3-6-07

TO: Andy

from: Curtis Cherne
Hydrology City of Albuquerque

Fax: 323-5868

Number of sheets including cover: #2

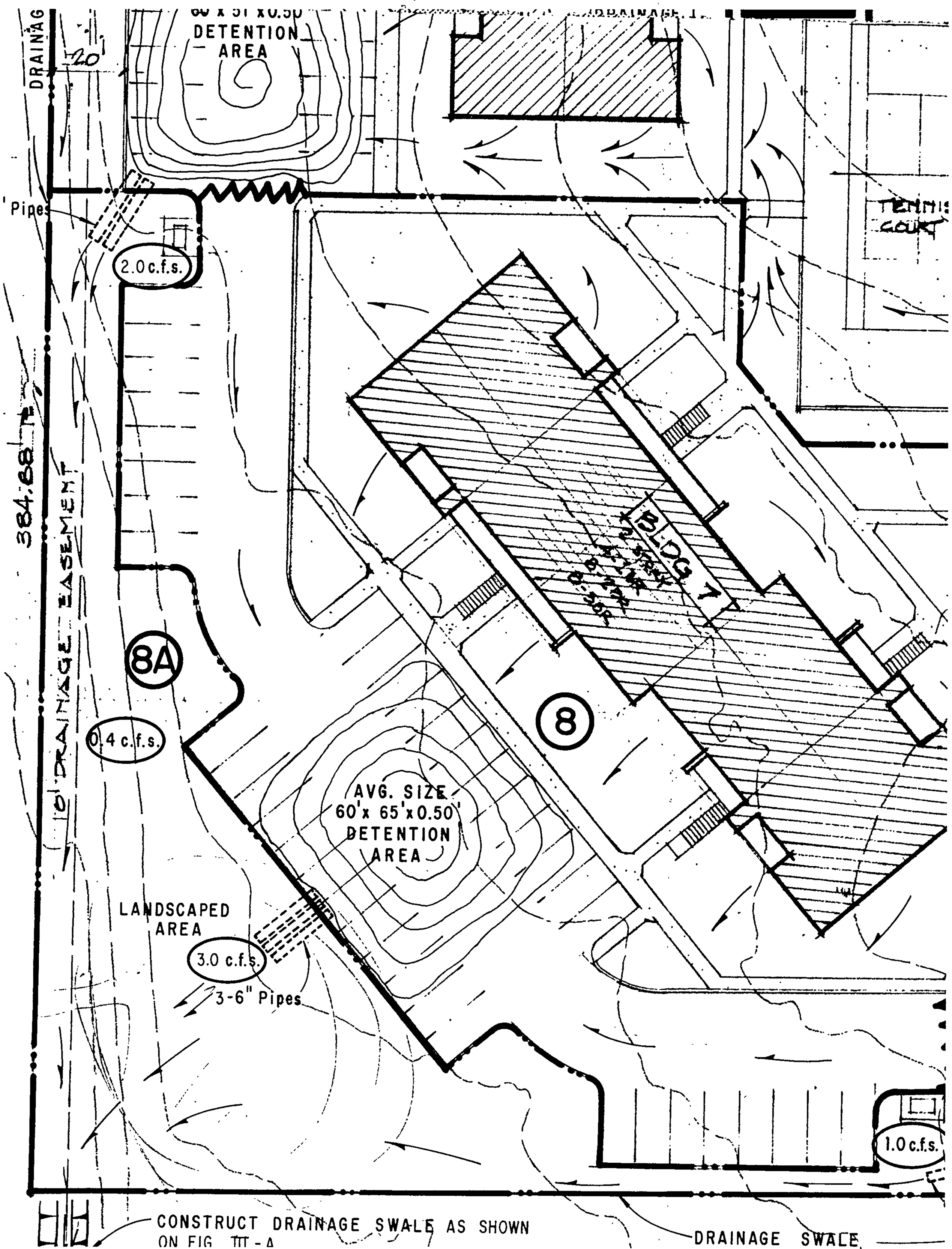
Andy,

2 sheets from plat
1 sheet from Grading & drainage plan

Curtis Cherne.

Easement is on their property and is for draining their property. They are responsible for maintaining it. to ensure it functions properly.

Curtis Cherne 3-5-07


DETENTION AREA
DRAINAGE
20'
Pipes
2.0 c.f.s.
TENNIS COURT
384.88
10' DRAINAGE EASEMENT
8A
0.4 c.f.s.
8
BLDG 7
AVG. SIZE 60' x 65' x 0.50' DETENTION AREA
LANDSCAPED AREA
3.0 c.f.s.
3-6" Pipes
1.0 c.f.s.
CONSTRUCT DRAINAGE SWALE AS SHOWN ON FIG. III-A
DRAINAGE SWALE

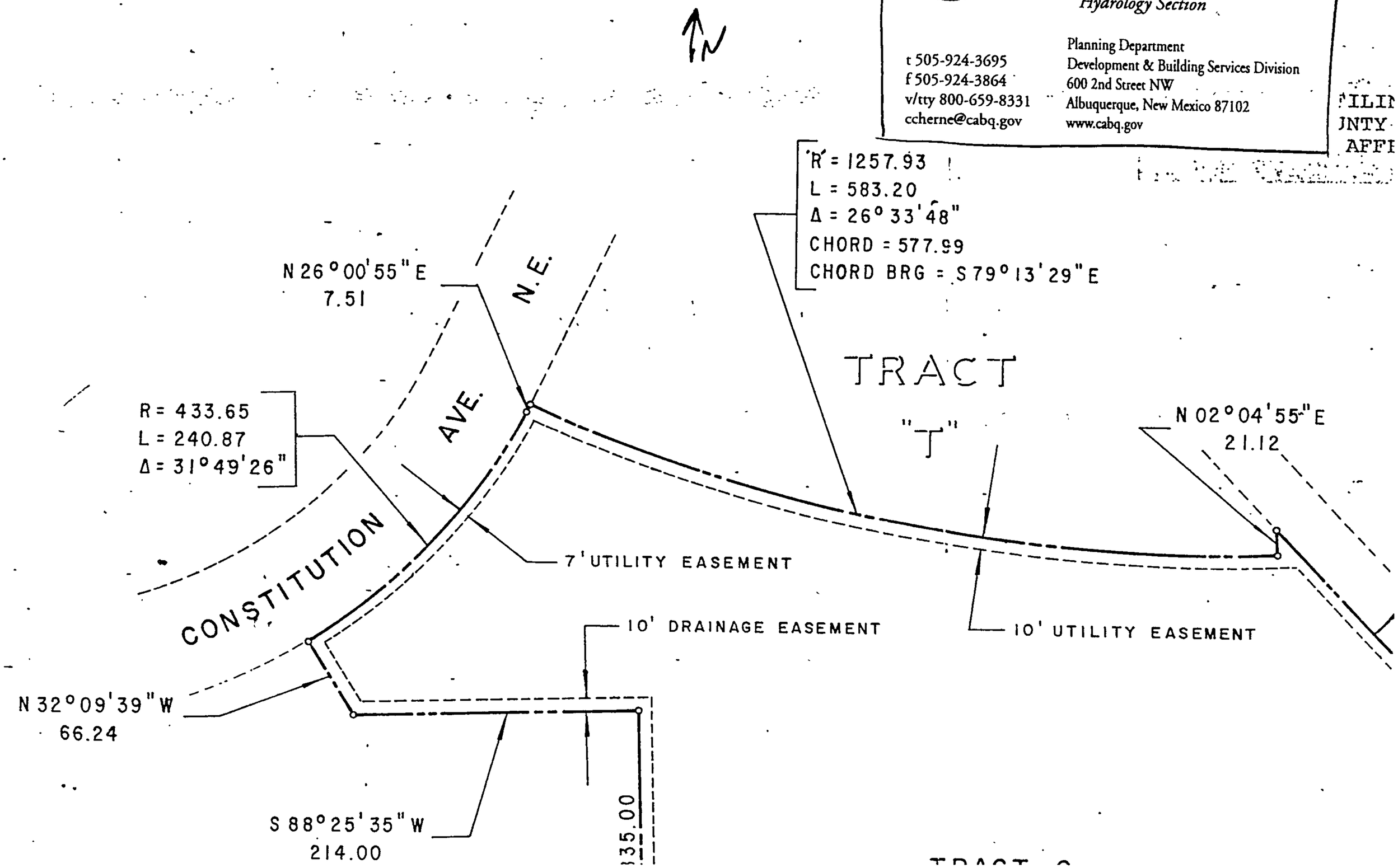
85-E12

LOG # 2-78-544

CITY OF ALBUQUERQUE
Curtis A. Cherne, E.I.
Engineering Associate
Hydrology Section

t 505-924-3695
f 505-924-3864
v/tty 800-659-8331
ccherne@cabq.gov

Planning Department
Development & Building Services Division
600 2nd Street NW
Albuquerque, New Mexico 87102
www.cabq.gov



S 88°25'35"W
214.00

N

PANORAMA HEIGHTS
PARCEL I-A

835.00

384.88

TRACT G
(8.000 Ac.)

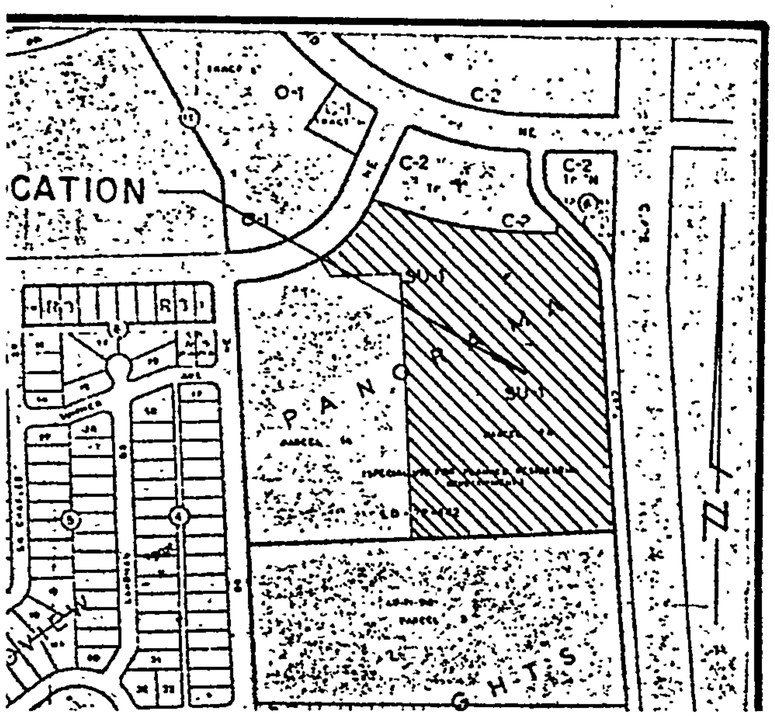
792.80

331.11

10' DRAINAGE EASEMENT

S 87°32'45"W
619.91

ROAD



450.12

TRACT H
(6.509 Ac.)

459.69

N 01°34'25"W

5' UTILITY EASEMENT

S 88°25'35"W

626.87

Apt Pondin / Moodins

2-28-07

292-2555

Andy Greenbaum Sunhouse 1212 Palmer Dr

alley

Manhattan | 115th Apts

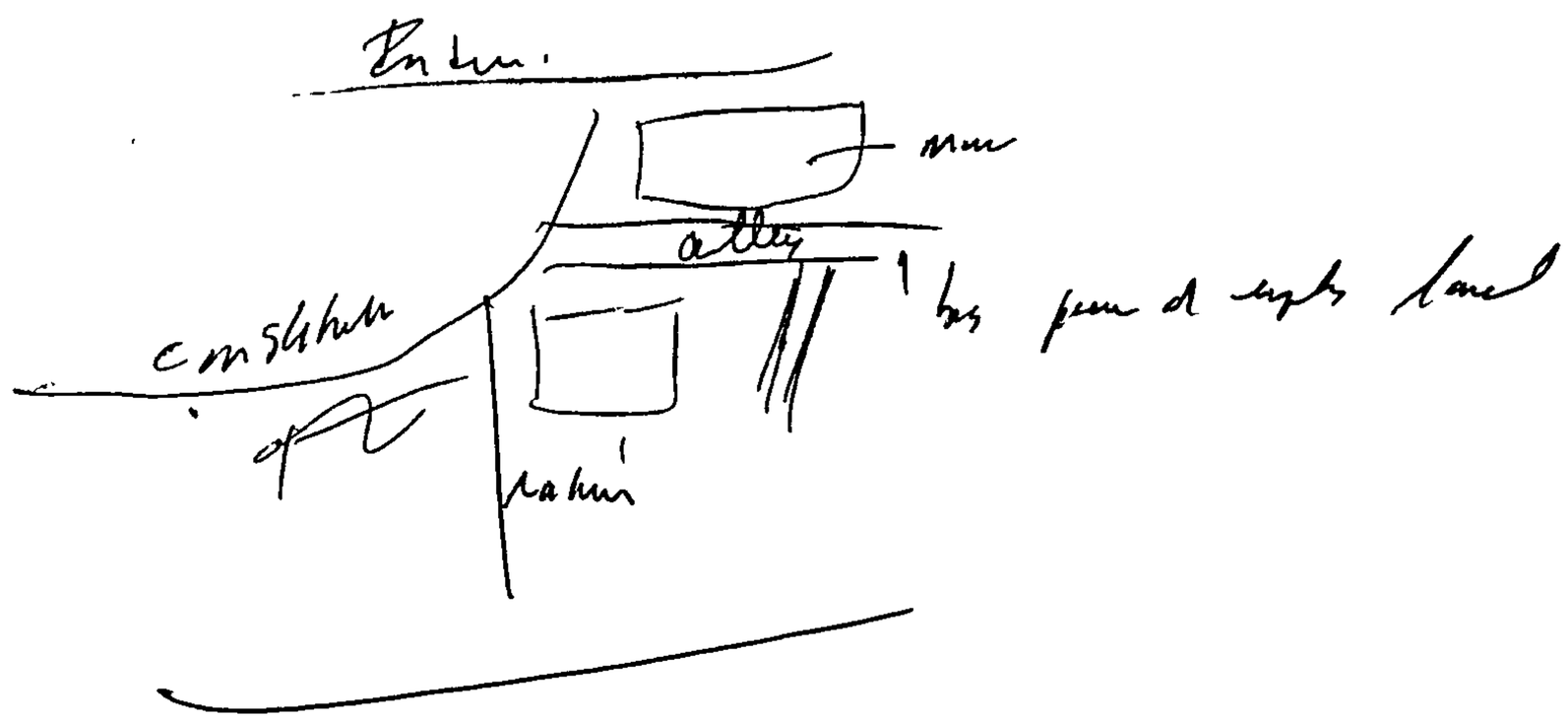
between Constitution and [illegible]

both been there 30 yrs

J-22

Constitution and Palmer

SE corner



gcoop@quest.net

for

323-5868

****
*** TX REPORT ***
****

TRANSMISSION OK

TX/RX NO	1476	
CONNECTION TEL		93235868
SUBADDRESS		
CONNECTION ID		
ST. TIME	03/05 14:44	
USAGE T	01'41	
PGS.	4	
RESULT	OK	

TO: Andy

from: Curtis Cherne
Hydrology City of Albuquerque

Fax: 323-5868

Number of sheets including cover: 4

Andy,

2 sheets from plat
1 sheet from Grading & drainage plan

[illegible] is on their property and is for

****
*** TX REPORT ***
****

TRANSMISSION OK

TX/RX NO	1485	
CONNECTION TEL		93235868
SUBADDRESS		
CONNECTION ID		
ST. TIME	03/06 12:16	
USAGE T	00'57	
PGS.	2	
RESULT	OK	

3-6-07

TO: Andy

from: Curtis Cherne
Hydrology City of Albuquerque

Fax: 323-5868

Number of sheets including cover: ~~4~~ 2

Andy,

2 sheets from plat
1 sheet from Grading & drainage plan

[illegible] is on their property and is for

Site visit 4-30-07

met with Priscilla Smith, manager, and Fred the maintenance person.

we walked the easement area. She agreed to contact an engineer to design the site properly.

She intends to have the work completed before the monsoon season, which means calling engineers today and tomorrow.

Cantrell Chew

called Andy at Greenbrier townhomes to let him know that action has been taken

CITY OF ALBUQUERQUE
DRAINAGE COMPLAINT REPORT

Location: Constitution, south of Indian School. Sheet ..... of .....

Reported by: Chuck Smith Phone 345-3655

Address: Resident of Greenbryar Ext.

Complainant Sharon (Manager of Greenbryar) Phone 292-2555

Address Constitution, south of Indian School Ext.

Taken by: Roger Green Date 7/19/88

COMPLAINT excess runoff from Mountain View Apartments flooded GreenBryar Townhouses and depositing sediment. Check for compliance with grading Plans.

Referred to: Rick Duran

INVESTIGATION — CAUSE RUNOFF FROM MOUNTAIN VIEW APTS. WAS NOT CONTAINED IN EASEMENT AND RAN INTO GREENBRYAR PROPERTY.

Recommendation: REWORK EASEMENT & OUTFALL TO PROVIDE PROPER DRAINAGE.

Investigated by: [signature] Date 8-3-88

Action taken:

Taken by: Date

Follow Up:

Taken by: Date

Zone Atlas J-22

Drainage Map

Complaint Report No. 122-66

Date

Plan No.

Date

Project No. J-22/D14

Approved

File
Nakomis
Townhouse
Development.

ENGINEER'S DRAINAGE REPORT

FOR

PROPOSED TOWNHOUSE DEVELOPMENT

AT SOUTHEAST CORNER OF NAKOMIS DRIVE

AND CONSTITUTION AVENUE, ALBUQUERQUE, NEW MEXICO

Panorama
Heights

WILSON & COMPANY

ALBUQUERQUE, NEW MEXICO

9 OCTOBER 1971

ENGINEER'S DRAINAGE REPORT
FOR
PROPOSED TOWNHOUSE DEVELOPMENT AT SOUTHEASE CORNER OF
NAKOMIS DRIVE AND CONSTITUTION AVENUE,
ALBUQUERQUE, NEW MEXICO

PURPOSE: The purpose of this report is to analyze the amount of run-off entering the study area and the carrying capacity of the existing and proposed streets, ditches and structures. A 100-year design rainfall was used to determine the run-off.

