, flows from the main internal drainage channel had to be conveyed to the Piedra Lisa Arroyo north of the property at Tramway Boulevard. In order to turn the flows 90° at section U-U, it is the recommendation of this report that a hydraulic jump be induced at section U-U to slow the channel velocity down below critical velocity. Flows can then return to the supercritical phase following the 90° turn.

CONCLUSIONS

The diverted waters of the Embudo Canyon will eventually be directed into improved drainage structures which the City of Albuquerque plans to construct as part of its drainage improvement program for Tramway Boulevard. The proposal for diversion of the Embudo waters outlined in this report conforms with the recommendations set forth in the City's "Tramway Boulevard Corridor and Drainage Study." The only exception is that this report proposes the north-south diversion berm be constructed 17 hundred feet east of the originally proposed location.

Of the total 56 acres to be developed in Crestview Heights, Unit 3, only 5.9 acres (represented as subsection 4) will not be diverted to a major drainage channel. The remaining 50.1 acres will be diverted via improved drainage structures into the Piedra Lisa Arroyo, a natural drainage channel of capacity many times the flows generated by the Unit 3 development. This concept is also in close agreement with the "Tramway Boulevard Corridor and Drainage Study."

For these reasons, and with the engineering analysis and recommendations made in this report, we feel the drainage plan for this property should be approved.

TABLE I
MISCELLANEOUS CALCULATIONS
for
DIVERSION BERM & CHANNELS

1) Specific Energy of Flow at Berm:

$Q = 7178$ cfs

$s = 5.3\%$

$n = .045$ (natural)

From section H and Mannings formula

Depth = 4.4 ft.
Vel = 14.5 ft/sec
$\therefore H_{max} = 4.4 + \frac{14.5^2}{2\,g} = 7.66$ ft.

2) Channel Dimensions Along Berm:

$Q = 7178$ cfs

$s = 2.76\%$

$n = .035$ (constructed earth channel)

Bottom Width = 50 ft.

Side Slope = 3

from Mannings formula

Depth = 5.65 ft.

Vel = 19 ft/sec

3) Ponding Height Assuming Total Loss of Dynamic Energy:

$H = 5.65 + \frac{19^2}{2g} = 11.25$ ft. > 7.66 ft.

Therefore we must use a 12.25 ft. berm allowing 1 foot of freeboard.

4) Downstream East-West Channel Dimensions:

Q = 7178 cfs

s = 6.25%

n = .03 (maintained earth channel)

Try bottom width = 0

Side slopes = 3

from Mannings formula

Depth = 8.67 ft.

Vel. = 32 ft/sec   N.G. Velocity too high

Try a channel 5' deep at lower end and 13' deep at upper end. Then s = 5%

Use bottom width = 60 ft.

from Mannings formula

Depth = 4 ft.

Vel. = 25 ft/sec

TABLE 2
SUBSECTION AREAS
AND
RUNOFF CALCULATIONS

Sec#	Area (acres)	tc (min.)	I (inches/hr)	C	Q (cfs)
1	15.34	15	4.65	.3	21.4
2	9.69	15	4.65	.5	22.5
3	5.31	16	4.55	.5	12.1
4	5.90	13 1/2	4.85	.5	14.3
5	3.73	12	5.0	.3	5.6
6	3.26	14	5.8	.3	5.7
7	3.46	12	5.0	.3	5.2
8	8.35	15	4.65	.5	19.4
9	2.59	11	5.2	.5	6.7
10	4.60	15	4.65	.3	6.4
11	2.12	13 1/2	4.85	.5	5.1
12	2.0	15	4.65	.5	4.7
13	26.0	16	4.55	.3	35.5

TABLE 3
MISCELLANEOUS CALCULATIONS
for
INTERNAL DRAINAGE

1) Calculation of C_{dev}:

Note: We will use Malcolm Avenue as a representative area.

Total area = 1000 x 270 = 270,000 ft^2

27 homes x 2000 ft^2/home = 54,000 ft^2 of roof.

1000 x 30 = 30,000 ft^2 of road.

Total area with C=1 is 84,000 ft^2

Total area left = 270,000 - 84,000 = 186,000 ft^2

Assume this area is split evenly between grassed surface and bare earth surface.

$\therefore C_{dev} = \frac{84}{270}(1) + \frac{93}{270}$ (.2 = grassed) +

$\frac{93}{270}$ (.3 = bare earth) = 0.48 say 0.5

2) Catch Basin Grate and Pipe Size:

Q(9+10) = 6.7 + 6.4 = 13.1 cfs

$Q = C_f CA\sqrt{2gh}$

$C_f = 0.67$

C= 0.6

h = 1' max.

$A = \frac{13.1}{(0.67)(0.6)\sqrt{64.4}}$ = 4.06 ft^2 of clear open space required on grate

Pipe Size

Q=13.1

s=3%

n=.013 (concrete)

∴ D = 18" from Manning nomagraph

3) Channel Dimensions:

Assume channel will taper from 2 1/2 feet deep through subdivision to 5 feet deep at section U-U.

Q(2+3+5+6+7+8+11+12) = 80.3 cfs

S = 6.75%

n (Bituminous Concrete) = 0.015

Side Slopes = 2

Bottom Width = 0

From Mannings formula

Depth = 1.45 ft.

Vel = 19.36 ft/sec

$H_1 = 1.44 + \frac{19.36^2}{2g} = 7.26$ ft.

$D_1/H_1 = 0.198$

$\frac{z H_1}{b} = \infty$

∴ from King and Brater "Handbook of Hydraulics" page 3-63, conjugate depth of hydraulic jump = 4.06 ft. < 5 ft.

Channel from section U-U to Piedra Lisa Arroyo

Q (above Q + section 13) = 116cfs

s = 1.8%

n = 0.03 (bare earth)

Bottom Width = 0

Side slopes = 3

from Mannings formula

Depth = 2.33 ft. < 5' so use 5' channel from section U-U on.

