E11 / D6

MONTANO WEST

SUBDIVISION

1 PLAN

DALE BELLAMAH CORPORATION

POST OFFICE BOX 3325
6400 UPTOWN BOULEVARD, N.E.
EAST TOWER, SUITE 600

ALBUQUERQUE, NEW MEXICO 87110
TELEPHONE (505) 299-7631

July 29, 1977

RECEIVED
AUG 03 1977
CITY ENGINEER

George Carruthers, Director
Planning Department
City of Albuquerque
P.O. Box 1293
Albuquerque, NM 87103

RE: Off site flows from Montano West, Unit #2

Dear Mr. Carruthers:

It has been brought to our attention that Montano West Unit #2 is being redesigned. As a result of the new plan, we understand that 200+ CFS would be deposited on to our Saddle Ridge West subdivison.

We are calling this to your attention because we believe this flow will be unmanageable within our subdivision and to try to coordinate the redesigning of Montano West Unit #2 with the designing of Saddle Ridge West.

I would appreciate your consideration of our problem. Thank you for your cooperation.

Very truly yours,

AMBELL ,
DALE BELLAMAH LAND CO.,INC.,
A partner

Donald F. Greene

Donald F. Greene
Development Engineer

DFG/gg

cc: Varne Kimmick, City Engineer
Bruno Conigliano, Assistant City Engineer, Hydrology

BUILDERS—DEVELOPERS—REALTORS
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Mobile Home Parks, Free-Standing Commercial Properties
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National Association of Home Builders, International Council of Shopping Centers, National Association of Realtors

T. T. Burnett Engineering, Inc.
Consulting Engineers
120 MORNINGSIDE N. E.
ALBUQUERQUE, NEW MEXICO 87108

TELEPHONE
(505) 255-7545

Dec. 10, 1977

Mr. V. M. Kimmick, City Engineer
City of Albuquerque
P.O. Box 1293
Albuquerque, New Mexico 87103

Attn: Mr. Bruno Conegliano,
Assistant City Engineer-Hydrology
Re: Montano West Unit II Drainage

Dear Sir:

As requested we submit the following comments regarding the filed drainage report for the subject subdivision. The original report prepared by Chambers, Campbell, Isaacson and Chaplin, Inc. in July, 1973 may be revised due to recent developments concerning the construction of Montano Rd. Also, composite runoff runoff factors developed in the report may be reduced due to an error in their development.

Montano Road

Elevations shown on Drawing No. SG-20-76, Sheet 2 of 5, Street Grades-Montano Road NW as prepared by the City of Albuquerque indicate that water blocks will definitely be built at the intersection of Montano Road and Whiteman Drive and most probably at the intersection of Montano Road and Golden Avenue. These water blocks will divert flows from Volcano Cliffs, Unit I, Montano West Units I & II and Saddle Ridge West such that the flow will remain in Montano Road and travel easterly to the La Mariposa drainage Channel. This will eliminate the 51 acre runoff source indicated in green shown on Plat B of the subject report.

Runoff Coefficients (Calculation Sheet II)

Typical Volcano Cliffs Lot

The computed composite runoff factor (assuming factors and areas are correct) may be reduced from the computed 0.47 to 0.43 as the 0.90 used for impervious surfaces cannot be increased by 25% without producing water.

Area Flowing into Montano West Subd. Unit II @ Point IV

The area may be reduced to a total of 71 acres (as per comment under Montano Road) and the runoff factor may be reduced to 0.43 (as per comment under Typical Volcano Cliffs Lot)

Flow at Point IV (as designated in original report)

Original - 209 cfs

Recommended revision

3,000 feet of street flow at ave. velocity of 3 fps, i = 189/(17÷25)

Q = (0.43) (4.5) (71) = 139 cfs plus 4 cfs from Point III

Inlet Condition at Point IV (as designated in original report)

Original - 209 cfs

14 foot broad crested weir

required head = 2.4 feet

Recommended Revision

60 foot broad crested weir

required head = 0.9 feet

Street Flow Condition (Flor del Sol)

Original - inverted crown section shown on approved construction plans

Recommeded Revision - construct standard crowned section and allow front yard flooding during 100 year storm. Assuming:

Street grade = 0.5%

Standard crowned section with n = 0.021 within curbs and n = 0.040 behind curbs.

Flow = 143 cfs

the depth of flow at the face of curb would be approximately 1.25 feet.

Based on the above it is recommended that the drainage report for the subject subdivision be revised at points IV & V to indicate flows are no longer entering the area from the north side of Montano Road. (It is also recommended that survey information at the intersection of Montano Road and Golden Avenue be updated to assure the effectiveness of planned water blocks.) It is recommended that Flor del Sol be constructed with a standard crown and that homes be constructed with a finished floor one foot or more above the top of curb.

Computations in this letter do not assure the accuracy or methods of the original drainage report, though they appear to be adequate.

Sincerely,
T.T. Burnett Engineering, Inc.

J.J. Bordenave

J.J. Bordenave, P.E. & L.S. # 5110

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

December 14, 1977

Jim Smith
AMAFCA
2600 Prospect Ave.,NE
Albuquerque, New Mexico

RE: Montano West Unit II

Dear Jim:

Some time ago we received a letter from Dale Bellaman Corporation complaining about the offsite drainage from Montano West Unit II which would affect the Saddle Ridge West Subdivision. This letter a copy of which is included is the result of some difference of opinion between Bellaman & Presley Homes, but does not reflect any inappropriate actions by Presley Homes.

An old and approved drainage report for the Montano West Subdivision anticipated a flow of 200 c.f.s. at the exit point. The revised plat for the above referenced subdivision does not change the flows that were known and approved. It further appears, that due to the regrading of Montano West only some 143 c.f.s. will be carried to the point of discharge (see attachment by T.T. Burnett Engineering). I'm therefore approving the plat for Montano West Unit II.

Very truly yours,

Bruno Conegliano
for Asst. City Engineer-Hydrology

BC/gm

MONTANO WEST SUBDIVISION

UNIT NO. 2

DRAINAGE REPORT

CHAMBERS — CAMPBELL — ISAACSON — CHAPLIN, INC.

3500 INDIAN SCHOOL RD. NE • ALBUQUERQUE, NEW MEXICO 87106 • TELEPHONE (AREA 505) 266-5521

THIS MICROIMAGE IS THE BEST POSSIBLE REPRODUCTION DUE TO THE POOR QUALITY OF THE ORIGINAL DOCUMENT.