ENGINEER'S DRAINAGE REPORT
FOR

CLIMATOLOGICAL INFORMATION: The City of Albuquerque has adopted a drainage master plan which gives the following formula for calculating the intensity of rainfall that is probable for a 100 year design storm:

$$i_{100} = \frac{189}{t_c + 25}$$

i_{100} = rainfall inches per hour

t_c = time of concentration in minutes

RUN-OFF CALCULATION: The Rational Method was used to calculate the run-off from the study area. The rational formula is as follows:

$Q = CiA$

Q = Quantity of run-off in cubic feet per second

C = Coefficient of run-off expressed in a ratio of rainfall to run-off

i = Rainfall expressed in inches per hour

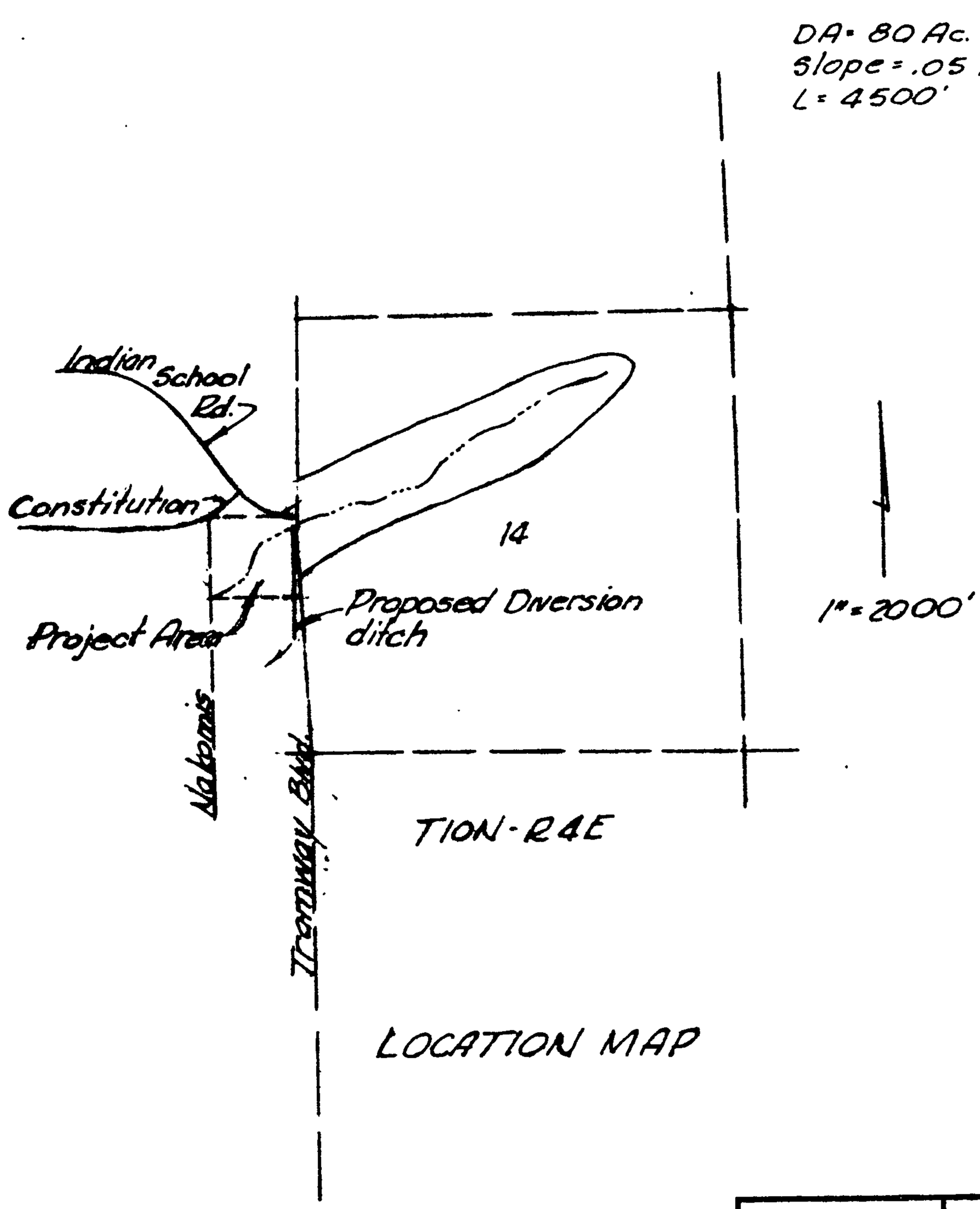
A = Drainage area expressed in acres

DISCUSSION: An arroyo, with a drainage area of 80 acres, enters the project area near the northeast corner. The calculated discharge at this point is 229 cfs. It is proposed that the existing arroyo be plugged and a diversion ditch be constructed to a point 1300 feet south to an existing arroyo. The proposed ditch

would have a 10 foot bottom with 2:1 side slopes. The ditch will have a capacity of 254 c.f.s. with a depth of flow of 2 feet. The proposed ditch was suggested by the City of Albuquerque. This ditch would be temporary until Tramway Boulevard is improved. Also the City is now making a study to determine a method of intercepting the flow from the Sandia foothills and diverting the run-off to Tijeras Canyon. This proposed diversion is at least 5 years away.

It has been assumed the site will be graded to drain to the southwest corner. The area of the site is 24.56 acres. The calculated discharge at the southwest corner is 66 c.f.s. The capacity of the street at this point is 79.2 c.f.s. and there are no other contributing areas; therefore, the capacity of the street will not be exceeded.

It is recommended that all streets and parking areas within the project be constructed with an inverted crown.



LOCATION MAP

WILSON & COMPANY
ENGINEERS & ARCHITECTS

File 71-509

Date 9 Oct. 71

Scale 1" = 2000'

Drainage Calculations

1. Area Entering development at NE corner

A= 80 acres

slope =.05'/ft. Length = 4500'

PCA Handbook Page 43

$K = \frac{L}{\sqrt{S}} = \frac{4500}{\sqrt{.05}} = \frac{4500}{.224} = 20{,}000$

time concentration = 18 min.

City Alb. Drainage Report

$i_{100} = \frac{189}{t_c + 25} = \frac{189}{18+25} = \frac{189}{43} = 4.4$ in/hr.

C= 0.65 (Recommended by City)

$Q = CiA = .65 \times 4.4 \times 80 = 229$ cfs

The City has requested that this water be diverted to south along the service Road

Propose to divert water 1300' South

Required ditch:

Proposed grade = .0200' ft./ft.

Proposed section 10' Bottom 2:1 side slope

max. depth flow = 2.0 ft. From Corps Eng. Handbook

n = .03 r = 1.48

A = 28.0 sq.ft. S = .02 '/ft.

velocity = 9.09 ft/sec

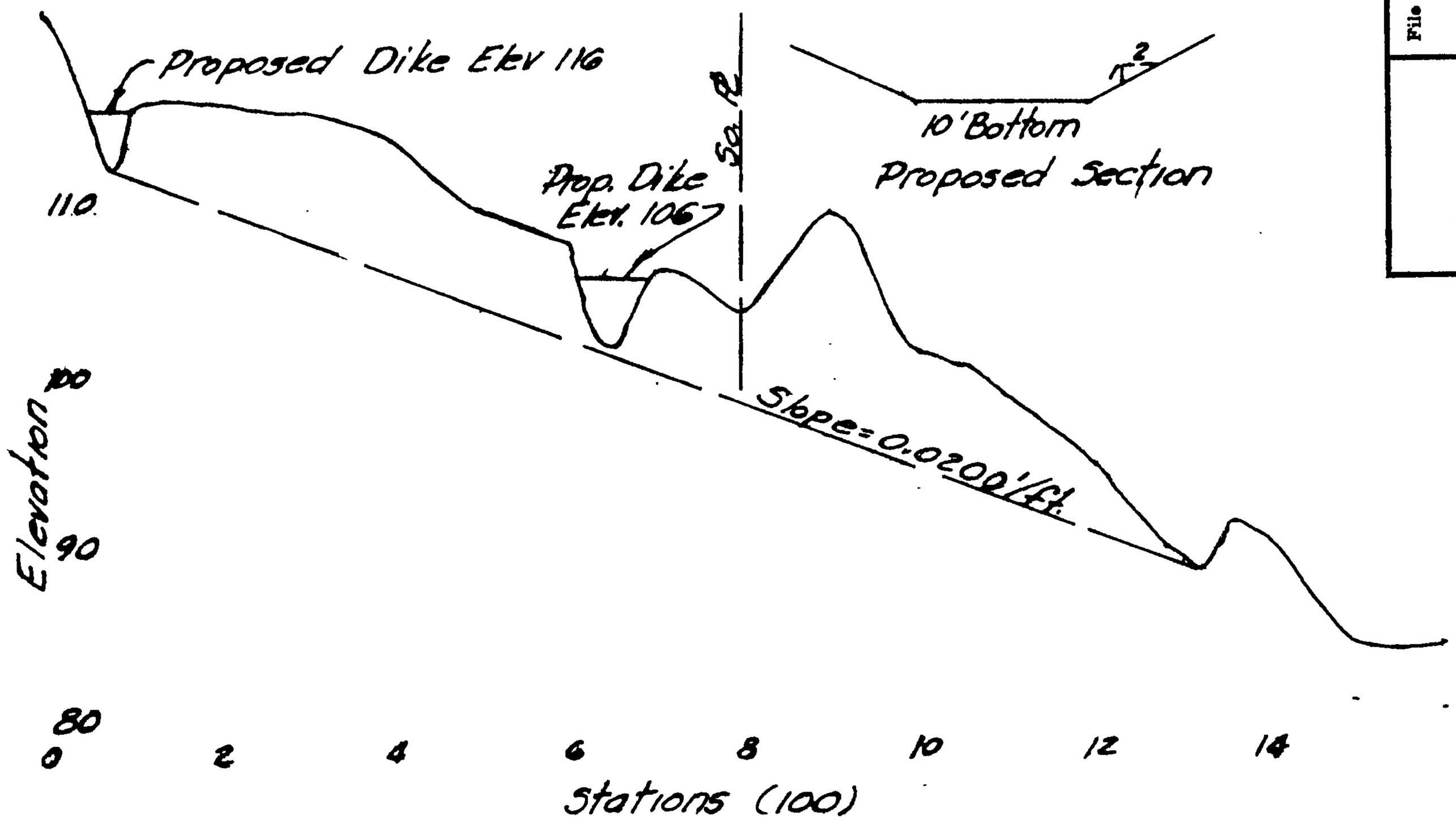
$Q_{cap} = AV = 28.0 \times 9.09 = 254$ cfs

$Q_{req.} = 229$ cfs.

WILSON & COMPANY ENGINEERS & ARCHITECTS

File 71-509

Date 9 Oct. 71



Profile Proposed Ditch

File 71-509

Date 9 Oct 71

WILSON & COMPANY
ENGINEERS & ARCHITECTS

Interior drainage

The drainage from the development will all discharge at the SW corner.

$DA = 24.56$ Ac.

$t_c = 10$ min

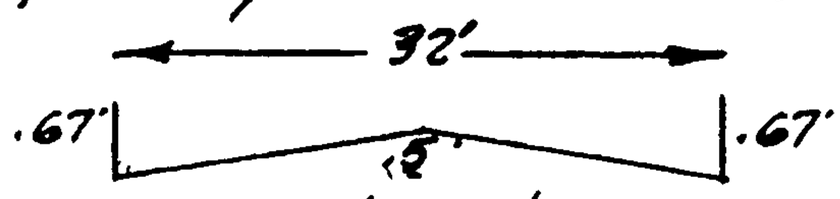
$i_{100} = \frac{189}{10+25} = \frac{189}{35} = 5.4$ in/hr

$Q_{100} = CiA \qquad C = 0.50$

$Q_{100} = 0.50 \times 5.4 \times 24.56$

$Q = 66$ cfs.

Capacity Nakomis St.



St. Section

$A_{st} = (.17 \times 32) + (.5 \times 16) = 13.33$ sq.ft.

Hyd. Rad $= R = \frac{A}{WP} = \frac{13.33}{33.33} = .40$

$R^{2/3} = .543 \qquad n = .015 \quad s =$ slope street $= 2.24\%$

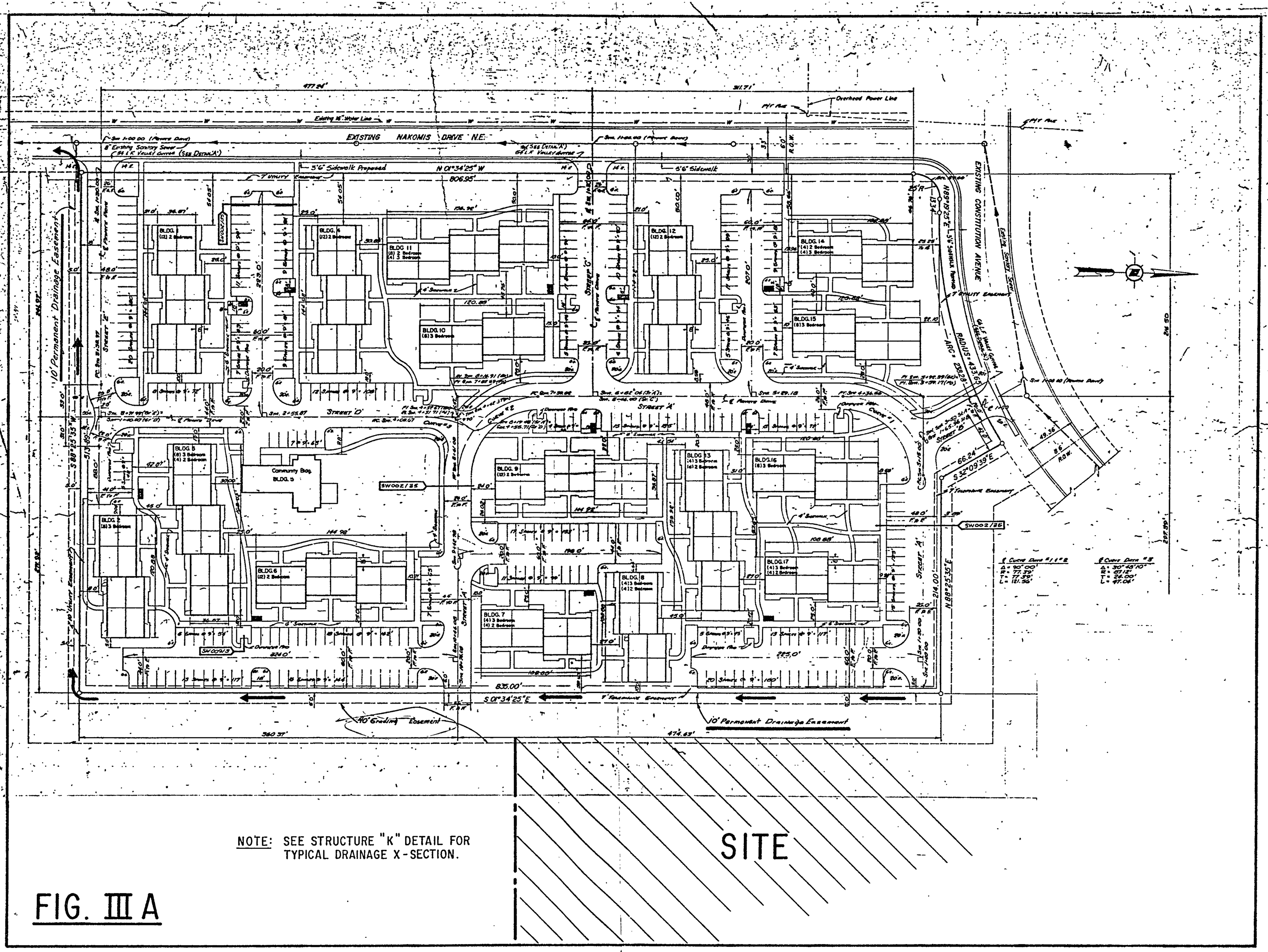
$s^{1/2} = .150$

Velocity $= V = \frac{1.486}{n} \times r^{2/3} \times s^{1/2} = \frac{1.486}{.015} \times .40 \times .150 = 5.94$ ft/sec.

$Q_{cap.} = AV = 13.33 \times 5.94 = 79.2$ cfs

Street capacity is adequate

WILSON & COMPANY ENGINEERS & ARCHITECTS	File 71-509
	Date 9 Oct 71



NOTE: SEE STRUCTURE "K" DETAIL FOR TYPICAL DRAINAGE X-SECTION.

SITE

FIG. III A

322/D14

3 Plans

Sub-drainage Areas 7, 8 and 9 will have total ponding. The following table has been revised to show total flows generated with these areas and total ponding capacities. A rainfall value of 2.6" for a 100 year, 6-hour storm was used.

Sub-Drainage	Composite "C" Factor	Area (ft^2)	Volume Runoff (ft^3)	Pond Volume (ft^3)
7	0.49	21,420	2134	2144
8	0.46	30,222	2815	2965
9	0.50	16,470	1677	1900

The pond storage available is based on a 0.5 deep depression. The swimming pool area and basketball court were assumed to be self contained in that these areas will not contribute runoff to surrounding areas.

Summary of Results

The following is a revised breakdown of the individual areas and their relationship to the overall drainage picture. (See Fig. III)

Area 1, at the northwest corner of the site, is the only sub-drainage area which drains onto Constitution Avenue. No more than 1.0 cfs can be released onto Constitution Avenue because of the historical undeveloped runoff rate. The detention pond at the southwest corner of Area 1 is too small to initially hold the total runoff of the area, so total ponding volume is divided between two pond areas. The north pond, on the parking area, detains runoff from only the north parking area. The rest of Area 1 runoff is detained by the south pond. The

Addendum to the Sunburst Apartments Drainage Study

Date: August 2, 1976

This addendum to the Sunburst Apartment Drainage Study was required because of changes in the site plan and grading plan. Figure III has been revised to show these changes.

The concept for handling the flows is the same--detaining the runoff on site and releasing these flows at controlled rates at designated outflow areas.

The revised Table of Controlled Outflows for Areas 1 thru 5 follows:

Sub-Drainage Area	1	2	3	4	5
Area (Ac)	1.279	1.271	0.481	1.074	1.839
Allowable Outflow (c.f.s.)	1.0	1.0	2.0	3.0	5.0
Runoff Coefficient	0.67	0.64	0.90	0.67	0.70
Qo (c.f.s./Ac.Imp.)	1.17	1.23	4.62	4.17	3.88
T (minutes)	52.9	50.9	14.2	16.2	17.7
Vs (ft^3/Ac.Imp.)	5229.75	5097.61	1487.11	1753.40	1951.74
Vt (ft^3)	4481	4147	643	1261	2512
Head (ft)	0.5	0.5	0.5	0.5	0.5
a (ft^2)	0.22	0.22	0.44	0.66	1.10
No. Pipe Required & Size (in.)	1 - 6"	1 - 6"	2 - 6"	3 - 6"	6 - 6"

	Area	C	I	Q
Area 6	0.26	0.35	5.4	0.5
Area 6-A	0.08	0.35	5.4	0.1

MEMORANDUM

TO : Property Management

FROM: Kleston Laws
City Drainage Engineer

RE : Vacation of Easement by Quitclaim Deed
Within Parcel 2-A, Panorama Heights Addition

DATE: August 24, 1976

Due to the realignment of the drainage channel in this area, the temporary 30' wide drainage easement is no longer needed.

ENGINEER'S DRAINAGE REPORT

FOR

PROPOSED TOWNHOUSE COMMUNITY

NEAR THE NORTHEAST CORNER OF NAKOMIS DRIVE & LOMAS BOULEVARD

ALBUQUERQUE, NEW MEXICO

WILSON & COMPANY

ALBUQUERQUE, NEW MEXICO

21 JUNE 1972

ENGINEER'S DRAINAGE REPORT
FOR
PROPOSED TOWNHOUSE COMMUNITY
NEAR THE NORTHEAST CORNER OF NAKOMIS DRIVE & LOMAS BOULEVARD
ALBUQUERQUE, NEW MEXICO

PURPOSE: The purpose of this report is to analyze the amount of run-off entering the study area and the carrying capacity of the existing and proposed streets, ditches and structures. A 100-year design rainfall is used to determine the run-off.

