K22/D10

Le Plans

Genge/Murray-McCormick
2601 Wyoming Blvd., N.E. Suite F
Albuquerque, N.M. 87110/505-292-1936
Engineering · Surveying · Planning
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RECEIVED
MAR 07 1977
CITY ENGINEERS

Drainage file
Approved plat 3-8-77
MS

March 7, 1977

City of Albuquerque
Department of Public Works
Engineering Division
P. O. Box 1293
Albuquerque, New Mexico 87103

Attention: Mr. V. M. Kimmick, City Engineer

Re: Monarch Village - Approved Drainage Study Amended Replat

Gentlemen:

We hereby amend the above Drainage Report to include the lot count and density as shown on the attached replat.

Note that the street pattern and dimensions remain as delineated on the previous replat. Further, the area of single family homes remains the same and therefore the area draining to lot ponding also remains the same.

As these basic parameters remain unchanged, the flow quantities and directions remain unchanged. We therefore respectfully request your signature on the Amended Replat of Monarch Village and attachment of this letter to your copies of the referenced Drainage Report.

Very truly yours,

GENGE/MURRAY-McCORMICK, INC.

Thomas J. Haack

TJH:dw

cc; Terry Connors, Bellamah Corp.

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

MAYOR
Harry E. Kinney

CHIEF
ADMINISTRATIVE OFFICER
Frank A. Steinhaus

March 3, 1977

Mr. Thomas J. Haack
Genge/Murray-McCormick Inc.
2601 Wyoming Blvd. N.E., Suite F
Albuquerque, New Mexico 87110

SUBJECT: MONARCH VILLAGE - TRACT B-B, JUAN TABO AND COPPER, DRAINAGE REPORT

Dear Mr. Haack:

The drainage report submitted by your letter of February 25, 1977 has been reviewed and the study is approved. Where the discharge of water to Juan Tabo occurs, water should be discharged into the gutter and should not flow out into the street. An additional copy of the report should be forwarded to AMAFCA.

Sincerely,

V. M. Kimmick
City Engineer

VMK/fs
cc: Jim Smith
Bob Kielich
Dwayne Sheppard
Drainage File

Public Works Department
Director -- Erwin F. Hensch, P. E. 766-7467
Engineering 766-7441 — V. M. Kimmick, P. E.
Street Maint. 766-7755 — G. E. Paul, P. E.
Ass't. Director — Harold R. Orr, Jr. P. E.
Liquid Waste 766-7535 — R. P. Lowe, P. E.
Water 766-7437 — W. H. Otto, P. E.

AN EQUAL OPPORTUNITY EMPLOYER

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

November 30, 1976

City of Albuquerque
Department of Public Works
Engineering Division
P. O. Box 1293
Albuquerque, New Mexico 87103

Attention: Mr. Kleston H. Laws
Assistant City Engineer, Hydrology

Re: Re-Plat of Monarch

Gentlemen:

We are transmitting herewith two copies of the above drainage study which has been revised to accommodate the proposed change in planning and zoning.

In addition, we have included for your use a copy of the previously approved study reflecting the revisions in red for both the text and exhibits.

Your early review and approval in addition to your signature on the plat of subdivision would be appreciated.

Very truly yours,

MURRAY-McCORMICK, INC.

Thomas J. Haack

TJH:dw

Encls.

2601 WYOMING BLVD., NE. SUITE F/ALBUQUERQUE, NEW MEXICO 87110/505-292-1935
CALIFORNIA ALASKA OREGON WASHINGTON TEXAS GEORGIA FLORIDA COLORADO

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

November 15, 1976

Mr. Kleston Laws
Asst. City Engineer, Hydrology
City of Albuquerque
Department of Public Works, Engineering Dept.
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: Monarch Village Subdivision

Dear Kleston:

It remains the desire of the Bellamah Corporation to file the current plat for the above subdivision and therefore we wish to offer the following response to your two memos of review dated October 5, 1976:

1. The super-elevated portion of Prince-Grand Avenue has been modified to place the crown 8.0 ft. from the north and west curbs thus increasing the capacity of the curb to carry irrigation waste water flow. This further has modified the relative difference between the tops of curb from 0.50' to 0.42'.

2. As a result of the increased right-of-way width of Grand Avenue, the water-block height has been modified to 0.40' + 0.42' of super elevation.

3. The grading plan has been revised to provide a minimum cover of 3.96' on Lot #12 and 3.83' for Lot #13, Block 4. Further, the easement covering both the existing sanitary sewer and water transmission line are now shown on the grading plan, along with the existing "grape-stake" fence along the east property line. It is proposed to provide water retention walls with the subdivision and further since the configuration of the various home plans varies substantially, in both size and shape, we have provided for the installation of retaining walls predicated on the actual site plan. The pond elevation of Lot 23, Block 3, is predicated on the median of the two westerly lot corners of this lot and thus falls between the pond elevation for Lots 5 and 6.

4. No grading is planned for the adjacent Tracts A and B at this time.

5. Retaining walls have been added along the westerly lines of Lots 22 thru 26, Block 2. The 1.2' difference on Lots 1 thru 5 is within the scope as detailed on Sheet 5 of 17.

6. The arroyo shown in the southeast project corner has been filled during the development of Manzano West. See the existing ground elevations shown along the east property line.

We trust the above explanation and attached plans have answered your questions and further you will affix your signature to the plat.

Very truly yours,

MURRAY-McCORMICK, INC.

Thomas J. Hauck

TJH:dw

Encls.

October 8, 1976

F22-D10

Geuge/Murray-McCormick
2601 Wyoming Blvd. N.E., Suite F
Albuquerque, New Mexico 87110

RE: MONARCH VILLAGE

Dear Mr. Johnson:

The drainage report for Monarch Village is acceptable. You may proceed with detail engineering plans.

Very truly yours,

Kleston H. Laws
Assistant City Engineer-Hydrology

KHL/fs

cc - John Robert

CITY OF ALBUQUERQUE, NEW MEXICO
CITY ENGINEER'S OFFICE

MEMORANDUM - October 5, 1976

TO: Mrs. Celia Tomlinson, Design Engineer
FROM: K. H. Laws, Assist. City Engineer-Hydrology
SUBJECT: MONARCH VILLAGE

Sheets 3 and 4. The grading plan arrived on the 5th of October only 3 days prior to the requested view date. Plans should not be accepted for review until they are complete.

Sheet 3. Lots 12 and 13, Block 4 have a sanitary sewer. The grading plan shows cutting lot 12,4.7 feet and lot 13, 8.3 feet. Won't that expose the sanitary sewer? The easement should be shown to avoid locating building in the easement. The cut along the east property is from 1 to 1.8 feet. What will that do to existing walls? Lots 18 and 20, Block 3 have 3 to 5 feet of difference in adjoining lots with no retaining wall. If wall is not planned, slopes should be shown. The west lots have fill from 1.5 to 2 feet; are retaining walls to be provided? If Tract A is graded, the wall could be significant. Now is the time to plan. The pond on lot 23, block 3 is lower than lot 6 which is down hill.

Sheet 4. Lots 7 and 8, block 2 are much lower than lots to east. Provide wall or slopes. Does the 1.2 feet difference in lots 1,2,3 and 4 and 5 between lots 33-29 require wall?

One and half feet of cut on east and one to two feet of fill on the west doesn't seem good. Contours show arroyo at south east corner, is it there? How will it be handled? What is source of contours? Two and a half feet difference between lots 10 and 16 in block 2, does it require a wall?

KHL/fs

CITY OF ALBUQUERQUE, NEW MEXICO
CITY ENGINEER'S OFFICE

F-22-D10

MEMORANDUM - October 5, 1976

TO: Mrs. Celia Tomlinson, Design Engineer
FROM: K. H. Laws, Assist. City Engineer-Hydrology
SUBJECT: MONARCH VILLAGE

1. Sheets 3 & 4 are not included in my set which makes a total review impossible. I have the feeling the consultant is merely trying to short circuit the interim review process. I do not feel incomplete sets of drawings should be accepted.

2. All street names need to change. We have a Queens Court and Queen Way, Prince Street, Royal Drive, Kings Row.

3. The northwest gutter of Prince-Grand Ave. will carry about 40 gpm or enough to handle wasted irrigation water from about 4 residences. All other water will flow across the street, resulting in maintenance, and safety hazard. I feel such a proposal is unacceptable. This curve has a difference of 100 feet in the two gutter lines. I only get 50 feet. Who is wrong?

4. The water block in Grand Avenue is 0.18' high. Is it enough?

Appears to me a check needs to be made of plans before they are accepted for distribution. We have received several plans lately which are incomplete and have not even been checked by the consultant.

KHL/fs

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

Received 24Sep76

September 24, 1976

City of Albuquerque
Department of Public Works
Engineering Division
P. O. Box 1293
Albuquerque, New Mexico 87103

Attention: Mr. Kleston H. Laws, Assistant City Engineer-Hydrology

Re: Monarch Village

Gentlemen:

Submitted for your review and approval are duplicate copies of our analysis and report for the above subdivision. Engineering plans for the improvement of this project are currently being completed and will be forwarded to you in the near future as additional documentation.

As our client, Dale Bellamah Corporation, would like to begin construction at the earliest possible date, your early review and approval would be appreciated.

Very truly yours,

MURRAY-McCORMICK, INC.

Thomas J. Hasek

TJH:dw

cc: Mr. Joe Shipley

Encl.

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

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

September 29, 1976

City of Albuquerque
Department of Public Works
Engineering Division
P. O. Box 1293
Albuquerque, New Mexico 87109

Attention: Mr. Kleston H. Laws
Assistant City Engineer, Hydrology

Re: Monarch Village

Gentlemen:

We are returning herewith two (2) revised copies of the Drainage Report for the above subdivision along with your comment copy.

Runoff coefficients and times of concentration have been modified and the resultant changes in flow have been noted on Figures I and V. In addition, Figure II, Typical Lot Drainage, has been modified to reflect the typical lot size in this project and the discussion of the downstream discharge and water course has been revised to reflect the inadequacy of the existing storm sewer. The development of composite runoff coefficients and the lot ponding requirements have also been reviewed and revised.

We trust the report is now in proper order and your letter of approval will be forthcoming.

Very truly yours,

MURRAY-McCORMICK, INC.

Thomas J. Haack

TJH:dw

Encls.

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

Klee. As the changes seemed rather small and offsetting I have retained the original composite 'C's'

Non-Ponded Lots

C = ~~0.90~~ 0.80

Streets & Walk Area	20x65		1300 S.F.
Roof Area	40x55		2200 S.F.
Driveway	25x15		~~375~~ 450 S.F.
Total Impervious Area			~~3875~~ 4950 S.F.
Total Lot Area			9400 S.F.
Less Roof Area			-2200 S.F.
Less Driveway			- ~~375~~ 450 S.F.
Total Pervious Area			6750 6285 S.F.

C = ~~0.20~~ 0.12

Impervious Area	~~3875~~ 4275 Sq.Ft.	~~39%~~ 36% @ 0.80	~~0.288~~ 0.312
Pervious Area	~~6825~~ 6750 Sq.Ft.	~~61%~~ 64% @ 0.12	~~0.077~~ 0.073
Total Area	~~10700~~ 11025 Sq.Ft.	100%	~~0.365~~ 0.385

Composite Runoff Coefficient - $C \times C_f$ = 0.37 x 1.25 = ~~0.46~~ 0.48

MULTIPLE FAMILY AREA

C = 0.60 x 1.25 = 0.75

COMMERCIAL AREA

C = 0.80 x 1.25 = 1.00

COMPOSITE RUNOFF COEFFICIENTS

Undeveloped Land

C = 0.30[1] x 1.25[2] = 0.38

Developed Land

Typical Lot Area

Gross Area			37.93 Ac.
Less:	Tract A	3.76 Ac.	
	Tract B	7.84 Ac.	
	Area in Streets	6.47	
Area in Lots			19.86 Ac.
Average Lot Area (92 Lots)			9,400 Sq.Ft.
Typical lot width			65 Ft.

Ponded Lots

C = 0.80	Streets & Walk Area	20x65	1,300 S.F.
	Roof Area	20x55	1,100 S.F.
	Driveway	~~25~~ 30 x15	~~375~~ 450 S.F.
	Total Impervious Area		~~2,775~~ 2,850 S.F.
C = 0.12	Front and Side Yards		~~2,925~~ 3,250 S.F.
	Less Roof Area		-1,100 S.F.
	Less Driveway		- ~~375~~ 450 S.F.
	Total Pervious Area		~~1,450~~ 1,700 S.F.

Impervious Area	~~2775~~ 2850 Sq.Ft.	~~66%~~ 63% @ 0.80	~~0.528~~ 0.504
Pervious Area	~~1450~~ 1700 Sq.Ft.	~~34%~~ 37% @ 0.12	~~0.041~~ 0.044
Total Area	~~4225~~ 4550 Sq.Ft.	100%	~~0.569~~ 0.548

Composite Runoff Coefficient - C x C_f = 0.57 x 1.25 = ~~0.71~~ 0.69

1. See Bibliography; Item (1) Table XII
2. See Bibliography; Item (4) Article 3.7

DRAINAGE REPORT

FOR

MONARCH VILLAGE

ALBUQUERQUE, NEW MEXICO

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

MONARCH VILLAGE

ALBUQUERQUE, NEW MEXICO

Prepared By

Murray-McCormick, Inc.
2601 Wyoming Boulevard N.E.
Albuquerque, New Mexico 87110
(505) 292-1936

August 24, 1976

Revised September 28, 1976

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APPENDIX

Figure I - Vicinity & Location Map
Developed Drainage Characteristics Plan

Composite "C" Factor Calculations

Figure II - Typical Lot Drainage

Figure III - Time of Concentration for Small Drainage Basins

Figure IV - Intensity Duration Curves

Figure V - Offsite Watershed

Figure VI - 100 Year-6 Hour Precipitation

Reference Copy
Preliminary Drainage Report For
Manzano Manor By: George E. Paul
N.M.P.E. & L.S. #2544 Dtd. Nov. 7, 1969

DRAINAGE REPORT

MONARCH VILLAGE

PURPOSE

The purpose of this report is to describe the drainage characteristics of the proposed development and make recommendations for controlling the drainage such that urban planning for this area can be made safely and with a minimum of risk to life and property.

To achieve this objective, a two phase approach has been selected. In the initial phase the subject subdivision is analyzed in its undeveloped state thus determining the basic drainage characteristics of the area. The second phase considers the subdivision in its developed state. Recommendations are then made for design compliance to the requirements of the City of Albuquerque and the Albuquerque Metropolitan Arroyo Flood Control Authority.

INTRODUCTION

Monarch Village, a proposed R-1 development, is located within northeast heights of Albuquerque, north of Copper Avenue, east of Juan Tabo Boulevard, south of Manzano High School, and west of Manzano Manor subdivision, or more particularly the site is located within the SW 1/4 of the NW 1/4 of Section 22, T. 10 N., R. 4 E., N.M.P.M.

GENERAL SITE CHARACTERISTICS 37.93 on plat

The site encompassing 37.32 acres, more or less, slopes from northeast to southwest with an average slope of 3% to 4%. The surface soils are predominantly loose sands covered with a light growth of grass. Surrounding land use includes undeveloped land of similar characteristics on the north side and developed residential land on the east. Both Copper Avenue and Juan Tabo Boulevard on the south and west perimeter are improved.

Flow patterns crossing the subdivision include sheet flow and several small arroyos. Off-site flow from the east (Manzano Manor Subdivision) passes thru the subdivision and to the intersection of Copper Avenue and Juan Tabo Boulevard.

The drainage report covering Manzano Manor Subdivision considered the subdivision to contain no lot ponding. The subdivision, however, was constructed in accordance with an area grading plan dated May 27, 1970, and prepared by Ralph K. Hicks and Associates. This plan included ponding on selected lots. Due to this alteration, the report of George Paul was used as reference material and a re-evaluation of the Manzano West water shed draining to Monarch Village was undertaken. The results of that study appear in the Appendix, pages A-5 thru A-7 and Figure V.

The development of Manzano High School has intercepted the flow from the remaining upstream and off-site area of this watershed. This water is detained in the parking lot north of the subject site and then

discharged via existing storm sewer flowing west to Juan Tabo Boulevard. Thus no other off-site flows traverse the site. On-site precipitation flows to Copper Avenue and Juan Tabo Boulevard.

DESIGN CRITERIA

In analyzing the storm runoff, the Rational Formula, $Q = CIA\ C_f$, is used.[1]

Where:

Q = Runoff quantity in cubic feet/second.

A = Contributing area in acres.

C_f = Frequency Factor for Rational formula.