MONTANO WEST SUBDIVISION
UNIT NO. 2

DRAINAGE REPORT

SUBMITTED BY:

CHAMBERS, CAMPBELL
ISAACSON & CHAPLIN, INC.
3500 INDIAN SCHOOL ROAD, N.E.
ALBUQUERQUE, NEW MEXICO 87106
TELEPHONE (505) 266-5521

JULY 1973

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Plat B	Location & Drainage Map - Scale 1" = 2000'
Plat C	Drainage Map
Plat D	Topo Map and Drainage of Montano West Subdivision Unit #2 in Undeveloped Stage
Plat E	Topo Map and Drainage of Montano West Subdivision Unit #2 in Developed Stage

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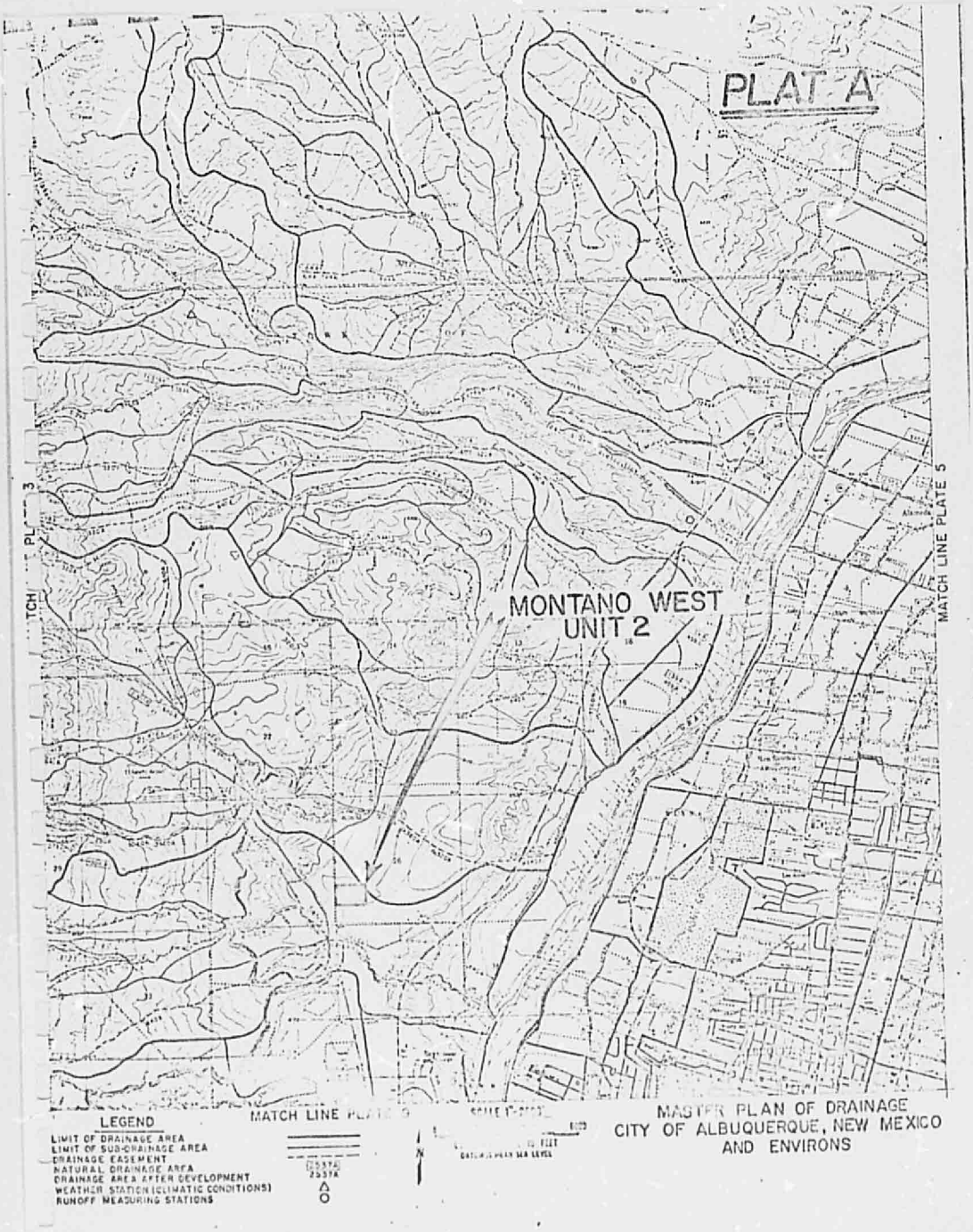
Calculation Sheet II . . . . . Page 12

Chart I	Time of Concentration of Small Drainage Basins
Chart II	Intensity Duration Frequency Curves
Chart III	Nomograph for Solution of Manning Equation
Table IV	Street Carrying Capacities



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

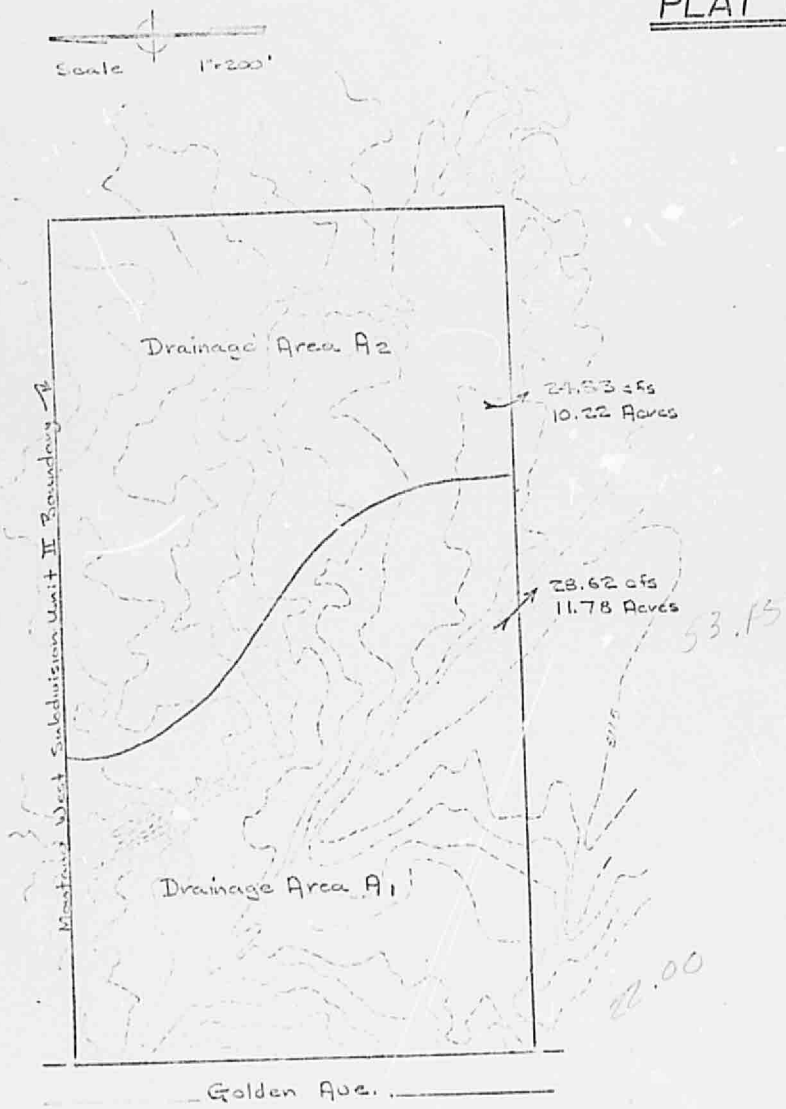
THIS MICROIMAGE IS THE BEST POSSIBLE REPRODUCTION DUE TO THE POOR QUALITY OF THE ORIGINAL DOCUMENT.