CLIMATOLOGICAL INFORMATION: The City of Albuquerque has adopted a drainage master plan which gives the following formula for calculating the intensity of rainfall that is probable for a 100-year design storm:

$$i_{100} = \frac{189}{t_c + 25}$$

i_{100} = rainfall intensity inches per hour

t_c = time of concentration in minutes

RUN-OFF CALCULATION: The Rational Method is used to calculate the run-off from the study area. The Rational Formula is as follows:

$Q = CiA$

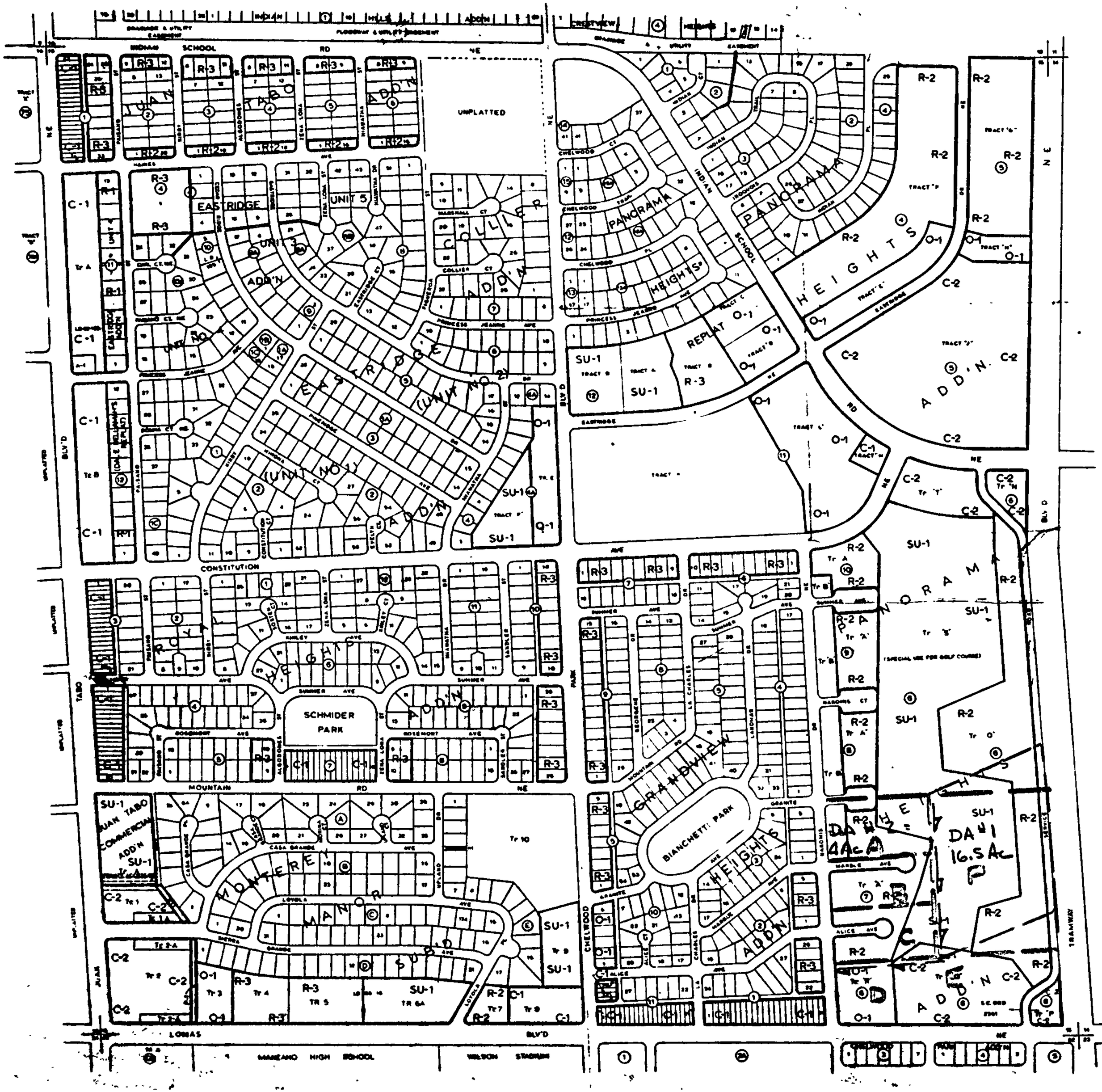
Q = Quantity of run-off in cubic feet per second

C = Coefficient of run-off expressed in a ratio of rainfall to run-off

i = Rainfall intensity expressed in inches per hour

A = Drainage area expressed in acres.

DISCUSSION: The housing developments east of Tramway Boulevard and north of Lomas Blvd. intercepts the drainage from the east. This water is diverted to



Location Map.

J-22-Z

Lomas Boulevard or to Tramway Boulevard and then south to Lomas Boulevard. At present time this runoff is ponded in an abandoned gravel pit at the northeast corner of Lomas and Tramway. It has been anticipated the gravel pit will be filled and the water will then drain west in Lomas Blvd.

The drainage from area east of the east property line of Tracts A, B, and C and Tramway Blvd. will be intercepted by a ditch along the east property line of Tracts A, B, and C. This ditch will then turn west along the south property line of Tract C and will discharge into Nakomis Drive.

The proposed ditch would have 4 foot flat bottom with 3 to 1 side slopes and a design flow depth 1.2 feet. The capacity of the earth ditch is 64 c.f.s. The required design capacity 58 c.f.s.

Each Townhouse development for Tracts A, B, and C are considered separately and the design discharge from each tract 20 c.f.s. The minimum street capacity for each tract is 106 c.f.s.

The proposed development does not alter the drainage that enters Nakomis Drive.

COMP. RFS

CK.

DATE 8 June 1972

WILSON & COMPANY
ENGINEERS & ARCHITECTS
BOX 3305
ALBUQUERQUE
NEW MEXICO

LOC. Albuquerque FILE

PROJ. SHEET 1

SUBJ. Drainage OF

Townhouse Community
Hugh Knoell Builders

Drainage Area No. 1

Area = 16.5 Acres.

t_c = time of concentration = 10 min (PCA Handbook

i = rainfall intensity

$$i_{100} = \frac{189}{t_c + 25} = \frac{189}{10+25} = 5.4 \text{ in/hr}$$

$Q_{DESIGN} = CiA$

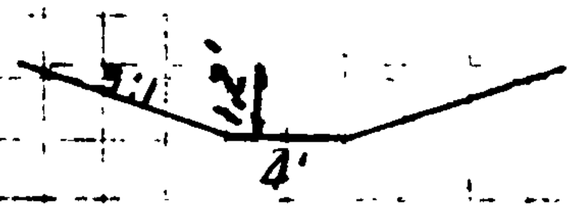
C = .65
i = rainfall intensity
A = Area Acres
Q = runoff in cubic ft/sec

$Q = .65 \times 5.4 \times 16.5 = 58$ cfs

Proposed Channel along East R. Tracts A, B, C and So. R. Tract C

Proposed Ditch 4' bottom, 3:1 side slopes

Design depth = 1.2'



$$A = \frac{11.2 + 4}{2} \times 1.2 = 9.12 \text{ ft}^2$$

$$r = \text{hydraulic radius} = \frac{9.12}{11.7} = .78$$

$n = .025$ min slope = .02 ft/ft.

$$V = \text{Velocity} = \frac{1.486}{n} \times r^{2/3} \times S^{1/2} = \frac{1.486}{.025} \times .78^{2/3} \times .02^{1/2}$$

$$= \frac{1.486}{.025} \times .85 \times .14$$

$$V = 7.07$$

Q.

COMP. RFS

CK.

DATE 8 June 1972

WILSON & COMPANY
ENGINEERS & ARCHITECTS
BOX 3305
ALBUQUERQUE
NEW MEXICO

LOC. Albuquerque FILE

PROJ. SHEET 2

SUBJ. Drainage OF

Q capcity channel = A v

$Q_{cap} = 9.12 \times 7.07 = 64$ cfs

$Q_{REQ} = 58$ cfs.

Channel capacity exceeds design requirements.

Drainage No 2 on site TRACT A.

Area = 2 Acres

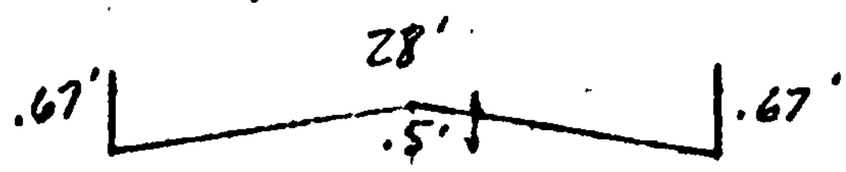
time concentraction = 2 minutes

$i_{100} = \frac{189}{t_c + 25} = \frac{189}{2+25} = 7$ in/hr.

$C = 0.70$

$Q_{DES.} = CiA = .7 \times 7 \times 2 = 19.6$ cfs.

Street capacity



X-section Area St. = (.17 x 28) + (.5 x 14)
= 4.76 + 7
A = 11.76 sq.ft.

$r = \frac{11.76}{29.33} = .40$

Assume $n = .015$ $S = .03$

$V = \frac{1.486}{.015} \times .4^{2/3} \times .03^{1/2}$

$V = \frac{1.486}{.015} \times .54 \times .17 = 9.09$ ft/sec

$Q_{cap} = Av = 11.76 \times 9.09$ 106.8 cfs.

Street capacity exceeds design runoff.

TI 90292-TMT

1054

278

GRANT OF EASEMENTS

SAN PEDRO OFFICE PARK ASSOCIATES, a New Mexico limited partnership, for consideration paid, does hereby grant to COMMUNIPLEX, INC., a corporation, easements over the following described real estate in Bernalillo County, New Mexico, for the purposes as set forth below:

A ten (10) foot wide drainage and utility easement on, over and across the following described parcel of land:

A certain parcel of land situate within the city limits of the City of Albuquerque, Bernalillo County, New Mexico, within Section 15, Township 10 North, Range 4 East, N.M.P.M., being and comprising portions of Parcels One-A (1-A) and Two-A (2-A) of the Panorama Heights Addition to the City of Albuquerque, New Mexico, as the same are shown and designated on the land division plat showing Parcels 1-A and 2-A of said Panorama Heights Addition filed in the office of the County Clerk of Bernalillo County, New Mexico, on March 20, 1972, and a northerly portion of Parcel Three (3) as the same is shown and designated on the amended and corrected land division plat showing Parcels 1 through 3, inclusive of the Panorama Heights Addition filed in the office of the County Clerk, Bernalillo County, New Mexico, on February 10, 1972.

Being more particularly described by metes and bounds as follows:

Beginning at the southwest corner of the easement herein described, a point on the easterly line of Nakomis Drive N.E.; whence the southwest corner of aforementioned Parcel "1-A" bears N. 01° 34' 25" W., 5.00 feet distance;

THENCE, N. 88° 25' 35" E., 523.89 feet distance to the southeast corner of the easement herein described;

THENCE, N. 01° 34' 25" W., 850.00 feet distance to a point;

THENCE, S. 88° 25' 35" W., 218.30 feet distance to a point;

THENCE, N. 32° 09' 39" W., 60.65 feet distance to a point on curve on the southeasterly line of Constitution Avenue N.E.;

THENCE, southwesterly, 10.01 feet distance along said southeasterly line of Constitution Avenue N.E. along the arc of a curve bearing to the right (said curve having a radius of 433.65 feet and a chord which bears S. 57° 10' 22" W., 10.00 feet distance) to a point on curve, said point being common to the most northerly corner of aforementioned Parcel "1-A";

THENCE, S. 32° 09' 39" E., 66.24 feet distance to a point;

THENCE, N. 88° 25' 35" E., 214.00 feet distance to a point;

THENCE, S. 01° 34' 25" E., 830.00 feet distance to a point;

THENCE, S. 88° 25' 35" W., 513.89 feet distance to a point on the easterly line of aforementioned Nakomis Drive N.E.;

THENCE, S. 01° 34' 25" E., 10.00 feet distance along said east line of Nakomis Drive N.E. to the southwest corner and place of beginning and containing 0.376 acre (16,388.323 square feet), more or less.

A thirty (30) foot wide temporary grading and drainage easement on, over and across the following described parcel of land:

A certain parcel of land situate within the city limits of the City of Albuquerque, Bernalillo County, New Mexico, within Section 15, Township 10 North, Range 4 East, N.M.P.M., being and comprising a portion of Parcel Two-A (2-A) of the Panorama Heights Addition to the City of Albuquerque, New Mexico, as the same are shown and designated on the land division plat showing Parcels 1-A and 2-A of said Panorama Heights Addition filed in the office of the County Clerk of Bernalillo County, New Mexico, on March 20, 1972, and a northerly portion of Parcel Three (3) as the same is shown and designated on the amended and corrected land division plat showing Parcels 1 through 3, inclusive of the Panorama Heights Addition filed in the office of the County Clerk, Bernalillo County, New Mexico, on February 10, 1972.

Being more particularly described by metes and bounds as follows:

Beginning at the southwest corner of the easement herein described, a point on the easterly line of Nakomis Drive N.E.; whence the southwest corner of aforementioned Parcel "1-A" bears N. 01° 34' 25" W., 35.00 feet distance;

THENCE, N. 88° 25' 35" E., 553.89 feet distance to the southeast corner of the easement herein described;

THENCE, N. 01° 34' 25" W., 910.00 feet distance to a point;

THENCE, S. 88° 25' 35" W., 231.18 feet distance to a point;

THENCE, N. 32° 09' 39" W., 45.27 feet distance to a point on curve on the southeasterly line of Constitution Avenue N.E.;

THENCE, southwesterly, 30.06 feet distance along said southeasterly line of Constitution Avenue N.E. along the arc of a curve bearing to the right (said curve having a radius of 433.65 feet and a chord which bears S. 54° 31' 52" W., 30.05 feet distance) to a point on curve;

THENCE, S. 32° 09' 39" E., 60.65 feet distance to a point;

THENCE, N. 88° 25' 35" E., 218.30 feet distance to a point;

THENCE, S. 01° 34' 25" E., 850.00 feet distance to a point;

THENCE, S. 88° 25' 35" W., 523.89 feet distance to a point on the easterly line of aforementioned Nakomis Drive N.E.;

THENCE, S. 01° 34' 25" E., 30.00 feet distance along said east line of Nakomis Drive N.E. to the southwest corner and place of beginning, and containing 1.168 acres (50,897.70 square feet), more or less.

Said thirty (30) foot wide temporary grading and drainage easement is granted for the limited and temporary purpose of permitting the grantee herein to perform necessary grading to construct drainage facilities upon the above described ten (10) foot wide drainage and utility easement, and shall terminate upon exercise by the Grantee herein of its option to purchase Parcel 2-A of said Panorama Heights Addition or upon the expiration of said option to purchase, whichever is earlier, said option to purchase being dated November 9, 1971 and granted by Jack M. Clifford & Co. to Alodex Corporation, whose right to purchase was assigned to the Grantee herein by Assignment dated March 8, 1972.

THE FOREGOING EASEMENTS GRANTED HEREBY ARE GIVEN WITHOUT ANY WARRANTIES WHATSOEVER.

WITNESS its hand and seal this 12th day of July, 1972.

SAN PEDRO OFFICE PARK ASSOCIATES,
by San Pedro Investment Company,
Inc., its general partner

By J. A. Dillahunt

STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

The foregoing instrument was acknowledged before me this 12th day of July, 1972, by J. A. Dillahunt, President of San Pedro Investment Company, Inc., a New Mexico corporation, on behalf of said corporation, as general partner of San Pedro Office Park Associates, a New Mexico limited partnership.

Cuzita S. Gurule
Notary Public

My commission expires:
11-16-73

State of New Mexico
County of Bernalillo
This instrument was filed for record on
2154 AUG 1 1972
At ... o'clock ... M. Recorded in Vol. 971
of records of said County Folio 278-280
Clerk & Recorder
Deputy Clerk

north pond does not empty onto Constitution Avenue, but rather drains to the south pond via a drainage swale. The south pond then empties onto Constitution at a rate of 1.0 cfs.

Area 2, which lies along the north boundary of the site, has runoff flows which accumulate in the parking area detention pond. Flows are released from this area at a rate of 1.0 cfs into a drainage swale in Area 5 before being released into a drainage swale at the southwest corner of the site.

Area 3, which lies along the east side of the site, forms the top of the chain of sub-drainage areas which interconnect to route the flows to the southwest corner of the site. Flows from Area 3 will be released at a rate of 2 cfs into Area 4. Flows from Area 4, likewise detained on the parking area are released at a controlled rate of 3.0 cfs into Area 5. Area 5, which is the last area of the chain, receives the flows from Areas 2, 3, and 4 before releasing total flows from the detention pond at a rate of 5.0 cfs. These flows depart from the site into a drainage swale at the southwest corner of the site, flow south, then turn 90° to the west before flowing onto Nakomis Drive N.E.

Areas 7, 8, and 9, will be completely ponded in a series of ponds. Each area has several ponds, with the higher ponds overflowing into the lower ponds when the depth exceeds 0.5'. Total capacity is reached when all the ponds are filled.

Area 6, a proposed landscaped area, has a total runoff of 0.5 cfs, which will be collected by swales and routed to the southwest corner of the site. Area 6-A was originally intended to drain to the southwest

corner, but this area has become a grade transition area between Sunburst Apartments and the project to the west, and as such, will have to drain directly to the west. This area contributes approximately 0.1 cfs in sheet flow and drains directly onto an existing parking lot.

Summing up the above, it can be shown that:

A. Total Runoff - Undeveloped State = 13 cfs.

B. Total Runoff-Controlled Developed State

1. 1.0 cfs onto Constitution Avenue (Area 1)
2. 5.0 cfs at southwest corner of project (Areas #2 thru 5)
3. 0.6 cfs (Area 6 and 6-A)

C. Therefore summing total runoff rates under developed conditions vs undeveloped conditions:

Developed State	vs	Undeveloped State
6.6 cfs		13 cfs

The net result is a reduction of the runoff rate by 6.4 cfs. The discharge from the individual detention areas was released as quickly as possible to avoid retaining water on pavement for any considerable length of time, but low enough to prevent problems downstream from the site.

The net result should be a reasonable compromise between protecting the site improvements and protecting the downstream facilities.

New Mexico Title Company

Representing

Lawyers Title Insurance Corporation

DIVISION
BERNALILLO COUNTY
ABSTRACT & TITLE

PRESIDENT
CHARLES S. LANIER

SENIOR VICE PRESIDENT
FRANK J. MORRATO

VICE PRESIDENTS
ELFEGO G. ARANDA
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CANDIDO C GUTIERREZ

ASSISTANT VICE PRESIDENTS
MARGIE LUCERO
MARY LOU ROADY

301 GOLD AVE., S.W. • ALBUQUERQUE, NEW MEXICO • TELEPHONE 247-1011

copy to Mr. Lewis

June 17, 1976

RECEIVED
JUN 21 1976
CITY ENGINEERS

Murray-McCormick, Inc.
2601 Wyoming Blvd., N.E.
Albuquerque, New Mexico 87110
Attn: Mr. Chris Weiss

Dear Mr. Weiss:

Attached is a copy of the plat of Parcels 1-A and 2-A, Panorama Heights Addition filed March 20, 1972.