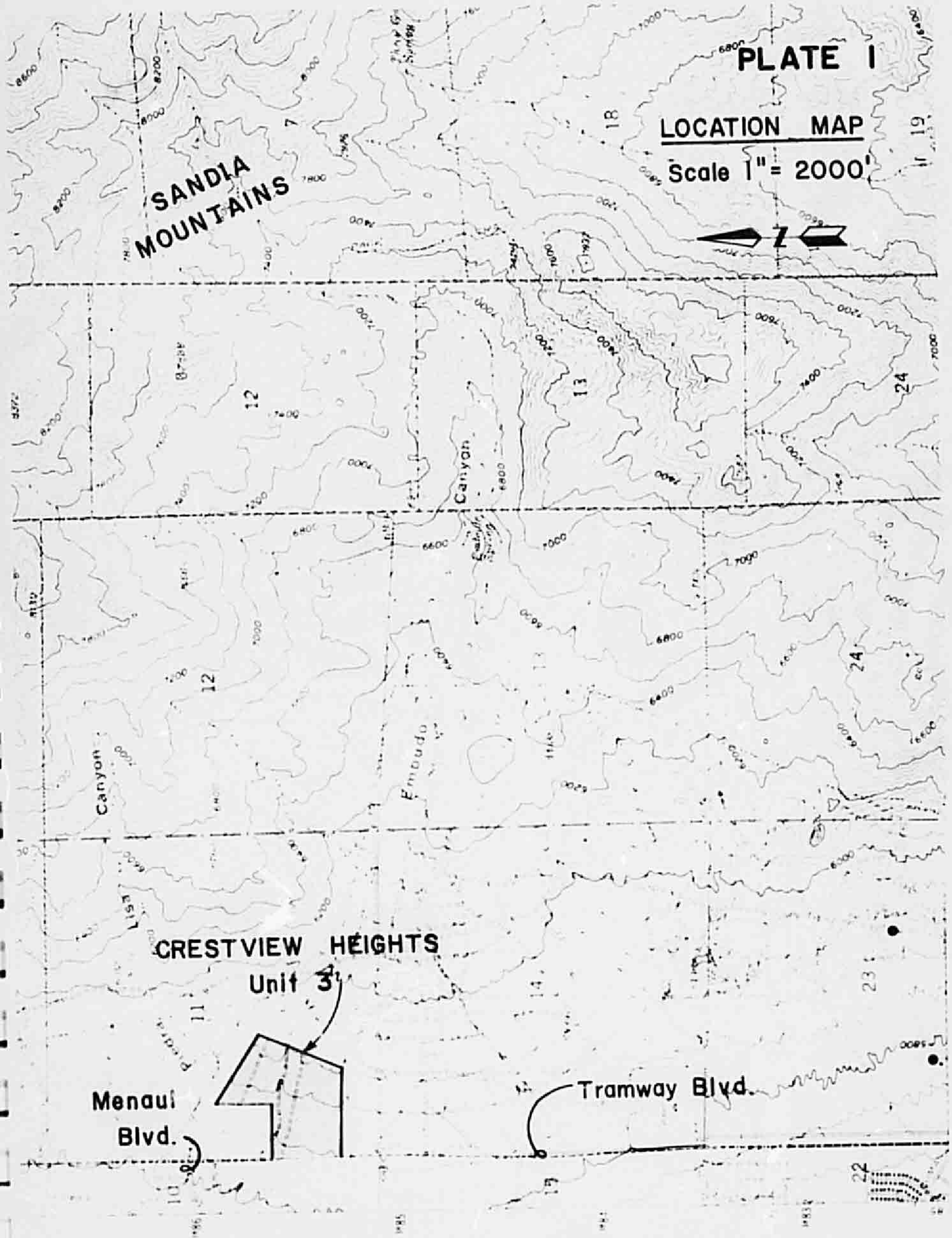


PLATE I
LOCATION MAP
Scale 1" = 2000'
SANDIA MOUNTAINS
CRESTVIEW HEIGHTS
Unit 3
Menaul Blvd.
Tramway Blvd.
Canyon
Embudo