PLAT B
GRANT BOUNDARY
~ Undeveloped Drainage Area
~ Developed Drainage Area
MONTANO WEST
UNIT 2
22
23
26
25
36
CORRALES
RIVERSIDE
GRANT
BOUNDARY
T O W N

PLAT C

VOLCANO
CLIFFS
SUB'D
UNIT 4
R-1
VOLCANO
CLIFFS
UNIT 3
SUB'D
CLIFFS
MONTANO
MUNICIPAL
Montano West Unit #1
VOLCANO
CLIFFS
SUB'D
MONTANO WEST UNIT 2

PLAT D



CHAMBERS, CAMPBELL,
MACSON & CHAPLIN
ENGINEERS ARCHITECT-PLANNERS
ALBUQUERQUE NEW MEXICO

SUBJECT Montano West Unit # 2
CLIENT _____ JOB NO. ____
BY _____ DATE _____ SHEET NO. ____ OF ____

PURPOSE

The purpose of this report is to determine the drainage characteristics of the subdivision and the capacities of the related drainage facilities. The subdivision was first analyzed in its undeveloped form to establish the base runoff. The second phase analyzed the subdivision in its developed condition, utilizing the back yard ponding concept. The final phase studied the ability of the subdivision's streets and drainageway to accept the total of external and internal drainage.

INTRODUCTION

Montano West Subdivision Unit #2 is located northwest of Albuquerque, in the west half of Section 26, T11N, R2E, N.M. P.M.

The subdivision lies in the center of a drainage area, with a natural drainage swale passing through the lower southwest half, sloping toward the southeast. The subdivision is bordered on the north by Montano West Subdivision Unit #1, and by Golden Avenue on the west. Offsite drainage enters the subdivision from Montano West Subdivision Unit #1 at points I and II, and from Golden Avenue at points III and IV. These flows, plus the internal drainage within the subdivision, leave the

subdivision at points V and VI on the south boundary and flow to the southeast via the natural drainage swale. (See Plat E). As it will be shown, these flows will be accommodated by the internal street system and related facilities.

CALCULATIONS

In analyzing the storm runoff, the Rational Formula, Q= AIR, was used. Where:

Q = Runoff quantity in cubic feet/second

A = Contributing area in acres

I = Intensity in inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from Chart 1, Appendix A, the "Master Plan of Drainage, City of Albuquerque, New Mexico" by Herkenhoff & Associates (where a Time of Concentration [Tc] is less than ten minutes, the Intensity value equal to ten minutes was used.)

R = Runoff coefficient (no unit)

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

PHASE I

This phase consisted of analyzing the subdivision in the undeveloped form. The resulting flow was broken down from two areas, A_1 and A_2 (See Plat D). In area A_1, the runoff

accumulated by flowing into a natural drainage swale. This flow concentrated at the south boundary before discharging to the southeast. In area A_2, the runoff had more characteristics of sheet flow with general accumulation to the east of the drainage swale. The two flows intersect each other south of the subdivision proper.

The runoff coefficient used for undeveloped areas = 0.45 (Table XII, Master Plan of Drainage, City of Albuquerque, New Mexico and Environs, 1963, G. Herkenhoff and Associates.)

TABULATION OF RESULTS - PHASE I - PLAT D

Drainage Basins	Elev. Diff. Feet	Length of Flow Feet	Tc Min.	I "/Hr.	R No Unit	Area Acres	Q cfs
A_1	11'	1000'	9.0 Use 10	5.4	0.45	11.78	28.62
A_2	7'	730'	7.3 Use 10	5.4	0.45	10.22	24.83

PHASE II

Phase II consisted of analyzing the subdivision in its developed form. Only internal flows were considered in this phase. The resulting runoff flows and area contributing to this runoff are shown at each street intersection on Plat E.

For Montano West Subdivision Unit #2, the back yard ponding concept was incorporated into the design (See Figure

I). The area ponding includes the side yard areas, starting at the middle of the house, and sloping to the rear. Because the majority of houses built today utilize pitch roof design, the assumption was made that one-half (1/2) the roof area flows to the rear yard while the other half flows to the front.

In this design, it was desirable to develop a composite runoff coefficient based on the percentage of different types of surface in the drainage area. This procedure was applied to a typical "sample" block to arrive at a reasonable value of the coefficient for the non-ponding areas. (See Calculation Sheet I). The runoff coefficients used are as follows- (Table 3-2, Urban Storm Drainage Criteria Manual, Volume I, Denver Regional Council of Governments).

Streets, Walks & Drives	R= 0.90
Roofs	R= 0.90
Lawns, Sandy Soils:	
Avg., 2 to 7%	R= 0.15

Because the above values are only applicable for storms of five to ten year frequencies, the Rational Formula can be adjusted by a frequency factor C_f, which is used to account for antecedent precipitation conditions. A C_f factor of 1.25 for a 100 recurrence interval was used and this adjustment was reflected in the composite runoff coefficient. See Calcula-

tion Sheet I. (Section 3.7 and Table 3-3, Urban Storm Drainage Criteria Manual, Volume I, Denver Regional Council of Governments.)

TABULATION OF RESULTS - PHASE II - PLAT E

Drainage Basins	Elev. Diff. Feet	Length of Flow Feet	Tc Min.	I "/Hr.	R No Unit	Area Acres	Q cfs
A	10	850	7.8 Use 10	5.4	0.76	2.24	9.19
B	1	200	3.5 Use 10	5.4	0.76	0.55	2.26
C	2	300	4.2 Use 10	5.4	0.76	0.83	3.41
D	4.8	680	7.8 Use 10	5.4	0.76	2.30	9.44
E	9	575	5.0 Use 10	5.4	0.76	1.53	6.28
F	3.2	380	4.8 Use 10	5.4	0.76	1.40	5.75
G	5.4	725	8.3 Use 10	5.4	0.76	2.19	8.98
H	2.5	430	5.8 Use 10	5.4	0.76	1.26	5.17
I	1.0	100	1.5 Use 10	5.4	0.76	0.18	0.74
Internal Concentration Flows (See Plat E)							
At Point							
V	10	1230	11.8	5.14	0.76	7.99	31.21
VI	7	1135	12.5	5.04	0.76	4.49	17.20

PHASE III

In Phase III, the streets and drainageway were analyzed for capacity to handle external and internal runoff drainage. External drainage enters the subdivision from points I and II on the north boundary and from points III and IV on Golden Avenue. (See Plats C and E).