The easement colored in yellow on this plat is a 10 foot Drainage and Utility Easement granted by separate document recorded in Book Misc. 271 page 278 (a copy of which is enclosed). The portion of the easement colored yellow which runs across the southerly portion of Lot 1-A is also a utility easement as reflected by the plat filed March 20, 1972.

The easement colored in blue which runs across the southerly portion Lot 2-A is a utility easement reflected on the plat filed March 20, 1972. I can find no documentation of a drainage easement being granted across this portion.

Your attention is also directed to the Note which appears in upper left hand corner of the plat and is underlined in red.

Should you have any questions or need anything further please feel free to contact the undersigned.

Sincerely,

Margie R. Lucero

Margie R. Lucero
Vice President

MRL/dh
Enclosure

Murray · McCormick, Inc.
2601 Wyoming Blvd. N.E., Suite F
Albuquerque, New Mexico 87110

LETTER OF TRANSMITTAL

DATE May 3, 1976

JOB NO.

RE: Sunburst Apartments
Drainage Report

FROM:

RECEIVED
MAY 04 1976
CITY ENGINEERS

TO Mr. Kleston Laws
Drainage Engineer
City of Albuquerque
ATTN: P.O. Box 1293
Albuquerque, New Mexico 87103

VIA: ☐ Parcel Post ☒ First Class ☐ Air Mail ☐ Special Delivery ☐ Messenger
☐ Air Freight via ☐ RR Express ☐ Other

GENTLEMEN: WE ARE SENDING YOU ☐ Attached ☐ Under separate cover

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ Payrolls ☒ Drainage Report

QUANT.	DATED	NO.	DESCRIPTION

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit copies for approval
☐ For your use ☐ Approved as noted ☐ Submit copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return corrected prints
☐ For review and comment ☐
☐ FOR BIDS DUE 19 ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS

The attached revised Drainage Study for Sunburst Apartments is submitted for your review and comments. This has been revised in accordance with our telephone conversation.

SIGNED: Chris Weiss
D.W

IF ENCLOSURES ARE NOT AS NOTED, KINDLY NOTIFY US AT ONCE.

Murray - McCormick, Inc.
2601 Wyoming Blvd. N.E., Suite E
Albuquerque, New Mexico 87110

~~McINTIRE & QUIROS / SOUTHWEST~~
~~4453 RIO RANCHO ESTATES DR., RIO RANCHO ESTATES, NEW MEXICO 87124~~

LETTER OF TRANSMITTAL

DATE 4-19-76
JOB NO.
RE: Sunburst Apts
FROM:

TO City of Albuquerque
City Engineer

ATTN: Mr. Laws

VIA: ☐ Parcel Post ☐ First Class ☐ Air Mail ☐ Special Delivery ☒ Messenger
☐ Air Freight via ☐ RR Express ☐ Other

GENTLEMEN: WE ARE SENDING YOU ☐ Attached ☐ Under separate cover

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ Payrolls ☒ Drainage Report

QUANT.	DATED	NO.	DESCRIPTION
1	4-19-76		Drainage Report for Sunburst Apts
			PANORAMA Heights

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit copies for approval
☐ For your use ☐ Approved as noted ☐ Submit copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return corrected prints
☒ For review and comment ☐
☐ FOR BIDS DUE 19 ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS This report is being submitted for your review and comments prior to the EPC meeting on May 20th.

COPY TO

SIGNED:

IF ENCLOSURES ARE NOT AS NOTED, KINDLY NOTIFY US AT ONCE.

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN
ARCHITECTURE · ENGINEERING · PLANNING · SURVEYING

August 2, 1976

Mr. Berry F. Davis
P. O. Box 1695
Colorado Springs, Colorado 80901

Re: Sunburst Apartments Drainage Report

Dear Mr. Davis:

We have included in the Sunburst Apartment Drainage Study an addendum which covers changes brought about by site plan revisions and the grading plan design. These revisions caused flow pattern changes from the original report and thus made the initial solutions for handling the runoff unworkable. The addendum is based on the final grading plan and is a direct representation of the final project.

Thank you for giving us the opportunity to serve you.

Very truly yours,

Christopher L. Weiss

Christopher L. Weiss

CLW:dw

cc: Mr. Bill Shelton
Mr. Kleston Laws

2601 WYOMING BLVD., NE. SUITE F/ALBUQUERQUE, NEW MEXICO 87110/505-292-1936
CALIFORNIA ALASKA OREGON WASHINGTON TEXAS GEORGIA FLORIDA COLORADO

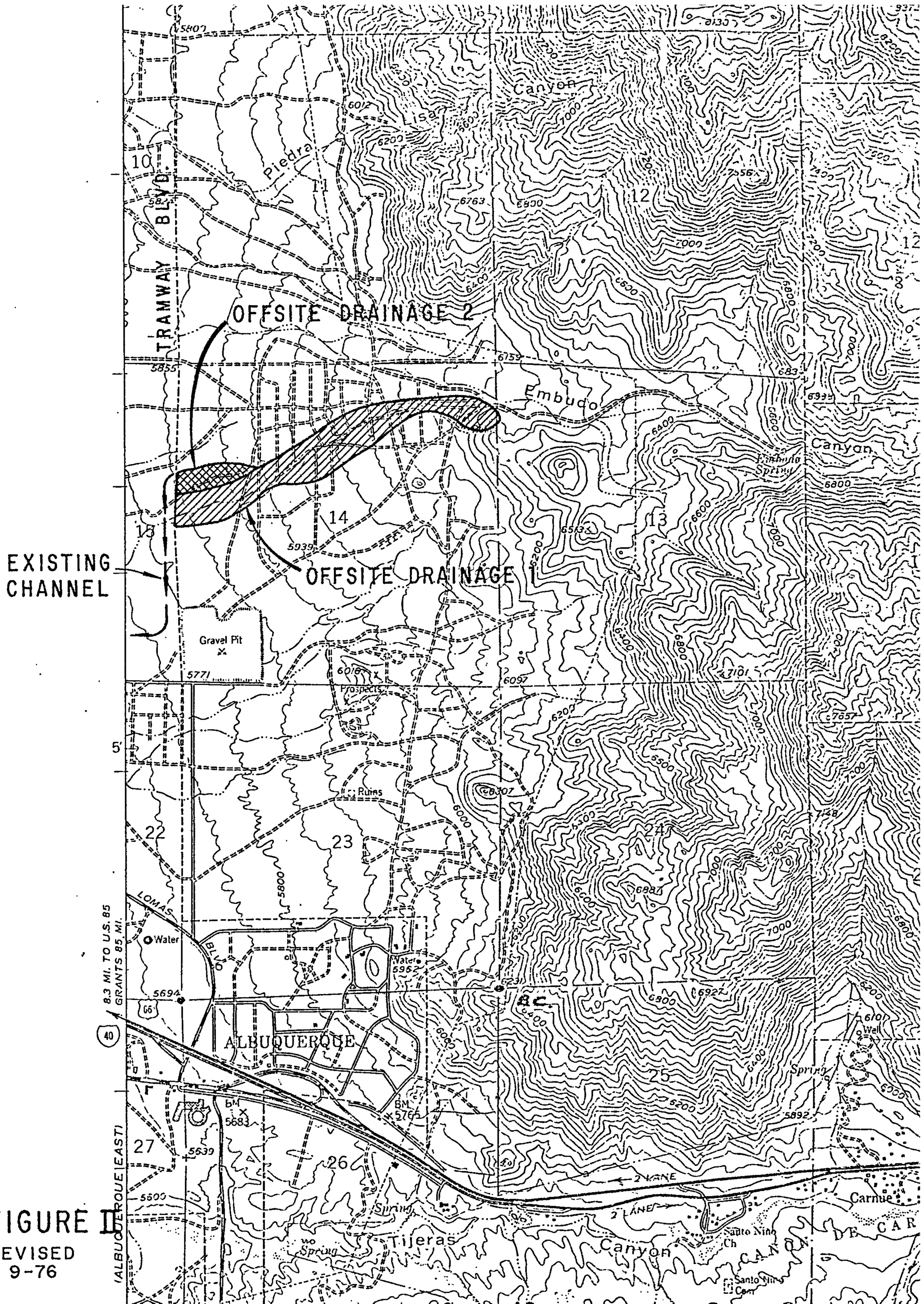

FIGURE II
REVISED
9-76

LETTER OF TRANSMITTAL

Genge/Murray-McCormick

2601 Wyoming Blvd., N.E. Suite F
Albuquerque, N.M. 87110/505·292-1936

RECEIVED
AUG 5 1976
CITY ENGINEERS

Date 8-2-76

To City of Albuquerque
City Engineers

Attn. Mr. Laws

Re: Sunbcust Apt's Drainage Report - Revised

Comments: This report has been revised to reflect changes made in the site plan and grading plans

Enclosures:

Quantity	Type of Enclosure and Description
1	Drainage Report Addendum

Signed: Chris Weiss

Copy to:

If enclosures are not as noted, kindly notify us at once.

Offsite Drainage Area 2

Data -

Length of flow	=	1000'
Height	=	70'
T.C.	=	10
$I = \frac{189}{35}$	=	5.4
C = 0.40		

$Q = CIA = 0.40 \times 5.4 \times 4.44 = \underline{\underline{10}}$ cfs

This information completes the addendum.

Revisions are noted on Figures II and III.

Addendum to the Sunburst Apartment Drainage Study
Date September 3, 1976

This addendum to the Sunburst Apartment Drainage Study refers to the offsite drainage areas.

Recent revised topographical information has been made available which details the offsite drainage area to a higher degree than that information previously available. In particular, this report made reference to and used information from another drainage study (See Footnote 1, page 1 of the main text of Sunburst Report), which had showed the offsite flow to be 229 cfs from Offsite Drainage Area 1 (Figure III).

Therefore, based upon the latest topographical information, the offsite flows are revised as follows:

Offiste Drainage Area 1

Data -

Length of flow = 5800'

Height = 430'

T.C. = 17 min.

$I = \frac{189}{42} = 4.5$

C = 0.40

Q = CIA = 0.40 x 4.5 x 46.21 = 83 cfs

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN
ARCHITECTURE · ENGINEERING · PLANNING · SURVEYING

August 31, 1976

RECEIVED
SEP 3 1976
CITY ENGINEERS

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

Dear Mr. Laws:

On the 25th of August 1976, Mr. Shelton and I met with you to discuss the relocation of the drainage channel which presently borders the east side of the proposed Sunburst Apartment Complex.

You had previously expressed a desire to have said channel moved to the east side of Tramway.

Mr. Shelton, architect for the developer, has stated that the developer is unwilling to accept this proposal because of added expense to him. The original concept, which meets the needs of the project, is to relocate the channel immediately adjacent to the proposed service road along the east side of the project, or on the west side of Tramway. Plans have been submitted to the City Engineers Office detailing this concept.

The developer feels that his approach is justified because of the following: to relocate the channel on the east side of Tramway there would be, 1) extra cost due to greater haul and dirt excavation; 2) extra cost due to relocation of existing surface and buried utilities; 3) possible disruption of north access to Todd Subdivision; 4) outlet of channel would cross Tramway at point where there is a constant downward slope to Lomas. This would cause the interception of flows and direct them down Tramway. Additional cost would have to be borne by the developer to regrade Tramway in this area to create a water block.

Because of these additional cost considerations, the developer requests that you approve our original channel plan which locates the channel on the west side of Tramway.

Very truly yours,

Bo K. Johnson, P.E.
Vice President

cc: Mr. Bill Shelton

2601 WYOMING BLVD., NE. SUITE F/ALBUQUERQUE, NEW MEXICO 87110/505-292-1936
CALIFORNIA ALASKA OREGON WASHINGTON TEXAS GEORGIA FLORIDA COLORADO

LETTER OF TRANSMITTAL

Genge/Murray-McCormick

2601 Wyoming Blvd., N.E. Suite F
Albuquerque, N.M. 87110/505·292-1936

Date Sept. 7, 1976

To Mr, Kleston Laws, Drainage Engineer
City of Albuquerque
P. O. Box 1293

Albuquerque, New Mexico 87103

Attn.

Re: Addendum to Sunburst Apartment Drainage Study

Comments:

The attached is forwarded to you for your information.

Enclosures:

Quantity	Type of Enclosure and Description
1	Addemdum to Sunburst Apartment Drainage Report

Signed:

Copy to:

If enclosures are not as noted, kindly notify us at once.

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN
ARCHITECTURE · ENGINEERING · PLANNING · SURVEYING

Received 8 Sep 76

September 8, 1976

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

Re: FIA - Sunburst Apartments

Dear Mr. Laws:

In compliance with the new FIA requirements, we are submitting a report on Sunburst Apartments detailing why the Flood Hazard Boundary Map should be amended to exclude this area.

It is our understanding that the first step in this process is to obtain your written approval of the report before submitting same to the FIA. Needless to say, the client is most anxious that the process of submittal proceed as quickly as possible so that final FIA approval transpires before the closing date of the property.

Very truly yours,

Bo K. Johnson

Bo K. Johnson, P.E.
Vice President

2601 WYOMING BLVD., NE. SUITE F/ALBUQUERQUE, NEW MEXICO 87110/505-292-1936
CALIFORNIA ALASKA OREGON WASHINGTON TEXAS GEORGIA FLORIDA COLORADO

[redacted]

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN

ECOSYSTEMS ANALYSIS • PLANNING • LAND SURVEYS • ENGINEERING

2601 WYOMING BLVD., NE. SUITE F / ALBUQUERQUE, N.M. 87110 / 505-292-1936

DRAINAGE REPORT

FOR

SUNBURST APARTMENTS

SUNBURST APARTMENTS DRAINAGE REPORT

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Purpose 1

Introduction 1

Design Criteria 2

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Summary of Results 10

Recommendations 13

Summary 14

APPENDIX

Calculations for Rational Formula A-1

Calculations and Derivations For An Orifice Outlet A-2

Figure I - Location Map, Plat J-22

Figure II - Location and Drainage Map, Scale 1" = 2000'

Figure III - Topographic Map and Drainage in Developed State

Figure III-A - Existing Apartments Plat

Figure IV - Time of Concentrations of Small Basins

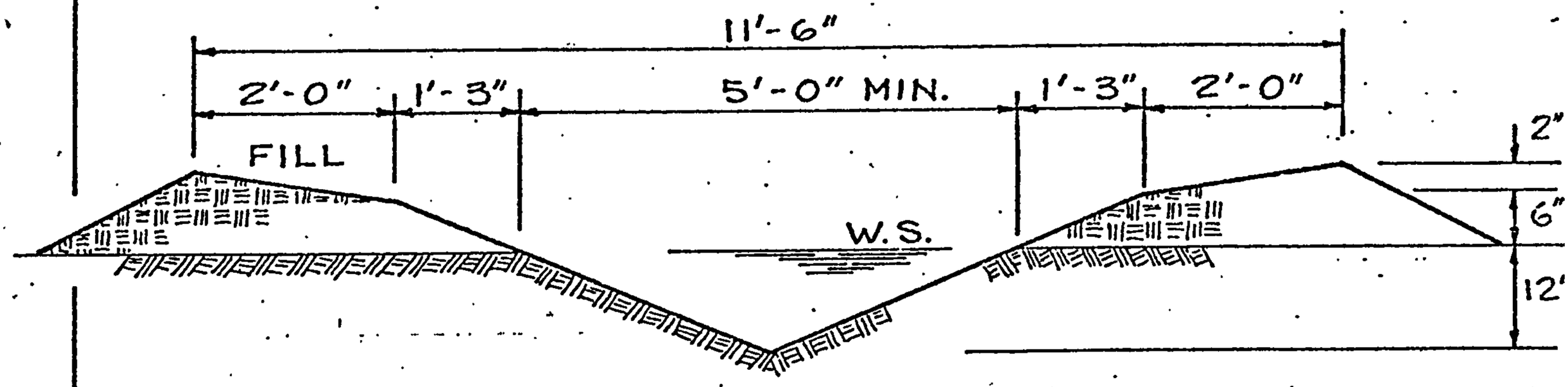
Figure V - Intensity-Duration Frequency Curves

Structure "k" Detail

Bibliography of References

STRUCTURE 'K'

EARTH CUT AND FILL "V" DITCH



A = 2.50 ☐' P = 5.40 R = 0.463

$R^{2/3}$ = 0.598 N = 0.020 D = 1'-0"

MIN. S_o = 0.0001 $S^{1/2}$ = 0.0100

Q = 2.50 × 74.30 × .598 × .0100 = 1.11 C.F.S.

Q = 111.08 $S^{1/2}$

PURPOSE

The purpose of this report is to analyze the drainage characteristics of the site in its proposed developed state. Recommendations for controlling this runoff will be presented.

INTRODUCTION

The subject property, an SU-1 Development, is located in the Northeast Heights of Albuquerque, southwest of the intersection of Indian School Road, N.E. and Tramway Boulevard N.E. More particularly, it is the north half of Parcel 2A of Panorama Heights Addition, Section 15, T. 10 N., R. 4 E., N.M.P.M. (Zone Atlas J-22).

The property is bordered by Tramway Boulevard, N.E. on the east side, an apartment complex on the west side, and undeveloped land on the north and south sides. The slope of the land is from east to west, with a 4-6% average fall.

The site is essentially isolated from any offsite drainage from the east by a man-made channel paralleling and located between the east site boundary and Tramway Boulevard. This channel was constructed as per recommendations from a previous drainage study for the townhouse complex located west of the subject site.[1] This channel should be extended north approximately 150' to intercept a small offsite drainage area

1. Engineer's Drainage Report for Proposed Townhouse Development at Southeast Corner of Nakomis Drive and Constitution Ave., Albuquerque, N.M. -Prepared by Wilson & Company, Albuquerque N.M., 9 October 1971.

which lies to the north of the main offsite area. (See Figure III). This extension should be made within the service road R/W to avoid any encroachment onto private land. This action will completely safeguard the site from any offsite drainage from the east. Future improvements of Tramway will include a permanent channel located on the east side of Tramway Boulevard which will intercept flows from the east.

Precipitation falling directly on the site forms into sheet flow and generally ends up in the defined drainage arroyo traversing the center of the site. This flow is routed thru the townhouse complex and out onto Nakomis Drive.

As it will be shown, these internal flows will be accommodated by a combination of detention ponding with controlled outlets, and ponding in open landscaped areas.

DESIGN CRITERIA

In analyzing the storm runoff to determine the runoff basis of the undeveloped site, the Rational Formula, Q - CIA, was used.

Where:

Q = Runoff quantity in cubic feet/second.

A = Contributing area in acres.

2. Tramway Boulevard Corridor, Central and I-40 to Montgomery, Albuquerque, N.M., Sheet 1 of 3, prepared by Bohannan, Westman, Huston.

