D19 / D6

LOMA DEL NORTE

UNIT 4-A

3 PLANS

6400 Uptown Blvd. N.E.
Albuquerque, New Mexico 87110

RE: LOMA DEL NORTE UNIT 4-A

RECEIVED
DEC 1 2 1978
CITY ENGINEERS

Dear Mr. Kimmick:

I am following with this letter on conversation of this morning regarding the captioned Subdivision. Approval for the development of this parcel will be contingent upon submission of channel profile and cross-section, an analysis of the existing conditions (100 yrs. water surface profile) and detailed proposal of the improvements necessary to prevent erosion and protection of the Southern boundary line of the property. From conversation with Mr. Dwayne Sheppard I understand that the Easternmost drop structure has failed and the one next to it is bypassed by the flows emanating from the East. These conditions need to be rectified in order to protect the parcel. Particular attention needs to be dedicated to the transition of the flows from the channel East of Wyoming through the dip section. Conditions analogous to those experienced in the Four Hills development across Bernalillo Rd. with which you are quite familiar, need to be prevented in this development. If you have further questions or disagree with my perspective, feel free to contact Mr. Heller.

Cordially yours,

Bruno Conegliano
Asst. City Engineer-Hydrology

BC/tl

cc: Rick Leonard, AMAFCA
Richard Heller, City Engineer
Dwayne Sheppard, Asst. City Engineer-Field
Frank Krim, M.S.M.
Dr. File

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

MAYOR
David Rusk

January 15, 1979

D19-D6

Mr. Carl Tebbens
Meurer, Serafini, & Meurer
2601 Wyoming Blvd. N.E., Suite F
Albuquerque, New Mexico 87110

Re: Loma Del Norte 4a

Dear Carl:

The drainage report for the referenced subdivision received on January 5, 1979 is not in compliance with the stipulations in my letter dated December 12, 1978 to Mr. V. M. Kimmick regarding the same.

Very truly yours,

Bruno Conegliano
Assistant City Engineer-Hydrology

BC/fs

cc - V. M. Kimmick
Rich Leonard
Dick Heller
Drainage File

DALE BELLAMAH CORPORATION

Land Division

January 30, 1979

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

RECEIVED
FEB 02 1979
CITY ENGINEERS

RE: NORTH LINING - ARROYO DEL PINO
(LOMA DEL NORTE 4-A)

Dear Dick:

Enclosed please find a section of our proposal to develop the north side of the above mentioned arroyo as prepared by Meurer, Serafini & Meurer, Inc. on January 30, 1979. It is our intent to develop the entire north side adjacent to our property in this manner.

We request your immediate attention to this matter so that we may be able to proceed with earthwork immediately.

Thank you for your cooperation.

Very truly yours,

DALE BELLAMAH LAND CO., INC.

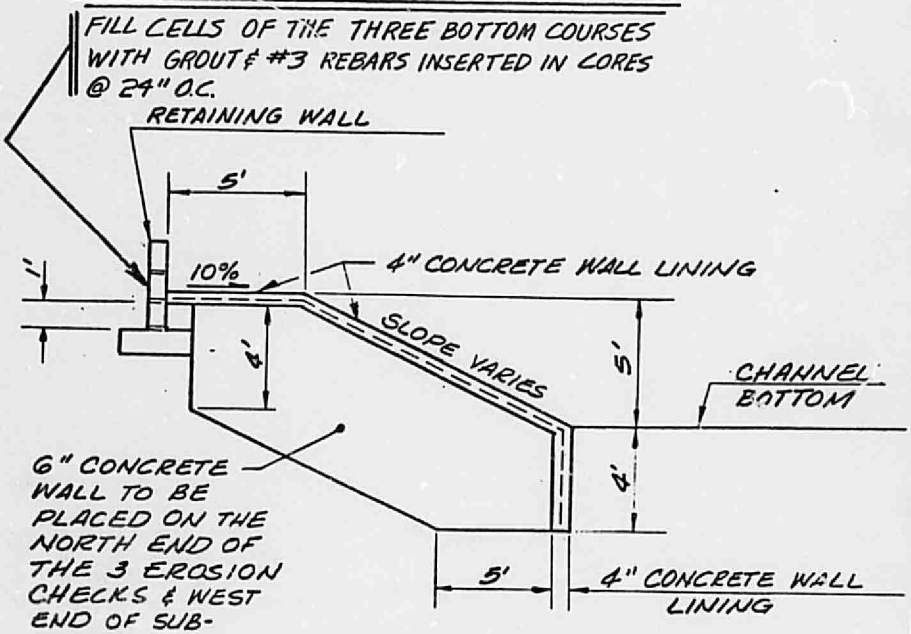
Thomas J. Di Rito
Development Engineer

TDR/rr

Enclosure

6400 Uptown Boulevard, NE • P.O. Box 3325 • Albuquerque, New Mexico 87190 • (505) 883-3000

LINING ON NORTH SIDE OF ARROYO DEL PINO



NOTE: ALL CONCRETE TO BE REINFORCED WITH 6"x6" W4xW4 W.W.F. WIRE MESH. CONTRACTOR TO EXPOSE THE WIRE MESH IN THE EROSION CHECK WALL & CONNECT TO WIRE MESH IN SLOPE PROTECTION.

CARL A. TERDENS
STATE OF NEW MEXICO
REGISTERED PROFESSIONAL ENGINEER

DATE: 1-30-79

MEURER, SERAFINI AND MEURER, INC.
CONSULTING ENGINEERS • SURVEYORS • PLANNERS
2801 Wyoming Blvd., N.E. Albuquerque, New Mexico 87110
(505) 292-1838 A Gengs Co

City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

MAYOR
David Rush

February 5, 1979

D19-D6

Mr. Carl Tebbens
Meurer, Serafini & Meurer
2601 Wyoming Blvd. N.E., Suite F
Albuquerque, New Mexico 87110

Re: Loma Del Norte, Unit 4A

Dear Mr. Tebbens:

On February 2, 1979 Mr. Heller received a letter from Tom DiRito with the Bellamah Corp. indicating that the north side of the North Arroyo Del Pino will be lined to protect the adjacent lots in the captioned subdivision. I would therefore like to receive a letter of amendment to the drainage report indicating this change, a profile of the arroyo (with cross sections) showing existing, proposed flowline & top of the bank and the resulting water surface elevation. At the same time submit also the revised site grading plan to comply with the concerns of the Planning Department.

Very truly yours,

Bruno Conegliano
Assistant City Engineer-Hydrology

BC/fs

cc - Dick Heller
Drainage File

MEURER, SERAFINI AND MEURER, INC.
CONSULTING ENGINEERS • SURVEYORS • PLANNERS
2601 WYOMING BLVD., N.E., SUITE F • ALBUQUERQUE, NEW MEXICO 87110 • (505) 292-1936

February 21, 1979

Mr. Bruno Conegliano
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: Addendum #1 to the Loma Del Norte 4A Drainage Study

Dear Bruno:

The Dale Bellamah Corporation has agreed to provide slope paving on the north bank of the Arroyo del Pino to prevent future erosion and undermining and the possibility of damage to adjacent property in Loma Del Norte 4A Subdivision.

A detail of the slope protection is shown on the attached plan. Also shown is a detailed plan and profile with cross-sections of locations indicated and the 100-year water surface level.

Very truly yours,

MEURER, SERAFINI AND MEURER, INC.

Carl A. Tebbens

Carl A. Tebbens, P.E.
Vice President

CAT:dw

cc: Mr. Tom DiRito, Bellamah Corp.

DRAINAGE REPORT

FOR

LOMA DEL NORTE
(UNIT 4-A)

ALBUQUERQUE, NEW MEXICO

Prepared By

Meurer, Serafini and Meurer, Inc.
2601 Wyoming Blvd. N.E.
Albuquerque, New Mexico
87110

(505) 292-1936

December, 1978

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ESTIMATED RUNOFF UNDEVELOPED STATE	2
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EXPLANATION OF RESULTS	5
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APPENDICES

APPENDIX 1	Composite Runoff Coefficient
APPENDIX 2	Ponding Requirements
APPENDIX 3	Runoff Computations
Figure I	Typical Lot Drainage
Figure II	Time of Concentration
Figure III	Overland Flow Time

DRAINAGE REPORT

Loma Del Norte
Unit 4-A

PURPOSE AND SCOPE

The Dale Bellamah Land Co., Inc., is planning on developing lands located in the northeast sector of metropolitan Albuquerque known as Loma Del Norte Unit 4-A. The purpose of this report is to present a plan for controlling surface runoff from said subdivision in a manner acceptable to the Albuquerque Arroyo Flood Control Authority and the Albuquerque City Engineer's office.

SITE LOCATION AND TOPOGRAPHY

Loma Del Norte is located in the northeast sector of Albuquerque at Wyoming Boulevard and the North Arroyo del Pino. The surrounding terrain is generally developed land on all sides. The North Arroyo del Pino is located on the south side of the proposed subdivision.

The soil of the site is generally comprised of disintegrated granite. The natural ground slopes from the east to the west with a few small swales. Ground cover consists mainly of native grasses.

DESIGN CRITERIA

In analyzing the storm runoff, the Rational Formula, $Q = CIA$ is used.

Where:

Q = Runoff quantity in cubic feet/second.

A = Contributing area in acres.

I = Intensity in inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from

Figure II. (Note: Where a Time Concentration [Tc] is less than 10 minutes from Figure II, the intensity value, derived from a Tc equal to 10 minutes, is employed.)

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.

ESTIMATED RUNOFF UNDEVELOPED STATE

Drainage within the boundary of the site is basically overland flow with some small swales. Most of the drainage naturally exits the area at the southwest corner of the property. Drainage flows from the east are diverted by Wyoming Boulevard; therefore, there are no offsite flows to be carried through the site. In addition, other adjacent improvements to the north and to the west and general topography prohibit offsite flows from entering the subdivision. For the purposes of this report, then, onsite flows within Unit 4-A have been developed.

The Arroyo del Pino, which abuts the development on the south, is an improved drainage channel with concrete drop structures which was previously dedicated to the City of Albuquerque in the form of a dedicated 50-foot right-of-way. Erosion around drop structures will require City maintenance as well as repair of damage to one drop structure. The 100-year flow in the channel is 885 cfs per the Northeast Heights Drainage Management Plan.

In order to better determine the flow characteristics of the North Arroyo del Pino, a backwater computation was performed. Based

on the existing conditions of the channel and the Wyoming Boulevard crossing, it was determined that the flow depth at the extension of the easterly curb at Wyoming Boulevard is 1.36 feet, with a velocity of 10.8 fps due to the narrowing of the upstream channel. The depth of flow at the westerly extension of the curb on Wyoming Boulevard is 1.61 feet, with a velocity of 7.7 fps. Flows in Wyoming Boulevard will not be of sufficient depth to enter the intersection at Calle del Plata.

The average flow depth in the channel adjacent to the subject development is 4.5 feet with a maximum overflow depth of 1.7 feet. The average velocity is approximately 10.5 fps.

A 2-foot diversion wall should be constructed along the south boundary line of the project which is also the north right-of-way line of the arroyo. As a safety precaution, it is also recommended that the 2-foot diversion wall be extended north along the west right-of-way line of Wyoming Boulevard to the intersection of Calle del Plata, as shown on the drainage plan. It is suggested that erosion protection be placed around the southeast corner of the development to prevent scouring of the embankment where flows discharge from Wyoming Boulevard into the channel.

Additional erosion protection should be placed at the point of discharge of the drainage rundown at the northwest corner of the development.

The following table shows the undeveloped onsite flows which are generally street flows traversing from east to west.

TABLE 1

Runoff in Undeveloped State Q = CIA

Onsite	Elev.	Length of Flow	Tc Min.	I-100 yr. In./Hr.	C	Area Ac.	Q C.F.S.
A-B	28 Ft.	850 L.F.	10 Min.	5.4	0.40	10.35	22.4

ESTIMATED RUNOFF DEVELOPED STATE

As development occurs, the area of impervious surfaces increases and thereby the amount of runoff also increases. To offset this increase, onsite restrictions of flows must be incorporated into the development. While this can take different forms, the most practical solution for this type of development is to utilize on-lot ponding. The contributing area to the backyard ponding includes the backyard, side yard, and in a majority of cases, one-half of the roof area due to the popularity of the pitched roof concept. The area drained to the street includes the front yard, driveway, sidewalk-parkway areas, and one-half the roof area. This approach will satisfy A.M.A.F.C.A.'s requirement that the runoff rate from the developed tract not exceed the runoff rate from the tract in its natural state.