Flow to the two points, I and II on the north boundary, occurs from the isolated area of Montano West Subdivision Unit #1. The flow entering at point III is from the east half of Golden Avenue extending from Montano Road to point III. The flow to point IV is from a drainage basin which includes developed and undeveloped areas. (See Plat B) Because of the different types of surface in the drainage area, a composite runoff coefficient was used for the entire area. The runoff coefficient for the undeveloped area = 0.45 (Table XII, Master Plan of Drainage, City of Albuquerque, New Mexico and Environs, 1963, G. Herkenhoff and Associates). The runoff coefficients for the developed area, i.e. Volcano Hills Subdivision Unit #1, are R = 0.90 for streets, walks, drives and roofs; R = 0.15 for lawns in sandy soil. The adjustment factor, C_f = 1.25, for antecedent precipitation conditions, was reflected in the composite runoff coefficient. All areas drain to the streets, with no ponding areas utilized. (Table 3-2, Section 3.7 and Table 3-3, Urban Storm Drainage Criteria Manual Volume I, Denver Regional Council of Governments) (See Calculation Sheet II).

The composite runoff coefficient for the developed area and the runoff coefficient for the undeveloped area were then

combined, relative to their areas, for an overall composite runoff coefficient for the entire drainage basin (See Calculation Sheet II).

TABULATION OF RESULTS - EXTERNAL FLOW (SEE PLAT E)

Point of Concentration	Elev. Diff.	Length Of Flow	Tc	I	R	Area	Q	
Point I	8	510	4.8 Use 10	5.4	0.74	1.4394	5.75	*
Point II	11	1910	19	4.30	0.74	12.2863	39.10	*
Point III	15.5	1365	10	5.4	0.90	0.94	4.57	
Point IV	89	4800	25.5	3.74	0.46	121.22	208.55	

*Data from Drainage Report for Montano West Subdivision Unit #1, prepared by Chambers, Campbell, Isaacson & Chaplin, Inc.

The flows at points I, II, and III are channeled through the subdivision via the internal street system. The flow at point IV is directed through a concrete-lined channel before it is diverted into the street system. The size of this channel was determined by the Manning Equation (See Calculation Sheet II).

The street that handles the flow from point IV has been designed at a minimum grade because of related engineering problems with the sewer flow. Because of this minimum slope and the quantity of runoff that the street has to handle, the street for drainage areas F, I, and a related area of A,

(See Plat E), will have a six inch inverted crown at the center-line. Although this type of design subjugates the basic function of a street, that of a vehicular traffic carrier, it was felt such design would eliminate future flooding potential of adjacent homes to a greater degree than that of a conventional street design. (See Table IV.)

The final discharge runoff flows at Points V and VI were then calculated, taking into consideration any further adjustment of the composite runoff coefficient due to a change of the ratio of developed area vs undeveloped area,

TABULATION OF RESULTS - PHASE III - PLAT E

Discharge Point	Difference in Elev.	Length of Flow	Tc	I	R	A	Q
V	96'	5575	29	3.50	0.48	130.65	219.50
VI	17	2635	24	3.86	0.75	16.78	48.58

SUMMARY

Montano West Subdivision Unit #2, by utilizing back yard ponding, after development will have less internal runoff than that which existed before development. Area A_1 = 28.62 cfs, before development; Area A_2 = 24.83 cfs, before development. Point V = 31.21 cfs after development; Point VI = 17.20 cfs after development. (See Plat E.)

Additionally, external flows will be routed through the subdivision such as not to disturb the overall drainage characteristics of the area. All flows can be accommodated by the street system and related drainage facilities within the subdivision.

Overall, the development of Montano West Subdivision Unit #II should have a beneficial effect on the drainage characteristics of this area.

Respectfully submitted,
July 13, 1973

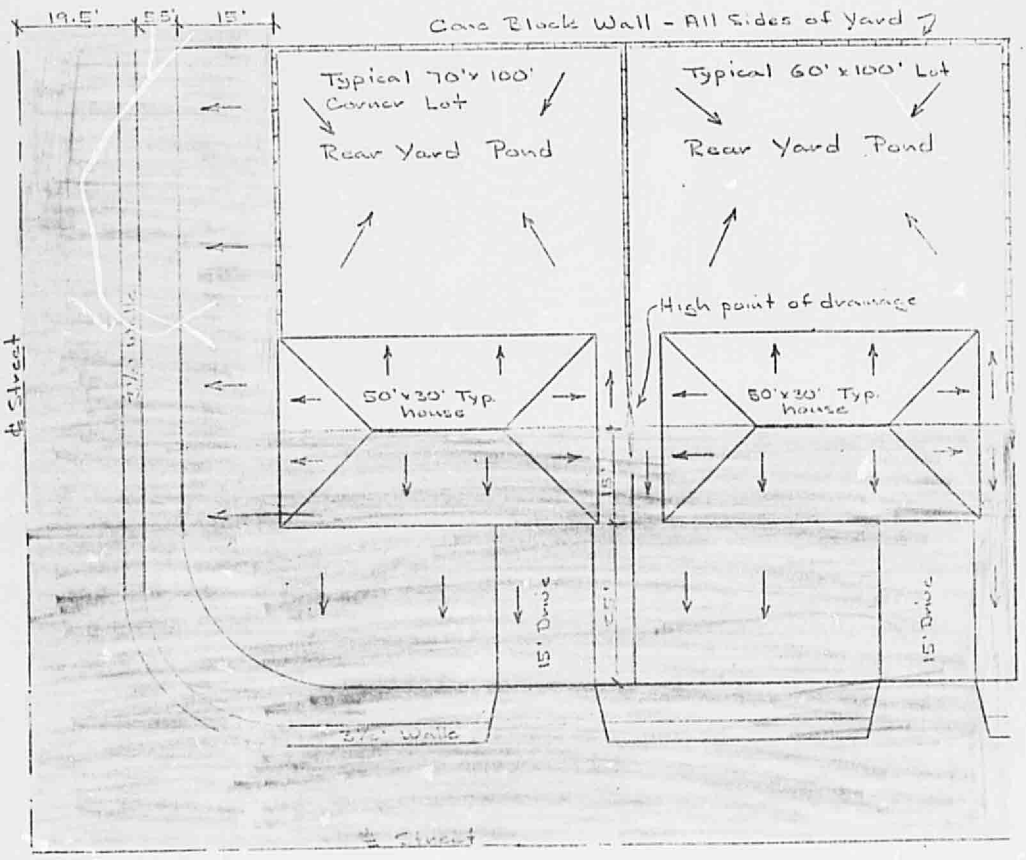
Thomas O. Isaacson

For:
CHAMBERS, CAMPBELL
ISAACSON & CHAPLIN, INC.

REGISTERED PROFESSIONAL ENGINEER AND LAND SURVEYOR
NO. 3095
NEW MEXICO
THOMAS O. ISAACSON

FIGURE I

Typical Lot Drainage



Shaded Area = Runoff Area for Composite Runoff Coefficient

Pond Area ... Lot

R = 0.15 class... Vol = 285 ft³ Runoff

R = 0.90 classification Vol = 178 ft³ Runoff

Σ = 463 ft³/6hr-100 yr.