I = Intensity in inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from Figure V - Intensity Duration Frequency Curves (Albuquerque Area - 1961). (Note: where a Time of Concentration [Tc] is less than 10 minutes from Figure IV, the intensity value equal to 10 minutes was used as shown on the curve for a 100 year storm in Figure V).

C = Runoff coefficient (no unit). This coefficient represents the integrated effects of infiltration, detention storage, evaporation, retention, flow routing, and interception which all affect the time distribution and peak rate of runoff.

For the proposed developed areas, it was desirable to develop a composite runoff coefficient based on the percentage of different types of surface in each sub drainage area. Different coefficients with respect to surface type are given below.[3]

Streets, walls and drives	C = 0.90
Roofs	C = 0.90
Lawns, Sandy Soils, Ave. 2 to 7% slope	C = 0.20

3. Table 3-2, Urban Storm Drainage Criteria Manual Vol. I, Denver Regional Council of Governments.

The following table is a summary of these values - Refer to the appendix for an example of the calculations.

Sub-Drainage Section	Area	By Area C=0.20	By Area C=0.90	Composite "C" Factor
1	1.124 Ac.	0.355 Ac.	0.769 Ac.	0.67
2	1.033 Ac.	0.455 Ac.	0.579 Ac.	0.59
3	0.688 Ac.	0.217 Ac.	0.471 Ac.	0.68
4	0.545 Ac.	0.136 Ac.	0.409 Ac.	0.73
5	0.622 Ac.	0.217 Ac.	0.405 Ac.	0.66
6	0.300 Ac.	0.087 Ac.	0.213 Ac.	0.70
7	0.979 Ac.	0.382 Ac.	0.597 Ac.	0.63
8	1.044 Ac.	0.186 Ac.	0.858 Ac.	0.77
8-A	0.38 Ac.	0.38 Ac.	--	0.20
9	0.403 Ac.	0.238 Ac.	0.165 Ac.	0.49
10	0.300 Ac.	0.190 Ac.	0.110 Ac.	0.46
11	0.312 Ac.	0.180 Ac.	0.132 Ac.	0.50
12	0.180 Ac.	0.126 Ac.	0.054 Ac.	0.41

Quantities of runoff were computed on a 100 year storm frequency for both the undeveloped condition and the proposed final developed state.

PHASE I

Phase I consists of analyzing the site in the undeveloped form. Runoff was based on general accumulation of flows into the natural arroyo traversing the center of the site.

The runoff coefficient used for undeveloped areas = 0.30.[4]

Tabulation of Results - Phase I

Estimated Flows - Undeveloped Site

Elev. Diff. feet	Length of Flow feet	Tc min.	I "/hr.	C	Area Ac.	Q cfs
32'	640'	10	5.4	0.30	8.00	13

PHASE II

Phase II consists of analyzing the site in its developed state. Only internal flows were considered in this phase. The resulting runoff flows and area contributing to this runoff are shown for each area on Figure III.

The following approach was taken for developing the runoff characteristics of the proposed site: the runoff flow will be detained on site where possible and released at controlled rates at designated receiving areas. Generally, low flows from small intensity storms will not be detained. However, for larger inflows, properly designed detention storage will reduce the outflow from the retention areas to a rate much less than the inflow. The final results will help reduce the impact of the outflowing drainage on the downstream facilities.

The detention areas will use a combination of the open spaces and the parking-street areas. It might seem objectionable to some to detain water on a common use parking area-street. However, if done properly, it can be accomplished

4. Table XII, Master Plan of Drainage, City of Albuquerque, New Mexico and Environs, 1963, G. Herkenhoff & Associates.

without interfering with the layout and functioning of the street. Furthermore, controlled rates of release are generally large enough so that water is ponded only during the larger storms. Therefore, theoretically once in a 100-years, the ponding volume of the parking area or street would be used to its maximum capacity. For a design storm having a recurrence period of five years, the depth of ponding would be 26% of that of a 100 year storm. It should be evident that the inconvenience to the street users would not be significant.

The flows generated in the undeveloped state will be 13 cfs. Since the developed discharge would equal approximately 25 cfs, controlled flow orifices will be constructed to release no more than the 13 cfs discharge rate. The following table is a breakdown of the sub-drainage areas to determine total developed runoff rate. I = 5.4"/hr. for all areas.

Area	Composite "C"	Area	Q
1	0.67	1.124	4
2	0.59	1.033	3
3	0.68	0.688	2
4	0.73	0.545	2
5	0.66	0.622	2
6	0.70	0.300	1
7	0.63	0.979	3
8	0.77	1.044	4
8A	0.20	0.382	0.4
9	0.49	0.403	1
10	0.46	0.300	0.7
11	0.50	0.312	0.8
12	0.41	0.180	0.4
		Total	24.3 cfs

The following is the format for calculating the peak discharge and the allowable runoff from each sub-area. Area I will be shown as an example. The remaining areas are summarized in table form. Refer to the appendix for the derivation of the calculations.

Area 1

Area =1.124 Ac.; set allowable outflow discharge at 1.0 cfs.

1. From the design criteria, calculate Q_o

$$Q_o = \frac{\text{Allowable outflow}}{\text{Acreage x runoff coefficient}}$$

$$Q_o = \frac{1.0 \text{ cfs}}{1.124 \text{ Ac. x } 0.67} = 1.33 \text{ cfs/Ac.Imp.}$$

2. Calculate time in minutes that the maximum volume of storage will occur from the orifice outlet storage time equation.

$$T = -25 + \sqrt{\frac{7087.5}{Q_o}}$$

$$= -25 + \sqrt{\frac{7087.5}{1.33}} = -25 + \sqrt{5328.95}$$

$$= -25 + 73.00$$

$$= \underline{48.0} \text{ minutes}$$

3. Calculate the maximum volume of storage per acre imperviousness from the orifice outlet storage equation.

$$Vs = \frac{11,340\ T}{T + 25} - 40\ QoT$$

$$Vs = \frac{(11,340)(48.0)}{48.0 + 25} - 40\ (1.33)(48.0)$$

$$Vs = 7456.44 - 2553.60$$

$$Vs = 4902.84 \text{ ft.}^3\text{/Ac. Imp.}$$

4. Calculate the total volume of storage required for the contributing Area 1.

V_t = Vs x # Acres x Runoff Coefficient

V_t = (4902.84)(1.124)(0.67)

V_t = $\underline{\underline{3692}}$ ft^3

5. Select an outflow pipe from the orifice formula that will yield the allowable outflow of 1.0 cfs under a head of 0.5:

$Q = ca\sqrt{2gh}$ - note c = 0.80 from trial and error solutions from Table 4-10, Handbook of Hydraulics, King & Brater, 1963.

Solving for "a"

$$a = \frac{Q}{c\sqrt{2gh}} = \frac{1.0}{0.80\sqrt{2\ (32.2)(0.50)}}$$

$$= \frac{1.0}{0.80\sqrt{32.2}} = \frac{1.0}{0.80 \times 5.67}$$

a = 0.22 ft.∴ Select 1 - 6" pipes

Table of Controlled Outflows

Areas 1 thru 8

Sub-Drainage Area	1	2	3	4	5	6	7	8
Area (Ac.)	1.124	1.033	0.688	0.545	0.622	0.300	0.979	1.044
Allowable Outflow (C.F.S.)	1.0	1.0	2.0	2.0	2.0	1.0	2.0	3.0
Runoff Coeffic.	0.67	0.59	0.68	0.73	0.66	0.70	0.63	0.77
Qo (cfs/Ac.Imp.)	1.33	1.64	4.27	5.03	4.87	4.76	3.24	3.73
T (minutes)	48.0	40.7	15.7	12.5	13.1	13.6	21.8	18.6
Vs (ft^3/Ac.Imp.)	4902.84	4355.01	1692.84	1265.00	1347.18	1399.97	2457.03	2062.59
V_t (ft^3)	3692	2654	792	503	553	294	1515	1658
Head (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
a (ft^2)	0.22	0.22	0.44	0.44	0.44	0.22	0.44	0.66
Size Pipe (in.)	1-6"	1-6"	2-6"	2-6"	2-6"	1-6"	2-6"	3-6"

Sub-drainage areas 9 thru 12 lend themselves to total ponding. The following table is a summary of total flows generated within these areas and total ponding capacities. A rainfall value of 2.6" for a 100 year-6 hour storm was used.

Sub-Drainage	Composite "C" Factor	Area (ft^2)	Volume Runoff (ft^3)	Pond Vol. (ft^3)
9	0.49	17,554	1864	2475
10	0.46	13,068	1302	1575
11	0.50	13,590	1472	1580
12	0.41	7,840	696	1125

The pond storage available is based upon a 0.5' deep depression. The actual depth of storage is shown on Figure III. The swimming pool area was assumed to be self contained in that this area will not contribute runoff to surrounding area.

SUMMARY OF RESULTS

The following is a breakdown of the individual areas and their relationship to the overall drainage picture (See Figure III).

Area 1, at the northwest corner of the site, is isolated from the drainage of the rest of the site. Flows originating within Area 1 will generally follow the slope of the land before being routed to the detention area in the southwest corner of the area. This detention area will use the combined area of the parking area and the open space. The parking area will handle 1050 ft^3 of temporary storage. The total volume, minus what percolates into

the ground, will flow onto Constitution Avenue at a controlled rate of 1.0 cfs. No more than 1.0 cfs can be released onto Constitution Avenue because the historical runoff from this part of the site is very low. It will take approximately eighteen minutes after the peak volume is reached to completely drain the detention area on the parking area. This is the only sub-drainage area which empties onto Constitution Ave. Areas 2 thru 8 all depart at the southwest corner of the site.

Area 2, which lies along the north boundary of the site, is also isolated from the drainage of the rest of the site. Flows from this area will accumulate in the street for final routing to a detention pond. This pond area has the capacity to hold 100 year storm flows while simultaneously releasing flows at a rate of 1.0 cfs. The flow rate from the pond is kept low to take advantage of percolation into the soil. Retaining water will also help sustain landscaping growth in this area. Flows from this detention pond will follow a drainage swale along the west boundary to a departure point at the southwest corner of the site.

Area 3, which lies at the northeast corner of the site, forms the top of the chain of sub-drainage areas which interconnect to route the flows to the southwest corner of the site. Flows from Area 3 will be detained on the parking area and released into Area 4 at a controlled rate of 2.0 cfs. Flows from Area 4 and Area 5 are likewise detained on the parking areas and released at

controlled rates of 2.0 cfs each. As the flows from Area 3 enter Area 4, Area 4 is emptying into Area 5. The flows from Area 5 empty into a drainage swale along the south property line. Area 6 also empties into this swale at a controlled rate of 1.0 cfs. Each area has the capacity to completely pond the flows originating within that area, provided there is a simultaneous release of flows from each area. The total time of detention in Area 3 would be sixteen minutes to reach it's peak volume, plus approximately seven minutes to drain the parking area. Areas 4 and 5 reach peak volumes in thirteen minutes, plus approximately five minutes to drain their respective parking areas.

Area 6 reaches peak volume in fourteen minutes plus approximately three minutes to drain the parking area. Areas 3 thru 6 all flow into a swale along the south boundary which will help sustain landscaping in this area.

Area 7 flows will be detained on the parking area and relased at a controlled rate of 2.0 cfs into a drainage swale along the west boundary. This same swale carries the flows away from Area 2. This area reaches peak volume in twenty-two minutes, plus approximately thirteen minutes to drain the parking area.

Area 8, is the last of the chain of sub-drainage areas which drain to a common point at the southwest corner of the site. The flows from this area are also detained on the parking area and released at a controlled rate of 3.0 cfs into the landscaped

area. This area reaches peak volume in nineteen minutes, plus approximately ten minutes to drain the parking areas. These flows can be routed thru the landscaped area to help sustain the plants and help increase the infiltration into the ground. Area 8-A is all open area and its proposed use will be as a landscaping screen from the units to the west. The amount of runoff originating within this area has a rate of flow of 0.4 cfs. This flow, while uncontrolled, is insignificant in magnitude.

The flows from Areas 9, 10, 11 and 12 will be completely ponded in a series of ponds. Areas 9 and 11 have several ponds, with the higher ponds overflowing into the lower ponds when a maximum depth of 0.5 is reached. Total capacity is reached when all the ponds are filled.

Summing up the above, it can be shown that:

A. Total Runoff-Undeveloped State = 13 cfs.

B. Total Runoff-Controlled Developed State.

1. 1.0 cfs onto Constitution Avenue. Area #1
2. 9.4 cfs at southwest corner of project. Area #2 thru #8

C. Therefore summing total runoff rates under developed conditions vs. undeveloped conditions:

Developed State		Undeveloped State
10.4 cfs	vs.	13 cfs

The net result is a reduction of the runoff rate by 2.6 cfs. The runoff rates were kept as low as possible to avoid downstream problems. In particular, no more than 1.0 cfs could be released onto Constitution Avenue because the historic runoff rate from that portion of the site was low. The release of flows at the southwest corner was kept as low as possible because the drainage swale makes a 90° turn before draining onto Nakomis Drive N.E. This situation could not have tolerated higher discharge rates.

On the other hand, discharge rates from the detention areas on the parking areas was released as quickly as possible to avoid retaining water on pavement for any considerable length of time.

The net result should be a reasonable compromise between protecting the site improvements and protecting the downstream facilities.

RECOMMENDATIONS

The following recommendations are made to enable the developer of the SU-1 area to complete this project within the design framework stated above:

1. It is recommended that all streets have a slight inverted crown in the center--a 2" inverted crown would be sufficient. The areas designated as detention areas should have a constant cross-section, with no inverted crown. The detention areas should slope toward the orifice with a positive slope of 0.5% maximum.

2. Because each detention area will have a positive slope to the orifice, the detention cross-section would assume a triangular section. However, the required volume is computed on a rectangular section. In order to compensate for the sloping pavement, the top of the curb around the detention area should be kept at a constant elevation. Thus, the depth between the curb and pavement will increase as the pavement slopes to the orifice. The elevation of the curb would be established at the upstream limit of the detention area, the minimum depth of each detention area being shown on Figure III.

This concept can be realized with the construction of a rectangular concrete curb. A typical section would be 6" wide x 18" deep, with 8" minimum above the pavement. This type of curb can be varied in depth in relation to the slope of the pavement.

3. Water blocks are recommended in the streets as shown in Figure III to facilitate the movements of the runoff as shown.

4. It is suggested that the ponds in the open areas be landscaped with grass and trees. This will not only increase infiltration, but will also lessen the visual impact of using the area for ponding.

5. The drainage swales on the west and south boundaries should have a typical cross-section as shown on the appendix. The slope of the swale should be a minimum of 0.6%, with the swale blending into the overall grading of the site.

SUMMARY

The subject property, by utilizing detention and retention ponding for the SU-1 development, will contribute less internal runoff to surrounding areas than that which existed before development.

In conclusion, the development of Sunburst Apartments should be a beneficial effect on the drainage characteristics of this area.

Respectfully submitted,

Bo K. Johnson
N.M.P.E. No. 5922

APPENDIX

CALCULATIONS FOR RATIONAL FORMULA

1. Sample calculation for arriving at a composite "C" factor.

   A = 1.033 Acres total Section 2

   = 0.455 Acres Turf

   = 0.579 Acres Pavement

   Where C = 0.90 for Pavement

   = 0.20 for Turf

   $$\text{Average } C = \frac{0.455 \times 0.20}{1.033} + \frac{0.579 \times 0.90}{1.033} = 0.59$$

2. Sample calculation for Rational Formula Q = CIA

   H = height above most remote point above outlet

   = 32'

   L = distance most remote point

   = 640'

   Tc= 3.5 min. (use 10 min.) - Figure V

   $$I = \frac{189}{T+25} \text{ for 100 year storm} = \frac{189}{35} = 5.4''/\text{Hr. (Figure V)}$$

   C = 0.35

   A = 8.00

   Q = CIA

   = (0.35)(5.4)(8.00) = 15 cfs

3. Sample calculation for required ponding area.

   Area = 0.403 Ac. or 17,554 ft^2

Design storm criteria = 2.6"-6 Hr./100 year

Therefore, Volume required for ponding = Area x Volume of Runoff x Composite "C" Factor =

17,554 ft.^{2} x 0.217 ft. x 0.49 = 1864 ft.^{3} min. storage required.

Pond size shown on Figure III.

CALCULATIONS AND DERIVATIONS FOR AN ORIFICE OUTLET

Definitions of Terms

A = Contributing acreage

a = Cross sectional area of outflow pipe (Ft.^{2})

C = Coefficient of imperviousness

c = Coefficient of contraction for an orifice

g = Acceleration due to gravity (32.2 ft/sec.^{2})

h = Head, defined as the distance from the water surface to the center line of the outflow pipe (ft.)

I = Rainfall intensity ($\frac{189}{T+25}$)

K_1 = Constant (h/t)

K_2 = Constant ($ca\sqrt{2gk}$)

Qi = Instantaneously changing outflow (CFS)

Qo = Maximum outflow per acre imperviousness (CFS/Ac)

T = Storage time, defined as the instant storage begins until peak storage is attained (min.)

t = Instantaneous time of storage (min.)

Vn = Volume of water flowing into the retention basin per acre imperviousness (ft.^{3}/AC.)

Vo = Volume of water flowing out of the retention basin per acre imperviousness (ft.^{3}/Ac.)

Vs = Maximum volume of water stored in the retention basin per acre imperviousness (ft.^{3}/Ac.)

Vt = Maximum volume of water stored in the retention basin (ft.^{3}).

Reference "Water & Sewage Works," December, 1973, Page 41.