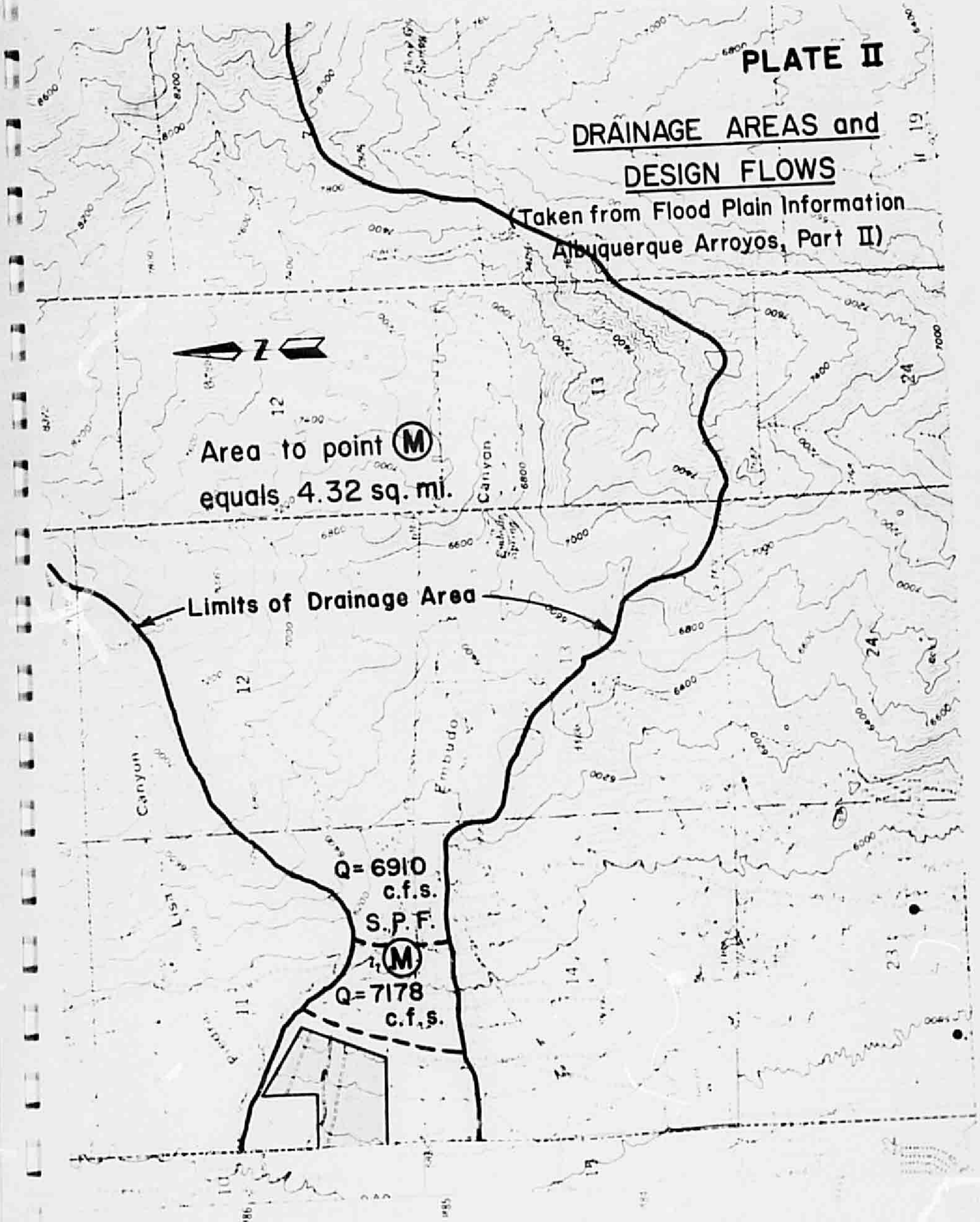


PLATE II
DRAINAGE AREAS and
DESIGN FLOWS
(Taken from Flood Plain Information
Albuquerque Arroyos, Part II)
N
Area to point (M)
equals 4.32 sq. mi.
Limits of Drainage Area
Q= 6910
c.f.s.
S.P.F.
(M)
Q= 7178
c.f.s.
Canyon
Embudo
Canyon

~~Rep. Or.~~
Bob.

Ralph K. Hicks and Associates, Inc.

Civil Engineers, Land Surveyors and Land Planning Consultants

CAMPBELL-HICKS and ASSOCIATES, Inc.
Soils Testing Laboratory
Consulting Civil Engineers
232 Muriel Street, N.E. • Phone (505) 296-7139 • Albuquerque, New Mexico 87123

DRAINAGE STUDY RELATIVE TO THE DEVELOPMENT OF CRESTVIEW HEIGHTS - UNIT 3 ALBUQUERQUE, NEW MEXICO

JANUARY 1972

DRAINAGE STUDY INDEX

DRAINAGE STUDY RELATIVE TO THE DEVELOPMENT OF CRESTVIEW HEIGHTS - UNIT 3

I. GENERAL

This report has been prepared to present findings of a study of storm drainage conditions in an area proposed for development, known as Crestview Heights - Unit 3, and to describe proposed methods for providing adequate storm drainage in the area.

II. LOCATION

The location proposed for development is located in Section 11, Township 10 North, Range 4 East, N.M.P.M. The area is situated in the Southwest one-quarter (SW 1/4) of Section 11, and is bounded on the West by Tramway Blvd., N.E.; on the East by Monte Largo, N.E.; on the North by Menual Blvd., N.E.; and on the South by property owned by the Albuquerque Board of Education.

III. EXISTING DRAINAGE CONDITIONS

A. General

This area, being generally located in the Southwest one-quarter (SW 1/4) of Section 11, Township 10 North, Range 4 East, N.M.P.M., lies in the mesas and alluvial fans located on the West side of the Sandia Mountains. It is crossed by one main arroyo and several small arroyos in an East-West direction.

B. Topography

Crestview Heights - Unit 3 lies between Menual Blvd., N.E., and a tract of property owned by the Albuquerque Board of Education, just East of Tramway Blvd., N.E. It is crossed by one minor arroyo and has one major arroyo called the Embudo Canyon Arroyo along its southern edge, as shown in Exhibit "A", a portion of a scale photograph by Koogle and Pouls Engineering, Inc., and Exhibit "B", from Part II, Flood Plain Information, Albuquerque Arroyos. Through field investigation, it is considered that the photograph (dated 1-3-72) is satisfactory for the purpose of location with the Flood Plain Information, Part II, for determining the original division lines.

C. Drainage Areas and Channels

At the present time there are two drainage areas, one major and one minor, contributing 4519 c.f.s. and 144 c.f.s. respectively from the East side of the development. The runoff from these areas can be carried by aligning master planned streets in such a manner (setting property lines high enough and adjust street grades within the development) as to carry water across the development, redepositing it in its original channel.

IV. PROPOSED DRAINAGE PLANS

4663

A. General

In order to provide an adequate system of storm drainage for this proposed development, it was necessary to:

(1) Determine the drainage areas which can and will contribute storm runoff during a 100 year design storm.

(2) Determine the amount of runoff which could be expected after the entire area is developed.

(3) Prepare a table of street carrying capacities for use in sizing streets and overflow sections (section above high curb to property line).

(4) Determine the points where the storm runoff will concentrate.

(5) Determine and recommend the means by which the expected runoff can be carried by the master planned area.

(6) Determine the ability of each of the drainage channels, streets plus overflow sections, and structures to handle the runoff that may concentrate on them.

(7) Design additional structures and channels to simulate and distribute the expected runoff in a manner similar to the existing terrain at the outlet end.

B. Drainage Areas

A study of the photography to determine the areas which could conceivably contribute runoff to the proposed development was made for which a copy of computations is contained in Exhibit "E" of this report. Finally, the Master Plan of Drainage, Exhibit "C", was prepared showing the entire area with directions of flow as well as runoff quantities.