Data - 3"/6hr - 100 yr Storm
Technical Paper No 40 - U.S. Dept. of Commerce.

CHAMBERS, CAMPBELL, ISAACSON & CHAPLIN
ENGINEER-ARCHITECT-PLANNERS
ALBUQUERQUE, NEW MEXICO

SUBJECT Montano West Subd. Unit #2
CLIENT _____ JOB NO. ____
BY _____ DATE _____ SHEET NO. ____ OF ____

Typical 60'x100' Runoff Area Breakdown

R = 0.90

Street & Walk Area (19.5'x60') = 1170 ft²
Roof Area (15.0'x50') = 750 "
Drive Way (30.5'x15') = 458 "
Σ = 2378 ft²

R = 0.15

Front & Side Yard – Minus Driveway & ½ Roof Area
(45.5'x60) – 1208 ft² = 1522 ft²
Σ = 1522 ft²

Total Area Drained = 3900 ft²

Typical 70'x100' Runoff Area Breakdown

R = 0.90

Street & Walk Area (19.5 x 200.5) = 3910 ft²
Roof Area (50.0 x 15) = 750 "
Driveway (30.5 x 15) = 458 "
Σ = 5118 ft²

R = 0.15

Front & Side Yard Areas – Minus Driveway & ½ Roof Area
(75.5x45.5) + (20.5x60) – 1208 ft² = 3457 ft²

Total Area Drained = 8575 ft²

Assuming a typical Block consisting of 8 lots, 2 of which are side street lots – total area drained for the Block is –

(3900 x 8) = 31,200
(8575 x 2) = 17,150
Σ = 48,350 ft² Drained Area

1) Total Area Drained under the 0.90 classification
= (19,024 + 10,236) = 29,260 / 48,350 = 61% of Area drained

2) Total Area Drained under the 0.15 classification
= (12,176 + 6914) = 19,090 / 48,350 = 39% of Area drained

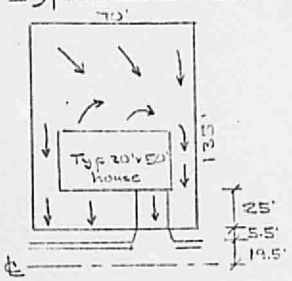
Composite Runoff Coefficient = (0.61)(0.90) = 0.55
(0.39)(0.15) = 0.06
Σ = 0.61

Adjusted Factor = (0.61)(Cf) = (0.61)(1.25) = 0.76

CHAMBERS, CAMPBELL, ISAACSON & CHAPLIN
ENGINEER-ARCHITECT-PLANNERS
ALBUQUERQUE, NEW MEXICO

SUBJECT Montano West Subd. Unit #2
CLIENT _____ JOB NO. ____
BY _____ DATE _____ SHEET NO. ____ OF ____

Typical Volcano Cliffs Lot



R = 0.90

Street & Walk = (19.5×70) = 1365.00
Roof = (50×30) = 1500.00
Drive = (30.5×15) = 458.00
Σ = 3323.0 ft²

R = 0.015

Lot (70×140.5) = 9835.00
− (458 + 1500) = −1958.00
Σ = 7877.00 ft²

Total Area drained = 11,200 ft²

Total Area Drained under the 0.90 classification = $\frac{3323}{11,200}$ = 30%
" " " " " 0.15 " = $\frac{7877}{11,200}$ = 70%

Composite Runoff Factor for Volcano Cliffs Subd. = (0.30)(0.90) = 0.27
(0.70)(0.15) = 0.11
0.38

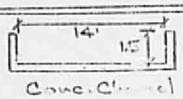
Adjusted Factor = (0.38)(C_f) = (0.38)(1.25) = 0.47 (Volcano Cliffs)

Area Flowing into Montano West Subd. Unit II @ Point IV

Undeveloped Land = 50.51 Acres = 41.7% of Total
Developed Land = 70.71 Acres = 58.3% of Total
Σ = 121.22

Composite Runoff Factor for Entire Drainage Area Flowing to Point IV

(0.417)(0.45) = 0.19
(0.583)(0.47) = 0.27
0.45 = Composite Runoff Factor



Conc. Channel

Manning Equation $U = \left(\frac{1.486}{n}\right)(r^{2/3} s^{1/2})$

where n = 0.014 (P. 7-17, Handbook of Hydraulics, King & Brater)
S = 0.01
R = 1.096

$R = \frac{bd}{b+2d} = \frac{14(1.5)}{14+3.0}$
= 1.235

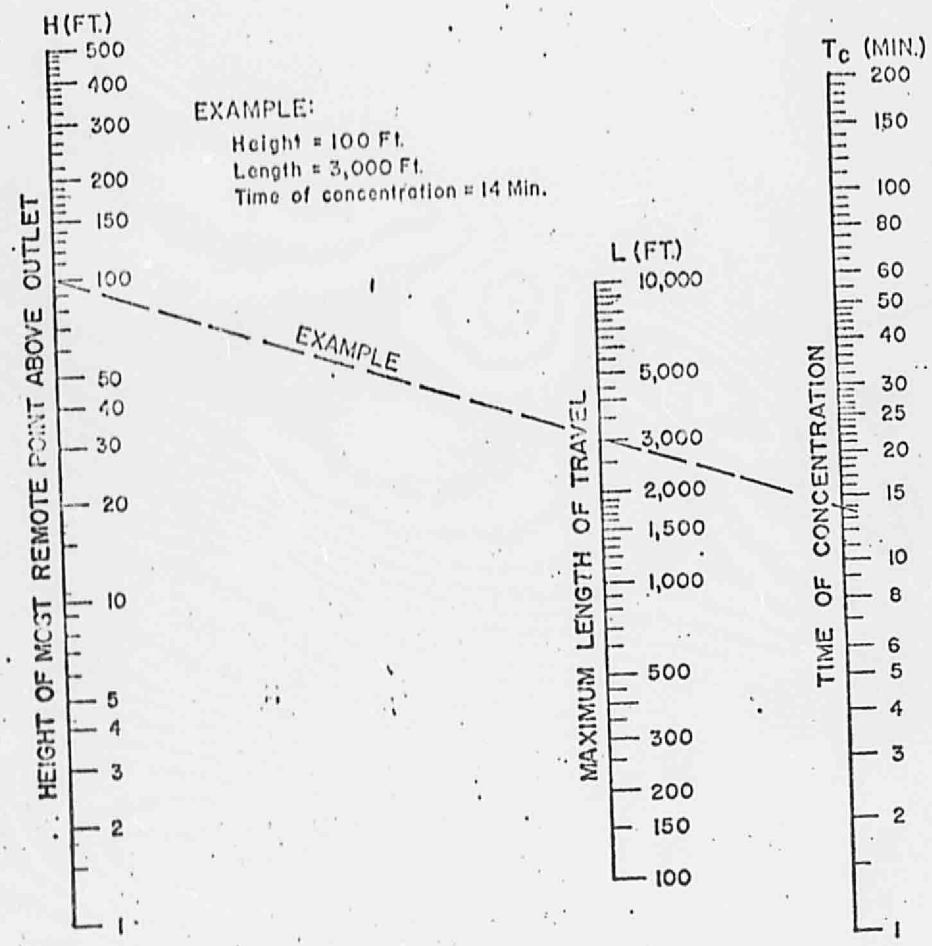
$U = \frac{1.486}{0.014}(1.24)^{2/3}(0.01)^{1/2}$
= (106.14)(1.154)(0.10) = 12.25