<u>Derivation for an Orifice Outlet.</u>

<u>Outflow</u>

Orifice formula (P4-3, King's Handbook)

$$Qi = ca\sqrt{2gh}$$

"Assume that the storm that fills the basin to the peak volume causes the water level to rise at a constant rate ($h=k_1t$)"

$$Qi = ca\sqrt{2gk_1t}$$

Let $K_2 = ca\sqrt{2gk_1}$

$$Qi = K_2t^{1/2}$$

$$Vo = 60\int_o^T Qidt$$

"A conversion factor of 60 sec/min is required because Qi is in cfs and t is in minutes."

$$Vo = 60k_2\int_o^T t^{1/2}\,dt$$

$$Vo = 60k_2\,(2/3)T^{3/2}$$

$$Vo = 40k_2\,T^{1/2}(T)$$

"Assume the maximum outflow occurs only at the end of the peak storm such that $Qo = k_2 T^{1/2}$"

$\therefore Vo = 40\ Qo\ T$

Inflow

Qn = CIA Rational Formula

Let C = 100%

A = 1 Acre

$I = \frac{189}{T+25}$ for a 100 year storm from Master Plan of Drainage, City of Albuquerque, New Mexico, 1963-Herkenhoff & Associates.

$$Qn = (100\%)\ \left(\frac{189}{T+25}\right)\ (1)$$

$$= \frac{189}{T+25}$$

$$Vn = Qn \times T \times 60 \text{ sec./min.}$$

$$Vn = \frac{11,340T}{T+25}$$

Storage

$$Vs = Vn - Vo$$

$$Vs = \frac{11,340T}{T+25} - 40\ QoT$$

"Since Qo is a fixed maximum outflow that will only occur for the peak storm, it is necessary to find the time from the instant the storage begins until the instant the peak storage is attained. This can be done by taking the first derivative of the storage volume equation and setting it equal to zero."

$$\frac{dVs}{dT} = \frac{d\ \frac{11,340T}{T+25}}{dT} - \frac{d(40\ Qo\ T)}{dT}$$

$$\frac{dVs}{dT} = \frac{(T+25)(11,340) - (11,340T)(1)}{(T+25)^2} - 40\ Qo$$

$$\frac{dVs}{dT} = \frac{283,500}{T^2+50T+625} - 40\ Qo = 0$$

$$T^2 + 50T + 625 - \frac{283,500}{40Qo} = 0$$

"This is a quadratic equation which may be reduced to the form: $ax^2 + bx + c = 0$"

Where x is T, a = 1, b = 50, and $c = 625 - \frac{283,500}{40Qo}$

The general solution is $x = \frac{-b \pm \sqrt{b^2 4ac}}{2a}$

$$T = \frac{-50 \pm \sqrt{(50)^2 - 4(1)(625 - \frac{283,500}{40Qo})}}{2(1)}$$

$$T = \frac{-50 \pm \sqrt{2500 - 2500 + \frac{28,350}{Qo}}}{2}$$

$$T = -25 + \sqrt{\frac{7087.5}{Qo}}$$

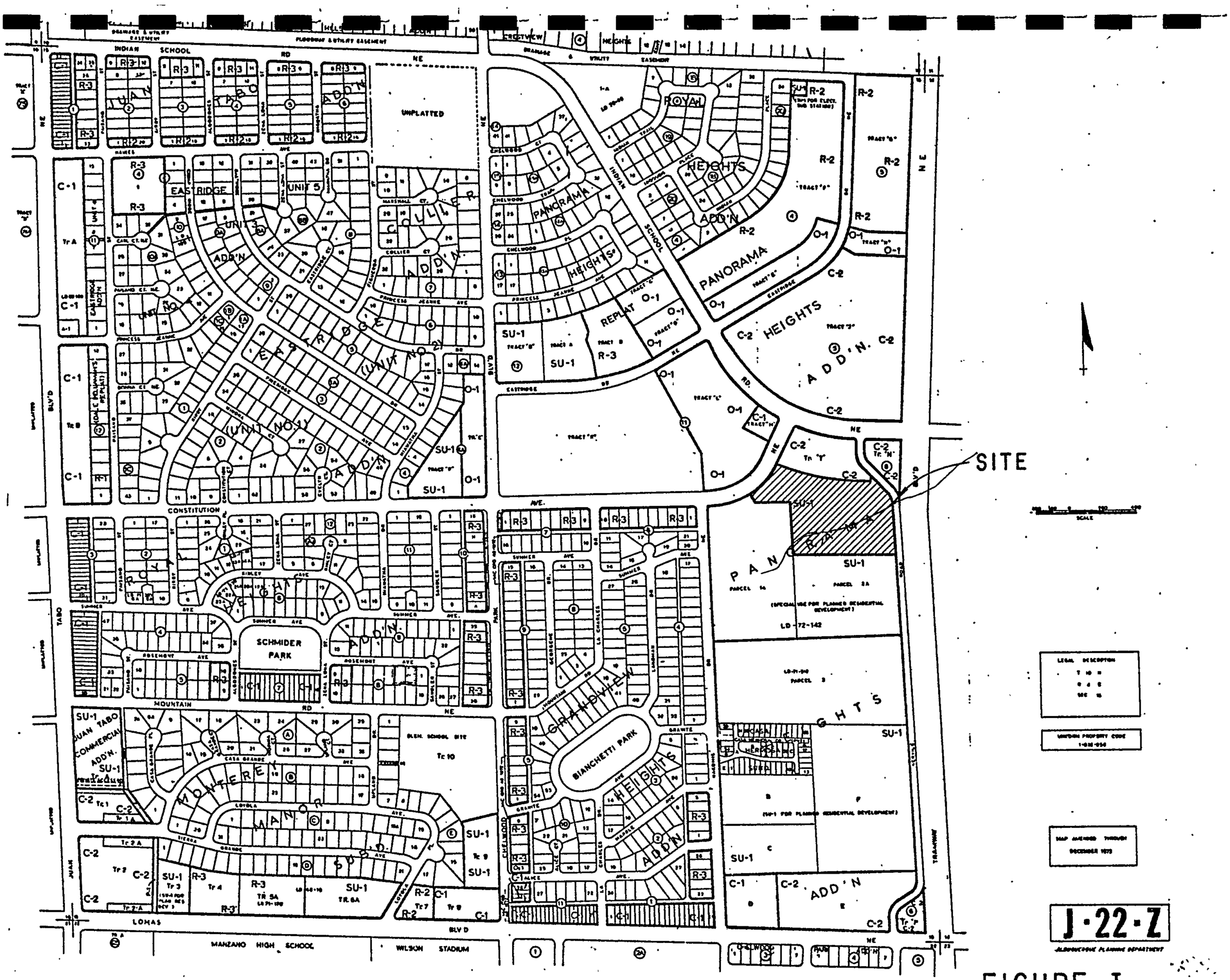

SITE
INDIAN SCHOOL RD NE
CRESTVIEW HEIGHTS
JUAN TABO BLVD
TRAMWAY
CONSTITUTION AVE.
MOUNTAIN RD NE
LOMAS BLVD
EASTRIDGE UNIT 5
EASTRIDGE ADD'N
EASTRIDGE (UNIT NO. 2)
EASTRIDGE (UNIT NO. 1)
PANORAMA HEIGHTS ADD'N
PANORAMA HEIGHTS ADD'N.
ROYAL HEIGHTS
ROYAL HEIGHTS ADD'N
SCHMIDER PARK
BIANCHETTI PARK
GRANDVIEW HEIGHTS ADD'N
MONTEREY MANOR ADD'N
PANORAMA HEIGHTS ADD'N
UNPLATTED
MANZANO HIGH SCHOOL
WILSON STADIUM
SCALE
LEGAL DESCRIPTION
UNIFORM PROPERTY CODE
MAP AMENDED THROUGH DECEMBER 1973
J-22-Z
ALBUQUERQUE PLANNING DEPARTMENT

FIGURE I

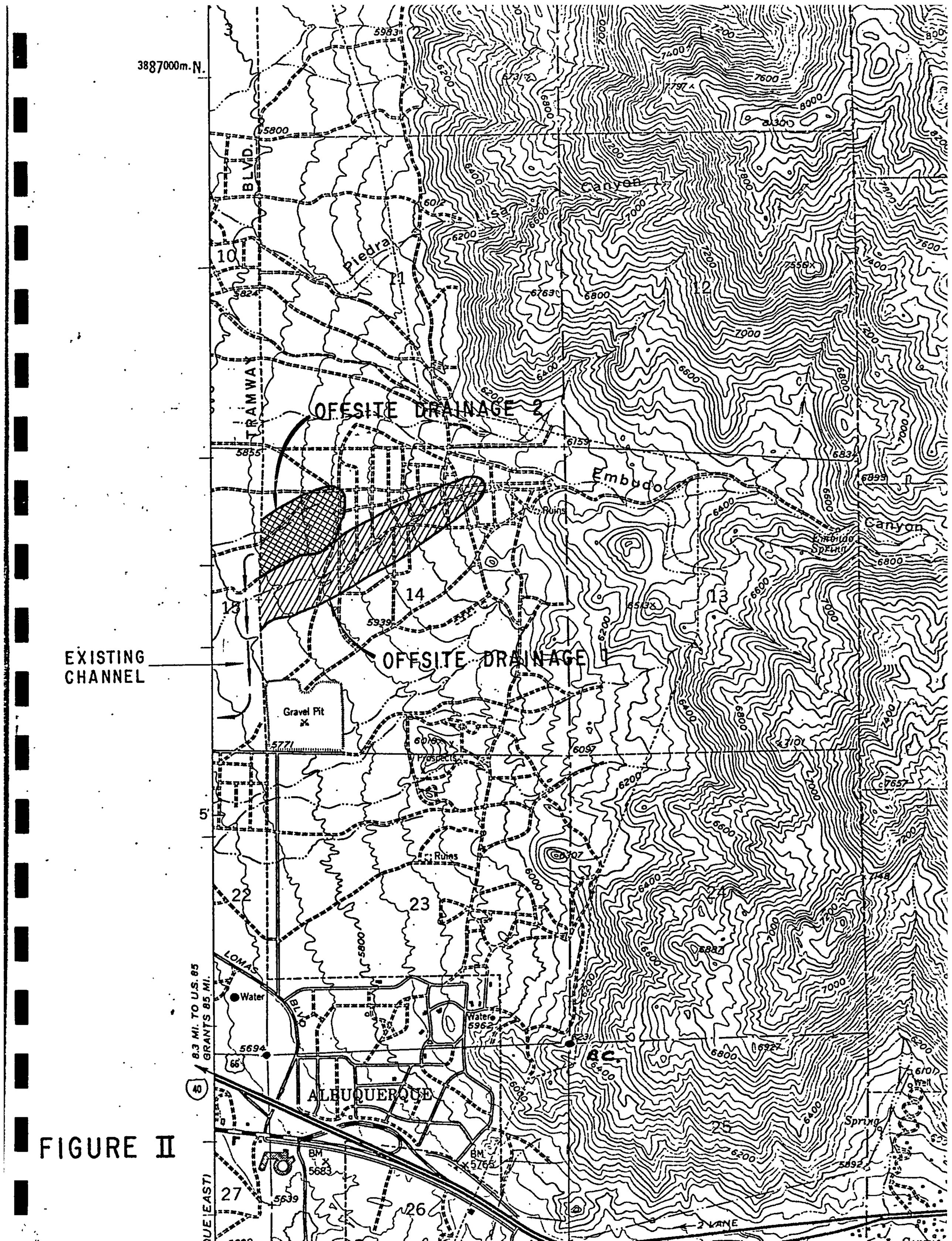
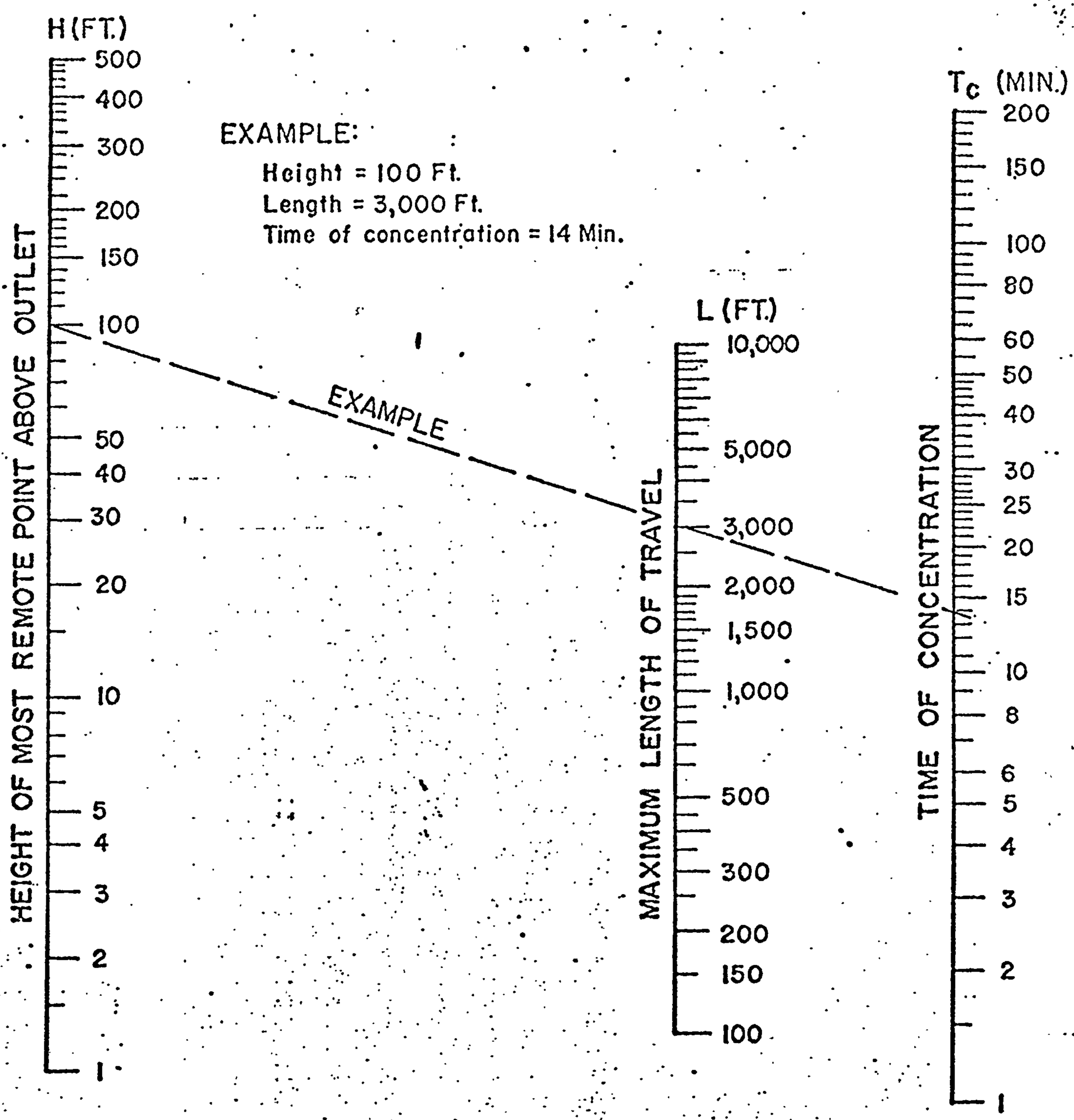

3887000m.N.
EXISTING CHANNEL
OFFSITE DRAINAGE 2
OFFSITE DRAINAGE 1
Embudo Canyon
Piedra
TRAMWAY BLVD.
LOMAS BLVD.
Gravel Pit
Prospects
Ruins
Embudo Spring
Spring
Water
ALBUQUERQUE
8.3 MI. TO U.S. 85 GRANTS 85 MI.
2 LANE
BM 5683
BM 5765
B.C.

FIGURE II



Based on study by P. Z. Kirpich,
Civil Engineering, Vol. 10, No. 6, June 1940, p. 332

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

Reprinted from "Design of Roadside Drainage Channels - Hydraulic Engineering Circular No. 6", April 1962, U. S. Dept.

FIGURE IV

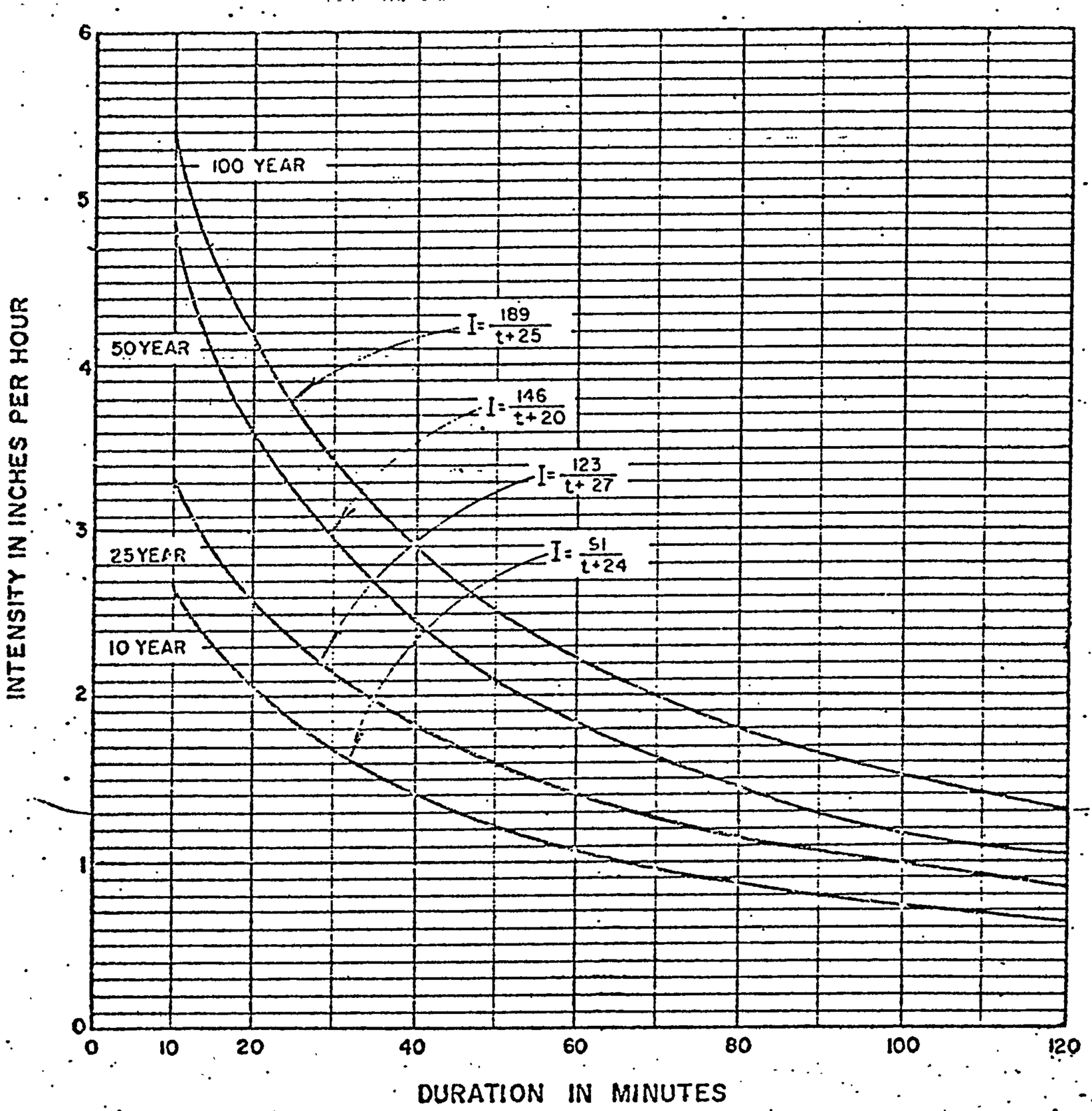

100 YEAR
50 YEAR
25 YEAR
10 YEAR
I = 189/(t+25)
I = 146/(t+20)
I = 123/(t+27)
I = 51/(t+24)
INTENSITY IN INCHES PER HOUR
DURATION IN MINUTES
0
1
2
3
4
5
6
0
10
20
40
60
80
100
120

FIGURE V

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Yrjanainen, G. and Warren, A.W., "A Simple Method for Retention Basin Design,"Water and Sewage Works, December, 1973.

[redacted]

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DRAINAGE REPORT

FOR

SUNBURST APARTMENTS
PANORAMA HEIGHTS

service Road cannot serve diversion and traffic. no arroyo.

easement SW corner. no arroyo

Designee agreement.

Ponding SW corner.

If flows to Constitution must be below flows contributed to Constitution

walk 4" high.

SUNBURST APARTMENTS DRAINAGE REPORT

INDEX — Page No.