The runoff coefficient factors are as follows:

Streets, Walks and Drives	C = 0.90
Roofs	C = 0.90
Lawns, Sandy Soils (Average 2 to 7%)	C = 0.40

Table 2

Runoff in Developed State

Onsite

A	Q = CIA = (0.70)(5.4)(2.8)	=	10.8 c.f.s
B	Q = CIA = (0.70)(5.4)(3.0)	=	11.3 c.f.s.
	Total Developed Flow	=	22.1 c.f.s.
	See Appendix #3		

EXPLANATION OF RESULTS

Undeveloped Runoff:

Onsite - Total Flow = 22.4 c.f.s.

Developed Runoff:

Onsite - Total Flow = 22.1 c.f.s.

As shown above, the development of this project, including the lot ponding, will not increase the storm runoff over that occurring in the natural undeveloped state. This flow will be directed to the North Arroyo del Pino channel with little earthwork improvements; runoff will be conveyed to the Arroyo del Pino by means of a drainage run down structure from the street to the channel.

RECOMMENDATIONS

The following recommendations are made to enable the developer on this site and the local government to complete this project within the design criteria:

1. The ponding areas in each backyard would be best situated toward the rear of the yard. There should be a minimum of five foot (5') buffer zone between the rear property lines and the edge of the pond. This will protect any walls which

might be constructed. In no case should ponded waters be allowed to stand against the wall or house foundation.

2. Ponds should average 6 inches deep and the minimum surface should not be less than 22 percent of the total area drained into the pond. All lots on the site should be ponded.
3. Flows within the streets of the development are distributed so that no one street assumes a critical burden in carrying capacities. However, no street should be graded at less than 0.4 percent slope in order to insure adequate carrying capacities. Minimum street capacities are shown in Appendix 3 and on the drainage plan.
4. All runoff on the site should be directed to the southwest corner of the development and directed into the North Arroyo del Pino channel. Drainage will be carried in streets to a standard drainage rundown and then will flow into the Arroyo del Pino channel.
5. Valley gutters and water blocks should be constructed at locations shown on the drainage plan in order to properly take care of the storm runoff.
6. Erosion protection measures and diversion walls shown on the drainage plan should be incorporated into the final construction plans.

SUMMARY

The subject property, by utilizing backyard ponding, will contribute no more surface runoff to surrounding areas than that which existed before development.

Prepared by:

Michael Whitney

Approved by:

Carl Tebbens
N.M.P.E. No. 6309

CARL A. TEBBENS
STATE OF
NO.
6309
NEW MEXICO
REGISTERED PROFESSIONAL ENGINEER

APPENDICES

APPENDIX 1

COMPOSITE RUNOFF COEFFICIENT

Undeveloped Land

C = 0.40

Developed Land

Typical Lot Area

Gross Area	10.35 Acres
Average Lot Area (40 Lots)	7,705 ft.^{2}
Typical Lot Width	67 Ft.

Ponded Lots (Area draining from lot, including 1/2 street)

C = 0.90	Streets & Walk Area	20 x 67	1,340 sq.ft.
	Roof Area	25 x 50	1,250 sq.ft.
	Driveway	30 x 15	450 sq.ft.
	Total Impervious Area		3,040 sq.ft.
C = 0.40	Front Landscaping	(67-15) x 30	1,560 sq.ft.
	Side Yards	17 x 25	25 sq.ft.
	Total Pervious Area		1,985 sq.ft.

Impervious Area	3040 sq.ft.	60% @ 0.90	0.54
Pervious Area	1985 sq.ft.	40% @ 0.40	0.16
Total Area	5025 sq.ft.	100%	0.70
	Composite Runoff Coefficient	=	0.70

APPENDIX-2

Ponding Requirements

1/2 Roof Area	(0.9)	25 x 50	1,250 sq.ft.
Patio Area	(0.9)	10 x 10	100 sq.ft.
Rear Lawn Area	(0.4)	(40 x 67) - 100	2,580 sq.ft.
Side Yards	(0.4)	25 x 17	425 sq.ft.
Total Area Draining to Pond			4,355 sq.ft.

Runoff Coefficient

Impervious Area:

$$C = 0.90 \frac{1350}{4355} = 0.27$$

Pervious Area:

$$C = 0.40 \frac{3005}{4355} = \underline{0.28}$$

Composite C = 0.55

Pond Volume Requirements:

100-year storm precipitation - 2.4 inches

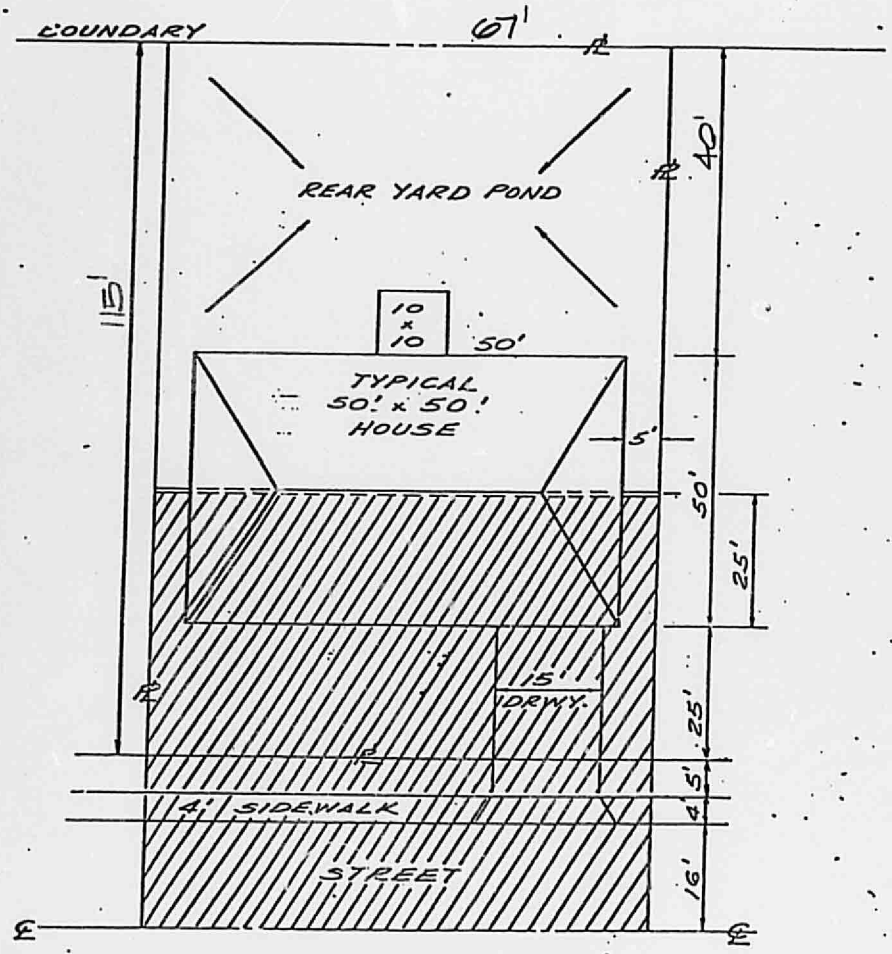
Volume = Runoff Coefficient x Area x Precipitation

$V = 2.4/12 \times 0.55 \times 4355 = 479$ ft.^{3}

Depth of Pond 0.50 ft. (6")

Minimum area of pond = 958 ft.^{2}

Pond area as a percentage of area drained = 22%



NOTE: REFER APPENDIX FOR CALCULATION.