C. Runoff Quantities

The quantities of storm runoff to be expected from each drainage area were determined using the Rational Formula, Q=CIA, where Q=quantity of storm runoff in cubic feet per second; C=coefficient of runoff dependent upon the type of surface drained; I=intensity of rainfall in inches per hour for a duration equal to the total accumulation time in minutes; and A=area of contributing watershed in acres.

The area (A) of each separate contributing area was determined by outlining the watershed on a scale photograph or the contour map and measuring the area (by planimeter) in acres.

The intensity (I) of rainfall was determined by assuming a 100 year frequency rainfall and then utilizing Intensity Duration Frequency Curves (Chart I) for the Albuquerque Area, "Master Plan of Drainage - City of Albuquerque, New Mexico and Environs," 1963, prepared by Gordon Herkenhoff and Associates, Consulting Engineers, together with expected accumulation of runoff from each of the areas. The total accumulation times are determined by a combination of Yarnell's method and probable future street and drainage channel alignments and grades, as shown, assuming overland flows to be either across poor grass, asphalt or bare soil surfaces, depending upon the probable type of development in each area and estimating the probable type of grading to be done in each area; assuming future streets to be paved with asphalt with concrete curbs and crowned with either full crown (8"), 3/4 crowned (6"), 1/2 crowned (4"). These times of flow were calculated by use of the tables on pages 5.00, 5.04, and 5.05 of Design by E.E. Seelye.

The coefficient of runoff (C) was determined by assuming the maximum possible development in the areas under consideration. A coefficient of 0.65 is used for areas where dense residential development was most probable. A coefficient of 0.70 should be used for commercial areas or where a large amount of the exposed surface is impermeable.

The quantities of runoff are shown along with areas after development on Exhibit "C", the Master Plan of Drainage for this subdivision.

D. Drainage Channels and Facilities

All existing structure capacities, as well as any proposed future structures, were verified from computer output which forms a part of Exhibit "D" and is based on Manning's Equation, Q=AV, where $V = \frac{1.486}{n} R^{2/3} S^{1/2}$

when A=cross-sectional area of the channel or sturcture; R=hydraulic radius of channel or area divided by wetted perimeter; S=slope of channel or facility in feet per foot; and "n" values of 0.015 for concrete and asphalt surfaces, 0.013 for concrete pipes, 0.0225 for dirt lined channels or a composite "n" value based on proportional wetted surfaces with different values.

V. CONCLUSIONS AND RECOMMENDATIONS

On the basis of this study it is concluded that if all recommendations are followed or a satisfactory alternative is used this area can be developed satisfactorily at this time.

The following is a list of recommendations that must be utilized to properly develop the area at this time. It should be noted that the Ken O'Brien study has not been used, however it is felt that when the results of this study are put in final form they will do nothing more than reduce the incoming flows, therefore, improving the conditions outlined in this report.

A. Construct the channels and provide easements as indicated on Exhibit "C" prior to or atleast concurrently with construction of the affected adjacent lots and street grading.

B. Recommended street grades are contained in Exhibit "F" of this report.

C. A channel with typical section as shown on Exhibit "C" must be constructed just North of the south boundary of Section 11 to a point about 2700' East of Tramway Blvd. This channel will require side lining as shown in the Exhibit.

D. A street along the West edge of Tramway Blvd. is required about 325' South of Rover Ave. to provide a means for conducting the runoff West and Southerly into the existing channel near the Southwest corner of the park site in Crestview Heights, Unit 2.

E. A 25' drainage easement is required from Malcolm Ave. just South of the Security Supply Company tract westerly to Tramway Blvd.

F. All channels and structures West of Tramway Blvd. may require revision to properly accomodate the new flow from Embudo Canyon Arroyo.

G. Both Tramway Blvd. and Monte Largo must be designed to provide for the requirements of this study which includes a minimum of 3.0 foot clearance from the top (invert) of the proposed CBC's with wingwalls and rip-rap.

If all the above recommendations are followed, this Master Plan of Drainage will provide the necessary requirements to satisfactorily accomodate this development.