I = Intensity in inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from Figure IV, Intensity Duration Frequency Curves, Albuquerque Area 1961. (Note: Where a Time of Concentration (Tc) is less than ten minutes from Figure III, the intensity value equal to ten 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 in the form of sheet flow with general accumulation into several small arroyos. Off-site drainage from the east passes thru the subdivision. The total runoff in

---

1. See Bibliography; Item (4), paragraph 3.7

the undeveloped site forms the basis for comparison with the flow in the developed state.

Table 1

RUNOFF IN UNDEVELOPED STATE

Drainage Basin	Elev. Diff.	Length of Flow	Tc	I100 yr. in./hr.	C[2]	Area Acres	Q C.F.S.
On-Site	52	1700'	10	5.4	0.38	37.9	77.8
Off-Site	From Manzano Manor at Grand Ave. Prepared by George E. Paul N.M.P.E. & L.S. #2544 November 7, 1969						
	As modified by this report						42.8
			Total Undeveloped Runoff				120.6

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, on-site 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, sideyard, and in a majority of cases, one-half 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 AMAFCA's requirement that the runoff rate from the developed tract not exceed the runoff rate from the tract in its natural state.

2. See Appendix; Page A-1

For non-ponded runoff, a composite runoff coefficient[3] is developed based upon the percentage of different types of surfaces in the drainage area. The runoff coefficients for various surfaces are as follows:

Streets, Walks and Drives	C = 0.80
Roofs	C = 0.80
Lawns, sandy soils, (Average 2 to 7% slope)	C = 0.12

doesn't relate to what is happening.

Table 2

RUNOFF IN DEVELOPED STATE

Area Designation	Acreage A	'C'[4]	I 100 year in./hr.	Q c.f.s.
A-1	4.28	0.75	4.40	14.1
A-2	1.52	0.63	5.25	5.0
A-3	3.52	0.67	--	--
A-4	2.20	0.67	4.85	7.2
A-5	3.61	0.66	4.97	11.8
A-6	0.95	0.58	5.40	3.0
A-7	3.76	0.75	5.40	15.2
A-8	7.84	1.00	5.40	42.3
A-2,A-3,A-4, A-5,A-6 and Offsite	29.9	0.62	4.11	76.2

27.68 vs 37.93 on plat.

SUMMARY OF RESULTS

Undeveloped Runoff (see Page 3)		77.8 c.f.s.
Developed Runoff -		
Single Family Area		
Area A-1		14.1 c.f.s.
Offsite + Area A-2 thru A-6	76.2	
Less Offsite	47.8	
		28.4 c.f.s.

3. See Bibliography; Item (4), Table 3-2
4. The runoff coefficient shown is a composite of the percentages of ponded and non ponded lots - see Appendix page A-1.

Multi-Family Area	15.2 c.f.s.	
Permitted Discharge		9.2 c.f.s.
Commercial Area	42.3 c.f.s.	
Permitted Discharge		26.1 c.f.s.
Total Developed Discharge		77.8 c.f.s.

As shown above, the development of this project including the lot ponding will not increase the storm runoff over that occuring in the natural undeveloped state. Further, offsite flow entering the project on the east perimeter is to be conducted to Copper Avenue via Grand and Prince Avenues. This flow will then be conducted by Copper Avenue to the intersection with Juan Tabo. On-site flows from Areas A-1, A-7 and A-8 are conducted to the above intersection by Juan Tabo. The existing catch basin and storm drain systems in Copper Avenue and Juan Tabo currently do not have sufficient capacity for the present runoff from this watershed. As the development of this site will not increase runoff above the current "undeveloped" runoff level, it is not within the scope of this report nor the responsibility of the developer to provide determination of the adequacy of downstream facilities.

Tract A (Area A-7) is a proposed R-3 multiple family residential area. A "C" value of 0.75[1] was used for this area with no ponding and some grass planting for computations of runoff.

Tract B (Area A-8) is a proposed commercial development area. A "C" value of 1.00[1] was used with no on-site ponding.

---

1. See Appendix; Page A-1.2

RECOMMENDATIONS

The following recommendations are made to enable the developer of this site and the local government to complete this project within the framework required by the City of Albuquerque and A.M.A.F.C.A.:

1. Flows within the streets of the development are distributed so that only Grand Avenue-Prince Avenue assumes a major role in conveying off-site flows. This street should be graded at not less than 1.0% slope in order to insure adequate carrying capacity.

2. The ponding areas in each backyard should be situated toward the rear of the yard. There should be a minimum of five foot buffer zone between the rear property lines and the edge of the pond to protect any walls which might be constructed. In no case should ponded waters be allowed to stand against a wall or house foundation.

3. Ponds should average 6" deep and the minimum surface area should not be less than 20%[5]. of the total area drained into the pond.

4. As the analysis of the commercial and multi-family area is predicated on estimated runoff coefficients and at this time no site plans for these areas have been prepared, the flows from these areas have been expressed as permitted discharges after development. It is recommended that at the time of development of each individual parcel, sufficient ponding, and/or detention be provided to limit the flow from each site to the amount shown.

5. See Figure 6

SUMMARY

The subject property, by utilizing backyard ponding on single family lots and outlet control in the multi-family and commercial areas, will contribute no more surface runoff to surrounding areas than that which existed before development.

In conclusion, the development of this site should have a beneficial effect on the drainage characteristics of this area, and can be developed safely with no harm to life or property.

Respectfully submitted,

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

APPENDIX

COMPOSITE RUNOFF COEFFICIENTS

Undeveloped Land

C = $0.30^{1.} \times 1.25^{2.} = 0.38$

Developed Land

Typical Lot Area

Gross Area			37.93 Ac.
Less:	Tract A	3.76 Ac.	
	Tract B	7.84 Ac.	
	Area in Streets	6.47	
Area in Lots			19.86 Ac.
Average Lot Area (92 Lots)			9,400 Sq.Ft.
Typical lot width			65 Ft. X 144.67

Ponded Lots

C = 0.80	Streets & Walk Area	20x65	1,300 S.E.	
	Roof Area	20x55	1,100 S.F.	
	Driveway	25x15	375 S.F.	65X50
	Total Impervious Area		2,775 S.F.	
C = 0.12	Front and Side Yards		2,925 S.F.	65X45
	Less Roof Area		-1,100 S.F.	
	Less Driveway		- 375 S.F.	
	Total Pervious Area		1,450 S.F.	

Impervious Area	2775 Sq.Ft.	66% @ 0.80	0.528
Pervious Area	1450 Sq.Ft.	34% @ 0.12	0.041
Total Area	4225 Sq.Ft.	100%	0.569

Composite Runoff Coefficient - $C \times C_f = 0.57 \times 1.25 = 0.71$ OK

1. See Bibliography; Item (1) Table XII
2. See Bibliography; Item (4) Article 3.7

Non-Ponded Lots

C = 0.80	Streets & Walk Area	20x65	1300 S.F.
	Roof Area	40x55	2200 S.F.
	Driveway	25x15	375 S.F.
	Total Impervious Area		3875 S.F.
C = 0.12	Total Lot Area		9400 S.F.
	Less Roof Area		-2200 S.F.
	Less Driveway		- 375 S.F.
	Total Pervious Area		6285 S.F.

Impervious Area	3875 Sq.Ft.	36% @ 0.80	0.288
Pervious Area	6825 Sq.Ft.	64% @ 0.12	0.077
Total Area	10700 Sq.Ft.	100%	0.365

Composite Runoff Coefficient - $C \times C_f = 0.37 \times 1.25 = 0.46$

Multiple Family Area

C = 0.60 x 1.25 = 0.75

Commercial Area

C = 0.80 x 1.25 = 1.00

PONDING REQUIREMENTS

Typical Lot Area

Draining to Pond	6,150 S.F. .6065 =	3900
Average Lot Area	9,400 S.F.	
Less: Front & Side Yards	3,250 S.F.	
Roof Area 20 x 55	1,100 S.F.	1100
Patio Area	100 S.F.	100
Lawn Area	3,025 S.F.	2700

Runoff Coefficient

Impervious Area	1200 S.F.	20% @ 0.80	0.16	.25
Pervious Area	4950 S.F.	80% @ 0.12	0.10	.08
			0.26	.33

$C \times C_1 = 0.26 \times 1.25 = 0.33$ .41

Pond Volume Requirement

100 year 6-hour precipition = 2.6 in.

Volume = Runoff coefficient x area x precipitation

V = 0.33 x 6150 x 0.25 = 507 cu.ft. .41 x 3900 = 400

Depth of pond 0.50 ft. (6")

Minimum area of pond 1014 sq.ft. 800

800/3900 = 21

Pond area as a percentage of area drained = 17% - use 20%

V = 20% x 6150 sq.ft. x 0.5 ft. = 615 cu.ft.

21 x 3900 = 819 x .5 = 409

BIBLIOGRAPHY OF REFERENCES

(1) Herkenhoff, Gordon & Associates, "Master Plan of Drainage City of Albuquerque, New Mexico and Environs, 1963". Albuquerque; Gordon Herkenhoff & Associates, Consulting Engineers.

(2) Paul, George E., "Drainage Study - Manzano Manor Subdivision" Albuquerque: George E. Paul, N.M.P.E. & L.S. #2544 November 1969

(3) U.S. Department of Commerce, "Technical Paper, No. 40, Rainfall Frequency Atlas of the United States", Washington, D.C., U.S. Government Printing Office, 1963.

(4) Wright-McLaughlin Engineers, "Urban Storm Drainage Criteria Manual, Volume 1", Denver, Colorado: Wright-McLaughlin Engineers, 1969.

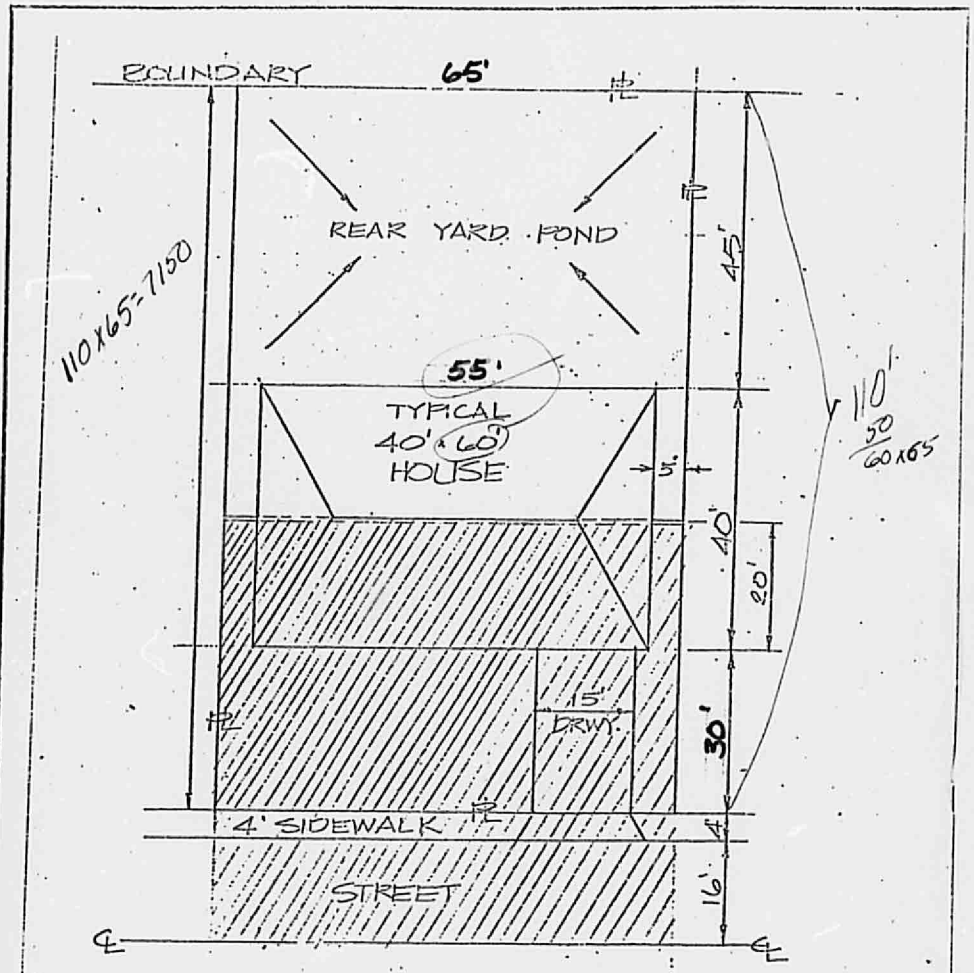


FIGURE II
TYPICAL LOT DRAINAGE

A-2

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN
ENGINEERING·PLANNING·SURVEYING
2601 WYOMING BLVD., NE SUITE F / ALBUQUERQUE, NEW MEXICO 87110 / 505-292-1936

JOB NO. _____ DATE 8-24-76
PROJECT MONARCH VILLAGE
REV 9-28-76 SCALE _____

FIG. G-INTENSITY EXPECTATION FOR ONE-HOUR RAINFALL.

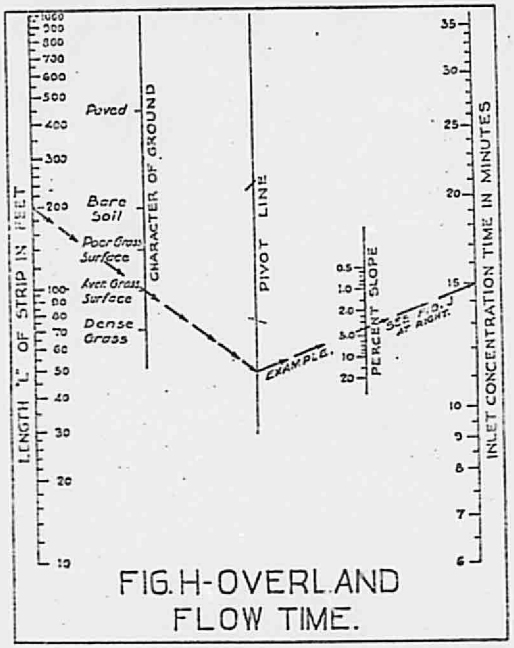


FIG. H-OVERLAND FLOW TIME.

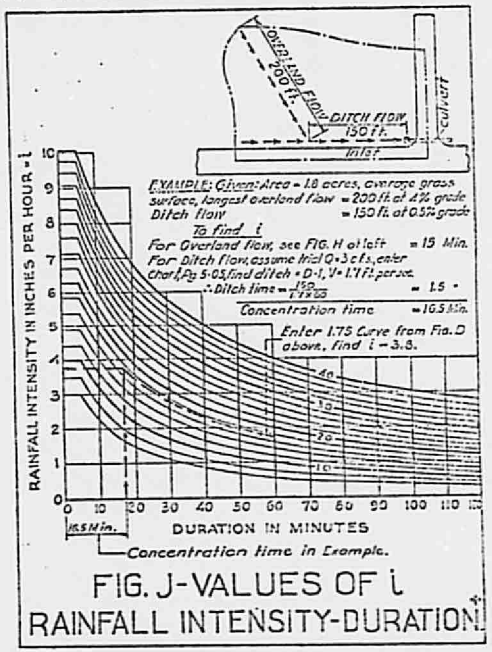


FIG. J-VALUES OF i
RAINFALL INTENSITY-DURATION*

*Reproduced from Miscellaneous Publication No. 204, U.S. Dept. of Agriculture, by David L. Yarnell.
*Adapted from Engineering Manual of the War Department, Part VIII, Chap. 1, Dec. 45.