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Phase II 5

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Summary 14

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Figure II - Location and Drainage Map, Scale 1" = 2000'

Figure III - Topographic Map and Drainage in Developed State

Figure IV - Time of Concentrations of Small Basins

Figure V - Intensity-Duration Frequency Curves

Structure "k" Detail

Bibliography of References

PURPOSE

The purpose of this report is to analyze the drainage characteristics of the site in its proposed developed state. Recommendations for controlling this runoff will be presented.

INTRODUCTION

The subject property, an SU-1 Development, is located in the Northeast Heights of Albuquerque, southwest of the intersection of Indian School Road, N.E. and Tramway Boulevard N.E. More particularly, it is the north half of Parcel 2A of Panorama Heights Addition, Section 15, T. 10 N., R. 4 E., N.M.P.M. (Zone Atlas J-22).

The property is bordered by Tramway Boulevard, N.E. on the east side, an apartment complex on the west side, and undeveloped land on the north and south sides. The slope of the land is from east to west, with a 4-6% average fall.

The site is essentially isolated from any offsite drainage from the east by a man-made channel paralleling and located between the east site boundary and Tramway Boulevard. This channel was constructed as per recommendations from a previous drainage study for the townhouse complex located west of the subject site.[1] This channel should be extended north approximately 150' to intercept a small offsite drainage area

1. Engineer's Drainage Report for Proposed Townhouse Development at Southeast Corner of Nakomis Drive and Constitution Ave., Albuquerque, N.M. -Prepared by Wilson & Company, Albuquerque N.M., 9 October 1971.

which lies to the north of the main offsite area. (See Figure III). This extension should be made within the service road R/W to avoid any encroachment onto private land. This action will completely safeguard the site from any offsite drainage from the east. Future improvements of Tramway will include a permanent channel located on the east side of Tramway Boulevard which will intercept flows from the east.

What about development of service road.

Designee agreement

Precipitation falling directly on the site forms into sheet flow and generally ends up in the defined drainage arroyo traversing the center of the site. This flow is routed thru the townhouse complex and out onto Nakomis Drive.

As it will be shown, these internal flows will be accommodated by a combination of detention ponding with controlled outlets, and ponding in open landscaped areas.

DESIGN CRITERIA

In analyzing the storm runoff to determine the runoff basis of the undeveloped site, the Rational Formula, Q - CIA, was used.

Where:

Q = Runoff quantity in cubic feet/second.

A = Contributing area in acres.

2. Tramway Boulevard Corridor, Central and I-40 to Montgomery, Albuquerque, N.M., Sheet 1 of 3, prepared by Bohannan, Westman, Huston.

I = Intensity in inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from Figure V - Intensity Duration Frequency Curves (Albuquerque Area - 1961). (Note: where a Time of Concentration [Tc] is less than 10 minutes from Figure IV, the intensity value equal to 10 minutes was used as shown on the curve for a 100 year storm in Figure V).

C = Runoff coefficient (no unit). This coefficient represents the integrated effects of infiltration, detention storage, evaporation, retention, flow routing, and interception which all affect the time distribution and peak rate of runoff.

For the proposed developed areas, it was desirable to develop a composite runoff coefficient based on the percentage of different types of surface in each sub drainage area. Different coefficients with respect to surface type are given below.[3]

Streets, walls and drives	C = 0.90
Roofs	C = 0.90
Lawns, Sandy Soils, Ave. 2 to 7% slope	C = 0.20

3. Table 3-2, Urban Storm Drainage Criteria Manual Vol. I, Denver Regional Council of Governments.

The following table is a summary of these values - Refer to the appendix for an example of the calculations.

Sub-Drainage Section	Area	By Area C=0.20	By Area C=0.90	Composite "C" Factor
1	1.124 Ac.	0.355 Ac.	0.769 Ac.	0.67
2	1.033 Ac.	0.455 Ac.	0.579 Ac.	0.59
3	0.688 Ac.	0.217 Ac.	0.471 Ac.	0.68
4	0.545 Ac.	0.136 Ac.	0.409 Ac.	0.73
5	0.622 Ac.	0.217 Ac.	0.405 Ac.	0.66
6	0.300 Ac.	0.087 Ac.	0.213 Ac.	0.70
7	0.979 Ac.	0.382 Ac.	0.597 Ac.	0.63
8	1.044 Ac.	0.186 Ac.	0.858 Ac.	0.77
8-A	0.38 Ac.	0.38 Ac.	--	0.20
9	0.403 Ac.	0.238 Ac.	0.165 Ac.	0.49
10	0.300 Ac.	0.190 Ac.	0.110 Ac.	0.46
11	0.312 Ac.	0.180 Ac.	0.132 Ac.	0.50
12	0.180 Ac.	0.126 Ac.	0.054 Ac.	0.41

Quantities of runoff were computed on a 100 year storm frequency for both the undeveloped condition and the proposed final developed state.

PHASE I

Phase I consists of analyzing the site in the undeveloped form. Runoff was based on general accumulation of flows into the natural arroyo traversing the center of the site.

The runoff coefficient used for undeveloped areas = 0.35.[4]

Tabulation of Results - Phase I

Estimated Flows - Undeveloped Site

Elev. Diff. feet	Length of Flow feet	Tc min.	I "/hr.	C	Area Ac.	Q cfs
32'	640'	10	5.4	0.35	8.00	15

PHASE II

Phase II consists of analyzing the site in its developed state. Only internal flows were considered in this phase. The resulting runoff flows and area contributing to this runoff are shown for each area on Figure III.

The following approach was taken for developing the runoff characteristics of the proposed site: the runoff flow will be detained on site where possible and released at controlled rates at designated receiving areas. Generally, low flows from small intensity storms will not be detained. However, for larger inflows, properly designed detention storage will reduce the outflow from the retention areas to a rate much less than the inflow. The final results will help reduce the impact of the outflowing drainage on the downstream facilities.

The detention areas will use a combination of the open spaces and the parking-street areas. It might seem objectionable to some to detain water on a common use parking area-street. However, if done properly, it can be accomplished

4. Table XII, Master Plan of Drainage, City of Albuquerque, New Mexico and Environs, 1963, G. Herkenhoff & Associates.

without interfering with the layout and functioning of the street. Furthermore, controlled rates of release are generally large enough so that water is ponded only during the larger storms. Therefore, theoretically once in a 100 years, the ponding volume of the parking area or street would be used to its maximum capacity. For a design storm having a recurrence period of five years, the depth of ponding would be 26% of that of a 100 year storm. It should be evident that the inconvenience to the street users would not be significant.

The flows generated in the undeveloped state will be 15 cfs. Since the developed discharge would equal approximately 25 cfs, controlled flow orifices will be constructed to release no more than the 15 cfs discharge rate. The following table is a breakdown of the sub-drainage areas to determine total developed runoff rate. I = 5.4"/hr. for all areas.

Area	Composite "C"	Area	Q
1	0.67	1.124	4
2	0.59	1.033	3
3	0.68	0.688	2
4	0.73	0.545	2
5	0.66	0.622	2
6	0.70	0.300	1
7	0.63	0.979	3
8	0.77	1.044	4
8A	0.20	0.382	0.4
9	0.49	0.403	1
10	0.46	0.300	0.7
11	0.50	0.312	0.8
12	0.41	0.180	0.4
		Total	24.3 cfs

The following is the format for calculating the peak discharge and the allowable runoff from each sub-area. Area I will be shown as an example. The remaining areas are summarized in table form. Refer to the appendix for the derivation of the calculations.

Area 1

Area =1.124 Ac.; set allowable outflow discharge at 1.0 cfs.

1. From the design criteria, calculate Q_o

$$Q_o = \frac{\text{Allowable outflow}}{\text{Acreage x runoff coefficient}}$$

$$Q_o = \frac{1.0 \text{ cfs}}{1.124 \text{ Ac. x } 0.67} = 1.33 \text{ cfs/Ac.Imp.}$$

2. Calculate time in minutes that the maximum volume of storage will occur from the orifice outlet storage time equation.

$$T = -25 + \sqrt{\frac{7087.5}{Q_o}}$$

$$= -25 + \sqrt{\frac{7087.5}{1.33}} = -25 + \sqrt{5328.95}$$

$$= -25 + 73.00$$

$$= \underline{48.0} \text{ minutes}$$

3. Calculate the maximum volume of storage per acre imperviousness from the orifice outlet storage equation.

$$Vs = \frac{11,340\ T}{T + 25} - 40\ QoT$$

$$Vs = \frac{(11,340)(48.0)}{48.0 + 25} - 40\ (1.33)(48.0)$$

$$Vs = 7456.44 - 2553.60$$

$$Vs = 4902.84 \text{ ft.}^3\text{/Ac. Imp.}$$

4. Calculate the total volume of storage required for the contributing Area 1.

V_t = Vs x # Acres x Runoff Coefficient

V_t = (4902.84)(1.124)(0.67)

V_t = $\underline{\underline{3692}}$ ft^3

5. Select an outflow pipe from the orifice formula that will yield the allowable outflow of 1.0 cfs under a head of 0.5:

Q = $ca\sqrt{2gh}$ - note c = 0.80 from trial and error solutions from Table 4-10, Handbook of Hydraulics, King & Brater, 1963.

Solving for "a"

$$a = \frac{Q}{c\sqrt{2gh}} = \frac{1.0}{0.80\sqrt{2\ (32.2)(0.50)}}$$

$$= \frac{1.0}{0.80\sqrt{32.2}} = \frac{1.0}{0.80 \times 5.67}$$

a = 0.22 ft^2 ∴ Select a 6" pipe.

Table of Controlled Outflows

Areas 1 thru 8

Sub-Drainage Area	1	2	3	4	5	6	7	8
Area (Ac.)	1.124	1.033	0.688	0.545	0.622	0.300	0.979	1.044
Allowable Outflow (C.F.S.)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Runoff Coeffic.	0.67	0.59	0.68	0.73	0.66	0.70	0.63	0.77
Qo (cfs/Ac.Imp.)	1.33	1.64	2.14	2.51	2.43	4.76	1.62	1.24
T (minutes)	48.0	40.7	32.6	28.1	28.9	13.6	41.1	50.5
Vs (ft^3/Ac.Imp.)	4902.84	4359.12	3624.24	3180.08	3279.66	1399.97	4390.55	5077.50
V_t (ft^3)	3692	2657	1696	1265	1346	294	2708	4081
Head (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
a (ft^2)	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Size Pipe (in.)	6"	6"	6"	6"	6"	6"	6"	6"

Sub-drainage areas 9 thru 12 lend themselves to total ponding. The following table is a summary of total flows generated within these areas and total ponding capacities. A rainfall value of 2.6" for a 100 year-6 hour storm was used.

Sub-Drainage	Composite "C" Factor	Area (ft^2)	Volume Runoff (ft^3)	Pond Vol. (ft^3)
9	0.49	17,554	1864	2475
10	0.46	13,068	1302	1575
11	0.50	13,590	1472	1580
12	0.41	7,840	696	1125

The pond storage available is based upon a 0.5' deep depression. The actual depth of storage is shown on Figure III. The swimming pool area was assumed to be self contained in that this area will not contribute runoff to surrounding area.

SUMMARY OF RESULTS

The following is a breakdown of the individual areas and their relationship to the overall drainage picture (See Figure III).

Area 1, at the northwest corner of the site, is isolated from the drainage of the rest of the site. Flows originating within Area 1 will generally follow the slope of the land before being routed to the detention area in the southwest corner of the area. This detention area will use the combined area of the parking area and the open space. The parking area will handle 1050 ft^3 of temporary storage. The total volume, minus what percolates into

the ground, will flow onto Constitution Avenue at a controlled rate of 1.0 cfs. This is the only sub-drainage area which empties onto Constitution Avenue. Areas 2 thru 8 all depart at the southwest corner of the site.

Area 2, which lies along the north boundary of the site, is also isolated from the drainage of the rest of the site. Flows from this area will accumulate in the street for final routing to a detention pond. This pond area has the capacity to hold 100 year storm flows while simultaneously releasing flows at a rate of 1.0 cfs. Flows from this detention pond will follow a drainage swale along the west boundary to a departure point at the southwest corner of the site.

Area 3, which lies at the northeast corner of the site, forms the top of the chain of sub-drainage areas which interconnect to route the flows to the southwest corner of the site. Flows from Area 3 will be detained on the parking area and released into Area 4 at a controlled rate of 1.0 cfs. Flows from Area 4, Area 5, and Area 6 are likewise detained on the parking areas and released at controlled rates of 1.0 cfs each. As the flows from Area 3 enter Area 4, Area 4 is emptying into Area 5. The flows from Area 5 empty into a drainage swale along the south property line. Area 6 also empties into this swale. Each area has the capacity to completely pond the flows originating within that area, provided there is a simultaneous release of flows from each area of 1.0 cfs.

Area 7 flows will be detained on the parking area and released at a controlled rate of 1.0 cfs into a drainage swale along the west boundary. This same swale carries the flows away from Area 2.

Area 8 is the last of the chain of sub-drainage areas which drain to a common point at the southwest corner of the site. The flows from this area are also detained on the parking area and released at a controlled rate of 1.0 cfs into the landscaped area. These flows can be routed thru the landscaped area to help sustain the plants and help increase the infiltration into the ground. Area 8-A is all open area and its proposed use will be as a landscaping screen from the units to the west. The amount of runoff originating within this area has a rate of flow of 0.4 cfs. This flow, while controlled, is insignificant in magnitude.

The flows from Areas 9, 10, 11 and 12 will be completely ponded in a series of ponds. Areas 9 and 11 have several ponds, with the higher ponds overflowing into the lower ponds when a maximum depth of 0.5 is reached. Total capacity is reached when all the ponds are filled.

Summing up the above, it can be shown that:

A. Total Runoff-Undeveloped State = 15 cfs.

B. Total Runoff-Controlled-Developed State.

1. 1.0 cfs onto Constitution Avenue. Area #1
2. 5.4 cfs at southwest corner of project. Area #2 thru 8

C. Therefore summing total runoff rates under developed conditions vs. undeveloped conditions:

Developed State		Undeveloped State
6.4 cfs	vs.	15 cfs

The net result is a reduction of the runoff rate by 8.6 cfs.

RECOMMENDATIONS

The following recommendations are made to enable the developer of the SU-1 area to complete this project within the design framework stated above:

1. It is recommended that all streets have a slight inverted crown in the center--a 2" inverted crown would be sufficient. The areas designated as detention areas should have a constant cross-section, with no inverted crown. The detention areas should slope toward the orifice with a positive slope of 0.5% maximum.

2. Because each detention area will have a positive slope to the orifice, the detention cross-section would assume a triangular section. However, the required volume is computed on a rectangular section. In order to compensate for the sloping pavement, the top of the curb around the detention area should be kept at a constant elevation. Thus the depth between the curb and pavement will increase as the pavement slopes to the orifice. The elevation of the curb would be established at

the upstream limit of the detention area, the minimum depth of each detention area being shown on Figure III.

This concept can be realized with the construction of a rectangular concrete curb. A typical section would be 6" wide x 18" deep, with 8" minimum above the pavement. This type of curb can be varied in depth in relation to the slope of the pavement.

3. Water blocks are recommended in the streets as shown in Figure III to facilitate the movements of the runoff as shown.

4. It is suggested that the ponds in the open areas be landscaped with grass and trees. This will not only increase infiltration, but will also lessen the visual impact of using the area for ponding.

5. The drainage swales on the west and south boundaries should have a typical cross-section as shown on the appendix. The slope of the swale should be a minimum of 0.5%, with the swale blending into the overall grading of the site.

SUMMARY

The subject property, by utilizing detention and retention ponding for the SU-1 development, will contribute less internal runoff to surrounding areas than that which existed before development.

In conclusion, the development of Sunburst Apartments should be a beneficial effect on the drainage characteristics of this area.

Respectfully submitted,

Bo K. Johnson
N.M.P.E. No. 5922

APPENDIX

CALCULATIONS FOR RATIONAL FORMULA

1. Sample calculation for arriving at a composite "C" factor.

   A = 1.033 Acres total Section 2

   = 0.455 Acres Turf

   = 0.579 Acres Pavement

   Where C = 0.90 for Pavement

   = 0.20 for Turf

   $$\text{Average } C = \frac{0.455 \times 0.20}{1.033} + \frac{0.579 \times 0.90}{1.033} = 0.59$$

2. Sample calculation for Rational Formula Q = CIA

   H = height above most remote point above outlet

   = 32'

   L = distance most remote point

   = 640'

   Tc= 3.5 min. (use 10 min.) - Figure V

   $$I = \frac{189}{T+25} \text{ for 100 year storm} = \frac{189}{35} = 5.4''/\text{Hr. (Figure V)}$$

   C = 0.35

   A = 8.00

   Q = CIA

   = (0.35)(5.4)(8.00) = 15 cfs

3. Sample calculation for required ponding area.

   Area = 0.403 Ac. or 17,554 ft^2

Design storm criteria = 2.6"-6 Hr./100 year

Therefore, Volume required for ponding = Area x Volume of Runoff x Composite "C" Factor =

17,554 ft.^{2} x 0.217 ft. x 0.49 = 1864 ft.^{3} min. storage required.

Pond size shown on Figure III.

CALCULATIONS AND DERIVATIONS FOR AN ORIFICE OUTLET

Definitions of Terms

A = Contributing acreage

a = Cross sectional area of outflow pipe (Ft.^{2})

C = Coefficient of imperviousness

c = Coefficient of contraction for an orifice

g = Acceleration due to gravity (32.2 ft/sec.^{2})

h = Head, defined as the distance from the water surface to the center line of the outflow pipe (ft.)

I = Rainfall intensity ($\frac{189}{T+25}$)

K_1 = Constant (h/t)

K_2 = Constant ($ca\sqrt{2gk}$)

Qi = Instantaneously changing outflow (CFS)

Qo = Maximum outflow per acre imperviousness (CFS/Ac)

T = Storage time, defined as the instant storage begins until peak storage is attained (min.)

t = Instantaneous time of storage (min.)

Vn = Volume of water flowing into the retention basin per acre imperviousness (ft.^{3}/AC.)