Respectfully submitted,

Donald L. Campbell
N.M. P.E. & L.S. No. 3633

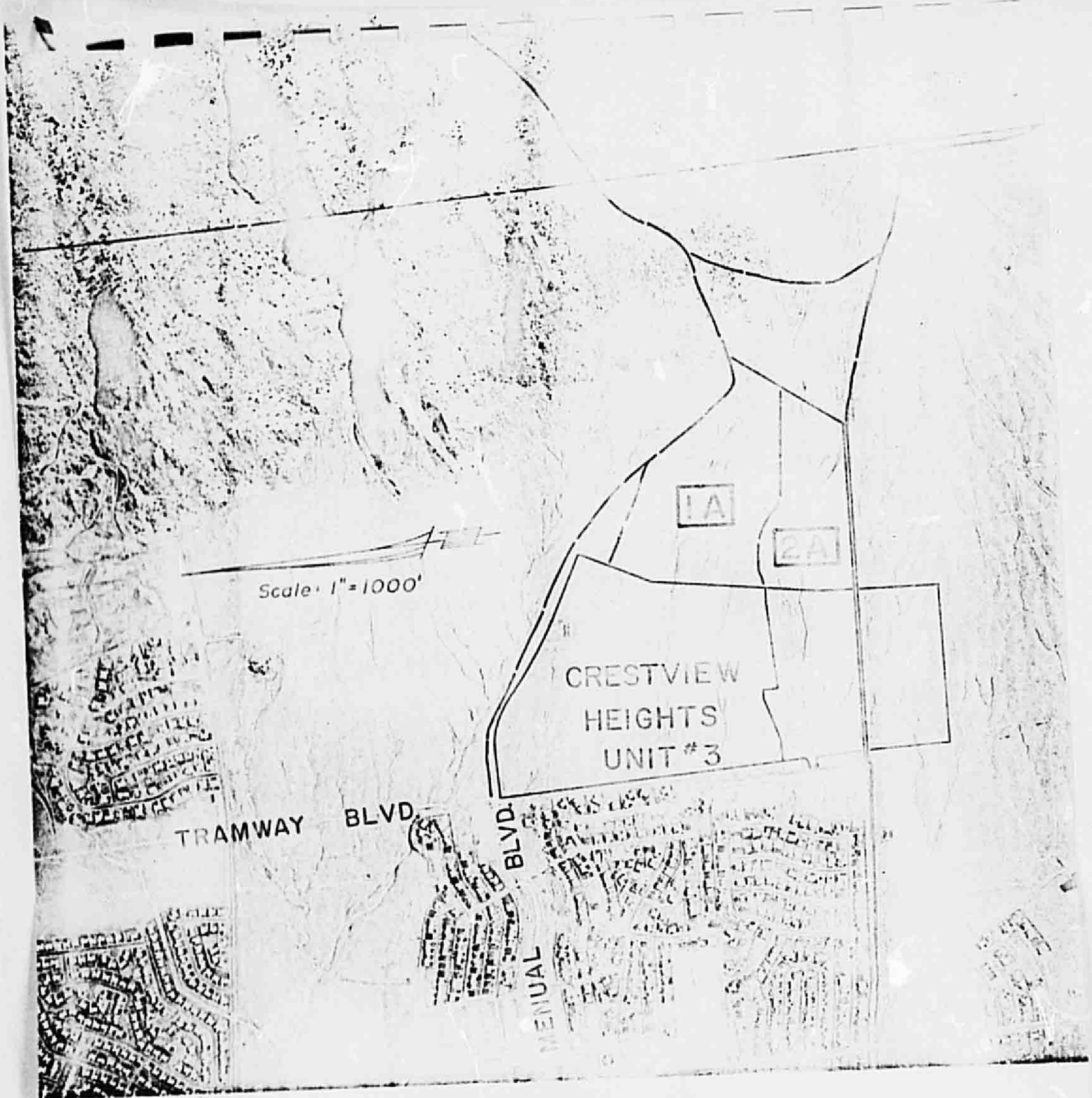


EXHIBIT A

CAMPBELL - HICKS & ASSOCIATES, INC.

CIVIL ENGINEERS, LAND SURVEYORS & LAND PLANNING CONSULTANTS
FROM PHOTOGRAPHY PREPARED BY KOOGLE & POULS ENGINEERING, INC.

LEGEND

——— Division Lines
——-—— Proposed Channel
[IA] Drainage Area

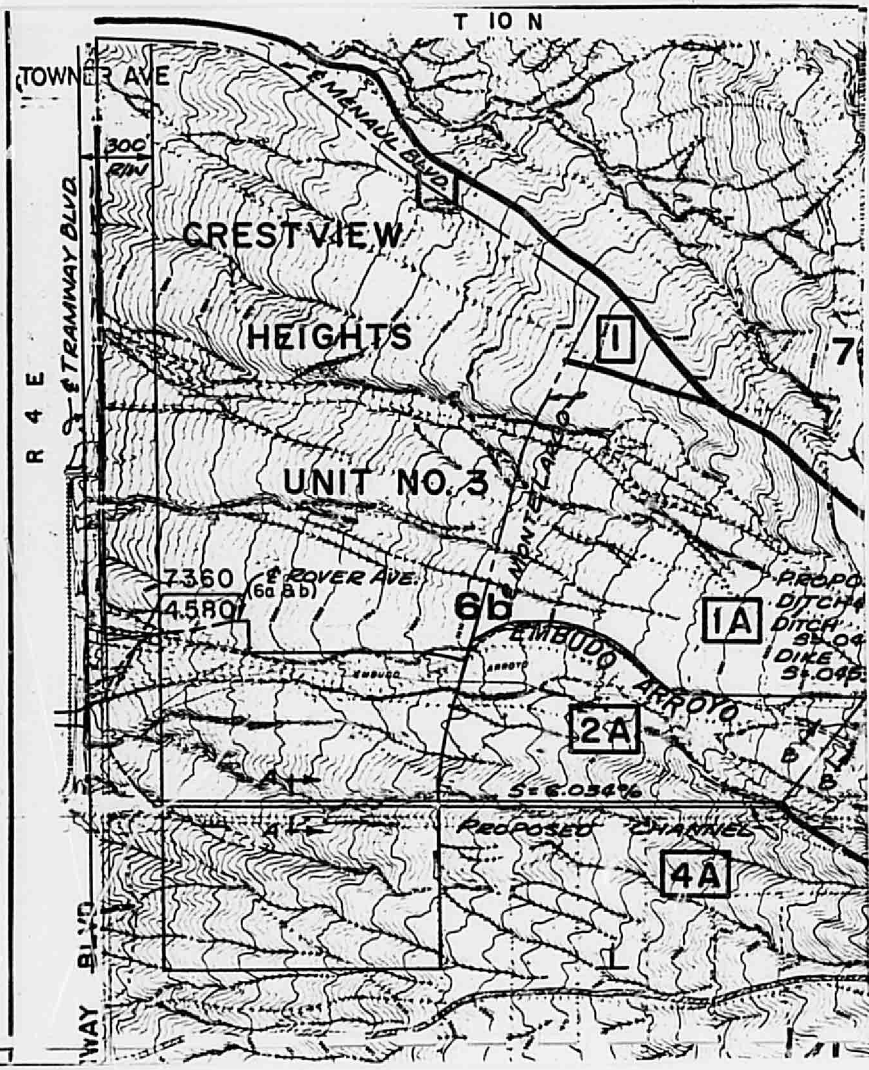


EXHIBIT B

CAMPBELL - HICKS & Associates, Inc.