TIME OF CONCENTRATION

FIGURE III

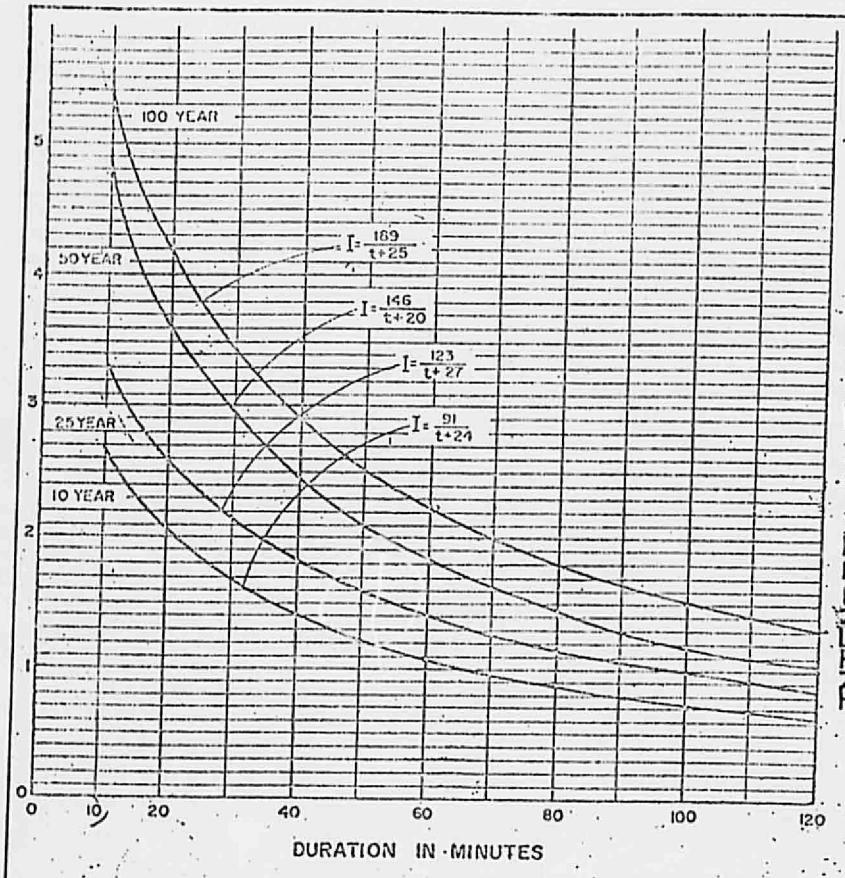
A-3

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN
ENGINEERING · PLANNING · SURVEYING
2501 WYOMING BLVD., NE, SUITE F / ALBUQUERQUE, NEW MEXICO 87112 / 505-292-1858

JOB NO. _____ DATE 8-24-72

PROJECT MONARCH VILLAGE

SCALE _____



A-4

FIGURE IV

INTENSITY-DURATION CURVES

MASTER PLAN OF DRAINAGE CITY OF ALBUQUERQUE - NEW MEXICO AND ENVIRONS
INTENSITY DURATION FREQUENCY CURVES (ALBUQUERQUE AREA - 1961)
GORDON HERKENHOFF & ASSOC. CONSULTING ENGINEERS — CHART

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN
ENGINEERING · PLANNING · SURVEYING
2501 WYOMING BLVD., NE SUITE F / ALBUQUERQUE, NEW MEXICO 87110 / 505-292-1936

JOB NO. _____ DATE 8-24-76

PROJECT MONARCH VILLAGE

SCALE _____

RUNOFF COMPUTATIONS

Sheet No. A-5

Project: MONARCH VILLAGE

Drainage Area No. OFF-SITE

Area = OI = 3.33 acres

Maximum Overland Flow: L = 180 L.F. S = 2.00%

Maximum Channel Flow:

Channel No. 1 L = 600 L.F. S = 3.3%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 9.5 min.

Channel No. 1 Flow:

Velocity = 3.0 ft/sec; Time = $\frac{200}{X\ 60}$ = 3.33 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 12.8 min.

I = 189/(13+25) = _____ = 4.40

Q = CIA = (0.60) (4.97) (3.33) = 8.79 c.f.s.

Date: 3-16-76

Comp. by: [illegible]

Checked by: _____

Rev. 9-23-76

RUNOFF COMPUTATIONS

Sheet No. 4-6

Project: MONARCH VILLAGE

Drainage Area No. OFF-SITE

Area = $O_I + O_{II} + O_{III} = 10.4$ acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 600' S = 2.5%

Channel No. 2 L = 350' S = 1.5%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 12.8 min.

Channel No. 1 Flow:

Velocity = 4.2 ft/sec; Time = $\frac{143}{X\ 60}$ = 2.4 min.

Channel No. 2 Flow:

Velocity = 3.6 ft/sec; Time = $\frac{97}{X\ 60}$ = 1.6 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 16.8 min.

I = 189/(17+25) = _____ = 4.50

Q = CIA = (0.6) (4.50) (10.4) = 28.08 c.f.s.

Date: 9-16-76

Comp. by: _____

Checked by: _____

Rev. 9-78-72

RUNOFF COMPUTATIONS

Sheet No. A-7

Project: MONARCH VILLAGE

Drainage Area No. OFFSITE

Area = $\frac{O_I + O_{II} + O_{III} + O_{IV} + O_V}{}$ = 18.1 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 250 S = 2.0%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 16.8 min.

Channel No. 1 Flow:

Velocity = 4.2 ft/sec; Time = $\frac{60}{X\ 60}$ = 1 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 17.8 min.

I = 189/(18+25) = _____ = 4.40

Q = CIA = (0.6) (4.40) (18.1) = 47.78 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

RUNOFF COMPUTATIONS

Sheet No. A-8

Project: MONARCH VILLAGE

Drainage Area No. A1

Area = 4.28 acres

Maximum Overland Flow: L = 200' S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = 400' S = 2.00%

Channel No. 2 L = 550' S = 3.00%

Channel No. 3 L = 450' S = 3.50%

Accumulation Time

Overland Flow or Inlet Time: 12 min.

Channel No. 1 Flow:

Velocity = 3.5 ft/sec; Time = $\frac{\quad}{X\ 60}$ = 1.9 min.

Channel No. 2 Flow:

Velocity = 4.0 ft/sec; Time = $\frac{\quad}{X\ 60}$ = 2.3 min.

Channel No. 3 Flow:

Velocity = 4.2 ft/sec; Time = $\frac{\quad}{X\ 60}$ = 1.8 min.

Total Accumulation Time: T = 18.2 min.

I = 152/(25+18) = 4.40

Q = CIA = (0.75) (4.40) (4.28) = 14.12 c.f.s.

Date: 9-16-76

Comp. by:

Checked by:

92% Paved @ 0.71 0.65

8% Non Paved @ 0.46 0.04

0.69

3.4 Ac = 79% @ 0.69 = 0.55

0.9 Ac = 21% @ 0.95 = 0.20

0.75 = C

Rev. 9-28-76

RUNOFF COMPUTATIONS

Sheet No. A9

Project: MONARCH VILLAGE

Drainage Area No. A-2

Area = 1.52 acres

Maximum Overland Flow: L = 150' S = 4.00%

Maximum Channel Flow:

Channel No. 1 L = 100' S = 0.50%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 10 min.

Channel No. 1 Flow:

Velocity = 2.0 ft/sec; Time = $\frac{\quad}{X\ 60}$ = 0.8 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 10.8 min.

I = 88/(25+11) = _____ = 5.25

Q = CIA = (0.63) (5.25) (1.52) = 5.02 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

71% Ponded @ 0.71 = 0.50

29% Non-Pond @ 0.46 = 0.13

0.63

RUNOFF COMPUTATIONS

Sheet No. A10

Project: MONARCH VILLAGE

Drainage Area No. A-4

Area = 2.70 acres

Maximum Overland Flow: L = 200' S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = 400' S = 3.00%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 12 min.

Channel No. 1 Flow:

Velocity = 3.5 ft/sec; Time = $\frac{\quad}{X\ 60}$ = 1.90 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 13.9 min.

I = 189/(25+14) = _____ = 4.85

Q = CIA = (0.67) (4.85) (2.70) = 7.15 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

84% Ponded @ 0.71 = 0.60

16% Non Ponded @ 0.4 = 0.07

0.67

RUNOFF COMPUTATIONS

Sheet No. A11

Project: MONARCH VILLAGE

Drainage Area No. A-5

Area = 3.61 acres

Maximum Overland Flow: L = 100' S = 4.00%

Maximum Channel Flow:

Channel No. 1 L = 1000' S = 3.00%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 8.5 min.

Channel No. 1 Flow:

Velocity = 3.5 ft/sec; Time = _____ / X 60 = 4.3 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 = 13.3 min.

I = 189/(35+13) = _____ = 4.97

Q = CIA = (0.64) (4.97) (3.61) = 11.8 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

76% Paved C 0.71 = 0.53

24% Non-Paved 0.46 = 0.11

0.64

RUNOFF COMPUTATIONS

Sheet No. A12

Project: MONARCH VILLAGE

Drainage Area No. A-6

Area = 0.95 acres

Maximum Overland Flow: L = 120' S = 4.00%

Maximum Channel Flow:

Channel No. 1 L = 160% S = 3.50%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 9.5 min.

Channel No. 1 Flow:

Velocity = 3.0 ft/sec; Time = _____ / X 60 = 0.9 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 = 10.4 min.

I = 184/(25+10) = _____ = 5.40

Q = CIA = (0.58) (5.40) (0.95) = 3.0 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

50% Ponded @ 0.71 0.36

50% Non Ponded @ 0.41 0.22

0.58

RUNOFF COMPUTATIONS

Sheet No. A-13

Project: MONARCH VILLAGE

Drainage Area No. OFF-SITE + A-2, A-3, A-4, A-5, A-6

Area = 18.1 + 11.8 = 29.9 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 650' S = 3.20%

Channel No. 2 L = 250' S = 1.80%

Channel No. 3 L = 550 S = 1.30%

Accumulation Time

Overland Flow or Inlet Time: 16.8 min.

Channel No. 1 Flow:

Velocity = 6.8 ft/sec; Time = $\frac{96}{X\ 60}$ = 1.6 min.

Channel No. 2 Flow:

Velocity = 6.0 ft/sec; Time = $\frac{42}{X\ 60}$ = 0.7 min.

Channel No. 3 Flow:

Velocity = 5.6 ft/sec; Time = $\frac{98}{X\ 60}$ = 1.6 min.

Total Accumulation Time: T = 20.7 min.

I = 18/(25+21) = _____ = 4.11

Q = CIA = (0.62) (4.11) (29) = 76.19 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

77% Ponded @ 0.71 = 0.56

23% Now Pond @ 0.46 = 0.11

0.67

18.1 Ac = 61% @ 0.60 = 0.36

11.8 Ac = 39% @ 0.67 = 0.26

0.62

Rev. 9-28-76

RUNOFF COMPUTATIONS

Sheet No. A-14

Project: MONARCH VILLAGE

Drainage Area No. A-7

Area = 3.76 acres

Maximum Overland Flow: L = 600' S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 10 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 = _____ min.

I = 189/(25+10) = _____ = 5.40

Q = CIA = (0.75) (5.40) (3.76) = 15.2 c.f.s.

C = C x Cf = 0.6 x 1.25 = 0.75

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

RUNOFF COMPUTATIONS

Sheet No. A-15

Project: MONARCH VILLAGE

Drainage Area No. A-8

Area = 7.84 acres

Maximum Overland Flow: L = 600' S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 10 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 = _____ min.

I = (39/(25+10)) = _____ = 5.40

Q = CIA = (1.00) (5.40) (7.84) = 42.3 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

PRELIMINARY DRAINAGE REPORT

for

MANZANO MANOR

A Subdivision
in

Albuquerque, New Mexico

Prepared By:

George E. Paul
N.M.P.E.& L.S. # 2544

Date:

November 7, 1969

A-16

PRELIMINARY DRAINAGE REPORT

INTRODUCTION:

The study, or "Project" area is situate in Section 22, T.10 N., R.4 E., N.M.P.M.; in the "Northeast Heights" portion of Albuquerque, N.M. It is bounded on the North by Albuquerque Public School Lands (Manzano High School), on the East by Chelwood Park Blvd., a dirt street; on the South by Copper Ave., a paved street with all City Utilities and on the West, by unplatted land under the same ownership as the project area.

Geologically, the Project is located on a portion of a vast Alluvial Fan, the result of outwash from numerous canyons on the Western slope of the Sandia Mountains, which lie about three miles directly East of the Project. The general character of the soil within the Project area and also the tributary drainage area, would best be described under Bureau of Public Roads classification "A-3", a clean sand & gravel mixture, with occasional colloidal deposits of Calcium Carbonate salts in fine, silty sand ("Caliche") which have a high plasticity, but occur in such small quantities as to be easily be combined with the sand-gravel soils, to achieve any desired stability or degree of compaction for road or foundation subgrade.

Erosion presents no major problem in the vicinity of the Project, since the surface of the Project area, as well as most of the watershed area leading to the Project, has moderate-to-good grass cover in the form of native range grass. Several small ephemeral streams carry storm runoff to the vicinity of the proposed development, but there are no major watercourses which affect this area. Although land to the East of the Project is presently not developed, a platted and recorded subdivision known as "Vista Oriente" exists there and streets in that subdivision are so platted as to intercept the greatest part of the runoff from the tributary drainage area serving Manzano Heights, and to divert that water to Copper Ave., about 1,000 feet East of the Project, whence such runoff would flow West on Copper Ave., along the South boundary of the Project, without damaging effect.

Directly North of the Project, a 30' easement for street purposes exists along the South boundary of Manzano High School. This would have been the School Board's share of right-of-way for future extension of Marquette Ave. However, the extension of that street adjacent to the school, would only create additional traffic and pedestrian hazards, and would result in a devaluation of any lots in this proposed Project, if such lots fronted on Marquette Ave. and faced the School land. It appears that the School Board would be wise to have their portion of this street easement vacated back to them as owners.

Through the Project, running diagonally Southeast-Northwest, A.T.&T. has Transcontinental transmission lines. Lots have been platted to provide access, while also "screening" that facility.

PRELIMINARY DRAINAGE REPORT

SCOPE:

Included in this Report are investigations of the drainage area tributary to the Project and also of drainage within the Project, itself; the latter item also being concerned with the means by which the drainage within the Project is to be handled as regards streets, easements, etc.

Portions of two (2) United States Geological Survey 0°-15' Quadrangle Maps are combined to provide the Location and Drainage Map for the Project. This is listed as "Exhibit 1." and follows the written section of this Report.

The method for handling drainage within the Project is discussed and illustrated,also. The illustration is listed as "Exhibit 2." and consists of a Planning Study and basic (5') Contour Map, scale 1"= 100', on which are superimposed flows (in cu.ft./sec.) and drainage areas (acres), with arrows indicating direction of flow.

Engineering calculations, using widely-accepted formulae and carefully-chosen criteria are used hereafter in this Report to make those determinations from which the final conclusions and recommendations are drawn.

CRITERIA TO BE USED FOR CALCULATION PURPOSES:

Storm Frequency:..... 100 Years

Runoff Coefficient:..... c = 0.65
(From the "Rational" Formula)

Rainfall Intensity (i):..... Based on Intensity-Duration Frequency Curves for the Albuquerque, N.M. Area; Sandia Conservancy District-1954.

(Note that above criteria for Storm Frequency and Runoff Coefficient exceed the minimum requirements of the Federal Housing Administration. In the event that this drainage study is submitted to the City of Albuquerque in conjunction with plat approval, the City's Master Plan of Drainage calls for streets to have a design carrying-capacity for runoff from a 100-year frequency storm and the City Engineer is also of the opinion that a runoff coefficient of 0.65 is a more realistic ratio of runoff to total rainfall.)

Formulae Used:

$Q = Aci$ ("Rational" Method) for determining runoff from Watershed area.

Formulae (Cont'd.):

$Q = a \cdot \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}}$ (Manning's Equation) for computing flow in open channels.

Additional Reference: SEELYE "DESIGN" Engineering Data Book; Tables and Nomograph on Pg. 5-00 for computing Overland Flow Time on Watershed areas.

CALCULATIONS:

Area (1): A small area whose drainage is collected by Marquette and Nambe Avenues in Vista Oriente Addition, immediately East of the Project. Actually the above streets are not graded out, but when graded will intercept runoff from the same area and carry it to Chelwood Blvd. at approximately the same area as shown on the Drainage Map.

A = 12.18 acres.

c = 0.65 (Ratio of Runoff/Total Rainfall)

i = Intensity in inches/hr., based on Inlet (Project Boundary) Time of Concentration, which is a combination of Overland (Sheet) Flow Time, plus Channel (Man-made or natural) Flow Time.

Overland Flow Time (from SEELYE, Pg.5-00) for max. length of 210 ft.; grade of 6.5% with average grass surface = 13.4 min.

Channel Flow Time (Manning Formula):

$V = \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}}$; where:

n = 0.050 for natural channel, winding; with some weeds and stones.

$R^{2/3} = 0.743$ for cross-sect. area 17.25 ft. and wetted perimeter of 26.80 ft.

$S^{\frac{1}{2}} = 0.2718$ for slope of 0.0739'/ft.

$V = \frac{1.486}{0.050} \cdot 0.743 \cdot 0.2718 = 6.01$ ft./sec.

Length of channel = 1370 ft: $\frac{1370}{6.01 \cdot 60} = 3.8$ min. Flow Time

Total Flow Time = 13.4 + 3.8 = 17.2 min.

CALCULATIONS (Cont'd.):

Area (1): From Sandia Conserv. Dist. Curves - Albuquerque Area (1954), for a 100-year storm with a Duration (Total Flow Time) of 17.2 minutes, Intensity (i) = 4.3 in./hr.

Then, Q = Aci = 12.18 • 0.65 • 4.3 = 34.04 cu. ft./sec.

Max. runoff for Area 1, from a 100-year storm.

Area (2): A larger area whose watershed extends well into a small canyon on the West slope of the Sandia Mountains. Although it is likely that future development to the East of the Project will eventually intercept much of the runoff from this Area and divert it South to Copper Ave., the calculations are made to show the potentially worst condition, in which no development would take place to the East for a number of years, and the existing watershed would continue to drain entirely, directly into this proposed Project area.