Q = AU = 257.22 cfs > 208.55 cfs Runoff

CHAMBERS, CAMPBELL,
ISAACSON & CHAPLIN
ENGINEER-ARCHITECT-PLANNERS
ALBUQUERQUE, NEW MEXICO

SUBJECT Montano West Subd. Unit II
CLIENT _____ JOB NO. ____
BY _____ DATE _____ SHEET NO. ____ OF ____

CHART I

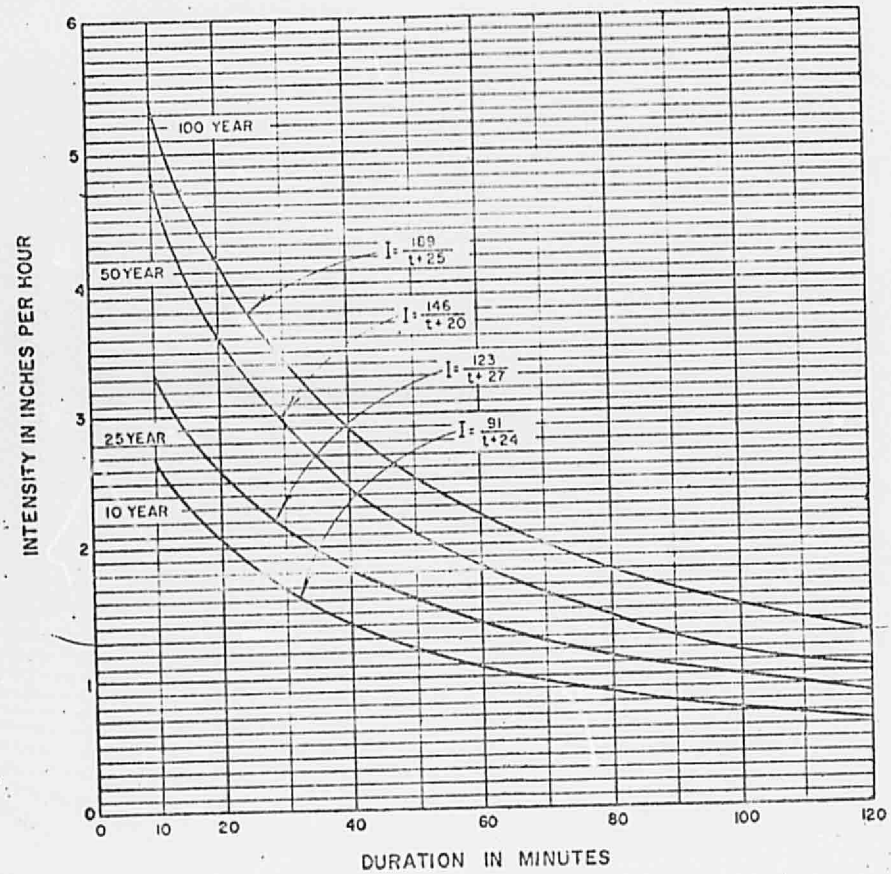


Based on study by P. Z. Kirpich,
Civil Engineering, Vol. 10, No. 6, June 1940, p. 332

FIG. 1 TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

Reprinted from "Design of Roadside Drainage Channels - Hydraulic Engineering

CHART II



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

INTENSITY DURATION
FREQUENCY CURVES

(ALBUQUERQUE AREA - 1961)

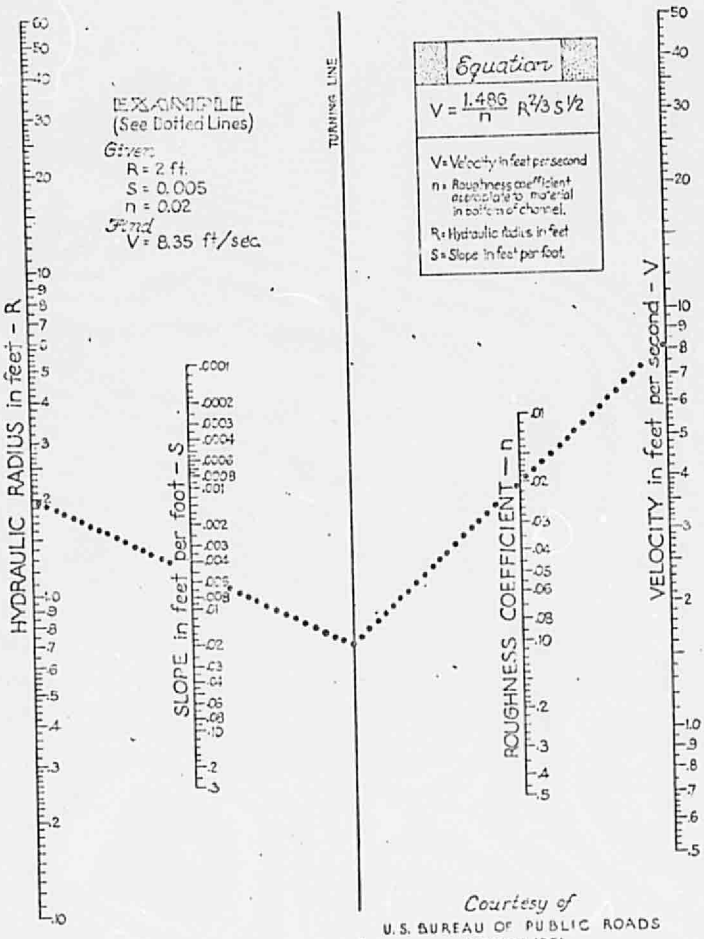
GORDON HERKENHOFF & ASSOC
CONSULTING ENGINEERS
ALBUQUERQUE, NEW MEXICO

CHART
1

FIGURE 7-006.1A

CHART III

NOMOGRAPH FOR SOLUTION OF MANNING EQUATION



Courtesy of
U.S. BUREAU OF PUBLIC ROADS
AUGUST 1951

TABLE IV

STREET CARRYING CAPACITIES
(CFS)