Scale: 1" = 500'

EXHIBIT D

STREET CARRYING CAPACITIES
AT VARIOUS GRADES
IN CFS

n(conc)=.015   n(soil)=.0225   ~~n(composite)=.006~~

STREET WIDTH	TYPE CROWN	CURB HT	.0050	.0100	.0150	.0200	.0250	.0300	.0350	.0400
32'	8"	8"	18	25	31	36	40	44	47	50
48'	8"	8"	27	38	47	54	60	66	71	76

09/21/71. 09.48.14.
PROGRAM KAPIMAN

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 8

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	7.1111	33.3703	.0050	.0707	.2131	.3568	2.4992	17.7719
.0150	7.1111	33.3703	.0100	.1000	.2131	.3568	3.5344	25.1333
.0150	7.1111	33.3703	.0150	.1225	.2131	.3568	4.3287	30.7819
.0150	7.1111	33.3703	.0200	.1414	.2131	.3568	4.9984	35.5439
.0150	7.1111	33.3703	.0250	.1581	.2131	.3568	5.5883	39.7392
.0150	7.1111	33.3703	.0300	.1732	.2131	.3568	6.1217	43.5322
.0150	7.1111	33.3703	.0350	.1871	.2131	.3568	6.6122	47.0201
.0150	7.1111	33.3703	.0400	.2000	.2131	.3568	7.0687	50.2666

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 6

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	10.6667	33.3542	.0050	.0707	.3198	.4676	3.2759	34.9430
.0150	10.6667	33.3542	.0100	.1000	.3198	.4676	4.6328	49.4169
.0150	10.6667	33.3542	.0150	.1225	.3198	.4676	5.6740	60.5231
.0150	10.6667	33.3542	.0200	.1414	.3198	.4676	6.5518	69.8860
.0150	10.6667	33.3542	.0250	.1581	.3198	.4675	7.3252	78.1350
.0150	10.6667	33.3542	.0300	.1732	.3198	.4675	8.0243	85.5926
.0150	10.6667	33.3542	.0350	.1871	.3198	.4676	8.6672	92.4505
.0150	10.6667	33.3542	.0400	.2000	.3198	.4676	9.2657	98.8338

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 4

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	14.2222	33.3426	.0050	.0707	.4265	.5666	3.9694	56.4537
.0150	14.2222	33.3426	.0100	.1000	.4265	.5666	5.6136	79.8375
.0150	14.2222	33.3426	.0150	.1225	.4265	.5666	6.8752	97.7806
.0150	14.2222	33.3426	.0200	.1414	.4265	.5666	7.9388	112.9073
.0150	14.2222	33.3426	.0250	.1581	.4265	.5666	8.8758	126.2342
.0150	14.2222	33.3426	.0300	.1732	.4265	.5666	9.7230	138.2827
.0150	14.2222	33.3426	.0350	.1871	.4265	.5666	10.5020	149.3623
.0150	14.2222	33.3426	.0400	.2000	.4265	.5666	11.2272	159.6751

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 2

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	17.7778	33.3356	.0050	.0707	.5333	.6576	4.6067	81.8972
.0150	17.7778	33.3356	.0100	.1000	.5333	.6576	6.5149	115.8201
.0150	17.7778	33.3356	.0150	.1225	.5333	.6576	7.9791	141.8501
.0150	17.7778	33.3356	.0200	.1414	.5333	.6576	9.2134	163.7944
.0150	17.7778	33.3356	.0250	.1581	.5333	.6576	10.3009	183.1277
.0150	17.7778	33.3356	.0300	.1732	.5333	.6576	11.2841	200.6064
.0150	17.7778	33.3356	.0350	.1871	.5333	.6576	12.1882	216.6796
.0150	17.7778	33.3356	.0400	.2000	.5333	.6576	13.0298	231.6403

FACE

0.640 / 1.192 / 3

RNH

FACE TO FACE = ? 48
CURB = ? 8
CROWN = ? 8

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	10.6667	49.3580	.0050	.0707	.2161	.3601	2.5227	26.9084
.0150	10.6667	49.3580	.0100	.1000	.2161	.3601	3.5676	38.0543
.0150	10.6667	49.3580	.0150	.1225	.2161	.3601	4.3694	46.6068
.0150	10.6667	49.3580	.0200	.1414	.2161	.3601	5.0453	53.8169
.0150	10.6667	49.3580	.0250	.1581	.2161	.3601	5.6409	60.1691
.0150	10.6667	49.3580	.0300	.1732	.2161	.3601	6.1792	65.9120
.0150	10.6667	49.3580	.0350	.1871	.2161	.3601	6.6743	71.1931
.0150	10.6667	49.3580	.0400	.2000	.2161	.3601	7.1352	76.1086

FACE TO FACE = ? 48
CURB = ? 8
CROWN = ? 6

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	16.0000	49.3472	.0050	.0707	.3242	.4720	3.3061	52.8978
.0150	16.0000	49.3472	.0100	.1000	.3242	.4720	4.6755	74.8088
.0150	16.0000	49.3472	.0150	.1225	.3242	.4720	5.7264	91.6216
.0150	16.0000	49.3472	.0200	.1414	.3242	.4720	6.6122	105.7955
.0150	16.0000	49.3472	.0250	.1581	.3242	.4720	7.3927	118.2830
.0150	16.0000	49.3472	.0300	.1732	.3242	.4720	8.0983	129.5726
.0150	16.0000	49.3472	.0350	.1871	.3242	.4720	8.7471	139.9544
.0150	16.0000	49.3472	.0400	.2000	.3242	.4720	9.3511	149.6175

FACE TO FACE = ? 48
CURB = ? 8
CROWN = ? 4

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	21.3333	49.3395	.0050	.0707	.4324	.5718	4.0055	85.4504
.0150	21.3333	49.3395	.0100	.1000	.4324	.5718	5.6646	120.8451
.0150	21.3333	49.3395	.0150	.1225	.4324	.5718	6.9377	148.0044
.0150	21.3333	49.3395	.0200	.1414	.4324	.5718	8.0110	170.9007
.0150	21.3333	49.3395	.0250	.1581	.4324	.5718	8.9565	191.0728
.0150	21.3333	49.3395	.0300	.1732	.4324	.5718	9.8114	209.3098
.0150	21.3333	49.3395	.0350	.1871	.4324	.5718	10.5975	226.0804
.0150	21.3333	49.3395	.0400	.2000	.4324	.5718	11.3292	241.6901