A = 261.17 acres.

c = 0.65 (Ratio of Runoff/Total Rainfall).

i = Intensity in inches/hr., as noted in calculations for Area (1).

Overland Flow Time, for a maximum length of 2,425 ft., at an average grade of 25%, with a ground condition varying between bare soil and hard-rock (From SEELYE, Pg.5-00) = 11.0 min. approx.

Channel Flow Time is computed as a summation of flows in three separate sections, due to different cross-sections, slopes and channel terrain conditions. Total length of channel is approximately 12,650 ft., of which Upper Section constitutes 1,600 ft., Middle Section constitutes 2,600 ft. and the remaining 8,450 feet complete the Lower Section.

Upper Section:

Cross-section area (a) = 36.75 sq.ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{36.75}{23.78} = 1.55$

Then, $R^{2/3} = 1.332$

CALCULATIONS (Cont'd.):

Area (2):

Gradient, or Slope of channel = 0.187

Then, $S^{\frac{1}{2}}$ = 0.3296

And, Roughness Coefficient (n) for a clean, but winding stream channel with some weeds and stones = 0.040.

$V = \frac{1.486}{0.040} \cdot 1.339 \cdot 0.3296 =$ 16.39 ft./sec.

Channel Flow Time = $\frac{1600}{16.39 \cdot 60}$ = 1.6 min. approx.

Middle Section:

Cross-section area (a) = 78.26 sq. ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{78.26}{66.41} = 1.18$

Then, $R^{2/3}$ = 1.117

Gradient, or Slope of channel = 0.085

Then, $S^{\frac{1}{2}}$ = 0.2915

And, Roughness Coefficient for channel remains 0.040

$V = \frac{1.486}{0.040} \cdot 1.117 \cdot 0.2915 =$ 12.10 ft./sec.

Channel Flow Time = $\frac{2600}{12.1 \cdot 60}$ = 3.6 min. approx.

Lower Section:

Cross-section area (a) = 113.6 sq.ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{113.6}{63.44} = 1.79$

Then, $R^{2/3}$ = 1.474

Gradient, or Slope of channel = 0.041

Then, $S^{\frac{1}{2}}$ = 0.2025

And, Roughness Coefficient (n) for channel increases to 0.050. (Winding Channel; weeds and stones; less effective grades and cross-sections).

$V = \frac{1.486}{0.050} \cdot 1.474 \cdot 0.2025 =$ 8.87 ft./sec.

Channel Flow Time = $\frac{8.450}{8.87 \cdot 60}$ = 15.9 min. approx.

CALCULATIONS (Cont'd.):

Area (2): Total Flow Time (Duration) = 11.0 + 1.6 + 3.6 + 15.9

= 32.1 minutes

From Sandia Conserv. Dist. Curves- Albuquerque Area (1954), for a 100-year storm with a Duration of 32.1 minutes, Intensity (i) = 3.12 in./hr.

Then, Q = Aci = 261.17 • 0.65 • 3.12 = 529.65 cfs

Max. Runoff for Area 2, from a 100- year storm.

Total anticipated flow to reach this Project from a 100-year frequency storm is: 34.04 + 529.65, or 563.69 cfs, from the two drainage areas computed.

Street-carrying capacity:

It will be noted from the contours on Exhibit 2, that Chelwood Park Blvd. has a fall of approximately 15 feet in 1,320 feet, along the East boundary of the Project. This amounts to a slope of 0.0114, from North to South. Chelwood Park Blvd. is designated a "Collector" type street by the City of Albuquerque, meaning that this street will be constructed 48 feet in width, face-to-face of curb, with City Standard 8" high curb, whenever it is paved.

Using the Manning Equation, with roughness coeff. (n) = 0.015, the carrying-capacity of a 48' wide street with no crown, on a slope of 0.0114, is:

$$Q = a \cdot \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}} = 32 \cdot \frac{1.486}{0.015} \cdot 0.75 \cdot 0.107$$

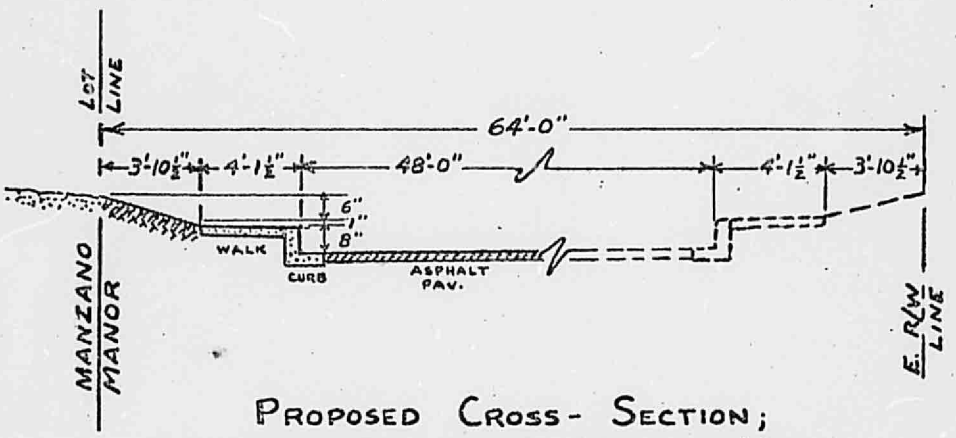
or,

Q = 253 cfs approx. This is obviously not sufficient to carry the anticipated 564 cfs (approx.) runoff from a 100-year storm, assuming Chelwood Park Blvd. would be made the water-carrier to intercept all drainage reaching the Project area. However, by raising the grade of all abutting lots to a Lot-Line elevation of 7" above top-of-curb, or 5" above gutter flow-line, and providing water-blocks 15" (1.25') in height along the West side of Chelwood Park Blvd. at each intersecting street (and alley) in the Project, the carrying-capacity of Chelwood can be increased to approx. 722 cfs, with all runoff still confined to the street

CALCULATIONS (Cont'd.):

Street-carrying capacity:

right-of-way. Shown below is a sketch giving a suggested cross-section for Chelwood Park Blvd. and adjacent property on the proposed Project:



PROPOSED CROSS-SECTION;
CHELWOOD PK. BLVD., N.E. AT MANZANO MANOR

(NOT TO SCALE)

There are many other means besides raising Lot grades as shown on the sketch, to protect the Lots from high water: Masonry unit screen walls (reinforced to meet City Building Code Requirements), or low concrete or masonry retainer walls at the Property Line would perform as well or better; although these alternates would be more costly to install. In any case, the 1.25 ft. water-block would be needed at both intersecting streets and at the alley, to prevent overflow from Chelwood, into the Project.

CALCULATIONS (Cont'd.):

Drainage Within The Project:

Exhibit 2 incorporates a Topographic Map with contours at 5' intervals (all elevations correspond to U.S.G.S. datum), and a Preliminary Layout Map indicating means for moving storm water through the Project.

The project boundaries contain seventeen separate drainage areas, the individual areas being broken down to show approximate drainage limits after lots are graded. However, this is not to be construed as any type of actual Grading Plan.

The general intent, as concerns handling of storm water through the Project, is to so grade the site that all external drainage will be prevented from entering the Project and only the runoff generated from rainfall on the site, itself, will need to be considered in designing street and lot grades within the subdivision. It has already been demonstrated in the preceding calculations, that, with construction of water-blocks and a slight raising of lot grades along Chelwood, all external drainage can be intercepted by Chelwood Park Blvd. and carried South to Copper Ave., where it will by-pass the Project.

Since sample calculations have been shown above, for all external drainage, the computed quantities for runoff within the Project will be shown below in Tabular form only, for simplification. The "Rational" Formula is again employed, and the resulting quantity, Q, in Column 5, is the product of Column 2 x Column 3 x Column 4. Column 1 carries the corresponding Area Designation shown on the Preliminary Layout Map:

1. Area Designation	2. Acreage (A)	3. Coeff. (c)	4. Intens.(i) 100-Year	5. Quantity (Q) Runoff
A	4.45	0.65	4.7	13.7
B	1.08	0.65	4.6	3.2
C	1.76	0.65	4.6	5.3
D	6.60	0.65	3.8	16.3
E	0.65	0.65	4.6	1.9
F	0.77	0.65	4.5	2.2
G	0.75	0.65	4.15	2.0
H	4.65	0.65	4.6	13.9
I	0.89	0.65	3.6	2.1

CALCULATIONS (Cont'd.):

Drainage Within The Project:

TABULATION OF CALCULATED RUNOFF WITHIN PROJECT

1. Area Designation	2. Acreage (A)	3. Coeff. (c)	4. Intens.(i) 100-Year	5. Quantity (Q) Runoff
J	1.76	0.65	4.2	4.8
K	2.52	0.65	5.03	8.2
L	0.78	0.65	4.03	2.0
M	2.16	0.65	4.36	6.1
N	2.01	0.65	5.25	6.9
O	2.03	0.95*	5.5	10.6
O_1	1.29	0.95*	5.5	6.7
P	2.50	0.65	5.04	8.2
Q	3.35	0.65	5.2	11.3

* Full paving anticipated in this area after development.

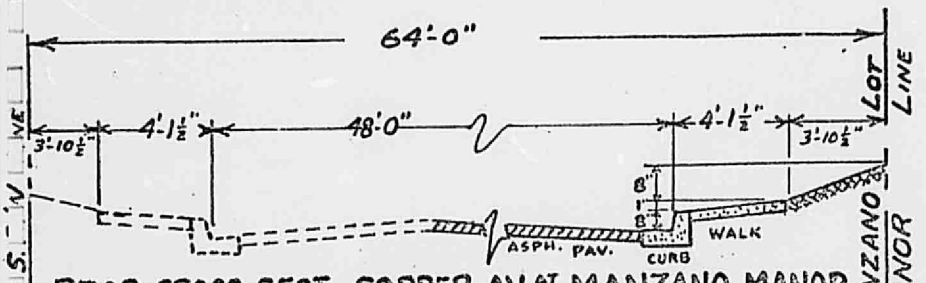
Taking the above-calculated runoff values from the respective drainage areas and combining them to form cumulative totals at successive intersections, it is seen on the Preliminary Layout Map (Exhibit 2.) that the worst condition for runoff occurs on the North-South street at the West end of the Project,also identified as Burma Drive, N.E. This street may be expected to receive a peak flow of 65.6 cfs. It has an average grade of 1.25%. A 32' curb-to-curb street with a 6" crown, on a slope of 0.0125, can carry 84.0 cfs, running full. Therefore, neither this street (Burma Drive) nor any other street within the Project is in any danger of overflow, during the period of peak runoff from a 100-year frequency storm.

To be considered, also, is the large accumulated flow on Copper Ave., N.E., along the South Boundary of the Project. This street can be expected to carry approximately 771 cfs maximum, in the vicinity of the Southwest corner of the Project.

CALCULATIONS (Cont'd.):

Drainage Within The Project
(Copper Ave., a perimeter street):

Copper Ave. is 48' in width, curb-to-curb; has a grade of approximately 3.35%. It is inadequate in width to carry the anticipated peak runoff without additional protective grading at lot-lines abutting this street. The sketch shown below gives a recommended cross-section, showing property-line elevations above existing curb and a calculation of carrying-capacity if these recommendations are followed:



PROP. CROSS-SECT.; COPPER AV. AT MANZANO MANOR (N.T.S.)

Cross-section Area: 55.0 sq.ft.

Hydraulic Radius ($\frac{a}{p}$): 0.837 ; $R^{2/3}$ = 0.888

Slope (Longitudinal): 0.0335; $S^{\frac{1}{2}}$ = 0.1831

Roughness Coefficient: n = 0.015

$Q = 55.0 \cdot \frac{1.486}{0.015} \cdot 0.888 \cdot 0.1831 =$ 883 cfs aproximate carrying-capacity within the street right-of-way.

Since 883 cfs capacity exceeds anticipated maximum runoff from a 100-year frequency storm of 771 cfs, the design may be considered adequate.

CONCLUSIONS AND RECOMMENDATIONS:

Of primary importance, it may be concluded from the preceding sets of calculations that this Project is in no danger from storm flooding, if some minor lot-grading is done along the Eastern and Southern perimeter streets, and water-blocks are established.

A-24

PRELIMINARY DRAINAGE REPORT

CONCLUSIONS AND RECOMMENDATIONS (Cont'd.):

It is also reasonable to conclude that a runoff coefficient of 0.65 is too high (conservative) for the undeveloped land presently comprising the tributary drainage areas for this Project; hence the computed maximum runoff figures indicate more flow than would likely occur. True, if the land is developed to the East of the Project, the ratio of runoff/rainfall could increase to a value of 0.65. However, future development will cause streets to be platted which will intercept some of the flow from the tributary drainage areas and divert it elsewhere. For example, construction of Tramway Blvd. between Interstate 40 and the North City Limits will cause these smaller drainageways to be intercepted one-half mile East of the Project and diverted South to Central Ave., or North to the Embudo Arroyo major drainageway, thus eliminating 70% or more, of the tributary drainage. An interceptor ditch is also planned by the City Engineer's office, which will intercept a major portion of the runoff East of Tramway Blvd. and South of the Embudo Arroyo drainage area; so the outlook for supplemental flood protection in the vicinity of this Project is good.

Since land development in this City has often shown erratic, "Leap Frog" patterns, it is not impossible for such development to occur along the habitable portions of the drainage areas leading to this Project, before major construction of interceptor ditches or improved arterial streets could take place. It is, therefore, believed that the precautionary measures indicated for lots abutting Copper Ave. and Chelwood Park Blvd. are reasonable and perhaps essential, and the same are recommended, herewith.

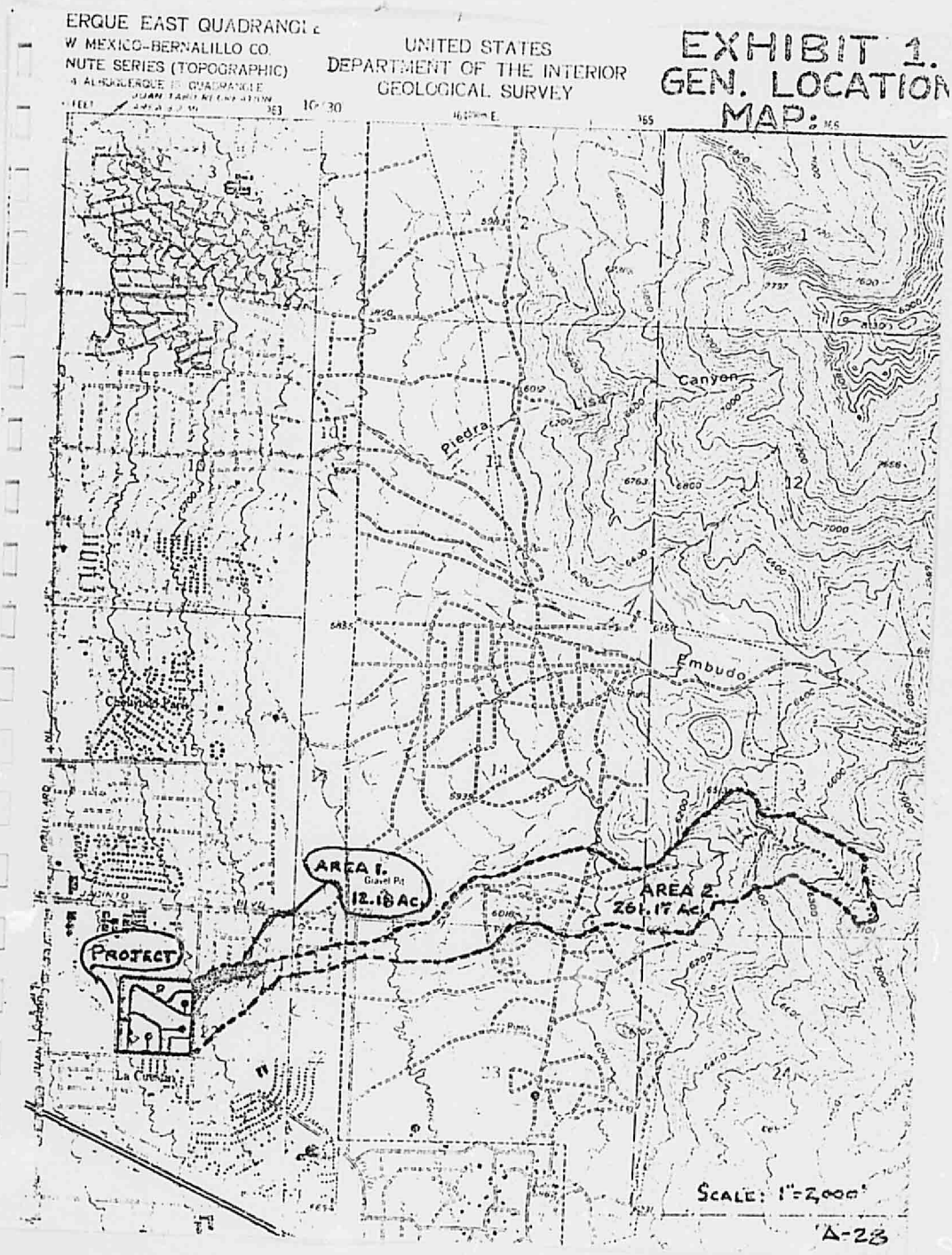
Within the Project, itself, no flood dangers exist from interior street and Lot platting; hence, no special measures are recommended for either Lots or streets inside Project boundaries.