Slope	32' Street 6" Crown at center line or 6" sidehill with no crown	32' Street Flat Cross-section	32' Street 6" Inverted crown at center line	32' Street with 8" sidehill with no crown	32' Street with 12" sidehill with no crown	40' Street 6" Crown at center-line or 6" sidehill with no crown	44' Street 6" Crown at center-line or 6" sidehill with no crown	48' Street 6" Crown at center-line or 6" sidehill with no crown
0.0025	37	78	133	25	17	47	51	56
0.0050	53	111	189	36	23	66	72	79
0.0075	65	136	231	44	29	81	89	97
0.0100	75	156	267	51	33	93	102	112
0.0125	84	175	299	57	37	104	115	125
0.0150	92	193	328	62	41	114	126	138
0.0175	99	207	352	67	44	123	135	148
0.0200	105	221	376	71	47	131	144	158
0.0225	112	235	400	76	50	139	154	168
0.0250	118	247	422	80	52	147	162	177
0.0275	124	260	444	84	55	155	170	185
0.0300	129	271	462	88	57	161	177	193
0.0325	134	282	480	91	59	167	184	202
0.0350	139	293	499	95	62	174	191	209
0.0375	145	304	518	98	64	180	199	217
0.0400	149	313	534	101	66	186	205	224
0.0425	154	322	550	104	68	192	211	231
0.0450	158	332	566	107	70	197	217	237
0.0475	163	341	582	110	72	203	223	244
0.0500	167	350	598	113	74	208	230	251

Coefficient of Roughness = n = 0.015 for all streets.
Carrying Capacity Given in Cubic Feet per Second (C.F.S.)
Arterial Design (Stage & Final) has a +2% Slope from the Top of Curb to the top of Median Curb.
Curb Height = 8"

BIBLIOGRAPHY OF REFERENCES

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MONTANO WEST SUBDIVISION

DRAINAGE REPORT

Submitted By:
CHAMBERS, CAMPBELL
ISAACSON & CHAPLIN, INC.
3500 Indian School Road, N.E.
Albuquerque, New Mexico 87106

February 15, 1973

MONTANO WEST SUBDIVISION

DRAINAGE REPORT

Introduction

Montano West Subdivision is located northwest of Albuquerque, in the west half of Section 26, T11N, R2E, NMPM.

The subdivision which slopes to the southeast, lies on the limit of two drainage areas (see plat "A") and is well situated away from any low areas that might flood or pond on the subdivision proper. The subdivision is bounded on the north by Montano Road and Golden Avenue on the west. Golden Avenue is presently being paved and an application has been submitted to place Montano Road, East of Golden Avenue into a paving district. Both streets will intercept any drainage from the northwest that would affect Montano West Subdivision. The two streets connecting the subdivision to Montano Road and Golden Avenue will have water blocks incorporated into them to prevent any outside drainage from entering the subdivision. Thus, the subdivision will not be affected by offsite drainage.

Calculations

In analyzing the storm runoff, the rational formula Q = AIR, was used. Q = Runoff Quantity in cubic feet/second. A = Contributing Area in Acres. I = Intensity in Inches/hour for a duration equal to the time of accumulation (duration) measured in minutes and obtained from Chart 1, Appendix A, the "Master Plan of Drainage, City of Albuquerque, New Mexico" by Herkenhoff & Associates. (Where a Time of Concentration [Tc] is less than 10 minutes, the Intensity valve equal to 10 minutes was used.) R = Runoff Coefficient (no unit). In undeveloped areas, R = 0.40; for paved streets, R = 0.95; the composite factor, R = 0.74 for undeveloped and street areas (see Figure A).

Each lot will incorporate back yard ponding, where the side yards slope to the back yard, starting at the middle of the house. Because many houses today are built with pitched roofs, the assumption was made that 1/2 the roof

area flows to the rear yard and the other 1/2 flows to the front yard.

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

Calculations - Q for undeveloped subdivision - page 1
Q for developed subdivision - pages 2-16
Q Summary for developed areas - page 17
Q's at Concentrated Points
1, 2, & 3 - page 18

Figure A - Composite R breakdown for typical lot.

<u>Summary</u>: The original total Q discharge from Montano West Subdivision is 62.93 c.f.s. In its developed form, the total discharge from the subdivision is 54.71 c.f.s., for an overall reduction of 8.22 c.f.s. This reduction was possible because of back yard ponding. Thus, the development of Montano West should have an overall beneficial effect on the drainage characteristics of this area.

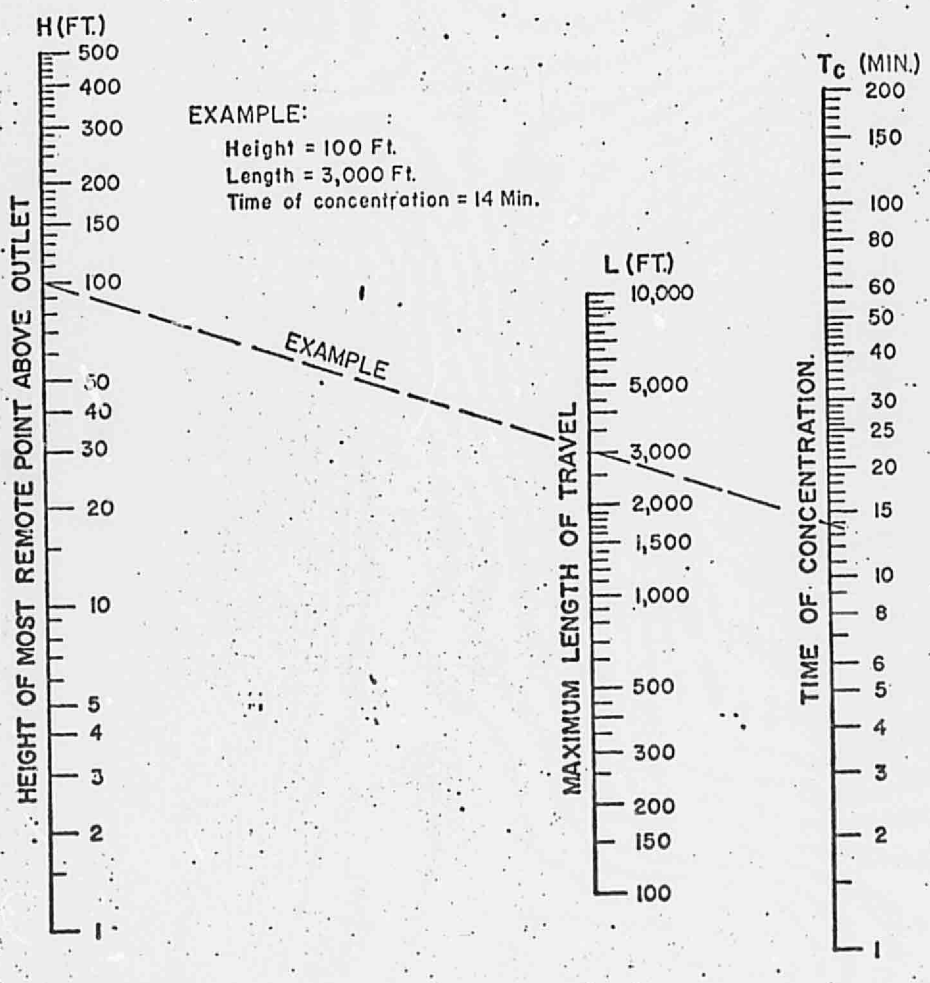
Respectfully submitted,
February 15, 1973

Thomas O. Isaacson

Thomas O. Isaacson

For:
CHAMBERS, CAMPBELL
ISAACSON & CHAPLIN, INC.