FACE TO FACE = ? 48
CURB = ? 8
CROWN = ? 2

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	26.6667	49.3349	.0050	.0707	.5405	.6636	4.6482	123.9532
.0150	26.6667	49.3349	.0100	.1000	.5405	.6636	6.5736	175.2963
.0150	26.6667	49.3349	.0150	.1225	.5405	.6636	8.0510	214.6932
.0150	26.6667	49.3349	.0200	.1414	.5405	.6636	9.2965	247.9064
.0150	26.6667	49.3349	.0250	.1581	.5405	.6636	10.3938	277.1678
.0150	26.6667	49.3349	.0300	.1732	.5405	.6636	11.3858	303.6221
.0150	26.6667	49.3349	.0350	.1871	.5405	.6636	12.2981	327.9493
.0150	26.6667	49.3349	.0400	.2000	.5405	.6636	13.1472	350.5926

0.663 / 1.229 /

EXHIBIT E

SUMMARY OF RUNOFF COMPUTATIONS

Sheet No.	Area Number	Area (in acres)	Expected Runoff (in c.f.s.) Individual	Total
1	1	34	108	
2	2	50	140	284
3	3	8	25	
4	1a	46	144	
5	2a	43	137	
6	3a	25	94	4374
7	4a	55	183	4540

RUNOFF COMPUTATIONS

Sheet No. 1

Job No. CRESTVIEW HEIGHTS UNIT 3

Drainage Area No. 1

Area = 34 acres

Maximum Overland Flow: L = 300' S = 8.0%

Maximum Channel Flow:

Channel No. 1 L = 1440' S = 6.5%

Channel No. 2 L = ______ S = ______

Channel No. 3 L = ______ S = ______

Accumulation Time:

Overland Flow: 11.2 min.

Channel No. 1 Flow:

Velocity = 11.8 ft/sec; Time = $\frac{1440}{11.8 \times 60}$ = 2.0 min.

Channel No. 2 Flow:

Velocity = ______ ft/sec; Time = $\frac{\quad}{\times 60}$ = ______ min.

Channel No. 3 Flow:

Velocity = ______ ft/sec; Time = $\frac{\quad}{\times 60}$ = ______ min.

Total Accumulation Time: T = 13.2 min.

$I = \frac{189}{T+25} = \frac{189}{38.2} = 4.9$

Q = CIA = (.65)(4.9)(34) = 108 c.f.s.

Date: 12-29-71

Comp. by: T. Gragmann

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 2

Job No. CRESTVIEW HEIGHTS UNIT 3

Drainage Area No. 2

Area = 50 acres

Maximum Overland Flow: L = 850' S = 5.2%

Maximum Channel Flow:

Channel No. 1 L = 1850' S = 5.1%

Channel No. 2 L = ______ S = ______

Channel No. 3 L = ______ S = ______

Accumulation Time:

Overland Flow: 17.9 min.

Channel No. 1 Flow:

Velocity = 31.6 ft/sec; Time = $\frac{1850}{31.6 \times 60}$ = 1.0 min.

Channel No. 2 Flow:

Velocity = ______ ft/sec; Time = $\frac{\quad}{\times 60}$ = ______ min.

Channel No. 3 Flow:

Velocity = ______ ft/sec; Time = $\frac{\quad}{\times 60}$ = ______ min.

Total Accumulation Time: T = 18.9 min.

$I = \frac{189}{T+25} = \frac{189}{43.9} = 4.3$

Q = CIA = (.65)(4.3)(50) = 140 c.f.s.

Q = 144 + 140 = 284 c.f.s.

Date: 12-29-70

Comp. by: T. Gragoe

Checked by: [signature]

RUNOFF COMPUTATIONS

Sheet No. 3

Job No. Crestview Heights Unit 3

Drainage Area No. 3

Area = 8 acres

Maximum Overland Flow: L = 250' S = 10.0 %

Maximum Channel Flow:

Channel No. 1 L = 1510' S = 5.6 %

Channel No. 2 L = ______ S = ______

Channel No. 3 L = ______ S = ______

Accumulation Time:

Overland Flow: 10.0 min.

Channel No. 1 Flow:

Velocity = 6.8 ft/sec; Time = $\frac{1510}{6.8 \times 60}$ = 3.7 min.

Channel No. 2 Flow:

Velocity = ______ ft/sec; Time = $\frac{\quad}{\times 60}$ = ______ min.

Channel No. 3 Flow:

Velocity = ______ ft/sec; Time = $\frac{\quad}{\times 60}$ = ______ min.

Total Accumulation Time: T = 13.7 min.

$I = \frac{189}{T+25} = \frac{189}{38.7} = 4.9$

Q = CIA = (.65)(4.9)(8) = 25 c.f.s.

Date: 12-29-71

Comp. by: [signature]

Checked by: [initials]

RUNOFF COMPUTATIONS

Sheet No. 4

Job No. CRESTVIEW HEIGHTS UNIT 2

Drainage Area No. 12

Area = 46 acres

Maximum Overland Flow: L = 250' S = 2.5%

Maximum Channel Flow:

Channel No. 1 L = 2150 S = 5.7%

Channel No. 2 L = ______ S = ______

Channel No. 3 L = ______ S = ______

Accumulation Time

Overland Flow: 13.0 min.

Channel No. 1 Flow:

Velocity= 31.6 ft/sec; Time= $\frac{2150}{31.6 \times 60}$ = 1.1 min.

Channel No. 2 Flow:

Velocity= ______ ft/sec; Time= $\frac{\quad}{\times 60}$ = ______ min.

Channel No. 3 Flow:

Velocity= ______ ft/sec; Time= $\frac{\quad}{\times 60}$ = ______ min.

Total Accumulation Time: T = 14.1 min.

$I = \frac{189}{T+25} = \frac{189}{39.1} = 4.8$

Q = CIA = (.65)(4.8)(46) = 144 c.f.s.

Date: 12-28-71

Comp. by: T. Aragon

Checked by: HCP

RUNOFF COMPUTATIONS

Sheet No. 5

Job No. CRESTVIEW HEIGHTS UNIT 3

Drainage Area No. 2a

Area = 43 acres

Maximum Overland Flow: L = 175' S = 2.0 %

Maximum Channel Flow:

Channel No. 1 L = 2500' S = 6.2 %

Channel No. 2 L = ______ S = ______

Channel No. 3 L = ______ S = ______

Accumulation Time

Overland Flow: 12.0 min.