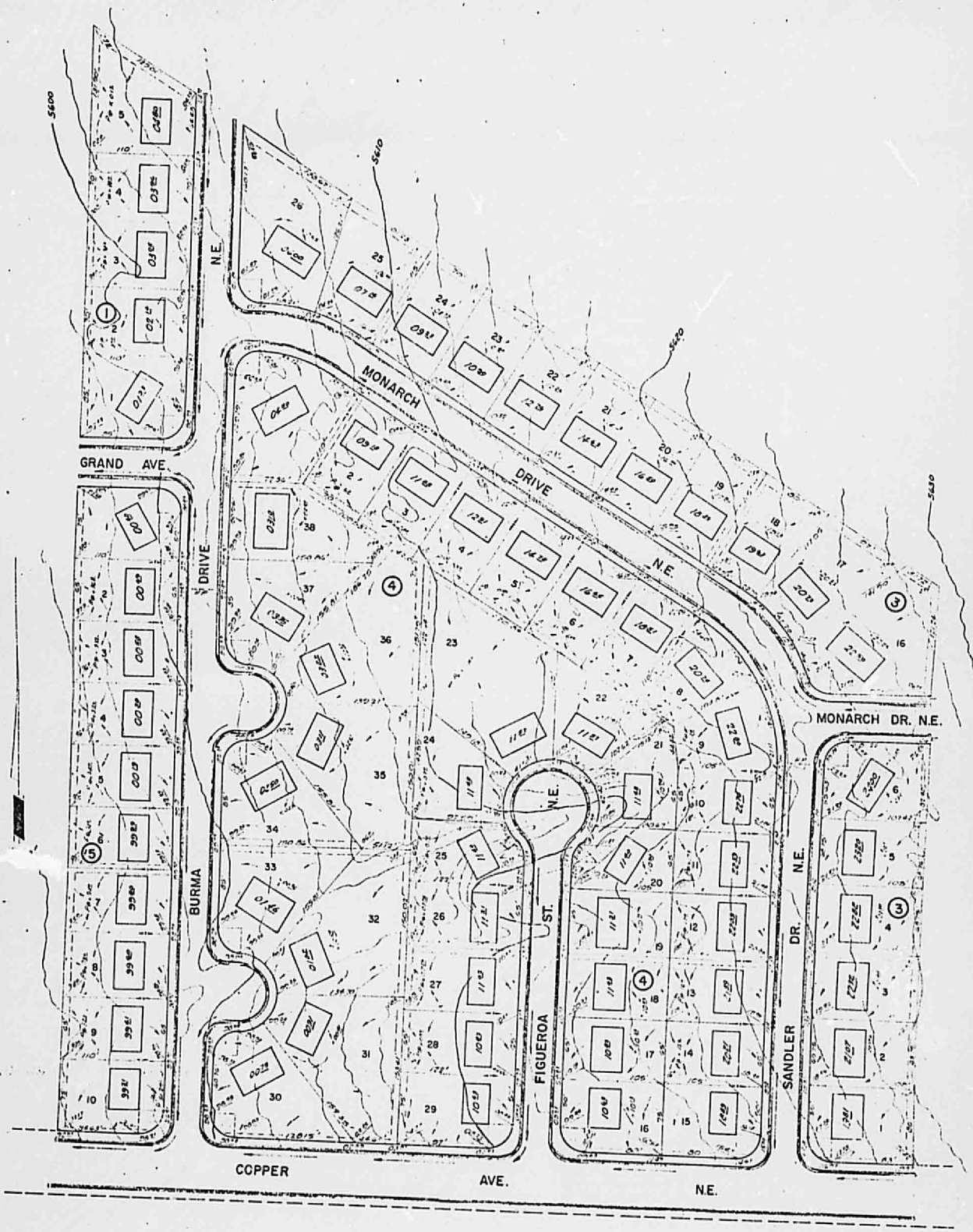
Respectfully Submitted,

George E. Paul

George E. Paul,
N.M.P.E.&L.S. # 2544

(SEAL)


ERQUE EAST QUADRANGLE
W MEXICO-BERNALILLO CO.
NUTE SERIES (TOPOGRAPHIC)
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
EXHIBIT 1.
GEN. LOCATION
MAP:
Canyon
Piedra
Lisa
Embudo
AREA 1.
Gravel Pit
12.18 Ac.
AREA 2.
261.17 Ac.
PROTECT
SCALE: 1"=2000'
A-28



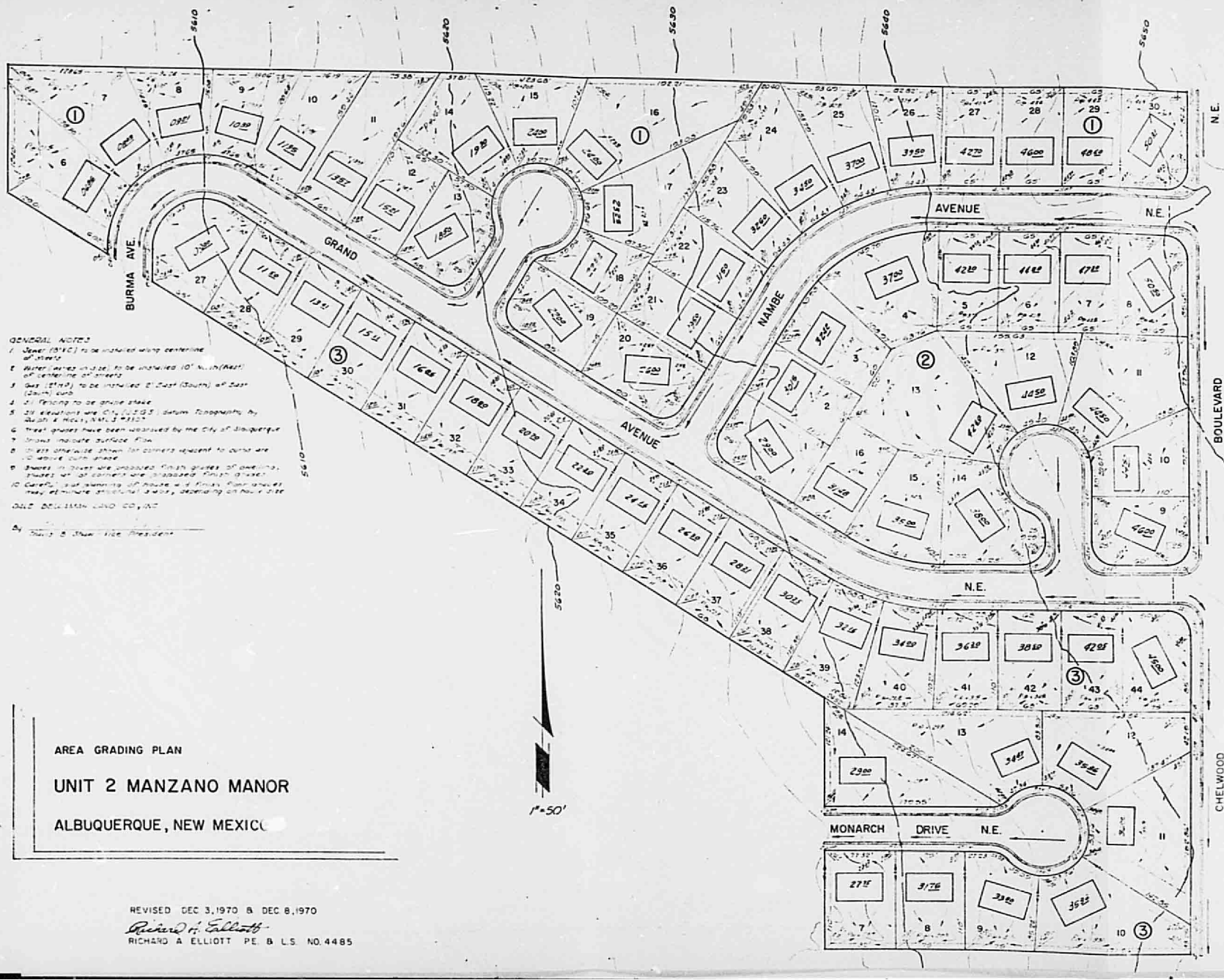
AREA GRADING PLAN

UNIT NO. 1 MANZANO MANOR

ALBUQUERQUE, NEW MEXICO

(UNLESS OTHERWISE SHOWN)

JULY 3, 1970



GENERAL NOTES

1. Sewer (S.S.C.) to be installed along centerline of streets
2. Water (W.L.) to be installed 10' N. or (East) of centerline of streets
3. Gas (G.L.) to be installed 5' East (South) of East (South) curb
4. All fencing to be grade stake
5. All elevations are City (U.S.G.S. datum. Topography by Ralph K. Hicks, N.M.L.S. #1157
6. Street grades have been established by the City of Albuquerque
7. Shows indicate surface flow
8. Unless otherwise shown lot corners adjacent to curbs are 12" above curb grade
9. Shades in sheet are proposed finish grades of one inch, shades on all corners are proposed finish grades
10. Careful, just planning of house and finish floor should be made at indicated structural grades, according on house size

DALE BELLMAN LAND CO., INC.

By _____
Travis B. Shaw - Vice President

AREA GRADING PLAN

UNIT 2 MANZANO MANOR

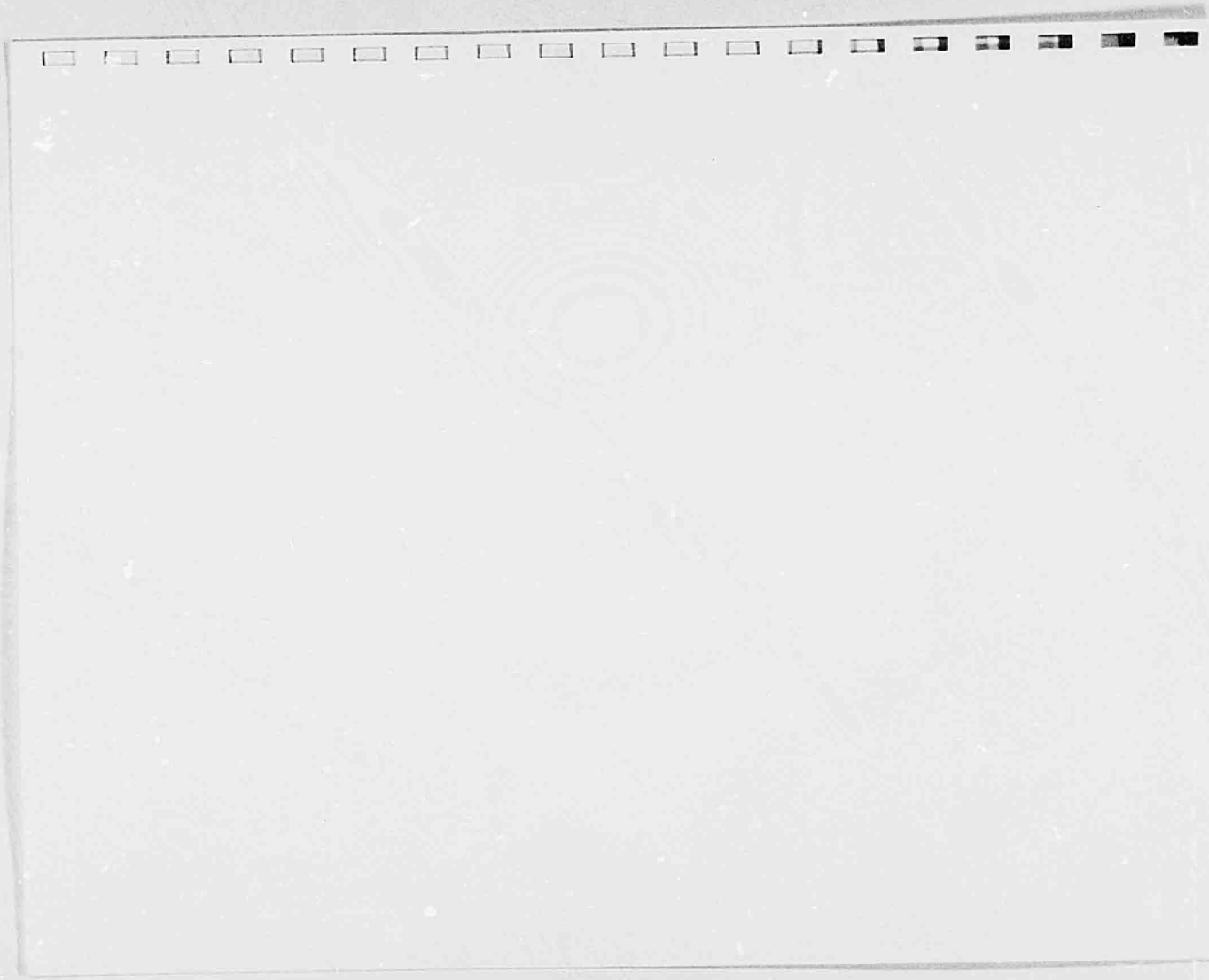
ALBUQUERQUE, NEW MEXICO

REVISED DEC 3, 1970 & DEC 8, 1970

Richard A. Elliott

RICHARD A. ELLIOTT P.E. & L.S. NO. 4485

Ralph K. Hicks & Assoc
200 Coal Ave. S.W.
Albuquerque, N.M.
May 27, 1970



DRAINAGE REPORT

FOR

THE REPLAT OF MONARCH VILLAGE

ALBUQUERQUE, NEW MEXICO

MAP NO. K-22

MURRAY-McCORMICK, INC.
ENVIRONMENTAL DESIGN
ECOSYSTEMS ANALYSIS · PLANNING · LAND SURVEYS · ENGINEERING

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

HYDROLOGY K22/D10 6 PLANS 2 of 2

DRAINAGE REPORT

FOR

THE REPLAT OF MONARCH VILLAGE

ALBUQUERQUE, NEW MEXICO

MAP NO. K-22

Prepared By

Murray-McCormick, Inc.
2601 Wyoming Boulevard N.E.
Albuquerque, New Mexico 87110
(505) 292-1936

November 29, 1976

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GENERAL SITE CHARACTERISTICS	2
DESIGN CRITERIA	3
ESTIMATED RUNOFF UNDEVELOPED STATE	3
ESTIMATED RUNOFF DEVELOPED STATE	4
SUMMARY OF RESULTS	5
RECOMMENDATIONS	6
SUMMARY	7

APPENDIX

Figure I - Vicinity & Location Map
Developed Drainage Characteristics Plan

Composite "C" Factor Calculations

Figure II - Typical Lot Drainage

Figure III - Time of Concentration for Small Drainage Basins

Figure IV - Intensity Duration Curves

Figure V - Offsite Watershed

Figure VI - 100 Year-6 Hour Precipitation

Reference Copy
Preliminary Drainage Report For
Manzano Manor By: George E. Paul
N.M.P.E. & L.S. #2544 Dtd. Nov. 7, 1969

DRAINAGE REPORT

MONARCH VILLAGE

PURPOSE

The purpose of this report is to describe the drainage characteristics of the proposed development and make recommendations for controlling the drainage such that urban planning for this area can be made safely and with a minimum of risk to life and property.

To achieve this objective, a two phase approach has been selected. In the initial phase the subject subdivision is analyzed in its undeveloped state thus determining the basic drainage characteristics of the area. The second phase considers the subdivision in its developed state. Recommendations are then made for design compliance to the requirements of the City of Albuquerque and the Albuquerque Metropolitan Arroyo Flood Control Authority.

INTRODUCTION

Monarch Village, a proposed R-1 development, is located within northeast heights of Albuquerque, north of Copper Avenue, east of Juan Tabo Boulevard, south of Manzano High School, and west of Manzano Manor subdivision, or more particularly the site is located within the SW 1/4 of the NW 1/4 of Section 22, T. 10 N., R. 4 E., N.M.P.M.