AREA DRAINED

FIGURE I
TYPICAL LOT DRAINAGE

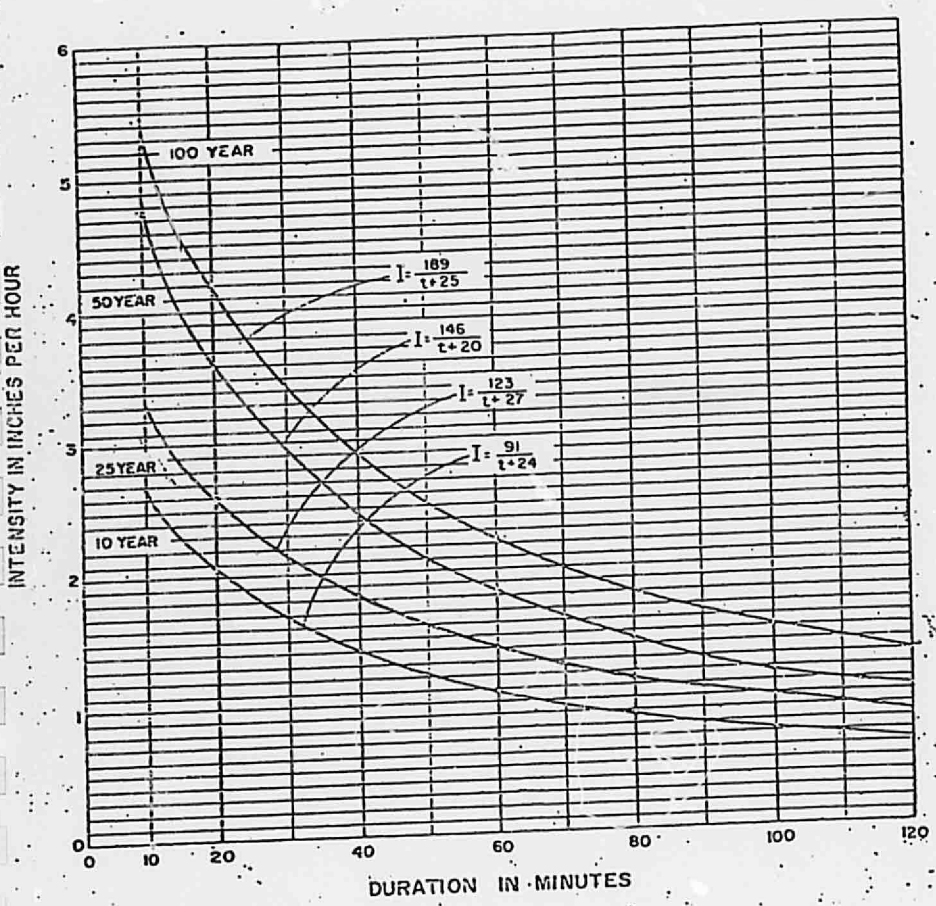


FIGURE II

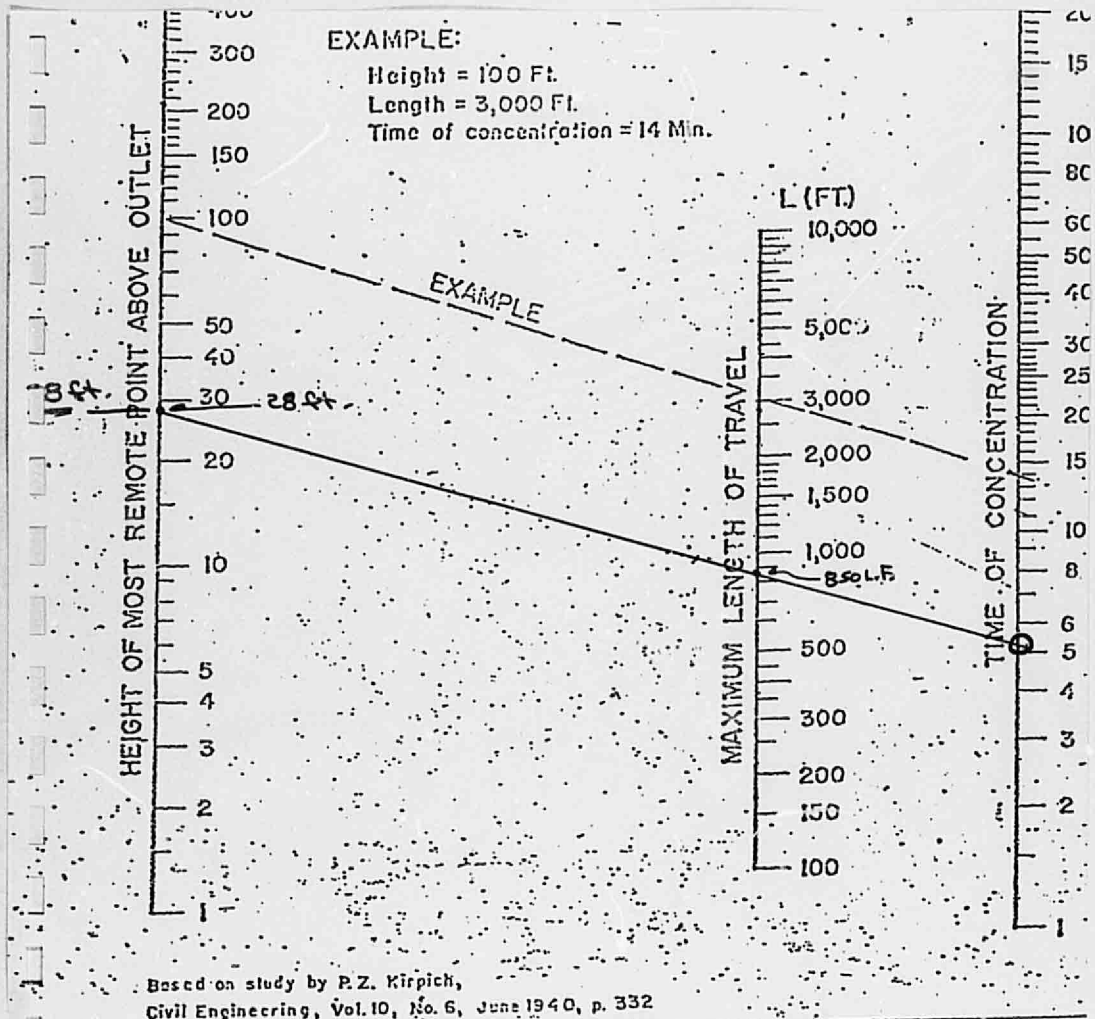
MASTER PLAN OF DRAINAGE
CITY OF ALBUQUERQUE - NEW MEXICO
AND ENVIRONS

INTENSITY DURATION
FREQUENCY CURVES

(ALBUQUERQUE AREA - 1961)

GORDON HERKENHOFF & ASSOC
CONSULTING ENGINEERS

CHART
1



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

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

FIG. III

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

50' R.O.W. 32' FACE-FACE 8" CURB 8" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0165	15.3611	51.3731	.0050	.0707	.2990	.4472	2.8545	43.8477
.0165	15.3611	51.3731	.0100	.1000	.2990	.4472	420368	62.0100
.0165	15.3611	51.3731	.0150	.1225	.2990	.4472	4.9441	75.9464
.0165	15.3611	51.3731	.0200	.1414	.2990	.4472	5.7009	87.6954
.0165	15.3611	51.3731	.0250	.1581	.2990	.4472	6.3828	98.0464
.0165	15.3611	51.3731	.0300	.1732	.2990	.4472	6.9920	107.4045
.0165	15.3611	51.3731	.0350	.1871	.2990	.4472	7.5522	116.0101
.0165	15.3611	51.3731	.0400	.2000	.2990	.4472	8.0736	124.0200

50' R.O.W. 32' FACE-FACE 8" CURB 6" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0165	18.9167	51.3569	.0050	.0707	.3683	.5138	3.2801	62.0482
.0165	18.9167	51.3569	.0100	.1000	.3683	.5138	4.6387	87.7494
.0165	18.9167	51.3569	.0150	.1225	.3683	.5138	5.6813	107.4706
.0165	18.9167	51.3569	.0200	.1414	.3683	.5138	6.5602	124.0964
.0165	18.9167	51.3569	.0250	.1581	.3683	.5138	7.3345	138.7439
.0165	18.9167	51.3569	.0300	.1732	.3683	.5138	8.0345	151.9864
.0165	18.9167	51.3569	.0350	.1871	.3683	.5138	8.6783	164.1640
.0165	18.9167	51.3569	.0400	.2000	.3683	.5138	9.2775	175.4988

50' R.O.W. 32' FACE-FACE 8" CURB 4" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0165	22.4722	51.3453	.0050	.0707	.4377	.5765	3.6797	82.6903
.0165	22.4722	51.3453	.0100	.1000	.4377	.5765	5.2038	116.9417
.0165	22.4722	51.3453	.0150	.1225	.4377	.5765	6.3734	143.2238
.0165	22.4722	5123453	.0200	.1414	.4377	.5765	7.3593	165.3806
.0165	22.4722	51.3453	.0250	.1581	.4377	.5765	8.2280	184.9011
.0165	22.4722	51.3453	.0300	.1732	.4377	.5765	9.0133	202.5490
.0165	22.4722	51.3453	.0350	.1871	.4377	.5765	9.7355	218.7780
.0165	22.4722	51.3453	.0400	.2000	.4377	.5765	10.4077	233.8835

50' R.O.W. 32' FACE-FACE 8" CURB 2" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0165	26.0278	51.3384	.0050	.0707	.5070	.6358	4.0585	105.6348
.0165	26.0278	51.3384	.0100	.1000	.5070	.6358	5.7396	149.3901
.0165	26.0278	51.3384	.0150	.1225	.5070	.6358	7.0296	182.9648
.0165	26.0278	51.3384	.0200	.1414	.5070	.6358	8.1171	211.2696
.0165	26.0278	51.3384	.0250	.1581	.5070	.6358	9.0752	236.2066
.0165	26.0278	51.3384	.0300	.1732	.5070	.6358	9.9414	258.7513
.0165	26.0278	51.3384	.0350	.1871	.5070	.6358	10.7379	279.4834
.0165	26.0278	51.3384	.0400	.2000	.5070	.6358	11.4793	298.7803

SUBDIVISION Loma del Norte - A
LOCATION Wyoming Blvd + Pine Avenue
JOB NO.
DESIGN STORM 100 YR. RECURRENCE INTERVAL
MAJOR STORM ____ YR.
COMPUTATIONS BY MW/CAT DATE 12-15-78

Appendix 3

RUNOFF COMPUTATIONS
(Rational Method)

PAGE ____ OF ____

Area Designation	A (Acres)	c	c_f	$\bar{c}$ = (c x c_f)	A·$\bar{c}$	ΣA·$\bar{c}$	tc (min)	I (in/hr)	Q = (ΣA·$\bar{c}$) x I cfs	Street capacity cfs	Flow in Pipe cfs	Pipe Dia. in.	Street Slope (min) %	Length ft.	VEL V fps	Δt (min)	
A	2.8	0.7	–		2.0		<10.0	5.4	10.8	160			1.9				Street will handle flow
B	3.0	0.7			2.1		<10.0	5.4	11.3	184			2.5				Street will handle flow
ΣA+B						4.1	<10.0	5.4	22.1		Developed site is 22.1 cfs compared with 22.4 cfs undeveloped. OK						Use Std City rundown (10' wide)
											10' wide drainage rundown per City drawing #K-1						
											@ 1.12% will carry 145 cfs (16" high block sidewalls).						

PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
LOMA DEL NORTE, UNIT 4

CAMPBELL-~~[illegible]~~ ASSOCIATES, INC.
ALBUQUERQUE, NEW MEXICO

CAMPBELL-HICKS and ASSOCIATES, Inc.
Soils Testing Laboratory

232 Muriel Street, N.E. • Phone (505) 296-7139 • Albuquerque, New Mexico 87123

PRELIMINARY DRAINAGE STUDY RELATIVE TO THE DEVELOPMENT OF LOMA DEL NORTE, UNIT 4

JANUARY 1973

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PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
LOMA DEL NORTE, UNIT 4

I. GENERAL

This report has been prepared to present findings of a study of storm drainage conditions in an area proposed for development as Loma Del Norte, Unit 4 (North Albuquerque Acres Subdivision) and to describe proposed methods for providing adequate storm drainage in the area.

II. LOCATION

The area proposed for development is located in Section 19, Township 11 North, Range 4 East, N.M.P.M. The area includes all of the parcel north of Unit 1 and south of North Hills Mobile Home Park and a cemetery owned by the Roman Catholic Church. It is bounded on the east by Wyoming Blvd., N.E. and on the west by Louisiana Blvd.

It should be noted that the Master Plan of Loma Del Norte Subdivision has been modified after a storm drainage study relative to the development of Loma Del Norte Subdivision was presented by this firm in September 1971. After reviewing and studying the modifications to the Master Plan, it was decided to prepare a new report rather than try to revise the previously submitted report. This report is now in compliance with the requirements of the City of Albuquerque Storm Drainage Facilities Policies effective 20 June 1972.

III. EXISTING DRAINAGE CONDITIONS

A. General

The area proposed for development lies almost entirely within the watersheds of the Arroyo Domingo de Baca and North Arroyo Del Pino. However, two other watersheds form well defined channels within the subdivision. Although these other channels are well defined in some areas, there are other locations where they are not so well defined and some channelization is required to provide for them.

This area is presently undeveloped except for Los Angeles which is paved as far as Wyoming Blvd., N.E.

(formerly Barstow Street) where the Roman Catholic cemetery and the Federal Aviation Agency properties are developed.

The existing runoff conditions of the Arroyo Domingo de Baca and the North Arroyo Del Pino have been determined at the eastern limits of the property by the Corps of Engineers. The values 6059 c.f.s. for the Arroyo Domingo de Baca and 1170 c.f.s. for the North Arroyo Del Pino are furnished.

B. Topography

The area of the prop sed development, a nine to ten mile wide clinoplain known as the Sandia Mesa, slopes gradually upward toward the Sandia Mountains at a nearly uniform rate of about 100 feet per mile. This mesa was built by deposits of gravels and clays from the Rio Grande River, intermixed with sands and gravels carried from the mountains by smaller streams. The mesa is crossed by sandy arroyos or usually dry stream channels which carry large volumes of water runoff for a few hours once or twice each summer.

Arroyo cutting is a problem in the area and is most acute during the rainy season. Peculiarities of drainage, differences in erodability of the soils, or variation in the density of protective vegetation allows the feeders of one arroyo to cut into and capture the headwaters of adjacent arroyos leading to the concentration of runoff in the second arroyo. Concomintantly, the amount of flow in the first arroyo, the headwaters of which were "pirated"* away, is diminished.

The above seems to warrant lining of channels, but due to its excessive cost ($8.00/sy in 1971), it appears economically advisable only to channelize the major arroyos.

C. Drainage Areas and Channels

At the present time, the area is drained by two major arroyos which have been discussed in Section III. A. of this report. Both of these arroyos drain through existing structures under Interstate 25 to the west. The limits of these two areas as proposed in a report prepared by the Corps of Engineers for the Albuquerque Metropolitan Arroyo Flood Control Authority are shown in Reference #2, Plates E, F and G. As shown in Plate #2, the entire area is in an area subject to flooding by the Standard Project Flood,

*See Reference #1

Two other minor arroyos with greater than 100 acres may be seen in Exhibit "B". However, the runoff from these can be carried by aligning master planned streets or temporary diversions in such a manner as to either carry water to a proposed channel or across the development redepositing it in its original channel.

IV. PROPOSED DRAINAGE PLANS

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 contribute storm runoff affecting the development.

(2) Determine the amounts of runoff which could be expected from each area.

(3) Determine the points at which the various runoffs would converge and then the runoff quantities to be expected at each of these points.

(4) Determine the ability of each of the proposed channels or structures to handle the quantities.

(5) Determine and recommend the means by which the expected runoff can be safely carried across the subdivision.

(6) Design additional channels and structures adequate to handle the runoff in the area to be developed.

B. Drainage Areas

A study was made by this firm to ascertain that no conflicting drainage studies had been made. After this, a study of the best available contour maps was made to determine which drainage areas could conceivable contribute storm runoff which might affect the development. Photographs used to prepare the contour maps which were prepared by Koogle and Poals Engineering, Inc. have also been used.

From this study it was determined that in addition to the Arroyo Domingo de Baca and the North Arroyo Del Pino there are seven contributing areas east of the area as shown in Exhibit "B". These areas are labeled A-1, B-1, C-1, D-1, E-1, F-1 and G-1. The internal areas are shown on Exhibit "C" along with expected runoff quantities. A Plan of Drainage, Exhibit "D", routes the 100 year frequency flood through Unit 4.

C. Runoff Quantities

The quantity of runoff to be expected from each drainage area was determined using the Rational Formula, $Q = CIA$, where Q=quantity of 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 time of accumulation in minutes; A=area of contributing watershed in acres.