Channel No. 1 Flow:

Velocity= 31.6 ft/sec; Time= $\frac{2500}{31.6 \times 60}$ = 1.3 min.

Channel No. 2 Flow:

Velocity= ______ ft/sec; Time= $\frac{\quad}{\times 60}$ = ______ min.

Channel No. 3 Flow:

Velocity= ______ ft/sec; Time= $\frac{\quad}{\times 60}$ = ______ min.

Total Accumulation Time: T = 13.3 min.

$I = \frac{189}{T+25} = \frac{189}{38.3} = 4.9$

Q = CIA = (.65)(4.9)(43) = 137 c.f.s.

Date: 1-25-72

Comp. by: [signature]

Checked by: [signature]

RUNOFF COMPUTATIONS

Sheet No. 6

Job No. CRESTVIEW HEIGHTS UNIT 3

Drainage Area No. 32

Area = 25 acres

Maximum Overland Flow: L = 150' S = 20 %

Maximum Channel Flow:

Channel No. 1 L = 1200' S = 6.4 %

Channel No. 2 L = ____ S = ____

Channel No. 3 L = ____ S = ____

Accumulation Time

Overland Flow: 7.2 min.

Channel No. 1 Flow:

Velocity = 32 ft/sec; Time = $\frac{1200}{32 \times 60}$ = 0.6 min.

Channel No. 2 Flow:

Velocity = ____ ft/sec; Time = $\frac{\quad}{\times 60}$ = ____ min.

Channel No. 3 Flow:

Velocity = ____ ft/sec; Time = $\frac{\quad}{\times 60}$ = ____ min.

Total Accumulation Time: T = 7.8 min.

$I = \frac{189}{T+25} = \frac{189}{32.8} = 5.76$

Q = CIA = (.65)(5.76)(25) = 94 c.f.s.

Date: 1-25-72

Comp. by: [signature]

Checked by: [signature]

Q = 94 + 4280 = 4374 CFS

RUNOFF COMPUTATIONS

Sheet No. 7

Job No. CRESTVIEW HEIGHTS UNIT 3

Drainage Area No. 42

Area = 55 acres

Maximum Overland Flow: L = 300' S = 3.0 %

Maximum Channel Flow:

Channel No. 1 L = 4200' S = 5.1 %

Channel No. 2 L = ______ S = ______

Channel No. 3 L = ______ S = ______

Accumulation Time

Overland Flow: 8.5 min.

Channel No. 1 Flow:

Velocity= 20 ft/sec; Time= $\frac{4200}{20 \times 60}$ = 3.5 min.

Channel No. 2 Flow:

Velocity= ______ ft/sec; Time= $\frac{\quad}{\times 60}$ = ______ min.

Channel No. 3 Flow:

Velocity= ______ ft/sec; Time= $\frac{\quad}{\times 60}$ = ______ min.

Total Accumulation Time: T = 12.0 min.

$I = \frac{189}{T+25} = \frac{189}{37} = 5.11$

Q = CIA = (.65)(5.11)(55) = 183 c.f.s.

Q = 183 + 4357 = 4540 CFS

Date: 1-25-72

Comp. by: APC

Checked by: E.H.

EXHIBIT F

RECOMMENDED STREET GRADES

STREET DESCRIPTION & LOCATION	MIN. % GRADE	CROWN HEIGTH	PROPERTY LINE ABOVE HIGH CURB
A. Monte Largo, N.E. - A 48' street from Menual Blvd., N.E. to 137' Southwest of Rover Ave., N.E.	0.5	8"	0.0'
B. Selby Loop, N.E. - A 32' street from Menual Blvd., N.E. Southwest 498'; then 270' Northwest; then 498' Northeast back to Menual Blvd., N.E. at a point 547' Northwest of junction of Monte Largo, N.E. and Menual Blvd., N.E.	0.5	8"	0.0'
C. West Holme Loop, N.E. - A 32' street from a point on Rover Ave., N.E. 260.51' Northwest of junction of Monte Largo, N.E. and Rover Ave., N.E., Northeast 724.10'; then 270' Northwest; then 798.97' Southwest to a point on Rover Ave., N.E., 530.38' Southwest of junction of Monte Largo Ave., N.E. and Rover Ave., N.E.	0.5	8"	0.0'
D. Tramway Blvd., N.E. - A 25' two lane street, from the West quarter (1/4) corner, Section 11, T 10 N, R 4 E, Southeast to section corner 11 and 14, T 10 N, R 4 E.	0.5	8"	
E. Menual Blvd., N.E. - A 76' street from Monte Largo, N.E. Northwest to an intersection with Tramway Blvd., N.E. (See 32' street capacity and multiply by 2).	4.0	8"	0.0'
F. Rover Ave., N.E. - a 48' street from Monte Largo, N.E. to an intersection with Tramway Blvd., N.E.	4.0	8"	0.0'
G. Malcolm Ave., N.E. - A 32' street from Menual Blvd., N.E. South to Rover Ave., N.E.	0.4	8"	0.0'

REFERENCES

A. Design by Elwyn E. Seelye, 1945.

B. Handbook of Hydraulics by Horace W. King and Ernest F. Brater.

C. Miscellaneous Publication No. 204, U.S. Department of Agriculture, by David L. Yarnell.

D. Flood Plain Information - Albuquerque Arroyos, Part II-Albuquerque, New Mexico by U.S. Corps of Engineers, U.S. Army, for the Albuquerque Metropolitan Arroyo Flood Control Authority.

E. "Master Plan of Drainage - City of Albuquerque, New Mexico and Environs," by Gordon Herkenhoff and Associates, 1963.

INSTRUCTIONS FOR DRAINAGE STUDY REVISIONS

CRESTVIEW HEIGHTS, UNIT 3

Page 9, Exhibit "D": Delete "n(composite)=.006"

REVISED MAY 1972