GENERAL SITE CHARACTERISTICS

The site encompassing 37.32 acres, more or less, slopes from northeast to southwest with an average slope of 3% to 4%. The surface soils are predominantly loose sands covered with a light growth of grass. Surrounding land use includes undeveloped land of similar characteristics on the north side and developed residential land on the east. Both Copper Avenue and Juan Tabo Boulevard on the south and west perimeter are improved.

Flow patterns crossing the subdivision include sheet flow and several small arroyos. Off-site flow from the east (Manzano Manor Subdivision) passes thru the subdivision and to the intersection of Copper Avenue and Juan Tabo Boulevard.

The drainage report covering Manzano Manor Subdivision considered the subdivision to contain no lot ponding. The subdivision, however, was constructed in accordance with an area grading plan dated May 27, 1970, and prepared by Ralph K. Hicks and Associates. This plan included ponding on selected lots. Due to this alteration, the report of George Paul was used as reference material and a re-evaluation of the Manzano West water shed draining to Monarch Village was undertaken. The results of that study appear in the Appendix, pages A-5 thru A-7 and Figure V.

The development of Manzano High School has intercepted the flow from the remaining upstream and off-site area of this watershed. This water is detained in the parking lot north of the subject site and then

discharged via existing storm sewer flowing west to Juan Tabo Boulevard. Thus no other off-site flows traverse the site. On-site precipitation flows to Copper Avenue and Juan Tabo Boulevard.

DESIGN CRITERIA

In analyzing the storm runoff, the Rational Formula, $Q = CIA\ C_f$, is used.[1].

Where:

Q = Runoff quantity in cubic feet/second.

A = Contributing area in acres.

C_f = Frequency Factor for Rational formula.

I = Intensity in inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from Figure IV, Intensity Duration Frequency Curves, Albuquerque Area 1961. (Note: Where a Time of Concentration (Tc) is less than ten minutes from Figure III, the intensity value equal to ten 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 in the form of sheet flow with general accumulation into several small arroyos. Off-site drainage from the east passes thru the subdivision. The total runoff in

---

1. See Bibliography; Item (4), paragraph 3.7

the undeveloped site forms the basis for comparison with the flow in the developed state.

Table 1

RUNOFF IN UNDEVELOPED STATE

Drainage Basin	Elev. Diff.	Length of Flow	Tc	I100 yr. in./hr.	C^2.	Area Acres	Q C.F.S.
On-Site	52	1700'	10	5.4	0.38	37.9	77.8
Off-Site	From Manzano Manor at Grand Ave. Prepared by George E. Paul N.M.P.E. & L.S. #2544 November 7, 1969						
	As modified by this report						42.8
			Total Undeveloped Runoff				120.6

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, on-site 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, sideyard, and in a majority of cases, one-half 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 AMAFCA's requirement that the runoff rate from the developed tract not exceed the runoff rate from the tract in its natural state.

2. See Appendix; Page A-1

For non-ponded runoff, a composite runoff coefficient[3] is developed based upon the percentage of different types of surfaces in the drainage area. The runoff coefficients for various surfaces are as follows:

Streets, Walks and Drives	C = 0.80
Roofs	C = 0.80
Lawns, sandy soils, (Average 2 to 7% slope)	C = 0.12

Table 2

RUNOFF IN DEVELOPED STATE

Area Designation	Acreage A	'C'[4]	I 100 year in./hr.	Q c.f.s.
A-1	5.25	0.70	4.40	16.2
A-2	1.52	0.63	5.25	5.0
A-3	4.26	0.67	--	--
A-4	0.69	0.71	4.97	2.4
A-5	2.93	0.63	5.10	9.4
A-6	0.95	0.58	5.40	3.0
A-7	3.76	0.75	5.40	15.2
A-8	8.56	1.00	5.40	46.2
A-2,A-3,A-4, A-5,A-6 and Offsite	28.5	0.62	4.20	74.2

SUMMARY OF RESULTS

Undeveloped Runoff (see Page 4) 77.8 c.f.s.

Developed Runoff -

Single Family Area

Area A-1 16.2 c.f.s.

Offsite + Area A-2 thru A-6 74.2

Less Offiste 42.8 31.4 c.f.s.

3. See Bibliography; Item (4), Table 3-2
4. The runoff coefficient shown is a composite of the percentages of ponded and non ponded lots - see Appendix page A-1.

Multi-Family Area	15.2 c.f.s.	
Permitted Discharge		7.50 c.f.s.
Commercial Area	46.2 c.f.s.	
Permitted Discharge		22.7 c.f.s.
Total Developed Discharge		77.8 c.f.s.

As shown above, the development of this project including the lot ponding will not increase the storm runoff over that occuring in the natural undeveloped state. Further, offsite flow entering the project on the east perimeter is to be conducted to Copper Avenue via Grand and Duchess Drive. This flow will then be conducted by Copper Avenue to the intersection with Juan Tabo. On-site flows from Areas A-1, A-7 and A-8 are conducted to the above intersection by Juan Tabo. The existing catch basin and storm drain systems in Copper Avenue and Juan Tabo currently do not have sufficient capacity for the present runoff from this watershed. As the development of this site will not increase runoff above the current "undeveloped" runoff level, it is not within the scope of this report nor the responsibility of the developer to provide determination of the adequacy of downstream facilities.

Tract A (Area A-7) is a proposed R-3 multiple family residential area. A "C" value of 0.75[1] was used for this area with no ponding and some grass planting for computations of runoff.

Tract B (Area A-8) is a proposed commercial development area. A "C" value of 1.00[1] was used with no on-site ponding.

1. See Appendix; Page A-1.2

RECOMMENDATIONS

The following recommendations are made to enable the developer of this site and the local government to complete this project within the framework required by the City of Albuquerque and A.M.A.F.C.A.:

1. Flows within the streets of the development are distributed so that only Grand Avenue-Duchess Drive assumes a major role in conveying off-site flows. This street should be graded at not less than 1.0% slope in order to insure adequate carrying capacity.

2. The ponding areas in each backyard should be situated toward the rear of the yard. There should be a minimum of five foot buffer zone between the rear property lines and the edge of the pond to protect any walls which might be constructed. In no case should ponded waters be allowed to stand against a wall or house foundation.

3. Ponds should average 6" deep and the minimum surface area should not be less than 20%[5]. of the total area drained into the pond.

4. As the analysis of the commercial and multi-family area is predicated on estimated runoff coefficients and at this time no site plans for these areas have been prepared, the flows from these areas have been expressed as permitted discharges after development. It is recommended that at the time of development of each individual parcel, sufficient ponding, and/or detention be provided to limit the flow from each site to the amount shown.

5. See Figure 6

SUMMARY

The subject property, by utilizing backyard ponding on single family lots and outlet control in the multi-family and commercial areas, will contribute no more surface runoff to surrounding areas than that which existed before development.

In conclusion, the development of this site should have a beneficial effect on the drainage characteristics of this area, and can be developed safely with no harm to life or property.

Respectfully submitted,

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

APPENDIX

COMPOSITE RUNOFF COEFFICIENTS

Undeveloped Land

C = 0.30[1]. x 1.25[2]. = 0.38

Developed Land

Typical Lot Area

Gross Area			37.93 Ac.
Less:	Tract A	3.76 Ac.	
	Tract B	8.56 Ac.	
	Area in Streets	5.70	
Area in Lots			19.91 Ac.
Average Lot Area (92 Lots)			9,400 Sq.Ft.
Typical lot width			65 Ft.

Ponded Lots

C = 0.80	Streets & Walk Area	20x65	1,300 S.F.
	Roof Area	20x55	1,100 S.F.
	Driveway	25x15	375 S.F.
	Total Impervious Area		2,775 S.F.
C = 0.12	Front and Side Yards		2,925 S.F.
	Less Roof Area		-1,100 S.F.
	Less Driveway		- 375 S.F.
	Total Pervious Area		1,450 S.F.

Impervious Area	2775 Sq.Ft.	66% @ 0.80	0.528
Pervious Area	1450 Sq.Ft.	34% @ 0.12	0.041
Total Area	4225 Sq.Ft.	100%	0.569

Composite Runoff Coefficient - C x C_f = 0.57 x 1.25 = 0.71

1. See Bibliography; Item (1) Table XII
2. See Bibliography; Item (4) Article 3.7

Non-Ponded Lots

C = 0.80	Streets & Walk Area	20x65	1300 S.F.
	Roof Area	40x55	2200 S.F.
	Driveway	25x15	375 S.F.
	Total Impervious Area		3875 S.F.
C = 0.12	Total Lot Area		9400 S.F.
	Less Roof Area		-2200 S.F.
	Less Driveway		- 375 S.F.
	Total Pervious Area		6285 S.F.

Impervious Area	3875 Sq.Ft.	36% @ 0.80	0.288
Pervious Area	6825 Sq.Ft.	64% @ 0.12	0.077
Total Area	10700 Sq.Ft.	100%	0.365

Composite Runoff Coefficient - $C \times C_f = 0.37 \times 1.25 = 0.46$

Multiple Family Area

C = 0.60 x 1.25 = 0.75

Commercial Area

C = 0.80 x 1.25 = 1.00

PONDING REQUIREMENTS

Typical Lot Area

Draining to Pond	6,150 S.F.
Average Lot Area	9,400 S.F.
Less: Front & Side Yards	3,250 S.F.
Roof Area 20 x 55	1,100 S.F.
Patio Area	100 S.F.
Lawn Area	3,025 S.F.

Runoff Coefficient

Impervious Area	1200 S.F.	20% @ 0.80	0.16
Pervious Area	4950 S.F.	80% @ 0.12	0.10
			0.26

$C \times C_1 = 0.26 \times 1.25 = 0.33$

Pond Volume Requirement

100 year 6-hour precipition = 2.6 in.

Volume = Runoff coefficient x area x precipitation

V - 0.33 x 6150 x 0.25 = 507 cu.ft.

Depth of pond 0.50 ft. (6")

Minimum area of pond 1014 sq.ft.

Pond area as a percentage of area drained = 17% - use 20%

V = 20% x 6150 sq.ft. x 0.5 ft. = 615 cu.ft.

BIBLIOGRAPHY OF REFERENCES

(1) Herkenhoff, Gordon & Associates, "Master Plan of Drainage City of Albuquerque, New Mexico and Environs, 1963". Albuquerque; Gordon Herkenhoff & Associates, Consulting Engineers.

(2) Paul, George E., "Drainage Study - Manzano Manor Subdivision" Albuquerque: George E. Paul, N.M.P.E. & L.S. #2544 November 1969

(3) U.S. Department of Commerce, "Technical Paper, No. 40, Rainfall Frequency Atlas of the United States", Washington, D.C., U.S. Government Printing Office, 1963.

(4) Wright-McLaughlin Engineers, "Urban Storm Drainage Criteria Manual, Volume 1", Denver, Colorado: Wright-McLaughlin Engineers, 1969.

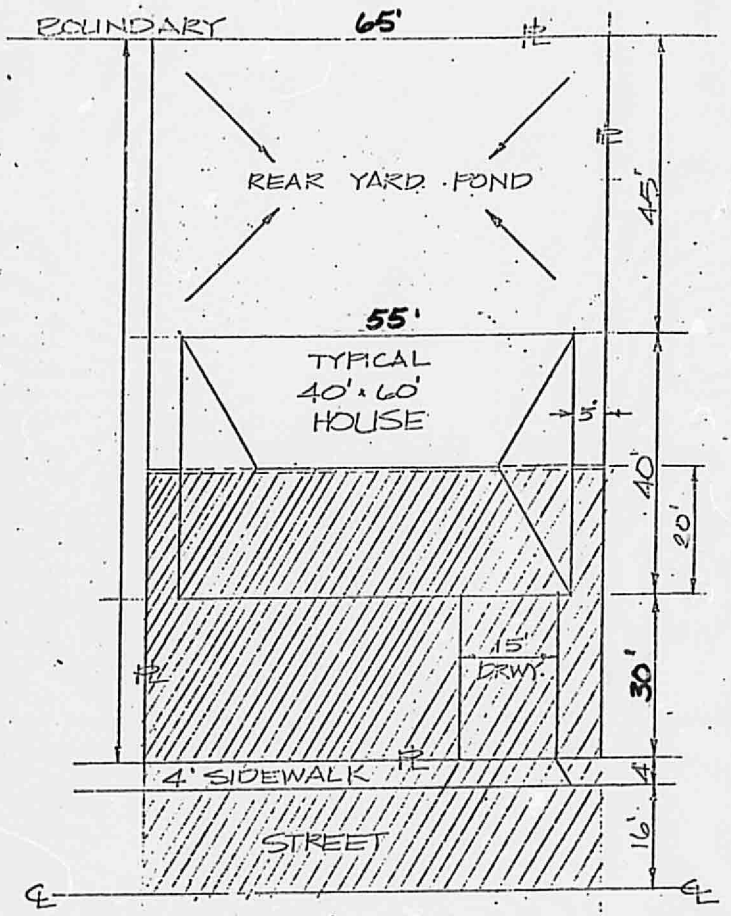

FIGURE II
TYPICAL LOT DRAINAGE

A-2

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JOB NO. _____ DATE 8-24-76

PROJECT MONARCH VILLAGE

REV 9-28-76 SCALE _____

*Reproduced from Miscellaneous Publication No 204, U.S. Dept. of Agriculture, by David L. Yarnell.
†Adapted from Engineering Manual of the War Department, Part VIII, Chap. I, Dec. '45.

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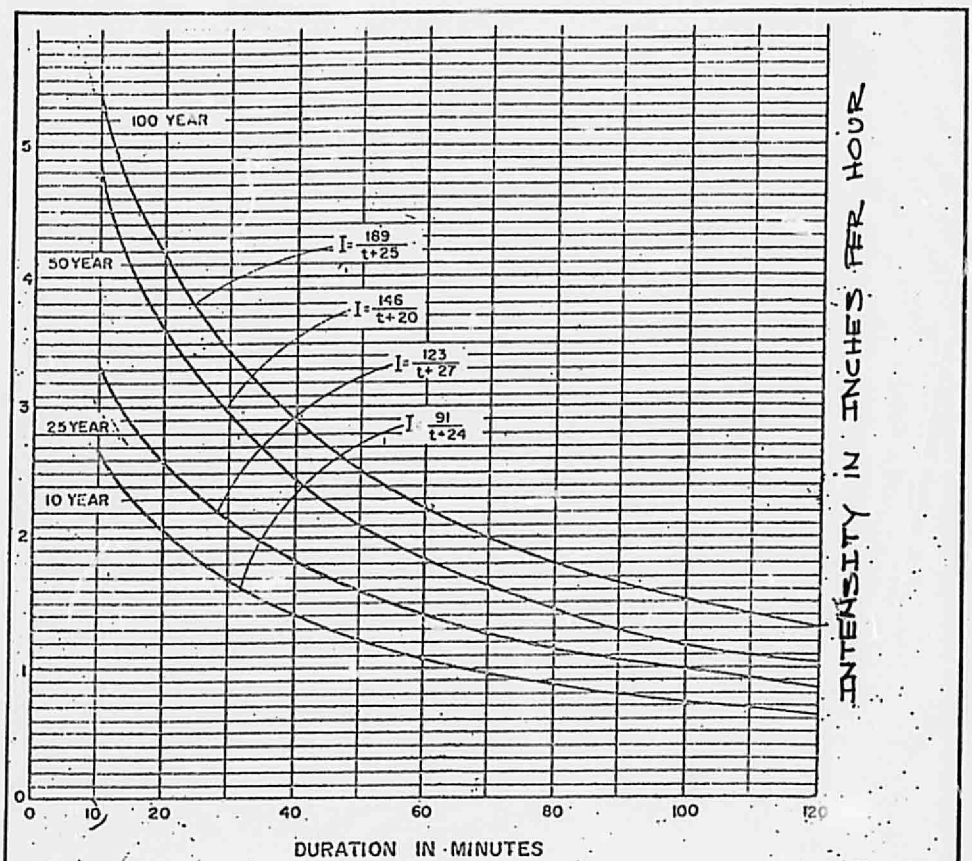
PROJECT MONARCH VILLAGE
SCALE _____



A-4

FIGURE IV

INTENSITY - DURATION CURVES

MASTER PLAN OF DRAINAGE CITY OF ALBUQUERQUE - NEW MEXICO AND ENVIRONS	
INTENSITY DURATION FREQUENCY CURVES (ALBUQUERQUE AREA - 1961)	
GORDON HERKENHOFF & ASSOC. CONSULTING ENGINEERS	CHART

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JOB NO. _____ DATE 8-24-76

PROJECT MONARCH VILLAGE

SCALE _____

RUNOFF COMPUTATIONS

Sheet No. A-5

Project: MONARCH VILLAGE

Drainage Area No. OFF-SITE

Area = OI = 3.33 acres

Maximum Overland Flow: L = 180 L.F. S = 2.00%

Maximum Channel Flow:

Channel No. 1 L = 600 L.F. S = 3.3%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 9.5 min.