The area (A) of each separate area was determined by outlining the watersheds on either a scaled photograph or a contour map and measuring the areas by planimeter.

The intensity of rainfall (I) was determined by assuming a 100 year frequency rainfall and then utilizing Intensity Duration Frequency Curves from Reference #3 together with the expected times of accumulation of runoff from each of the areas. The times of accumulation were determined using probable future streets and drainage channel alignments and grades as shown, assuming the overland flows to be across either average or dense grass, asphalt pavement 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 asphalt paved with concrete curbs and 2" crowned section and determining the times of flow by utilizing the tables on pages 5.00, 5.04 and 5.05 of Reference #4.

The coefficient of runoff (C) was determined by assuming the maximum possible development in the areas under consideration. A coefficient of 0.65 was used where dense residential development was most probable. A coefficient of 0.70 was used in probable commercial developments or areas that will likely have considerable of the surfaces paved by either roofs or parking areas.

The quantities of runoff expected from each area and the points of concentration with the runoff quantities at each of these points are indicated in Exhibits "C" and "D" and tabulated in Exhibit "E" along with the Runoff Computation Sheets.

D. Drainage Channels and Facilities

All existing structure capacities as well as any proposed structures were verified from computer output sheets (see Exhibit "F") which utilizes Manning's Equation, $Q=AV$, where $V=\frac{1.486}{n} R^{2/3} S^{1/2}$ when A=cross-sectional area of channel or pipe in square feet; R=hydraulic ra-

dius or area divided by wetted perimeter; S=slope of channel or facility in feet per foot; and "n" values of 0.015 for concrete or asphalt, .013 for concrete pipes, and .0225 for earth lined channels.

V. CONCLUSIONS AND RECOMMENDATIONS

On the basis of this study and its calculations, it is concluded that the development of this area can be accomplished satisfactorily provided adequate storm drainage and the following recommendations are followed:

A. Construct the channels as indicated on Exhibit "C" prior to or at least concurrently with construction of the adjacent lots.

B. A 50' drainage easement be provided for the North Arroyo Del Pino with a typical section as shown on Exhibit "C" with a minimum slope of about 2.86%.

C. An existing 70' drainage easement for the Arroyo Domingo de Baca from Louisiana to Wyoming Blvd. (formerly Barstow) as shown on Exhibit "C" with a minimum slope of about 2.80%. The same section as is presently existing is satisfactory to handle the runoff after the area is fully developed.

D. From Wyoming Blvd., NE (formerly Barstow) to the eastern limits of the property, the same section will be satisfactory in the interest of continuity of a grade of about 2.95% and a 70' drainage easement.

E. Design streets to carry maximum runoffs contained in Exhibit "G" through use of tables in Exhibit "F".

F. The following structures are recommended to properly drain the area:

(1) On Wyoming Blvd., N.E. (Barstow on Exhibit "A") over the North Arroyo Del Pino a standard 4-4X6 CBC Design 1, normal, with four wingwalls and rip-rap.*

(2) On Wyoming Blvd., N.E. (Barstow on Exhibit "A") over the Arroyo Domingo de Baca, a standard 5-5X8 CBC Design 1, normal, with four wingwalls and rip-rap.*

(3) On Louisiana Blvd. at the North Arroyo Del Pino crossing, a standard 3-6X6 CBC Design 1, normal, with four wingwalls and rip-rap.*

(4) On Louisiana Blvd. at the Arroyo Domingo de Baca crossing, a standard 7-5X6 CBC Design 1, normal, with four wingwalls and rip-rap.*

(5) In lieu of any of these four structures, an open dip section with 4% grades on either side of the channel with cutoff walls to protect the pavement may be used with at least 20' of wire enclosed rip-rap at the downstream end used to reduce the C.I.P. costs. The above four structures would have a cost of about $125,000 based on estimated concrete, steel and wire enclosed rip-rap quantities and using the 1971 New Mexico State Highway Department Average Unit Bid Prices.

(6) The diversions as shown on Exhibit "C" with 2% fall on southerly channel (for future street) and 1.5% fall on northerly channel (future remaster planning desirable).

(7) Improve both the Arroyo Domingo de Baca and the North Arroyo Del Pino as shown in Exhibit "C". Both will have supercritical velocities during the design storm and should be stabilized through developed areas.

(8) Construct water blocks, division lines and diversionary walls as shown in Exhibit "D".

(9) Increase San Francisco Road, N.E. width to 48 foot face to face from Gill Street, N.E. to Louisiana Blvd., N.E.

(10) The North Arroyo Del Pino must be stabilized from Louisiana Blvd. to the eastern edge of Loma Del Norte, Unit 1 to protect the channel from erosion velocities.

(11) The typical section for the concrete lined Arroyo Domingo de Baca given in Reference #8 will be satisfactory with a maximum water depth of six feet.

If all of the above recommendations are followed, this Master Plan of Drainage should provide the necessary requirements to make this a very satisfactory development.

Respectfully submitted,

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

*NOTE: See New Mexico State Highway Department Standards CB-34, WCB-0 and EC-61 for typical design and quantities.

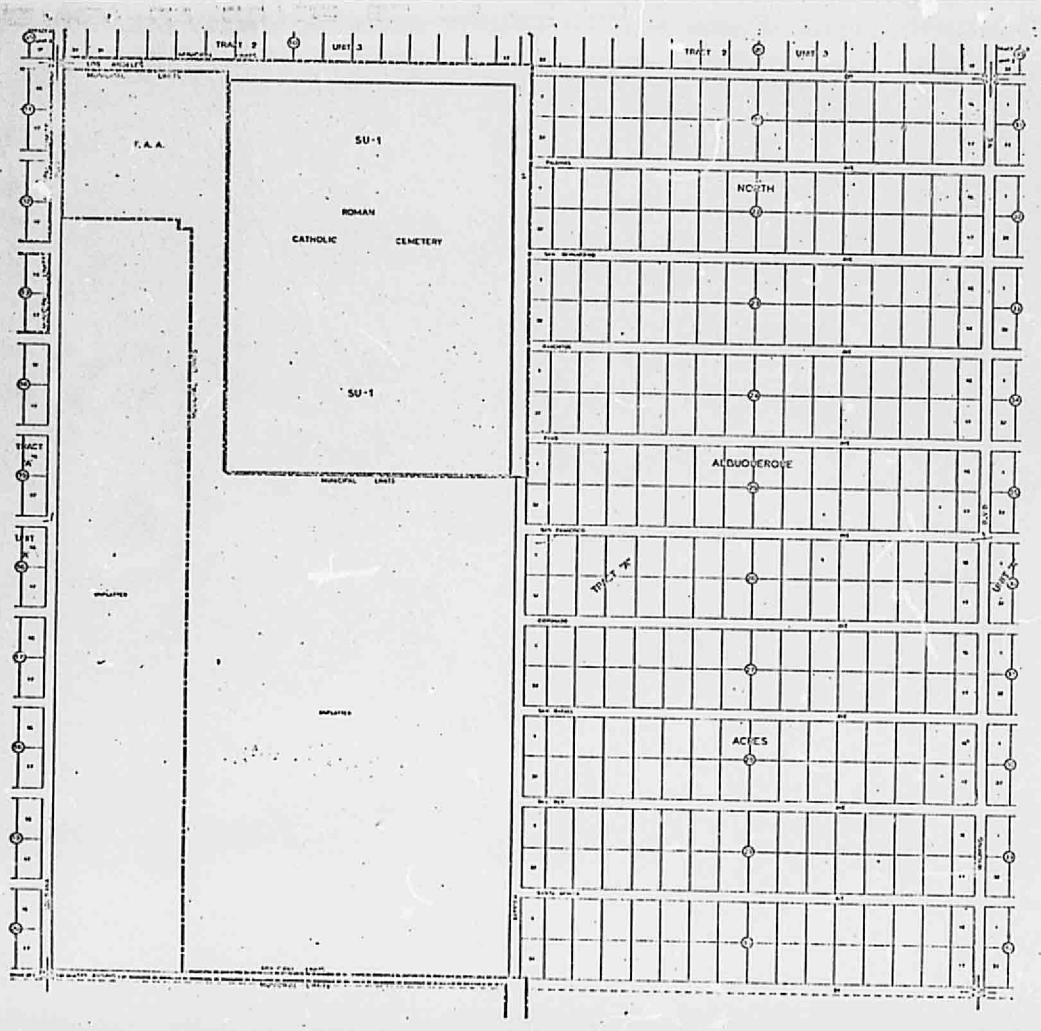

EXHIBIT "A"

D-19-Z

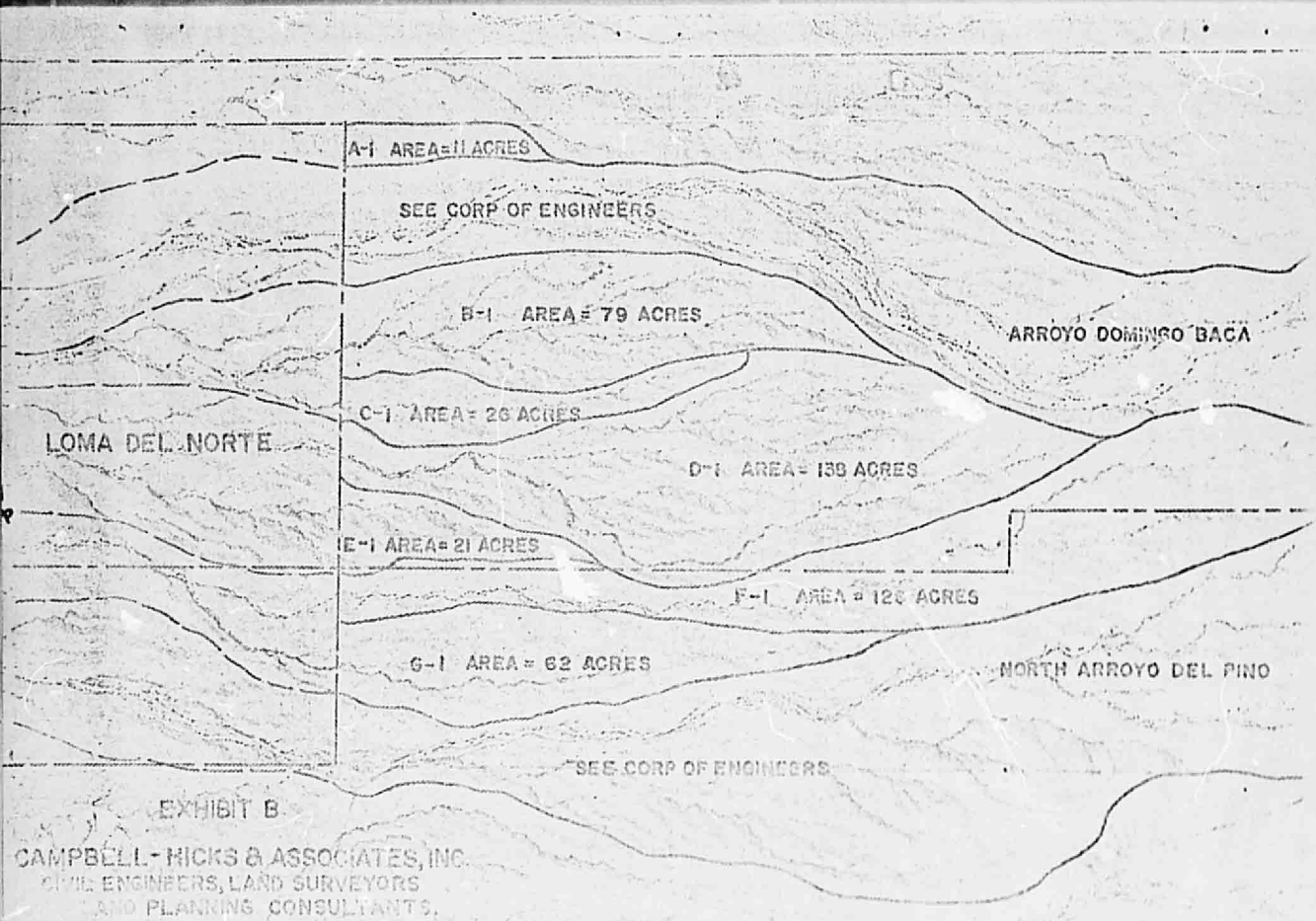

EXHIBIT B

CAMPBELL-HICKS & ASSOCIATES, INC.
CIVIL ENGINEERS, LAND SURVEYORS
AND PLANNING CONSULTANTS.