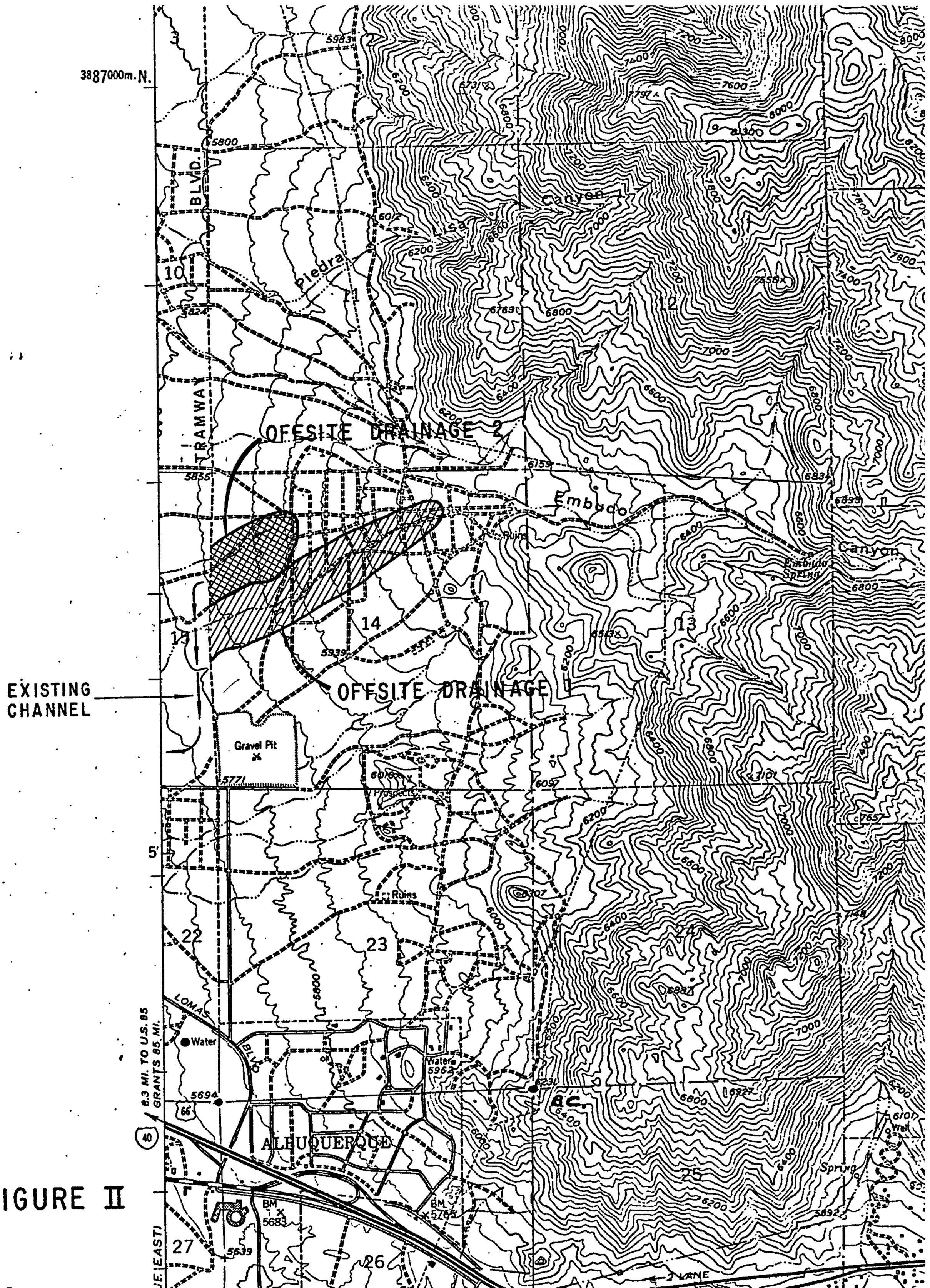

3887000m.N.
EXISTING CHANNEL
OFFSITE DRAINAGE 2
OFFSITE DRAINAGE 1
Piedra
Canyon
Embudo
Canyon
Embudo Spring
Gravel Pit
Prospects
Ruins
TRAMWAY BLVD.
LOMAS BLVD.
8.3 MI. TO U.S. 85
GRANTS 85 MI.
ALBUQUERQUE
Water
Spring
Well
2 LANE

FIGURE II

Vo = Volume of water flowing out of the retention basin per acre imperviousness (ft.^{3}/Ac.)

Vs = Maximum volume of water stored in the retention basin per acre imperviousness (ft.^{3}/Ac.)

Vt = Maximum volume of water stored in the retention basin (ft.^{3}).

Reference "Water & Sewage Works," December, 1973, Page 41.

<u>Derivation for an Orifice Outlet.</u>

<u>Outflow</u>

Orifice formula (P4-3, King's Handbook)

$$Qi = ca\sqrt{2gh}$$

"Assume that the storm that fills the basin to the peak volume causes the water level to rise at a constant rate ($h=k_1t$)"

$$Qi = ca\sqrt{2gk_1t}$$

Let $K_2 = ca\sqrt{2gk_1}$

$$Qi = K_2t^{1/2}$$

$$Vo = 60\int_0^T Qidt$$

"A conversion factor of 60 sec/min is required because Qi is in cfs and t is in minutes."

$$Vo = 60k_2\int_0^T t^{1/2}\,dt$$

$$Vo = 60k_2\,(2/3)T^{3/2}$$

$$Vo = 40k_2\,T^{1/2}(T)$$

"Assume the maximum outflow occurs only at the end of the peak storm such that $Qo = k_2 T^{1/2}$"

$\therefore Vo = 40\ Qo\ T$

Inflow

Qn = CIA Rational Formula

Let C = 100%

A = 1 Acre

$I = \frac{189}{T+25}$ for a 100 year storm from Master Plan of Drainage, City of Albuquerque, New Mexico, 1963-Herkenhoff & Associates.

$$Qn = (100\%)\ \left(\frac{189}{T+25}\right)\ (1)$$

$$= \frac{189}{T+25}$$

Vn = Qn x T x 60 sec./min.

$$Vn = \frac{11,340T}{T+25}$$

Storage

Vs = Vn - Vo

$$Vs = \frac{11,340T}{T+25} - 40\ QoT$$

"Since Qo is a fixed maximum outflow that will only occur for the peak storm, it is necessary to find the time from the instant the storage begins until the instant the peak storage is attained. This can be done by taking the first derivative of the storage volume equation and setting it equal to zero."

$$\frac{dVs}{dT} = \frac{d\ \frac{11,340T}{T+25}}{dT} - \frac{d(40\ Qo\ T)}{dT}$$

$$\frac{dVs}{dT} = \frac{(T+25)(11,340) - (11,340T)(1)}{(T+25)^2} - 40\ Qo$$

$$\frac{dVs}{dT} = \frac{283,500}{T^2+50T+625} - 40\ Qo = 0$$

$$T^2 + 50T + 625 - \frac{283,500}{40Qo} = 0$$

"This is a quadratic equation which may be reduced to the form: $ax^2 + bx + c = 0$"

Where x is T, a = 1, b = 50, and $c = 625 - \frac{283,500}{40Qo}$

The general solution is $x = \frac{-b \pm \sqrt{b^2 4ac}}{2a}$

$$T = \frac{-50 \pm \sqrt{(50)^2 - 4(1)(625 - \frac{283,500}{40Qo})}}{2(1)}$$

$$T = \frac{-50 \pm \sqrt{2500 - 2500 + \frac{28,350}{Qo}}}{2}$$

$$T = -25 + \sqrt{\frac{7087.5}{Qo}}$$

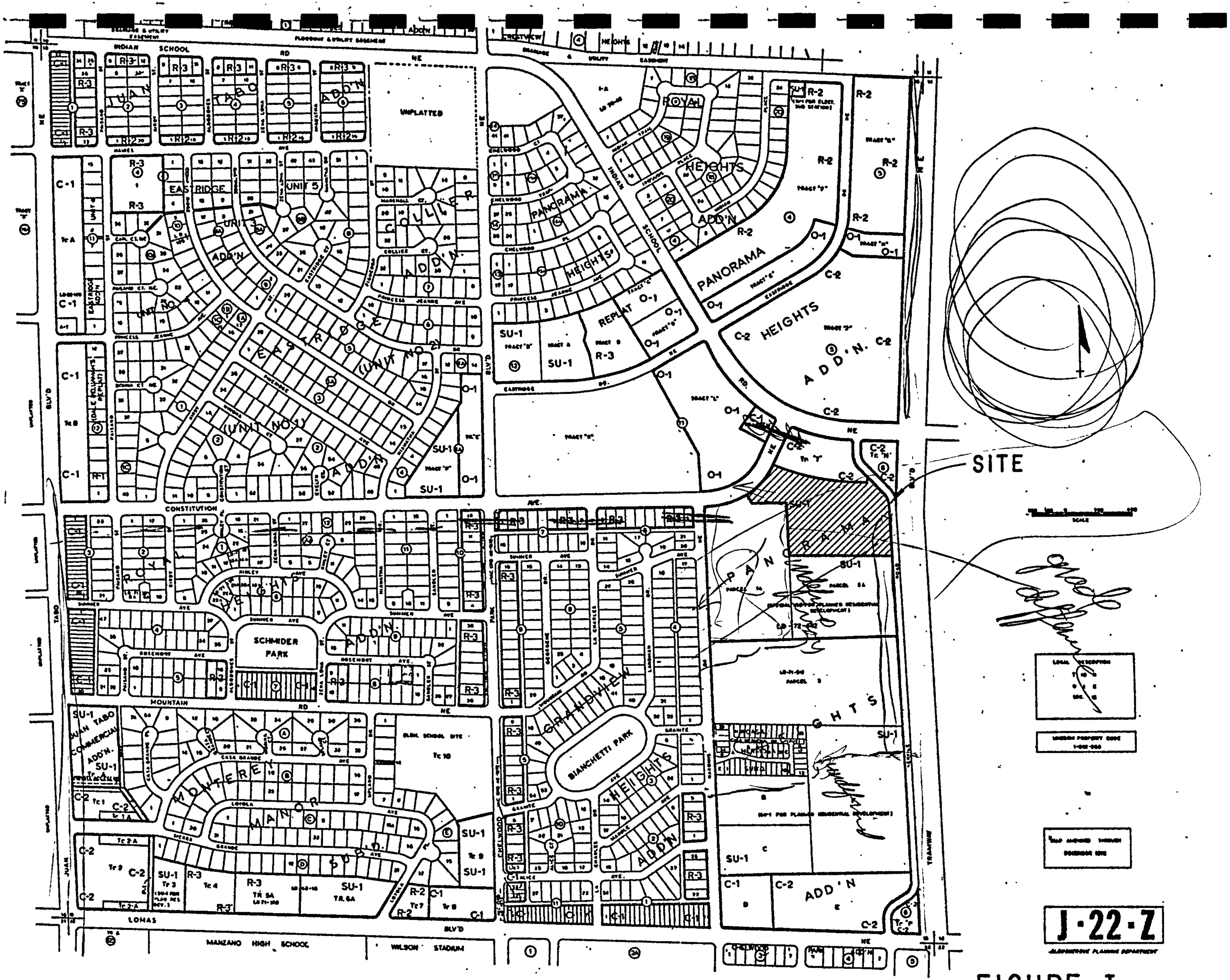
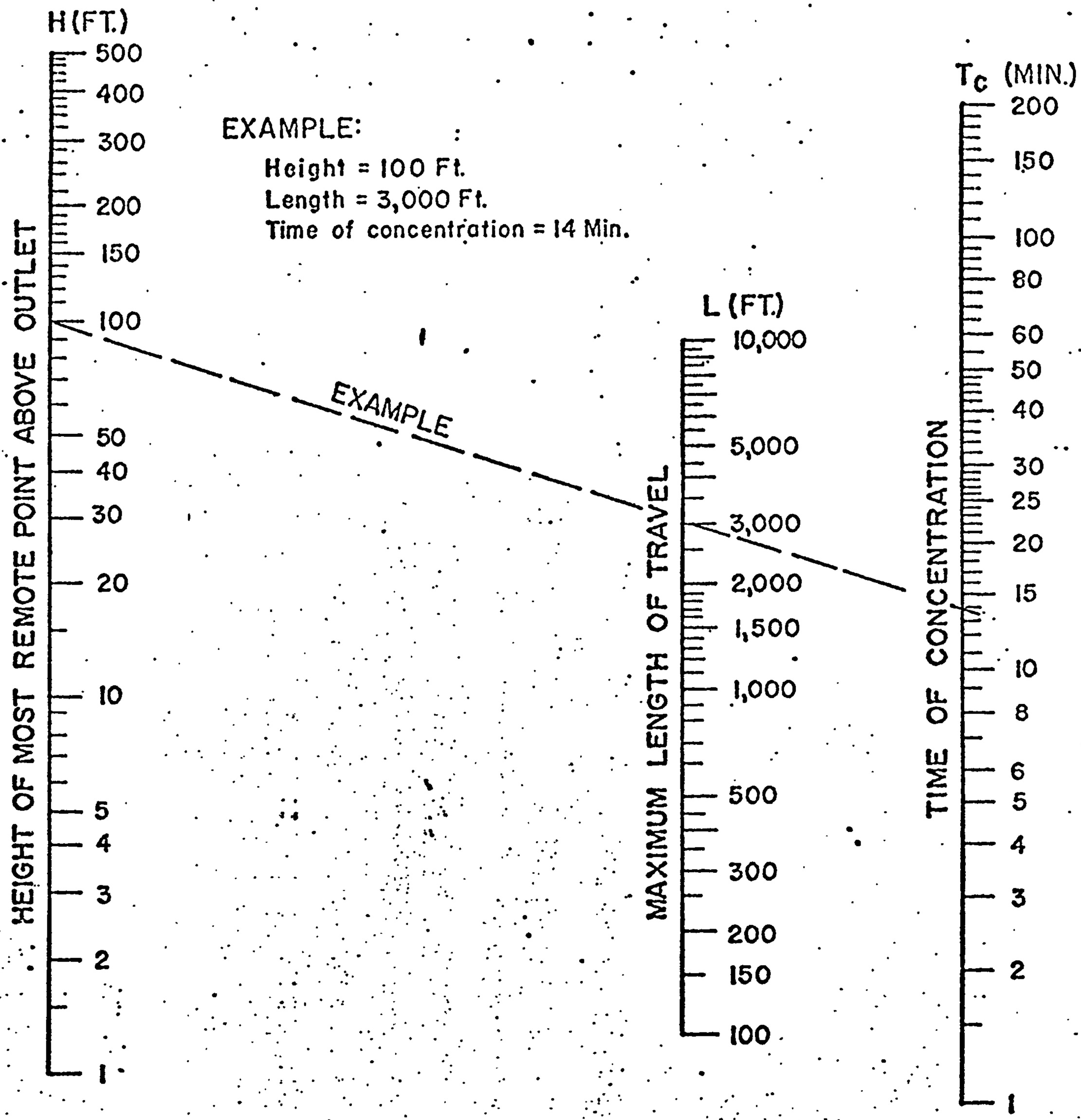

INDIAN SCHOOL RD NE
UNPLATTED
EASTRIDGE UNIT 5
EASTRIDGE UNIT 3
EASTRIDGE UNIT NO. 2
EASTRIDGE UNIT NO. 1
COLLIER ADD'N
ROYAL HEIGHTS ADD'N
PANORAMA HEIGHTS ADD'N
PANORAMA HEIGHTS ADD'N. C-2
SITE
CONSTITUTION AVE.
SCHNIDER PARK
MOUNTAIN RD NE
BIANCHETTI PARK
MONTEREY MANOR SUB.
LOMAS BLVD
MANZANO HIGH SCHOOL
WILSON STADIUM
J-22-Z

FIGURE I



Based on study by P. Z. Kirpich,
Civil Engineering, Vol. 10, No. 6, June 1940, p. 332

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

Reprinted from "Design of Roadside Drainage Channels - Hydraulic Engineering Circular No. 6", April 1962, U. S. Dept.

FIGURE IV

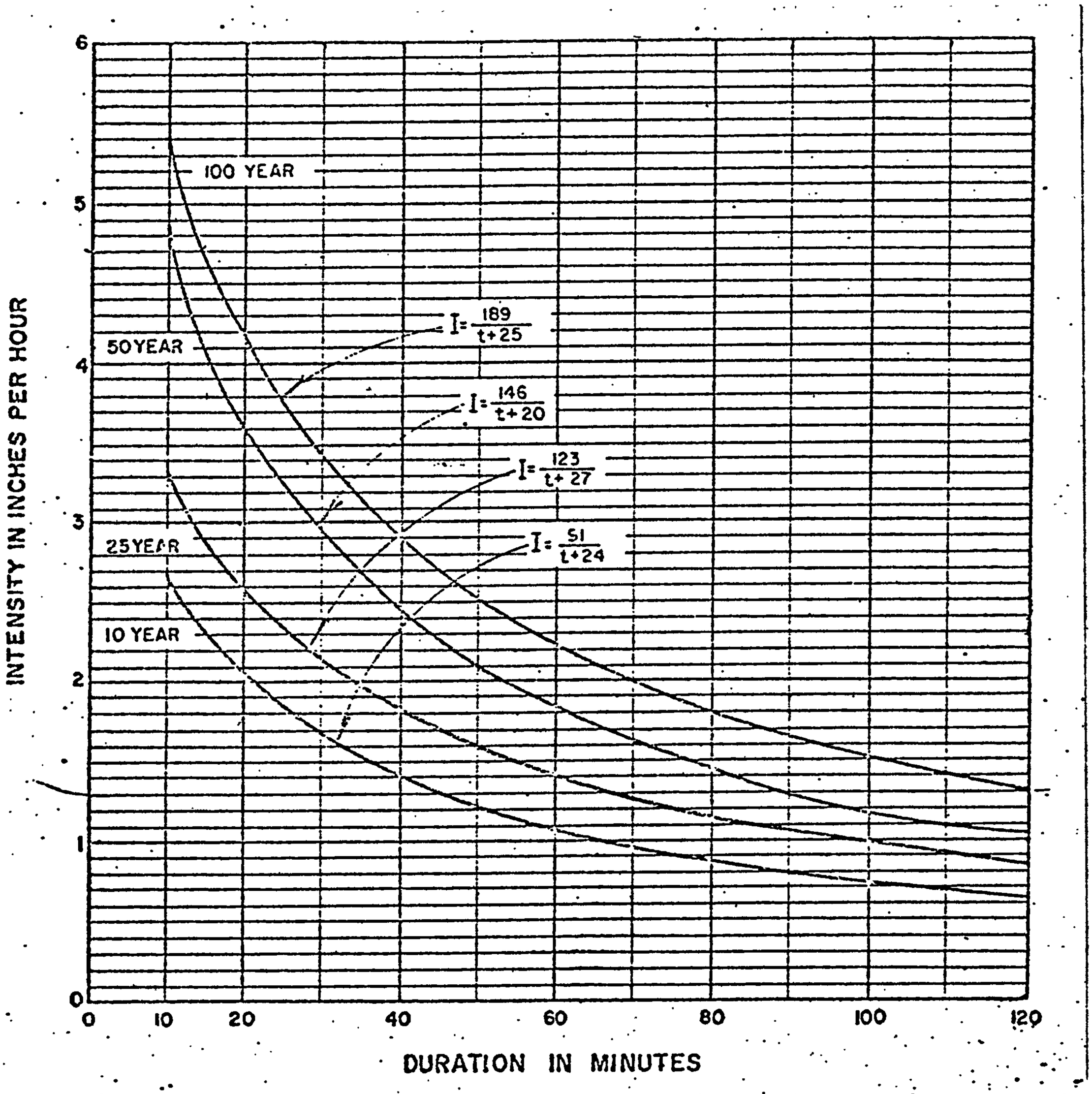

100 YEAR
50 YEAR
25 YEAR
10 YEAR
I = 189/(t+25)
I = 146/(t+20)
I = 123/(t+27)
I = 51/(t+24)
INTENSITY IN INCHES PER HOUR
DURATION IN MINUTES
0
1
2
3
4
5
6
0
10
20
40
60
80
100
120

FIGURE V

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Yrjanainen, G. and Warren, A.W., "A Simple Method for Retention Basin Design,"Water and Sewage Works, December, 1973.