Channel No. 1 Flow:

Velocity = 3.0 ft/sec; Time = $\frac{200}{X\ 60}$ = 3.33 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 12.8 min.

I = 184/(13+8.5) = 4.40

Q = CIA = (.60) (4.37) (3.33) = 8.79 c.f.s.

Date: 1-16-76

Comp. by: [illegible]

Checked by: _____

RUNOFF COMPUTATIONS

Sheet No. L-6

Project: MOELLER VILLAGE

Drainage Area No. OFF-SITE

Area = $Q_I + Q_{II} + Q_{III}$ = 10.4 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 600' S = 2.5%

Channel No. 2 L = 350' S = 1.5%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 12.8 min.

Channel No. 1 Flow:

Velocity = 4.2 ft/sec; Time = $\frac{143}{X\ 60}$ = 2.4 min.

Channel No. 2 Flow:

Velocity = 3.6 ft/sec; Time = $\frac{97}{X\ 60}$ = 1.6 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 16.8 min.

I = (18.7/(17+25)) = _____ = 4.50

Q = CIA = (0.6) (4.50) (10.4) = 28.08 c.f.s.

Date: 7-16-76

Comp. by: [signature]

Checked by: _____

Rev. 9-28-76

RUNOFF COMPUTATIONS

Sheet No. A-7

Project: MONARCH VILLAGE

Drainage Area No. OFFSITE

Area = $\frac{O_I + O_{II} + O_{III} + O_{IV}}{+O_V}$ = 18.1 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 250 S = 2.0%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 16.8 min.

Channel No. 1 Flow:

Velocity = 4.2 ft/sec; Time = $\frac{60}{X\ 60}$ = 1 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 17.8 min.

I = 183/(18+25) = _____ = 4.40

Q = CIA = (.6) (4.40) (18.1) = 47.78 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

Rev. 1-25-76

RUNOFF COMPUTATIONS

Sheet No. A-8

Project: MONARCH [illegible]

Drainage Area No. A1

Area = 5.25 acres

Maximum Overland Flow: L = 200' S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = 400' S = 2.00%

Channel No. 2 L = 550' S = 3.00%

Channel No. 3 L = 450' S = 3.50%

Accumulation Time

Overland Flow or Inlet Time: 12 min.

Channel No. 1 Flow:

Velocity = [illegible] ft/sec; Time = ____ / X 60 = 1.9 min.

Channel No. 2 Flow:

Velocity = 4.0 ft/sec; Time = ____ / X 60 = [illegible] min.

Channel No. 3 Flow:

Velocity = 4.2 ft/sec; Time = ____ / X 60 = 1.8 min.

Total Accumulation Time: T = 18.0 min.

I = 100/(25+18) = ____ = 4.40

Q = CIA = (0.70) (4.40) (5.25) = 16.2 c.f.s.

Date: 9-16-76 Rev. 11-29-76

Comp. by: [signature]

Checked by: ____

88% Pond [illegible] = 0.11 0.62

12% Non P[illegible] = [illegible] 0.06

0.68

4.77 Δc = 91% C 0.68 = 0.62

0.48 Δc = 9% C 0.95 = 0.08

0.70 C

Rev. 9-28-76

RUNOFF COMPUTATIONS

Sheet No. A9

Project: MONARCH VILLAGE

Drainage Area No. A-2

Area = 1.52 acres

Maximum Overland Flow: L = 150' S = 4.00%

Maximum Channel Flow:

Channel No. 1 L = 100' S = 0.50%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 10 min.

Channel No. 1 Flow:

Velocity = 2.0 ft/sec; Time = _____ / X 60 = 0.8 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 = 10.8 min.

I = (88/(25+T)) = _____ = 5.25

Q = CIA = (0.63) (5.25) (1.52) = 5.02 c.f.s.

Date: 7-16-76

Comp. by: W.J.

Checked by: _____

71% Paved @ 0.71 = 0.50

29% Non-Pvd @ 0.46 = 0.13

0.63

RUNOFF COMPUTATIONS

Sheet No. A10

Project: MONARCH VILLAGE

Drainage Area No. A-4

Area = 0.69 acres

Maximum Overland Flow: L = 200' S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = 150' S = 3.00%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 12 min.

Channel No. 1 Flow:

Velocity = 3.5 ft/sec; Time = _____ / X 60 = 0.07 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 = 12.7 min.

I = 159/(25+13) = _____ = 4.97

Q = CIA = (0.71) (4.97) (0.69) = 2.43 c.f.s.

Date: 9-16-76 Rev 11-29-76

Comp. by: [illegible]

Checked by: _____

100% Ponded C 0.71 = 0.71

RUNOFF COMPUTATIONS

Sheet No. A11

Project: MONARCH VILLAGE

Drainage Area No. A-5

Area = 2.93 acres

Maximum Overland Flow: L = 100' S = 4.00%

Maximum Channel Flow:

Channel No. 1 L = 1760' S = 3.00%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 8.5 min.

Channel No. 1 Flow:

Velocity = 3.5 ft/sec; Time = $\frac{\quad}{\text{X } 60}$ = 3.6 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 12.1 min.

I = 189/(25+12) = _____ = 5.10

Q = CIA = (0.63) (5.10) (2.93) = 9.4 c.f.s.

Date: 9-16-76 r.d. 11-29-76

Comp. by: [signature]

Checked by: _____

67% Paved @ 0.71 = 0.48

33% Non-Paved @ 0.4 = 0.15

0.63

RUNOFF COMPUTATIONS

Sheet No. A12

Project: MONARCH VILLAGE

Drainage Area No. A-6

Area = 0.95 acres

Maximum Overland Flow: L = 120' S = 4.00%

Maximum Channel Flow:

Channel No. 1 L = 160% S = 3.50%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 9.5 min.

Channel No. 1 Flow:

Velocity = 3.2 ft/sec; Time = $\frac{\quad}{X\ 60}$ = 0.9 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 10.4 min.

I = 18÷(25+10) = _____ = 5.40

Q = CIA = (0.58) (5.40) (0.95) = 3.0 c.f.s.

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

50% Ponded @ 71 0.36

50% Non Ponded @ 0.4% 0.22

0.58

RUNOFF COMPUTATIONS

Sheet No. A-13

Project: MONARCH VILLAGE

Drainage Area No. OFF-SITE + A-2, A-3, A-4, A-5, A-6

Area = 18.1 + 10.4 = 28.5 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 400' S = 3.20%

Channel No. 2 L = 250' S = 1.80%

Channel No. 3 L = 550 S = 1.30%

Accumulation Time

Overland Flow or Inlet Time: 16.8 min.

Channel No. 1 Flow:

Velocity = 6.8 ft/sec; Time = $\frac{96}{X\ 60}$ = 0.98 min.

Channel No. 2 Flow:

Velocity = 6.0 ft/sec; Time = $\frac{42}{X\ 60}$ = 0.7 min.

Channel No. 3 Flow:

Velocity = 5.6 ft/sec; Time = $\frac{98}{X\ 60}$ = 1.6 min.

Total Accumulation Time: T = 20.0 min.

I = 18/(25+20) = _____ = 4.2

Q = CIA = (0.62) (4.20) (28.5) = 74.2 c.f.s.

Date: 9-16-76 / Rev. 11-29-76

Comp. by: [illegible]

Checked by: _____

77% Ponded @ 0.71 = 0.56

23% Now Pond @ 0.46 = 0.11

0.67

18.1 Ac = 61% @ 0.60 = 0.36

11.8 Ac = 39% @ 0.67 = 0.26

0.62

Rev. 9-23-76

RUNOFF COMPUTATIONS

Project: MONARCH VILLAGE Sheet No. A-14

Drainage Area No. A-7

Area = 3.76 acres

Maximum Overland Flow: L = 600' S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 10 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 = _____ min.

I = 189/(25+10) = _____ = 5.40

Q = CIA = (0.75) (5.40) (3.76) = 15.2 c.f.s.

C = C x Cf = 0.6 x 1.25 = 0.75

Date: 9-16-76

Comp. by: [signature]

Checked by: _____

RUNOFF COMPUTATIONS

Sheet No. A-15

Project: MONARCH VILLAGE

Drainage Area No. A-8

Area = 8.56 acres

Maximum Overland Flow: L = 720' S = 3.00%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow or Inlet Time: 15 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 = _____ min.

I = (80)/(25+10) = _____ = 5.40

Q = CIA = (1.00) (5.40) (8.56) = 46.2 c.f.s.

Date: 9-16-76 Rev 11-29-76

Comp. by: [signature]

Checked by: _____

PRELIMINARY DRAINAGE REPORT

for

MANZANO MANOR

A Subdivision
in

Albuquerque, New Mexico

Prepared By:

George E. Paul
N.M.P.E.& L.S. # 2544

Date:

November 7, 1969

A-16

PRELIMINARY DRAINAGE REPORT

INTRODUCTION:

The study, or "Project" area is situate in Section 22, T.10 N., R.4 E., N.M.P.M.; in the "Northeast Heights" portion of Albuquerque, N.M. It is bounded on the North by Albuquerque Public School Lands (Manzano High School), on the East by Chelwood Park Blvd., a dirt street; on the South by Copper Ave., a paved street with all City Utilities and on the West, by unplatted land under the same ownership as the project area.

Geologically, the Project is located on a portion of a vast Alluvial Fan, the result of outwash from numerous canyons on the Western slope of the Sandia Mountains, which lie about three miles directly East of the Project. The general character of the soil within the Project area and also the tributary drainage area, would best be described under Bureau of Public Roads classification "A-3", a clean sand & gravel mixture, with occasional colloidal deposits of Calcium Carbonate salts in fine, silty sand ("Caliche") which have a high plasticity, but occur in such small quantities as to be easily be combined with the sand-gravel soils, to achieve any desired stability or degree of compaction for road or foundation subgrade.

Erosion presents no major problem in the vicinity of the Project, since the surface of the Project area, as well as most of the watershed area leading to the Project, has moderate-to-good grass cover in the form of native range grass. Several small ephemeral streams carry storm runoff to the vicinity of the proposed development, but there are no major watercourses which affect this area. Although land to the East of the Project is presently not developed, a platted and recorded subdivision known as "Vista Oriente" exists there and streets in that subdivision are so platted as to intercept the greatest part of the runoff from the tributary drainage area serving Manzano Heights, and to divert that water to Copper Ave., about 1,000 feet East of the Project, whence such runoff would flow West on Copper Ave., along the South boundary of the Project, without damaging effect.

Directly North of the Project, a 30' easement for street purposes exists along the South boundary of Manzano High School. This would have been the School Board's share of right-of-way for future extension of Marquette Ave. However, the extension of that street adjacent to the school, would only create additional traffic and pedestrian hazards, and would result in a devaluation of any lots in this proposed Project, if such lots fronted on Marquette Ave. and faced the School land. It appears that the School Board would be wise to have their portion of this street easement vacated back to them as owners.

Through the Project, running diagonally Southeast-Northwest, A.T.&T. has Transcontinental transmission lines. Lots have been platted to provide access while also "screening" that facility

PRELIMINARY DRAINAGE REPORT

SCOPE:

Included in this Report are investigations of the drainage area tributary to the Project and also of drainage within the Project, itself; the latter item also being concerned with the means by which the drainage within the Project is to be handled as regards streets, easements, etc.

Portions of two (2) United States Geological Survey 0^{o}-15' Quadrangle Maps are combined to provide the Location and Drainage Map for the Project. This is listed as "Exhibit 1." and follows the written section of this Report.

The method for handling drainage within the Project is discussed and illustrated,also. The illustration is listed as "Exhibit 2." and consists of a Planning Study and basic (5') Contour Map, scale 1"= 100', on which are superimposed flows (in cu.ft./sec.) and drainage areas (acres), with arrows indicating direction of flow.

Engineering calculations, using widely-accepted formulae and carefully-chosen criteria are used hereafter in this Report to make those determinations from which the final conclusions and recommendations are drawn.

CRITERIA TO BE USED FOR CALCULATION PURPOSES:

Storm Frequency:..... 100 Years

Runoff Coefficient:..... c = 0.65
(From the "Rational" Formula)

Rainfall Intensity (i):..... Based on Intensity-Duration Frequency Curves for the Albuquerque, N.M. Area; Sandia Conservancy District-1954.

(Note that above criteria for Storm Frequency and Runoff Coefficient exceed the minimum requirements of the Federal Housing Administration. In the event that this drainage study is submitted to the City of Albuquerque in conjunction with plat approval, the City's Master Plan of Drainage calls for streets to have a design carrying-capacity for runoff from a 100-year frequency storm and the City Engineer is also of the opinion that a runoff coefficient of 0.65 is a more realistic ratio of runoff to total rainfall.)

Formulae Used:

$Q = Aci$ ("Rational" Method) for determining runoff from Watershed area.

Formulae (Cont'd.):

$Q = a \cdot \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}}$ (Manning's Equation) for computing flow in open channels.

Additional Reference: SEELYE "DESIGN" Engineering Data Book; Tables and Nomograph on Pg. 5-00 for computing Overland Flow Time on Watershed areas.

CALCULATIONS:

Area (1): A small area whose drainage is collected by Marquette and Nambe Avenues in Vista Oriente Addition, immediately East of the Project. Actually the above streets are not graded out, but when graded will intercept runoff from the same area and carry it to Chelwood Blvd. at approximately the same area as shown on the Drainage Map.

A = 12.18 acres.

c = 0.65 (Ratio of Runoff/Total Rainfall)

i = Intensity in inches/hr., based on Inlet (Project Boundary) Time of Concentration, which is a combination of Overland (Sheet) Flow Time, plus Channel (Man-made or natural) Flow Time.

Overland Flow Time (from SEELYE, Pg.5-00) for max. length of 210 ft.; grade of 6.5% with average grass surface = 13.4 min.

Channel Flow Time (Manning Formula):

$V = \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}}$; where:

n = 0.050 for natural channel, winding; with some weeds and stones.

$R^{2/3} = 0.743$ for cross-sect. area 17.25 ft. and wetted perimeter of 26.80 ft.

$S^{\frac{1}{2}} = 0.2718$ for slope of 0.0739'/ft.

$V = \frac{1.486}{0.050} \cdot 0.743 \cdot 0.2718 = 6.01$ ft./sec.

Length of channel = 1370 ft: $\frac{1370}{6.01 \cdot 60} = 3.8$ min. Flow Time

Total Flow Time = 13.4 + 3.8 = 17.2 min.

PRELIMINARY DRAINAGE REPORT

CALCULATIONS (Cont'd.):

Area (1): From Sandia Conserv. Dist. Curves - Albuquerque Area (1954), for a 100-year storm with a Duration (Total Flow Time) of 17.2 minutes, Intensity (i) = 4.3 in./hr.

Then, Q = Aci = 12.18 • 0.65 • 4.3 = 34.04 cu. ft./sec.

Max. runoff for Area 1, from a 100-year storm.

Area (2): A larger area whose watershed extends well into a small canyon on the West slope of the Sandia Mountains. Although it is likely that future development to the East of the Project will eventually intercept much of the runoff from this Area and divert it South to Copper Ave., the calculations are made to show the potentially worst condition, in which no development would take place to the East for a number of years, and the existing watershed would continue to drain entirely, directly into this proposed Project area.

A = 261.17 acres.

c = 0.65 (Ratio of Runoff/Total Rainfall).

i = Intensity in inches/hr., as noted in calculations for Area (1).

Overland Flow Time, for a maximum length of 2,425 ft., at an average grade of 25%, with a ground condition varying between bare soil and hard-rock (From SEELYE, Pg.5-00) = 11.0 min. approx.

Channel Flow Time is computed as a summation of flows in three separate sections, due to different cross-sections, slopes and channel terrain conditions. Total length of channel is approximately 12,650 ft., of which Upper Section constitutes 1,600 ft., Middle Section constitutes 2,600 ft. and the remaining 8,450 feet complete the Lower Section.

Upper Section:

Cross-section area (a) = 36.75 sq.ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{36.75}{23.78} = 1.55$

Then, $R^{2/3} = 1.339$

PRELIMINARY DRAINAGE REPORT

CALCULATIONS (Cont'd.):

Area (2):

Gradient, or Slope of channel = 0.187

Then, $S^{\frac{1}{2}}$ = 0.3296

And, Roughness Coefficient (n) for a clean, but winding stream channel with some weeds and stones = 0.040.

$V = \frac{1.486}{0.040} \cdot 1.339 \cdot 0.3296 = 16.39$ ft./sec.

Channel Flow Time = $\frac{1600}{16.39 \cdot 60}$ = 1.6 min. approx.