SCALE 1" = 1000'

AERIAL PHOTOGRAPHY PREPARED BY
SL & B POOL ENGINEERING, INC.

EXHIBIT E

SUMMARY OF RUNOFF COMPUTATIONS

Sheet No.	Area Number	Area (in acres)	Expected Runoff (in c.f.s.) Individual	Total
1	1	19.0	82	413
2	2	25.7	61	
3	3	30.0	69	
4	4	2.8	7	1720
5	5	33.5	80	
6	6	59.0	161	217
7	7	51.6	146	
8	8	11.5	25	
9	9	30.5	82	583
10	10	28.7	68	6710
11	11	57.0	141	7022
12	12	20.8	46	7068
13	13	12.3	28	7096
14	14	16.2	45	1765
15	A-1	0.3	1	80
16	A-2	2.2	6	66
17	A-3	1.8	5	60
18	A-4	1.6	4	
19	A-5	9.7	18	
20	A-6	5.0	12	95
21	A-7	6.6	20	29
22	A-8	4.3	10	135
23	A-9	0.8	2	35

Sheet No.	Area Number	Area (in acres)	Expected Runoff (in c.f.s.) Individual	Total
24	A-10	8.4	20	
25	A-11	0.4	1	56
26	B-1	0.4	1	218
27	B-2	2.9	7	28
28	B-3	2.5	7	252
29	B-4	1.7	5	15
30	B-5	1.0	3	9
31	B-6	13.4	30	290
32	B-7	1.2	4	106
33	B-8	0.5	1	397

RUNOFF COMPUTATIONS

Sheet No. 1

Job No. L.D.N. #4

Drainage Area No. 1

Area = 19.0 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 1320' S = 2.0 %

Channel No. 2 L = 290 S = 3.4 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 7.4 ft/sec; Time= $\frac{1320}{7.4 \times 60}$ = 3.0 min.

Channel No. 2 Flow:

Velocity= 11.0 ft/sec; Time= $\frac{290}{11.0 \times 60}$ = 0.4 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 3.4 min.

$I = \frac{189}{T+25} = \frac{189}{3.4+25} = 6.65$

Q = CIA = (0.65)(6.65)(19.0) = 82.0 c.f.s.

Total Runoff

126 + 205 + 82 = 413 C.F.S.

Date: 12-15-72

Comp. by: CAR

Checked by: ZKP

RUNOFF COMPUTATIONS

Sheet No. 2

Job No. L.D.N. #4

Drainage Area No. 2

Area = 25.7 acres

Maximum Overland Flow: L = 500' S = 1.0%

Maximum Channel Flow:

Channel No. 1 L = 1350' S = 2.8 %

Channel No. 2 L = 1520' S = 2.86 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 23.1 min.

Channel No. 1 Flow:

Velocity= 11.0 ft/sec; Time= $\frac{1350}{11.0 \times 60}$ = 2.0 min.

Channel No. 2 Flow:

Velocity= 21.2 ft/sec; Time= $\frac{1520}{21.2 \times 60}$ = 1.2 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 26.3 min.

$I = \frac{189}{T+25} = \frac{189}{26.3+25} = 3.69$

Q = CIA = (0.65)(3.69)(25.7) = 61.4 c.f.s.

Date: 12-21-72

Comp. by: CGR

Checked by: HSP

RUNOFF COMPUTATIONS

Sheet No. 3

Job No. L.D.N. #4

Drainage Area No. 3

Area = 30.0 acres

Maximum Overland Flow: L = 700' S = 3.6 %

Maximum Channel Flow:

Channel No. 1 L = 800' S = 2.8 %

Channel No. 2 L = 550' S = 1.5 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 24.0 min.

Channel No. 1 Flow:

Velocity= 3.0 ft/sec; Time= $\frac{800}{3.0 \times 60}$ = 4.4 min.

Channel No. 2 Flow:

Velocity= 21.2 ft/sec; Time= $\frac{550}{21.2 \times 60}$ = 0.4 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 28.8 min.

$I = \frac{189}{T+25} = \frac{189}{28.8+25} = 3.51$

Q = CIA = (0.65)(3.51)(30.0) = 68.5 c.f.s.

Date: 12-15-72

Comp. by: GLR

Checked by: ZGP

RUNOFF COMPUTATIONS

Sheet No. 4

Job No. L.D.N #4

Drainage Area No. 4

Area = 2.8 acres

Maximum Overland Flow: L = 450' S = 2.8 %

Maximum Channel Flow:

Channel No. 1 L = 500' S = 1.8 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 22.5 min.

Channel No. 1 Flow:

Velocity= 4.73 ft/sec; Time= $\frac{500}{4.73 \times 60}$ = 1.7 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 = 24.2 min.

$I = \frac{189}{T+25} = \frac{189}{24.2+25} = 3.84$

Q = CIA = (0.65)(3.84)(2.8) = 7.0 c.f.s.

Total Runoff

1170 + 443 + 61.4 + 68.5 + 7.0 = 1719.9 c.f.s.

Date: 12-21-77

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 5

Job No. L.D.N. #4

Drainage Area No. 5

Area = 33.5 acres

Maximum Overland Flow: L = 300' S = 4.0 %

Maximum Channel Flow:

Channel No. 1 L = 1000' S = 5.0%

Channel No. 2 L = 1500' S = 3.0%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 17.4 min.

Channel No. 1 Flow:

Velocity= 6.9 ft/sec; Time= $\frac{1000}{6.9 \times 60}$ = 2.4 min.

Channel No. 2 Flow:

Velocity= 3.6 ft/sec; Time= $\frac{1500}{3.6 \times 60}$ = 6.9 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 26.7 min.

$I = \frac{189}{T+25} = \frac{189}{26.7+25} = 3.66$

Q = CIA = (0.65)(3.66)(33.5) = 79.7 c.f.s.

Date: 12-15-72

Comp. by: CJR

Checked by: JP

RUNOFF COMPUTATIONS

Sheet No. 6

Job No. I.D.N 4

Drainage Area No. 6

Area = 59.0 acres

Maximum Overland Flow: L = 200' S = 4.5%

Maximum Channel Flow:

Channel No. 1 L = 2000' S = 2.6%

Channel No. 2 L = 1120' S = 2.4%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 14.3 min.

Channel No. 1 Flow:

Velocity= 9.5 ft/sec; Time= $\frac{2000}{9.5 \times 60}$ = 3.5 min.

Channel No. 2 Flow:

Velocity= 8.0 ft/sec; Time= $\frac{1120}{8.0 \times 60}$ = 2.3 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 20.1 min.

$I = \frac{189}{T+25} = \frac{189}{20.1+25} = 4.19$

Q = CIA = (0.65)(4.19)(59.0) = 160.7 c.f.s.

Total Runoff

56.0 + 160.7 = 216.7 C.F.S.

Date: 12-15-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 7

Job No. L.D.N # 4

Drainage Area No. 7

Area = 51.6 acres

Maximum Overland Flow: L = 150' S = 5.3 %

Maximum Channel Flow:

Channel No. 1 L = 2200' S = 2.9 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 12.2 min.

Channel No. 1 Flow:

Velocity= 6.1 ft/sec; Time= $\frac{2200}{6.1 \times 60}$ = 6.0 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 18.2 min.

$$I = \frac{189}{T+25} = \frac{189}{18.2+25} = 4.37$$

$$Q = CIA = (0.65)(4.37)(51.6) = 146.0 \text{ c.f.s.}$$

Date: 12-15-72

Comp. by: CJR

Checked by: RSP

RUNOFF COMPUTATIONS

Sheet No. 8

Job No. L.D.N. #4

Drainage Area No. 8

Area = 11.5 acres

Maximum Overland Flow: L = 1300' S = 3.0 %

Maximum Channel Flow:

Channel No. 1 L = 400' S = 3.0%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 30.9 min.

Channel No. 1 Flow:

Velocity= 6.6 ft/sec; Time= $\frac{400}{6.6 \times 60}$ = 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 = 31.9 min.

$I = \frac{189}{T+25} = \frac{189}{31.9+25} = 3.32$

Q = CIA = (0.65)(3.32)(11.5) = 24.8 c.f.s.

Date: 12-15-72

Comp. by: CJR

Checked by: HP

RUNOFF COMPUTATIONS

Sheet No. 9

Job No. L.D.N. #4

Drainage Area No. 9

Area = 50.5 acres

Maximum Overland Flow: L = 200' S = 2.0%

Maximum Channel Flow:

Channel No. 1 L = 2000' S = 1.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 17.0 min.

Channel No. 1 Flow:

Velocity= 9.9 ft/sec; Time= $\frac{2000}{9.9 \times 60}$ = 3.4 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 = 20.4 min.

$I = \frac{189}{T+25} = \frac{189}{20.4+25} = 4.16$

Q = CIA = (0.65)(4.16)(50.5) = 82.4 c.f.s.

Total Runoff

262 + 64 + 175 + 82.4 = 503.4 C.F.S.

Date: 12-15-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 10

Job No. L.D.N. # 4

Drainage Area No. 10

Area = 28.7 acres

Maximum Overland Flow: L = 300' S = 0.7 %

Maximum Channel Flow:

Channel No. 1 L = 1350' S = 2.6 %

Channel No. 2 L = 1420' S = 3.23 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 24.7 min.

Channel No. 1 Flow:

Velocity= 16.2 ft/sec; Time= $\frac{1320}{16.2 \times 60}$ = 1.4 min.

Channel No. 2 Flow:

Velocity= 26.82 ft/sec; Time= $\frac{1420}{26.82 \times 60}$ = 0.9 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 27.0 min.

$I = \frac{189}{T+25} = \frac{189}{27.0+25} = 3.64$

Q = CIA = (0.65)(3.64)(28.7) = 67.8 c.f.s.

Total Runoff

67.8 + 583.4 + 6059 = 6710.2 C.F.S.

Date: 12-20-72

Comp. by: [illegible]

Checked by: HEP

RUNOFF COMPUTATIONS

Sheet No. 11

Job No. L.D.N. #4

Drainage Area No. 11

Area = 57.0 acres

Maximum Overland Flow: L = 400' S = 3.0 %

Maximum Channel Flow:

Channel No. 1 L = 1250' S = 2.7 %

Channel No. 2 L = 950' S = 0.7 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 20.5 min.

Channel No. 1 Flow:

Velocity= 16.0 ft/sec; Time= $\frac{1250}{16.0 \times 60}$ = 1.3 min.

Channel No. 2 Flow:

Velocity= 5.53 ft/sec; Time= $\frac{950}{5.53 \times 60}$ = 2.9 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 24.7 min.

$I = \frac{189}{T+25} = \frac{189}{24.7+25} = 3.80$

Q = CIA = (0.65)(3.80)(57.0) = 140.8 c.f.s.

Total Runoff

140.8 + 146 + 6710.4 + 25 = 7022.2 C.F.S.

Date: 12-20-72

Comp. by: [illegible]

Checked by: HEP

RUNOFF COMPUTATIONS

Sheet No. 12

Job No. L.D.N. #4

Drainage Area No. 12

Area = 20.8 acres

Maximum Overland Flow: L = 970' S = 3.4 %

Maximum Channel Flow:

Channel No. 1 L = 1060' S = 2.8 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 29.5 min.

Channel No. 1 Flow:

Velocity= 11.1 ft/sec; Time= $\frac{1060}{11.1 \times 60}$ = 1.6 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 = 31.1 min.

$I = \frac{189}{T+25} = \frac{189}{31.1+25} = 3.37$

Q = CIA = (0.65)(3.37)(20.8) = 45.6 c.f.s.

Total Runoff

7022.2 + 45.6 = 7067.8 C.F.S.

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 13

Job No. L.D.N. #4

Drainage Area No. 13

Area = 12.3 acres

Maximum Overland Flow: L = 800' S = 3.0 %

Maximum Channel Flow:

Channel No. 1 L = 350' S = 1.1 %

Channel No. 2 L = 140' S = 1.0 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 26.7 min.

Channel No. 1 Flow:

Velocity= 3.6 ft/sec; Time= $\frac{350}{3.6 \times 60}$ = 1.6 min.

Channel No. 2 Flow:

Velocity= 3.6 ft/sec; Time= $\frac{140}{3.6 \times 60}$ = 0.6 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 28.9 min.