Middle Section:

Cross-section area (a) = 78.26 sq. ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{78.26}{66.41} = 1.18$

Then, $R^{2/3}$ = 1.117

Gradient, or Slope of channel = 0.085

Then, $S^{\frac{1}{2}}$ = 0.2915

And, Roughness Coefficient for channel remains 0.040

$V = \frac{1.486}{0.040} \cdot 1.117 \cdot 0.2915 = 12.10$ ft./sec.

Channel Flow Time = $\frac{2600}{12.1.60}$ = 3.6 min. approx.

Lower Section:

Cross-section area (a) = 113.6 sq.ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{113.6}{63.44} = 1.79$

Then, $R^{2/3}$ = 1.474

Gradient, or Slope of channel = 0.041

Then, $S^{\frac{1}{2}}$ = 0.2025

And, Roughness Coefficient (n) for channel increases to 0.050. (Winding Channel; weeds and stones; less effective grades and cross-sections).

$V = \frac{1.486}{0.050} \cdot 1.474 \cdot 0.2025 = 8.87$ ft./sec.

Channel Flow Time = $\frac{8.450}{8.87 \cdot 60}$ = 15.9 min. approx.

CALCULATIONS (Cont'd.):

Area (2): Total Flow Time (Duration) = 11.0 + 1.6 + 3.6 + 15.9

= 32.1 minutes

From Sandia Conserv. Dist. Curves- Albuquerque Area (1954), for a 100-year storm with a Duration of 32.1 minutes, Intensity (i) = 3.12 in./hr.

Then, Q = Aci = 261.17 • 0.65 • 3.12 = 529.65 cfs

Max. Runoff for Area 2, from a 100- year storm.

Total anticipated flow to reach this Project from a 100-year frequency storm is: 34.04 + 529.65, or 563.69 cfs, from the two drainage areas computed.

Street-carrying capacity:

It will be noted from the contours on Exhibit 2, that Chelwood Park Blvd. has a fall of approximately 15 feet in 1,320 feet, along the East boundary of the Project. This amounts to a slope of 0.0114, from North to South. Chelwood Park Blvd. is designated a "Collector" type street by the City of Albuquerque, meaning that this street will be constructed 48 feet in width, face-to-face of curb, with City Standard 8" high curb, whenever it is paved.

Using the Manning Equation, with roughness coeff. (n) = 0.015, the carrying-capacity of a 48' wide street with no crown, on a slope of 0.0114, is:

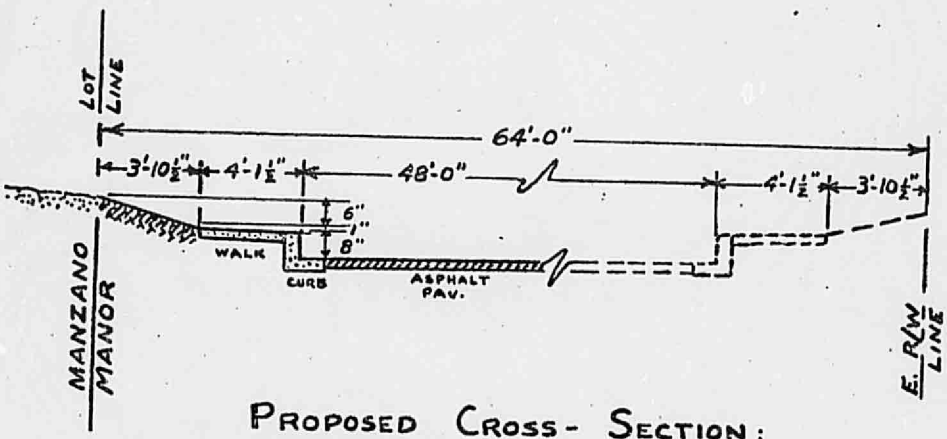
$$Q = a \cdot \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}} = 32 \cdot \frac{1.486}{0.015} \cdot 0.75 \cdot 0.107$$

or,
Q = 253 cfs approx. This is obviously not sufficient to carry the anticipated 564 cfs (approx.) runoff from a 100-year storm, assuming Chelwood Park Blvd. would be made the water-carrier to intercept all drainage reaching the Project area. However, by raising the grade of all abutting lots to a Lot-Line elevation of 7" above top-of-curb, or 15" above gutter flow-line, and providing water-blocks 15" (1.25') in height along the West side of Chelwood Park Blvd. at each intersecting street (and alley) in the Project, the carrying-capacity of Chelwood can be increased to approx. 722 cfs, with all runoff still confined to the street

CALCULATIONS (Cont'd.):

Street-carrying capacity:

right-of-way. Shown below is a sketch giving a suggested cross-section for Chelwood Park Blvd. and adjacent property on the proposed Project:



PROPOSED CROSS-SECTION;
CHELWOOD PK. BLVD., N.E. AT MANZANO MANOR
(NOT TO SCALE)

There are many other means besides raising Lot grades as shown on the sketch, to protect the lots from high water: Masonry unit screen walls (reinforced to meet City Building Code Requirements), or low concrete or masonry retainer walls at the Property Line would perform as well or better; although these alternates would be more costly to install. In any case, the 1.25 ft. water-block would be needed at both intersecting streets and at the alley, to prevent overflow from Chelwood, into the Project.

PRELIMINARY DRAINAGE REPORT

CALCULATIONS (Cont'd.):

Drainage Within The Project:

Exhibit 2 incorporates a Topographic Map with contours at 5' intervals (all elevations correspond to U.S.G.S. datum), and a Preliminary Layout Map indicating means for moving storm water through the Project.

The project boundaries contain seventeen separate drainage areas, the individual areas being broken down to show approximate drainage limits after lots are graded. However, this is not to be construed as any type of actual Grading Plan.

The general intent, as concerns handling of storm water through the Project, is to so grade the site that all external drainage will be prevented from entering the Project and only the runoff generated from rainfall on the site, itself, will need to be considered in designing street and lot grades within the subdivision. It has already been demonstrated in the preceding calculations, that, with construction of water-blocks and a slight raising of lot grades along Chelwood, all external drainage can be intercepted by Chelwood Park Blvd. and carried South to Copper Ave., where it will by-pass the Project.

Since sample calculations have been shown above, for all external drainage, the computed quantities for runoff within the Project will be shown below in Tabular form only, for simplification. The "Rational" Formula is again employed, and the resulting quantity, Q, in Column 5, is the product of Column 2 x Column 3 x Column 4. Column 1 carries the corresponding Area Designation shown on the Preliminary Layout Map:

1. Area Designation	2. Acreage (A)	3. Coeff. (c)	4. Intens.(i) 100-Year	5. Quantity (Q) Runoff
A	4.45	0.65	4.7	13.7
B	1.08	0.65	4.6	3.2
C	1.76	0.65	4.6	5.3
D	6.60	0.65	3.8	16.3
E	0.65	0.65	4.6	1.9
F	0.77	0.65	4.5	2.2
G	0.75	0.65	4.15	2.0
H	4.65	0.65	4.6	13.9
I	0.89	0.65	3.6	2.1

PRELIMINARY DRAINAGE REPORT

CALCULATIONS (Cont'd.):

Drainage Within The Project:

TABULATION OF CALCULATED RUNOFF WITHIN PROJECT

1. Area Designation	2. Acreage (A)	3. Coeff. (c)	4. Intens.(i) 100-Year	5. Quantity (Q) Runoff
J	1.76	0.65	4.2	4.8
K	2.52	0.65	5.03	8.2
L	0.78	0.65	4.03	2.0
M	2.16	0.65	4.36	6.1
N	2.01	0.65	5.25	6.9
O	2.03	0.95*	5.5	10.6
O_1	1.29	0.95*	5.5	6.7
P	2.50	0.65	5.04	8.2
Q	3.35	0.65	5.2	11.3

* Full paving anticipated in this area after development.

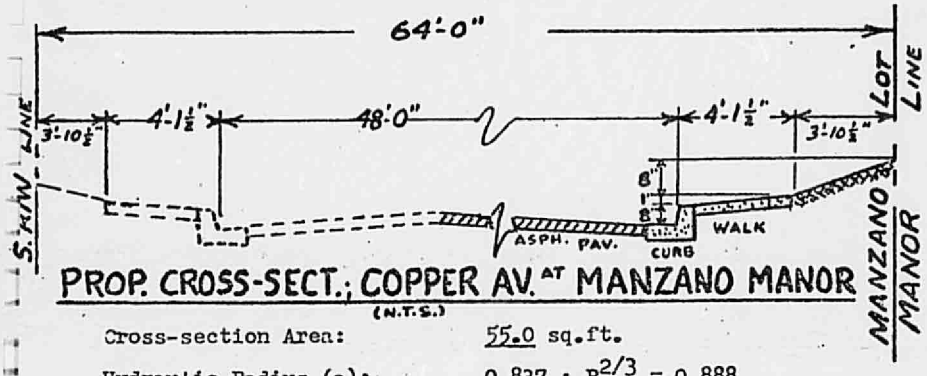
Taking the above-calculated runoff values from the respective drainage areas and combining them to form cumulative totals at successive intersections, it is seen on the Preliminary Layout Map (Exhibit 2.) that the worst condition for runoff occurs on the North-South street at the West end of the Project,also identified as Burma Drive, N.E. This street may be expected to receive a peak flow of 65.6 cfs. It has an average grade of 1.25%. A 32' curb-to-curb street with a 6" crown, on a slope of 0.0125, can carry 84.0 cfs, running full. Therefore, neither this street (Burma Drive) nor any other street within the Project is in any danger of overflow, during the period of peak runoff from a 100-year frequency storm.

To be considered, also, is the large accumulated flow on Copper Ave., N.E., along the South Boundary of the Project. This street can be expected to carry approximately 771 cfs maximum, in the vicinity of the Southwest corner of the Project.

CALCULATIONS (Cont'd.):

Drainage Within The Project
(Copper Ave., a perimeter street):

Copper Ave. is 48' in width, curb-to-curb; has a grade of approximately 3.35%. It is inadequate in width to carry the anticipated peak runoff without additional protective grading at lot-lines abutting this street. The sketch shown below gives a recommended cross-section, showing property-line elevations above existing curb and a calculation of carrying-capacity if these recommendations are followed:



PROP. CROSS-SECT.; COPPER AV. AT MANZANO MANOR (N.T.S.)

Cross-section Area: 55.0 sq.ft.

Hydraulic Radius ($\frac{a}{p}$): 0.837 ; $R^{2/3}$ = 0.888

Slope (Longitudinal): 0.0335; $S^{\frac{1}{2}}$ = 0.1831

Roughness Coefficient: n = 0.015

$Q = 55.0 \cdot \frac{1.486}{0.015} \cdot 0.888 \cdot 0.1831 =$ 883 cfs aproximate carrying-capacity within the street right-of-way.

Since 883 cfs capacity exceeds anticipated maximum runoff from a 100-year frequency storm of 771 cfs, the design may be considered adequate.

CONCLUSIONS AND RECOMMENDATIONS:

Of primary importance, it may be concluded from the preceding sets of calculations that this Project is in no danger from storm flooding, if some minor lot-grading is done along the Eastern and Southern perimeter streets, and water-blocks are established.

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PRELIMINARY DRAINAGE REPORT

CONCLUSIONS AND RECOMMENDATIONS (Cont'd.):

It is also reasonable to conclude that a runoff coefficient of 0.65 is too high (conservative) for the undeveloped land presently comprising the tributary drainage areas for this Project; hence the computed maximum runoff figures indicate more flow than would likely occur. True, if the land is developed to the East of the Project, the ratio of runoff/rainfall could increase to a value of 0.65. However, future development will cause streets to be platted which will intercept some of the flow from the tributary drainage areas and divert it elsewhere. For example, construction of Tramway Blvd. between Interstate 40 and the North City Limits will cause these smaller drainageways to be intercepted one-half mile East of the Project and diverted South to Central Ave., or North to the Embudo Arroyo major drainageway, thus eliminating 70% or more, of the tributary drainage. An interceptor ditch is also planned by the City Engineer's office, which will intercept a major portion of the runoff East of Tramway Blvd. and South of the Embudo Arroyo drainage area; so the outlook for supplemental flood protection in the vicinity of this Project is good.

Since land development in this City has often shown erratic, "Leap Frog" patterns, it is not impossible for such development to occur along the habitable portions of the drainage areas leading to this Project, before major construction of interceptor ditches or improved arterial streets could take place. It is, therefore, believed that the precautionary measures indicated for lots abutting Copper Ave. and Chelwood Park Blvd. are reasonable and perhaps essential, and the same are recommended, herewith.

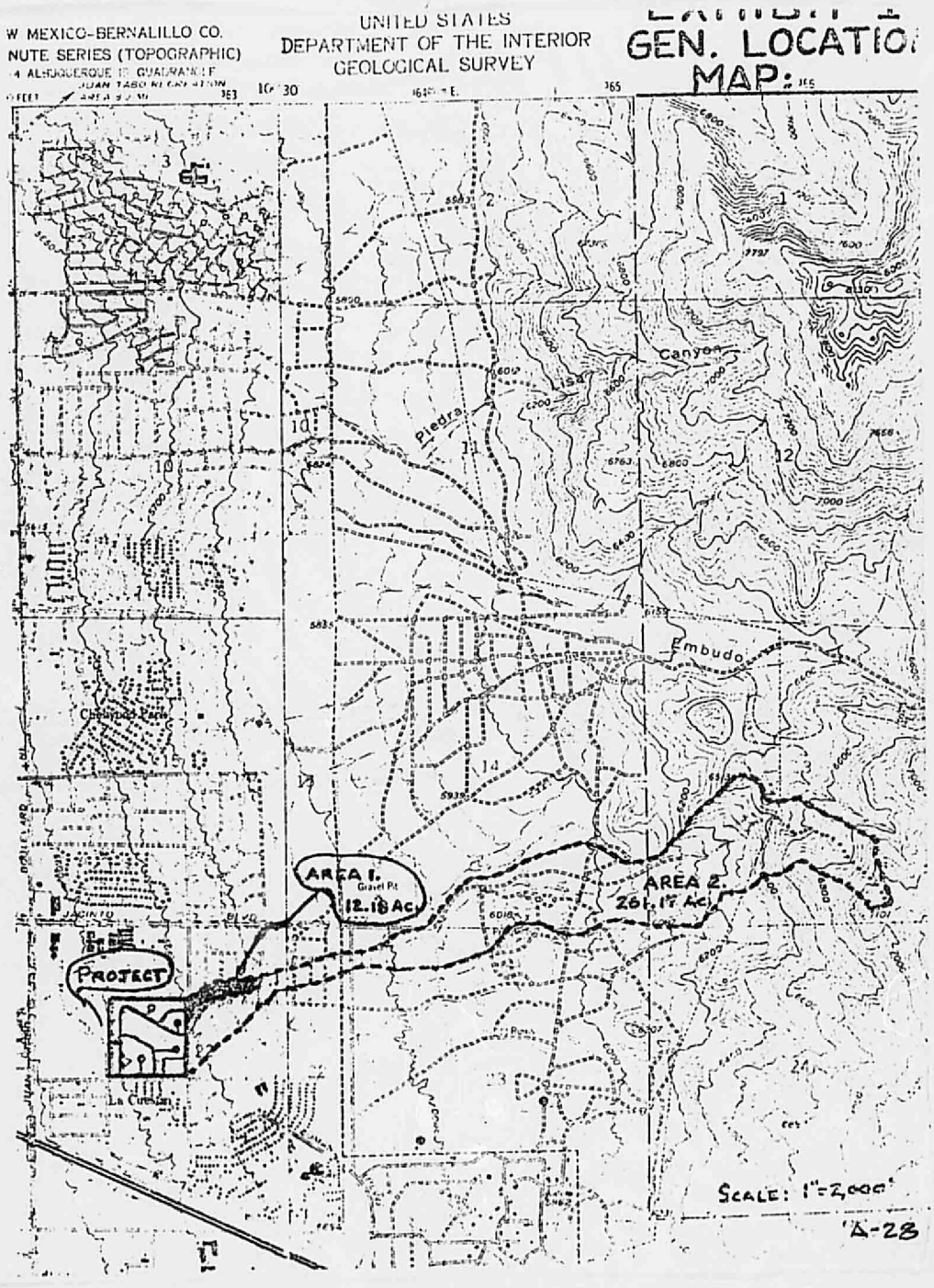
Within the Project, itself, no flood dangers exist from interior street and Lot platting; hence, no special measures are recommended for either Lots or streets inside Project boundaries.

Respectfully Submitted,

George E. Paul

George E. Paul,
N.M.P.E.&L.S. # 2544

(SEAL)


W MEXICO-BERNALILLO CO.
NUTE SERIES (TOPOGRAPHIC)
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
GEN. LOCATIO
MAP:
Canyon
Piedra
Embudo
AREA 1.
Gravel Pit
12.18 Ac
AREA 2.
261.17 Ac
PROTECT
La Cueva
SCALE: 1"=2,000'
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