$I = \frac{189}{T+25} = \frac{189}{28.9+25} = 3.50$

Q = CIA = (0.65)(3.50)(12.3) = 28.0 c.f.s.

Total Runoff

7067.8 + 28.0 = 7095.8 C.F.S.

Date: 12-29-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 14

Job No. L.D.N #4

Drainage Area No. 14

Area = 16.2 acres

Maximum Overland Flow: L = 260' S = 3.5%

Maximum Channel Flow:

Channel No. 1 L = 500' S = 2.8%

Channel No. 2 L = 400' S = 2.86 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 17.2 min.

Channel No. 1 Flow:

Velocity= 6.0 ft/sec; Time= $\frac{500}{6.0 \times 60}$ = 1.4 min.

Channel No. 2 Flow:

Velocity= 16.7 ft/sec; Time= $\frac{400}{16.7 \times 60}$ = 0.4 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 19.0 min.

$I = \frac{189}{T+25} = \frac{189}{19.0+25} = 4.30$

Q = CIA = (0.65)(4.30)(16.2) = 45.3 c.f.s.

Total Runoff

1720 + 45 = 1765 C.F.S.

Date: 12-29-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 15

Job No. LDN-4

Drainage Area No. A-1

Area = 0.26 acres

Maximum Overland Flow: L = 100' S = 2.5%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 16.2 min.

Channel No. 1 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Channel No. 2 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Total Accumulation Time: T = 16.2 min.

$I = \frac{189}{T+25} = \frac{189}{16.2+25} = 4.59$

Q = CIA = (0.65)(4.59)(0.26) = 0.7 c.f.s.

Total Runoff

Q = 79.7 + 0.7 = 80.4 c.f.s.

Date: 1-4-73

Comp. by: JEP

Checked by: DA

Note: A-1 Splits

Area A-2 = $\frac{2.63}{3.505}$ = 0.7503 x 80.4 = 60.3

Area B-2 $\frac{0.875}{3.505}$ = 0.2497 x 80.4 = 20.1

RUNOFF COMPUTATIONS

Sheet No. 16

Job No. LDN #4

Drainage Area No. A-2

Area = 2.25 acres

Maximum Overland Flow: L = 165' S = 1.35 %

Maximum Channel Flow:

Channel No. 1 L = 126' S = 2.1 %

Channel No. 2 L = 180' S = 2.63 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 22.0 min.

Channel No. 1 Flow:

Velocity= 9.44 ft/sec; Time= $\frac{126}{9.44 \times 60}$ = 0.5 min.

Channel No. 2 Flow:

Velocity= 10.07 ft/sec; Time= $\frac{180}{10.07 \times 60}$ = 0.3 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 22.6 min.

$I = \frac{189}{T+25} = \frac{189}{22.6+25} = 3.98$

$Q = CIA = (0.65)(3.98)(2.25) = 5.8$ c.f.s.

Total Runoff

Q = 60.3 + 5.8 = 66.1 cfs

Date: 1-4-73

Comp. by: [illegible]

Checked by: [illegible]

Note A-2 Splits

A-3 = $\frac{2.63}{3.13}$ = 0.8403 × 66.1 = 55.5

B-4 = $\frac{.5}{3.13}$ = 0.1597 × 66.1 = 10.6

RUNOFF COMPUTATIONS

Sheet No. 17

Job No. LDN #4

Drainage Area No. A-3

Area = 1.82 acres

Maximum Overland Flow: L = 170' S = 1.0%

Maximum Channel Flow:

Channel No. 1 L = 191' S = 0.63%

Channel No. 2 L = 280' S = 3.0%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 24.0 min.

Channel No. 1 Flow:

Velocity= 10.07 ft/sec; Time= $\frac{191}{10.07 \times 60}$ = 0.3 min.

Channel No. 2 Flow:

Velocity= 10.76 ft/sec; Time= $\frac{280}{10.76 \times 60}$ = 0.4 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 24.7 min.

$I = \frac{189}{T+26} = \frac{189}{24.7+26} = 3.80$

Q = CIA = (0.65)(3.80)(1.82) = 4.5 c.f.s.

Total Runoff

Q = 55.5 + 4.5 = 60.0 c.f.s.

Date: 1-4-75

Comp. by: [illegible]

Checked by: MC

RUNOFF COMPUTATIONS

Sheet No. 18

Job No. LDN#4

Drainage Area No. A-4

Area = 1.62 acres

Maximum Overland Flow: L = 160' S = 1.0%

Maximum Channel Flow:

Channel No. 1 L = 280' S = 0.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 23.0 min.

Channel No. 1 Flow:

Velocity= 4.06 ft/sec; Time= $\frac{280'}{4.06 \times 60}$ = 1.1 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 24.1 min.

$I = \frac{189}{T+25} = \frac{189}{24.1+25} = 3.85$

$Q = CIA = (0.65)(3.85)(1.62) = 4.1$ c.f.s.

Date: 1-5-73

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 19

Job No. LDN #4

Drainage Area No. A-5

Area = 9.74 acres

Maximum Overland Flow: L = 980' S = 2.4 %

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 40.0 min.

Channel No. 1 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Channel No. 2 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Total Accumulation Time: T = 40.0 min.

$I = \frac{189}{T+25} = \frac{189}{40+25} = 2.91$

$Q = CIA = (0.65)(2.91)(9.74) = 18.4$ c.f.s.

Date: 1-4-73

Comp. by: [illegible]

Checked by: AC

RUNOFF COMPUTATIONS

Sheet No. 20

Job No. LDN#4

Drainage Area No. A-6

Area = 5.04 acres

Maximum Overland Flow: L = 200' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 536' S = 3.0%

Channel No. 2 L = 200' S = 2.17%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 23.5 min.

Channel No. 1 Flow:

Velocity= 10.76 ft/sec; Time= $\frac{536}{10.76 \times 60}$ = 0.8 min.

Channel No. 2 Flow:

Velocity= 9.15 ft/sec; Time= $\frac{200}{9.15 \times 60}$ = 0.4 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 24.7 min.

$I = \frac{189}{T+25} = \frac{189}{24.7+25} = 3.80$

Q = CIA = (0.65)(3.80)(5.04) = 12.4 c.f.s.

Total Runoff

Q = 60.0 + 4.1 + 18.4 + 12.4 = 94.9 c.f.s.

Date: 1-4-73

Comp. by: [illegible]

Checked by: DC

RUNOFF COMPUTATIONS

Sheet No. 21

Job No. LDN-4

Drainage Area No. A-7

Area = 6.62 acres

Maximum Overland Flow: L = 75' S = 5.0 %

Maximum Channel Flow:

Channel No. 1 L = 1015' S = 2.68 %

Channel No. 2 L = 331' S = 2.04 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 13.4 min.

Channel No. 1 Flow:

Velocity= 9.39 ft/sec; Time= $\frac{1015}{9.39 \times 60}$ = 1.8 min.

Channel No. 2 Flow:

Velocity= 8.18 ft/sec; Time= $\frac{331}{8.18 \times 60}$ = 0.7 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 15.9 min.

$I = \frac{189}{T+25} = \frac{189}{15.9+25} = 4.62$

$Q = CIA = (0.65)(4.62)(6.62) = 19.9$ c.f.s.

Total Runoff

$Q = 9.5 + 19.9 = 29.4$ c.f.s.

Date: 1-5-75

Comp. by: [illegible]

Checked by: DC

RUNOFF COMPUTATIONS

Sheet No. 22

Job No. LDN 64

Drainage Area No. A-8

Area = 4.30 acres

Maximum Overland Flow: L = 159' S = 1.0%

Maximum Channel Flow:

Channel No. 1 L = 68' S = 2.17%

Channel No. 2 L = 600 S = 2.52%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 24.0 min.

Channel No. 1 Flow:

Velocity= 9.15 ft/sec; Time= $\frac{68}{9.15 \times 60}$ = 0.1 min.

Channel No. 2 Flow:

Velocity= 9.86 ft/sec; Time= $\frac{600}{9.86 \times 60}$ = 1.0 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 25.1 min.

$I = \frac{189}{T+25} = \frac{189}{25.1+25} = 3.77$

$Q = CIA = (0.65)(3.77)(4.30) = 10.5$ c.f.s.

Total Runoff

$Q = 94.9 + 29.4 + 10.5 = 134.8$ c.f.s.

Date: 1-4-73

Comp. by: [illegible]

Checked by: AC

Note: A-8 splits

$A\text{-}7 = \frac{0.65}{2.27} = .2863 \times 134.8 = 38.6$

$B\text{-}7 = \frac{1.72}{2.27} = .7577 \times 134.8 = 102.2$

RUNOFF COMPUTATIONS

Sheet No. 23

Job No. LDN-4

Drainage Area No. A-9

Area = 0.81 acres

Maximum Overland Flow: L = 105' S = 1.4%

Maximum Channel Flow:

Channel No. 1 L = 190' S = 0.55%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 18.3 min.

Channel No. 1 Flow:

Velocity= 4.40 ft/sec; Time= $\frac{190}{4.40 \times 60}$ = 0.7 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 = 19.0 min.

$I = \frac{189}{T+25} = \frac{189}{19.0+25} = 4.30$

$Q = CIA = (0.65)(4.30)(0.81) = 2.3$ c.f.s.

Total Runoff

Q= 32.6 + 2.3 = 34.9 c.f.s.

Date: 1-5-73

Comp. by: [illegible]

Checked by: DC

RUNOFF COMPUTATIONS

Sheet No. 24

Job No. LDN#4

Drainage Area No. A-10

Area = 8.35 acres

Maximum Overland Flow: L = 237' S = 1.8 %

Maximum Channel Flow:

Channel No. 1 L = 1213.8' S = 3.0 %

Channel No. 2 L = 452.7' S = 2.35 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 24.3 min.

Channel No. 1 Flow:

Velocity= 9.94 ft/sec; Time= $\frac{1213.8}{9.94 \times 60}$ = 2.0 min.

Channel No. 2 Flow:

Velocity= 8.79 ft/sec; Time= $\frac{452.7}{8.79 \times 60}$ = 0.9 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 27.2 min.

$I = \frac{189}{T+25} = \frac{189}{27.2+25} = 3.62$

$Q = CIA = (0.65)(3.62)(8.35) = 19.6$ c.f.s.

Date: 1-5-73

Comp. by: RCP

Checked by: AC

RUNOFF COMPUTATIONS

Sheet No. 25

Job No. LDN #4

Drainage Area No. A-11

Area = 0.44 acres

Maximum Overland Flow: L = 100' S = 2.9 %

Maximum Channel Flow:

Channel No. 1 L = 120' S = 2.35 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 16.0 min.

Channel No. 1 Flow:

Velocity= 8.79 ft/sec; Time= $\frac{120}{8.79 \times 60}$ = 0.2 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 = 16.2 min.

$I = \frac{189}{T+25} = \frac{189}{16.2+25} = 4.59$

Q = CIA = (0.65)(4.59)(0.44) = 1.3 c.f.s.

Total Runoff

Q = 34.9 + 19.6 + 1.3 = 55.8 c.f.s.

Date: 1-4-73

Comp. by: [illegible]

Checked by: DC

RUNOFF COMPUTATIONS

Sheet No. 26

Job No. LDN-4

Drainage Area No. B-1

Area = 0.36 acres

Maximum Overland Flow: L = 137' S = 0.5%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 26.3 min.

Channel No. 1 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Channel No. 2 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Channel No. 3 Flow:

Velocity= _____ ft/sec; Time= _____ / X 60 = _____ min.

Total Accumulation Time: T = 26.3 min.

$I = \frac{189}{T+25} = \frac{189}{26.3+25} = 3.76$

$Q = CIA = (0.66)(3.76)(0.36) = 0.9$ c.f.s.

Total Runoff

$Q = 216.7 + 0.9 = 217.6$ c.f.s.

Date: 1-5-73

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 27

Job No. LDN-4

Drainage Area No. B-2

Area = 2.90 acres

Maximum Overland Flow: L = 145' S = 1.0 %

Maximum Channel Flow:

Channel No. 1 L = 300' S = 0.875 %

Channel No. 2 L = 166' S = 2.31 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 21.7 min.

Channel No. 1 Flow:

Velocity= 6.31 ft/sec; Time= $\frac{300}{6.31 \times 60}$ = 0.9 min.

Channel No. 2 Flow:

Velocity= 8.71 ft/sec; Time= $\frac{166}{8.71 \times 60}$ = 0.3 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 22.9 min.

$I = \frac{189}{T+25} = \frac{189}{22.9+25} = 3.96$

$Q = CIA = (0.65)(3.96)(2.90) = 7.4$ c.f.s.

Total Runoff

$Q = 20.1 + 7.4 = 27.5$ c.f.s.

Date: 1-5-73

Comp. by: [illegible]

Checked by: AC

RUNOFF COMPUTATIONS

Sheet No. 28

Job No. LDN#4

Drainage Area No. B-3

Area = 2.49 acres

Maximum Overland Flow: L = 118' S = 1.7%

Maximum Channel Flow:

Channel No. 1 L = 210' S = 1.1%

Channel No. 2 L = 187' S = 2.61%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 19.1 min.

Channel No. 1 Flow:

Velocity= 6.39 ft/sec; Time= $\frac{210}{6.39 \times 60}$ = 0.5 min.

Channel No. 2 Flow:

Velocity= 10.0 ft/sec; Time= $\frac{187}{10.0 \times 60}$ = 0.3 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 19.9 min.

$I = \frac{189}{T+25} = \frac{189}{19.9+25} = 4.21$

$Q = CIA = (0.65)(4.21)(2.49) = 6.8$ c.f.s.

Total Runoff

Q= 217.6 + 27.5 + 6.8 = 251.9 cfs

Date: 1-5-73

Comp. by: [illegible]

Checked by: DC

RUNOFF COMPUTATIONS

Sheet No. 29

Job No. LDN #4

Drainage Area No. B-4

Area = 1.71 acres

Maximum Overland Flow: L = 165' S = 3.4 %

Maximum Channel Flow:

Channel No. 1 L = 340' S = 0.5 %

Channel No. 2 L = 615' S = 1.62 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 18.8 min.

Channel No. 1 Flow:

Velocity= 4.06 ft/sec; Time= $\frac{340}{4.06 \times 60}$ = 1.4 min.

Channel No. 2 Flow:

Velocity= 7.29 ft/sec; Time= $\frac{615}{7.29 \times 60}$ = 0.1 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 20.3 min.

$I = \frac{189}{T+25} = \frac{189}{20.3+25} = 4.17$

Q = CIA = (0.65)(4.17)(1.71) = 4.6 c.f.s.

Total Runoff

Q = 10.6 + 4.6 = 15.2 c.f.s.

Note: B-4 splits

A-7 = $\frac{2.62}{4.30}$ = .6233 × 15.2 = 9.5

B-5 = $\frac{1.62}{4.30}$ = .3767 × 15.2 = 5.7

Date: 1-5-73

Comp. by: JEP

Checked by: DC

RUNOFF COMPUTATIONS

Sheet No. 30

Job No. LDN-4

Drainage Area No. B-5

Area = 1.04 acres

Maximum Overland Flow: L = 145' S = 4.0%

Maximum Channel Flow:

Channel No. 1 L = 263.8 S = 1.62%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 18.0 min.

Channel No. 1 Flow:

Velocity= 7.29 ft/sec; Time= $\frac{263.8}{7.29 \times 60}$ = 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 = 18.6 min.

$I = \frac{189}{T+25} = \frac{189}{18.6+25} = 4.33$

Q = CIA = (0.65)(4.33)(1.04) = 2.9 c.f.s.

Total Runoff

Q=5.7+2.9 = 8.6 c.f.s.

Date: 1-5-73

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 31

Job No. LDN 24

Drainage Area No. B-6

Area = 13.37 acres

Maximum Overland Flow: L = 153' S = 0.50 %

Maximum Channel Flow:

Channel No. 1 L = 715' S = 2.61 %

Channel No. 2 L = 800' S = 3.00 %

Channel No. 3 L = 430.2' S = 2.68 %

Accumulation Time

Overland Flow: 26.5 min.

Channel No. 1 Flow:

Velocity= 10.0 ft/sec; Time= $\frac{715}{10.0 \times 60}$ = 1.2 min.

Channel No. 2 Flow:

Velocity= 10.76 ft/sec; Time= $\frac{800}{10.76 \times 60}$ = 1.2 min.

Channel No. 3 Flow:

Velocity= 10.41 ft/sec; Time= $\frac{430.2}{10.41 \times 60}$ = 2.7 min.

Total Accumulation Time: T = 30.6 min.

$I = \frac{189}{T+25} = \frac{189}{30.6+25} = 3.40$

$Q = CIA = (0.65)(3.40)(13.37) = 29.5$ c.f.s.

Total Runoff

Q= 251.9+3.6+29.5= 290.0 c.f.s

Date: 1-5-73

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 32

Job No. LDN #4

Drainage Area No. B-7

Area = 1.21 acres

Maximum Overland Flow: L = 120' S = 2.8 %

Maximum Channel Flow:

Channel No. 1 L = 230' S = 1.72 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 17.6 min.

Channel No. 1 Flow:

Velocity= 7.51 ft/sec; Time= $\frac{230}{7.51 \times 60}$ = 0.5 min.

Channel No. 2 Flow:

Velocity=_____ft/sec; Time= $\frac{\quad}{\quad \times 60}$ = _____min.

Channel No. 3 Flow:

Velocity=_____ft/sec; Time= $\frac{\quad}{\quad \times 60}$ = _____min.

Total Accumulation Time: T = 18.0 min.

$I = \frac{189}{T+25} = \frac{189}{18.0+25} = 4.40$

Q = CIA = (0.65)(4.40)(1.21) = 3.5 c.f.s.

Total Runoff

Q = 102.2 + 3.5 = 105.7 c.f.s.

Date: 1-5-73

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 33

Job No. LDN 84

Drainage Area No. B-8

Area = 0.46 acres

Maximum Overland Flow: L = 200' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 148' S = 2.68%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 23.6 min.

Channel No. 1 Flow:

Velocity= 10.41 ft/sec; Time= $\frac{148}{10.41 \times 60}$ = 0.2 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 23.8 min.

$I = \frac{189}{T+25} = \frac{189}{23.8+25} = 3.87$

$Q = CIA = (0.65)(3.87)(0.46) = 1.2$ c.f.s.

Total Runoff

Q = 290.0 + 105.7 + 1.2 = 396.9 c.f.s.

Date: 1-5-73

Comp. by: [illegible]

Checked by: [illegible]

EXHIBIT F
STREET CARRYING CAPACITIES AT VARIOUS GRADES IN CFS

n(conc)=.015 Curb Ht=8"

R/W	ST WD	TYPE CROWN	.0050	.0100	.0150	.0200	.0250	.0300	.0350	.0400
50'	32'	2"	106	149	183	211	236	259	279	299
50'	36'	2"	128	181	222	256	286	313	338	362
64'	44'	2"	149	211	259	299	334	366	395	422
64'	48'	2"	175	247	303	350	391	428	462	494

50' R.O.W. 32' FACE-FACE 8" CURB 8" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0165	15.3611	51.3731	.0050	.0707	.2990	.4472	2.8545	43.8477
.0165	15.3611	51.3731	.0100	.1000	.2990	.4472	420368	62.0100
.0165	15.3611	51.3731	.0150	.1225	.2990	.4472	4.9441	75.9464
.0165	15.3611	51.3731	.0200	.1414	.2990	.4472	5.7089	87.6954
.0165	15.3611	51.3731	.0250	.1581	.2990	.4472	6.3828	98.0464
.0165	15.3611	51.3731	.0300	.1732	.2990	.4472	6.9920	107.4045
.0165	15.3611	51.3731	.0350	.1871	.2990	.4472	7.5522	116.0101
.0165	15.3611	51.3731	.0400	.2000	.2990	.4472	8.0736	124.0200

50' R.O.W. 32' FACE-FACE 8" CURB 6" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0165	18.9167	51.3569	.0050	.0707	.3683	.5138	3.2801	62.0482
.0165	18.9167	51.3569	.0100	.1000	.3683	.5138	4.6387	87.7494
.0165	18.9167	51.3569	.0150	.1225	.3683	.5138	5.6813	107.4706
.0165	18.9167	51.3569	.0200	.1414	.3683	.5138	6.5602	124.0964
.0165	18.9167	51.3569	.0250	.1581	.3683	.5138	7.3345	138.7439
.0165	18.9167	51.3569	.0300	.1732	.3683	.5138	8.0245	151.9864
.0165	18.9167	51.3569	.0350	.1871	.3683	.5138	8.6783	164.1640
.0165	18.9167	51.3569	.0400	.2000	.3683	.5138	9.2775	175.4988

50' R.O.W. 32' FACE-FACE 8" CURB 4" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0165	22.4722	51.3453	.0050	.0707	.4377	.5765	3.6797	82.6903
.0165	22.4722	51.3453	.0100	.1000	.4377	.5765	5.2038	116.9417
.0165	22.4722	51.3453	.0150	.1225	.4377	.5765	6.3734	143.2238
.0165	22.4722	5123453	.0200	.1414	.4377	.5765	7.3593	165.3806
.0165	22.4722	51.3453	.0250	.1581	.4377	.5765	8.2280	184.9011
.0165	22.4722	51.3453	.0300	.1732	.4377	.5765	9.0133	202.5490
.0165	22.4722	51.3453	.0350	.1871	.4377	.5765	9.7355	218.7780
.0165	22.4722	51.3453	.0400	.2000	.4377	.5765	10.4077	233.8835

50' R.O.W. 32' FACE-FACE 8" CURB 2" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0165	26.0278	51.3384	.0050	.0707	.5070	.6358	4.0585	105.6348
.0165	26.0278	51.3384	.0100	.1000	.5070	.6358	5.7396	149.3901
.0165	26.0278	51.3384	.0150	.1225	.5070	.6358	7.0296	182.9648
.0165	26.0278	51.3384	.0200	.1414	.5070	.6358	8.1171	211.2696
.0165	26.0278	51.3384	.0250	.1581	.5070	.6358	9.0752	236.2066
.0165	26.0278	51.3384	.0300	.1732	.5070	.6358	9.9424	258.7513
.0165	26.0278	51.3384	.0350	.1871	.5070	.6358	10.7379	279.4834
.0165	26.0278	51.3384	.0400	.2000	.5070	.6358	11.4793	298.7803

NEWKIRK FORMS CORPORATION, ALBUQUERQUE, NEW MEXICO 87110

50' R.O.W.		36' FACE-FACE		3.0" CROWN		8" CURB	0.2' OVERFLOW	
N	A	P	S	S1/2	R	R2/3	V	Q
0.0159	16.6000	51.3719	0.0050	0.0707	0.3231	0.4709	3.1096	51.6
0.0159	16.6000	51.3719	0.0100	0.1000	0.3231	0.4709	4.3976	73.0
0.0159	16.6000	51.3719	0.0150	0.1225	0.3231	0.4709	5.3860	89.4
0.0159	16.6000	51.3719	0.0200	0.1414	0.3231	0.4709	6.2192	103.2
0.0159	16.6000	51.3719	0.0250	0.1581	0.3231	0.4709	6.9533	115.4
0.0159	16.6000	51.3719	0.0300	0.1732	0.3231	0.4709	7.6169	126.4
0.0159	16.6000	51.3719	0.0350	0.1871	0.3231	0.4709	8.2272	136.6
0.0159	16.6000	51.3719	0.0400	0.2000	0.3231	0.4709	8.7953	146.0

50' R.O.W.		36' FACE-FACE		6.0" CROWN		8" CURB	0.2' OVERFLOW	
N	A	P	S	S1/2	R	R2/3	V	Q
0.0159	20.6000	51.3576	0.0050	0.0707	0.4011	0.5439	3.5916	74.0
0.0159	20.6000	51.3576	0.0100	0.1000	0.4011	0.5439	5.0792	104.6
0.0159	20.6000	51.3576	0.0150	0.1225	0.4011	0.5439	6.2208	128.1
0.0159	20.6000	51.3576	0.0200	0.1414	0.4011	0.5439	7.1831	148.0
0.0159	20.6000	51.3576	0.0250	0.1581	0.4011	0.5439	8.0310	165.4
0.0159	20.6000	51.3576	0.0300	0.1732	0.4011	0.5439	8.7975	181.2
0.0159	20.6000	51.3576	0.0350	0.1871	0.4011	0.5439	9.5024	195.7
0.0159	20.6000	51.3576	0.0400	0.2000	0.4011	0.5439	10.1585	209.3

50' R.O.W.		36' FACE-FACE		4.0" CROWN		8" CURB	0.2' OVERFLOW	
N	A	P	S	S1/2	R	R2/3	V	Q
0.0159	24.6000	51.3473	0.0050	0.0707	0.4791	0.6123	4.0431	99.5
0.0159	24.6000	51.3473	0.0100	0.1000	0.4791	0.6123	5.7178	140.7
0.0159	24.6000	51.3473	0.0150	0.1225	0.4791	0.6123	7.0029	172.3
0.0159	24.6000	51.3473	0.0200	0.1414	0.4791	0.6123	8.0862	198.9
0.0159	24.6000	51.3473	0.0250	0.1581	0.4791	0.6123	9.0407	222.4
0.0159	24.6000	51.3473	0.0300	0.1732	0.4791	0.6123	9.9036	243.6
0.0159	24.6000	51.3473	0.0350	0.1871	0.4791	0.6123	10.6971	263.1
0.0159	24.6000	51.3473	0.0400	0.2000	0.4791	0.6123	11.4356	281.3

50' R.O.W.		36' FACE-FACE		2.0" CROWN		8" CURB	0.2' OVERFLOW	
N	A	P	S	S1/2	R	R2/3	V	Q
0.0159	28.6000	51.3411	0.0050	0.0707	0.5571	0.6770	4.4706	127.9
0.0159	28.6000	51.3411	0.0100	0.1000	0.5571	0.6770	[illegible]	180.8
0.0159	28.6000	51.3411	0.0150	0.1225	0.5571	0.6770	[illegible]	221.5
0.0159	28.6000	51.3411	0.0200	0.1414	0.5571	0.6770	8.9412	255.7
0.0159	28.6000	51.3411	0.0250	0.1581	0.5571	0.6770	9.9966	285.9
0.0159	28.6000	51.3411	0.0300	0.1732	0.5571	0.6770	10.9507	313.2
0.0159	28.6000	51.3411	0.0350	0.1871	0.5571	0.6770	11.8282	338.3
0.0159	28.6000	51.3411	0.0400	0.2000	0.5571	0.6770	12.6448	361.6

MANNING FORMULA COMPUTATIONS
JANUARY 9, 1973

64' R.O.W.		44' FACE-FACE		3.0" CROWN		3" CURB	0.2' OVERFLOW	
N	A	P	S	S1/2	R	R2/3	V	Q
0.0164	20.5778	65.3643	0.0050	0.0707	0.3148	0.4628	2.9592	60.9
0.0164	20.5778	65.3643	0.0100	0.1000	0.3148	0.4628	4.1849	86.1
0.0164	20.5778	65.3643	0.0150	0.1225	0.3148	0.4628	5.1255	105.5
0.0164	20.5778	65.3643	0.0200	0.1414	0.3148	0.4628	5.9184	121.8
0.0164	20.5778	65.3643	0.0250	0.1581	0.3148	0.4628	6.6170	136.2
0.0164	20.5778	65.3643	0.0300	0.1732	0.3148	0.4628	7.2485	149.2
0.0164	20.5778	65.3643	0.0350	0.1871	0.3148	0.4628	7.8293	161.1
0.0164	20.5778	65.3643	0.0400	0.2000	0.3148	0.4628	8.3699	172.2

64' R.O.W.		44' FACE-FACE		6.0" CROWN		3" CURB	0.2' OVERFLOW	
N	A	P	S	S1/2	R	R2/3	V	Q
0.0164	25.4667	65.3525	0.0050	0.0707	0.3897	0.5335	3.4114	86.9
0.0164	25.4667	65.3525	0.0100	0.1000	0.3897	0.5335	4.8245	122.9
0.0164	25.4667	65.3525	0.0150	0.1225	0.3897	0.5335	5.9087	150.5
0.0164	25.4667	65.3525	0.0200	0.1414	0.3897	0.5335	6.8228	173.8
0.0164	25.4667	65.3525	0.0250	0.1581	0.3897	0.5335	7.6282	194.3
0.0164	25.4667	65.3525	0.0300	0.1732	0.3897	0.5335	8.3562	212.9
0.0164	25.4667	65.3525	0.0350	0.1871	0.3897	0.5335	9.0253	229.9
0.0164	25.4667	65.3525	0.0400	0.2000	0.3897	0.5335	9.6489	245.7

64' R.O.W.		44' FACE-FACE		4.0" CROWN		3" CURB	0.2' OVERFLOW	
N	A	P	S	S1/2	R	R2/3	V	Q
0.0164	30.3556	65.3441	0.0050	0.0707	0.4645	0.5998	3.8354	116.4
0.0164	30.3556	65.3441	0.0100	0.1000	0.4645	0.5998	5.4241	164.7
0.0164	30.3556	65.3441	0.0150	0.1225	0.4645	0.5998	6.6431	201.7
0.0164	30.3556	65.3441	0.0200	0.1414	0.4645	0.5998	7.6708	232.9
0.0164	30.3556	65.3441	0.0250	0.1581	0.4645	0.5998	8.5762	260.3
0.0164	30.3556	65.3441	0.0300	0.1732	0.4645	0.5998	9.3943	285.2
0.0164	30.3556	65.3441	0.0350	0.1871	0.4645	0.5998	10.1475	308.0
0.0164	30.3556	65.3441	0.0400	0.2000	0.4645	0.5998	10.8482	329.3

64' R.O.W.		44' FACE-FACE		2.0" CROWN		3" CURB	0.2' OVERFLOW	
N	A	P	S	S1/2	R	R2/3	V	Q
0.0164	35.2444	65.3390	0.0050	0.0707	0.5394	0.6626	4.2371	149.3
0.0164	35.2444	65.3390	0.0100	0.1000	0.5394	0.6626	5.9921	211.2
0.0164	35.2444	65.3390	0.0150	0.1225	0.5394	0.6626	7.3388	258.7
0.0164	35.2444	65.3390	0.0200	0.1414	0.5394	0.6626	8.4741	298.7
0.0164	35.2444	65.3390	0.0250	0.1581	0.5394	0.6626	9.4744	333.9
0.0164	35.2444	65.3390	0.0300	0.1732	0.5394	0.6626	10.3787	365.8
0.0164	35.2444	65.3390	0.0350	0.1871	0.5394	0.6626	11.2102	395.1
0.0164	35.2444	65.3390	0.0400	0.2000	0.5394	0.6626	11.9842	422.4

MANNING FORMULA COMPUTATIONS
JANUARY 9, 1973

64' R.O.W. 48' FACE-FACE 8" CURB 8" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0159	22.0000	65.3614	.0050	.0707	.3366	.4839	3.1940	70.2688
.0159	22.0000	65.3614	.0100	.1000	.3366	.4839	4.5170	99.3750
.0159	22.0000	65.3614	.0150	.1225	.3366	.4839	5.5322	121.7090
.0159	22.0000	65.3614	.0200	.1414	.3366	.4839	6.3881	140.5375
.0159	22.0000	65.3614	.0250	.1581	.3366	.4839	7.1421	157.1257
.0159	22.0000	65.3614	.0300	.1732	.3366	.4839	7.8238	172.1226
.0159	22.0000	65.3614	.0350	.1871	.3366	.4839	8.4506	185.9136
.0159	22.0000	65.3614	.0400	.2000	.3366	.4839	9.0341	198.7500

64' R.O.W. 48' FACE-FACE 8" CURB 6" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0159	27.3333	65.3506	.0050	.0707	.4183	.5593	3.6917	100.9073
.0159	27.3333	65.3506	.0100	.1000	.4183	.5593	5.2209	142.7044
.0159	27.3333	65.3506	.0150	.1225	.4183	.5593	6.3943	174.7765
.0159	27.3333	65.3506	.0200	.1414	.4183	.5593	7.3835	201.8145
.0159	27.3333	65.3506	.0250	.1581	.4183	.5593	8.2550	225.6355
.0159	27.3333	65.3506	.0300	.1732	.4183	.5593	9.0429	247.1713
.0159	27.3333	65.3506	.0350	.1871	.4183	.5593	9.7674	266.9755
.0159	27.3333	65.3506	.0400	.2000	.4183	.5593	10.4418	285.4039

64' R.O.W. 48' FACE-FACE 8" CURB 4" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0159	32.6667	65.3429	.0050	.0707	.4999	.6299	4.1579	135.8232
.0159	32.6667	65.3429	.0100	.1000	.4999	.6299	5.8801	192.0830
.0159	32.6667	65.3429	.0150	.1225	.4999	.6299	7.2016	235.2527
.0159	32.6667	65.3429	.0200	.1414	.4999	.6299	8.3157	271.6465
.0159	32.6667	65.3429	.0250	.1581	.4999	.6299	9.2972	303.7100
.0159	32.6667	65.3429	.0300	.1732	.4999	.6299	10.1846	332.6976
.0159	32.6667	65.3429	.0350	.1871	.4999	.6299	11.0006	359.3545
.0159	32.6667	65.3429	.0400	.2000	.4999	.6299	11.7602	384.1661

64' R.O.W. 48' FACE-FACE 8" CURB 2" CROWN .2' OVERFLOW

N	A	P	S	S1/2	R	R2/3	V	Q
.0159	38.0000	65.3383	.0050	.0707	.5816	.6968	4.5991	174.7662
.0159	38.0000	65.3383	.0100	.1000	.5816	.6968	6.5041	247.1567
.0159	38.0000	65.3383	.0150	.1225	.5816	.6968	7.9659	302.7039
.0159	38.0000	65.3383	.0200	.1414	.5816	.6968	9.1982	349.5324
.0159	38.0000	65.3383	.0250	.1581	.5816	.6968	10.2839	390.7891
.0159	38.0000	65.3383	.0300	.1732	.5816	.6968	11.2655	428.0000
.0159	38.0000	65.3383	.0350	.1871	.5816	.6968	12.1681	462.3879
.0159	38.0000	65.3383	.0400	.2000	.5816	.6968	13.0082	494.3134

EXHIBIT G

STREETS AND MAXIMUM RUNOFFS

STREET NAME & DESCRIPTION	MIN. SLOPE	ST. WIDTH	CROWN
San Francisco Road, N.E., from Wyoming Blvd., N.E. west to Gill Street, N.E., 290 cfs	2.61%	44'	2"
San Francisco Road, N.E., from Gill Street, N.E. to Louisiana Blvd., N.E., 397 cfs	2.68%	48'	2"
Raymond Drive, N.E., from Burke Street, N.E. to Loma Del Norte Road, N.E., 29cfs	2.04%	32'	2"
Loma Del Norte Road, N.E., from Wyoming Blvd., N.E. to Gill Street, N.E., 135 cfs	2.17%	36'	2"
Coulson Drive, N.E. from Frieda Street, N.E. ot Louisiana Blvd., N.E., 56cfs	2.35%	32'	2"
Gill Street, N.E. from Coulson Drive, N.E. to Loma Del Norte Road, N.E., 35 cfs	0.55%	32'	2"
Gill Street, N.E. from Loma Del Norte Road, N.E. to San Francisco Road, N.E., 106cfs	1.72%	32'	2"
Frieda Street, N.E. from Coulson Drive, N.E. to Loma Del Norte Road, N.E., 4 cfs	0.497%	32'	2"
Burke Street, N.E. from Loma Del Norte Road, N.E. to San Francisco Road, N.E. 15cfs	0.50%	32'	2"
Saint Clair Street, N.E. from Loma Del Norte Road, N.E. to San Francisco Road, N.E., 286 cfs	0.875%	32'	2"

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2. Flood Plain Information, Albuquerque Arroyos, Part I, prepared for the Albuquerque Metrolpoitan Arroyo Flood Control Authority by the Corps of Engineers, U.S. Army, Albuquerque District, New Mexico, June 1970 and supplement.

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

4. Design by E.E. Seelye, Volume I, 2nd edition, 1945.

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

6. Handbook of Hydraulics by Horace W. King and Ernest F. Brater, 1963.

7. "Storm Drainage Study Relative to the Development of Loma del Norte" by Campbell-Hicks and Associates, Inc., September 1971.

8. "Storm Drainage Study Relative to the Development of North Hills Mobile Home Park" by MacCornack and Burns Consulting Engineers, Inc., Albuquerque, N.M., October 1972 (Revised November 1972).