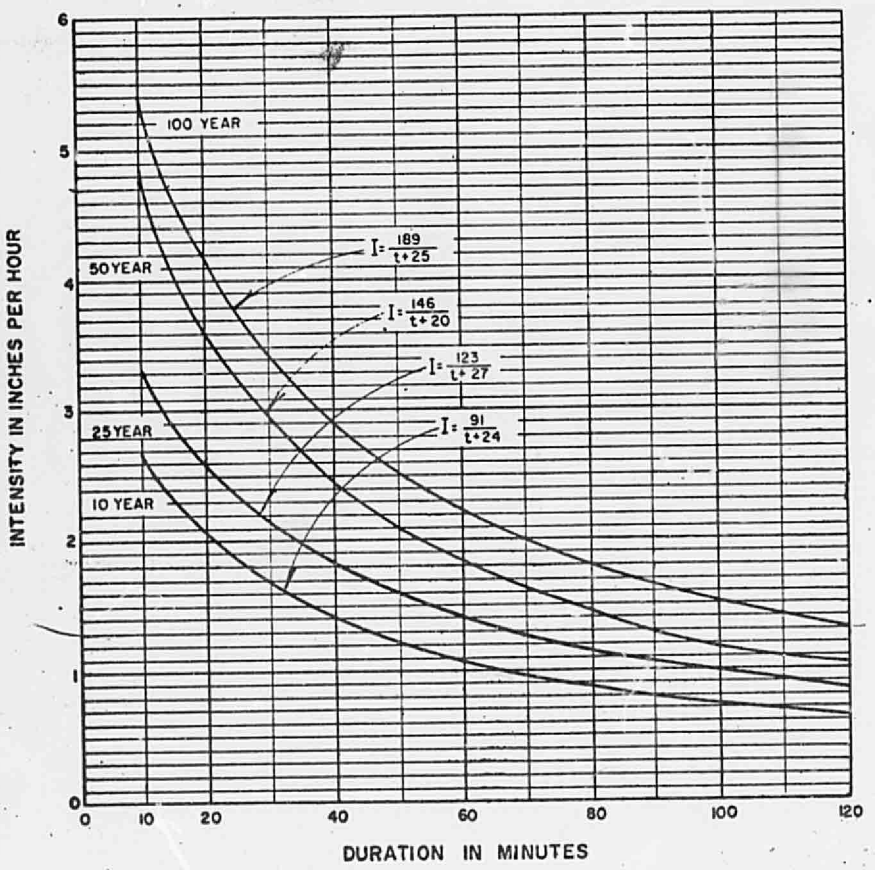
REGISTERED PROFESSIONAL ENGINEER AND LAND SURVEYOR
THOMAS O. ISAACSON
NO. 3395
NEW MEXICO



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

FIG. 1 TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

Reprinted from "Design of Roadside



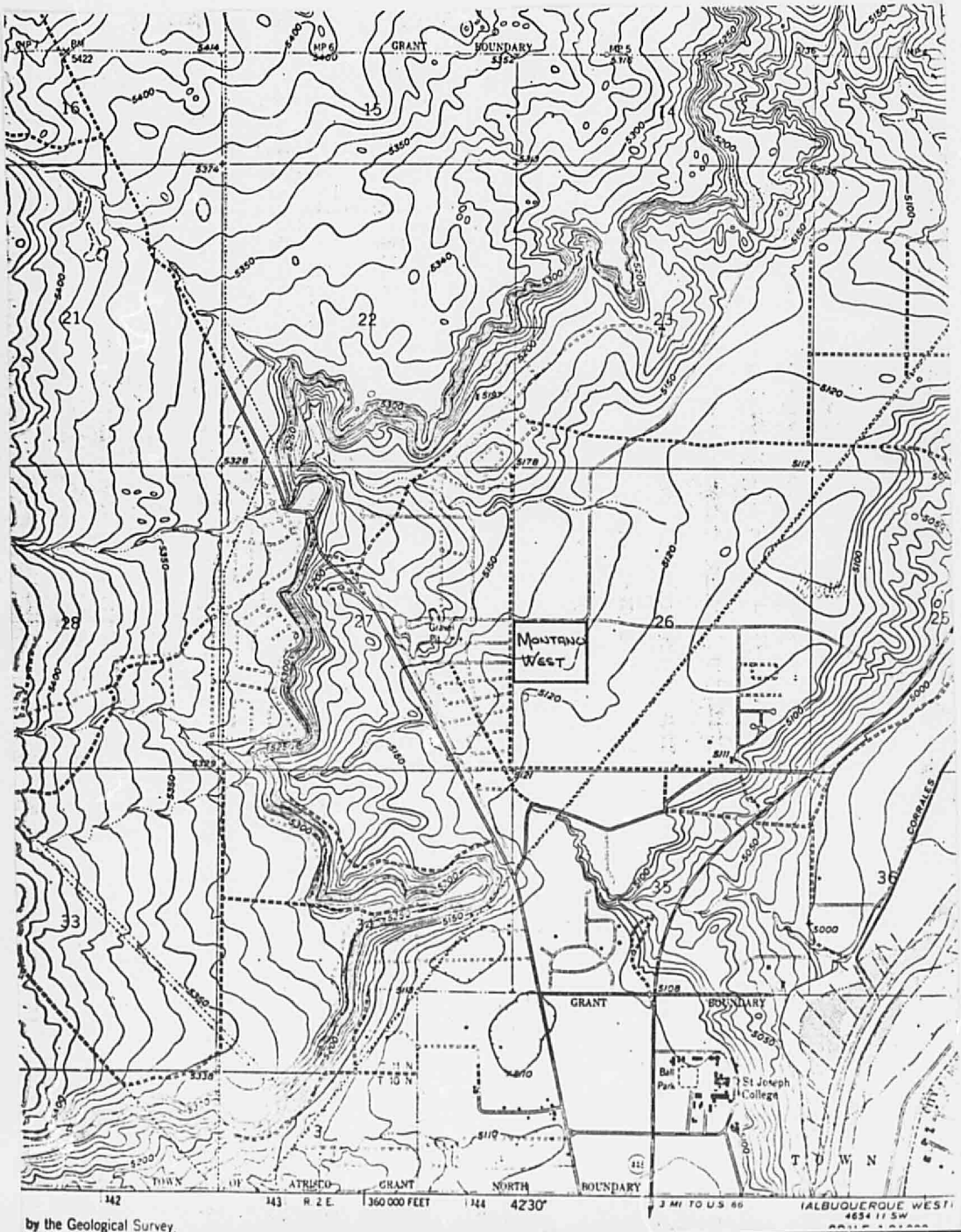
MASTER PLAN OF DRAINAGE
CITY OF ALBUQUERQUE - NEW MEXICO
AND ENVIRONS

INTENSITY DURATION
FREQUENCY CURVES

(ALBUQUERQUE AREA - 1961)

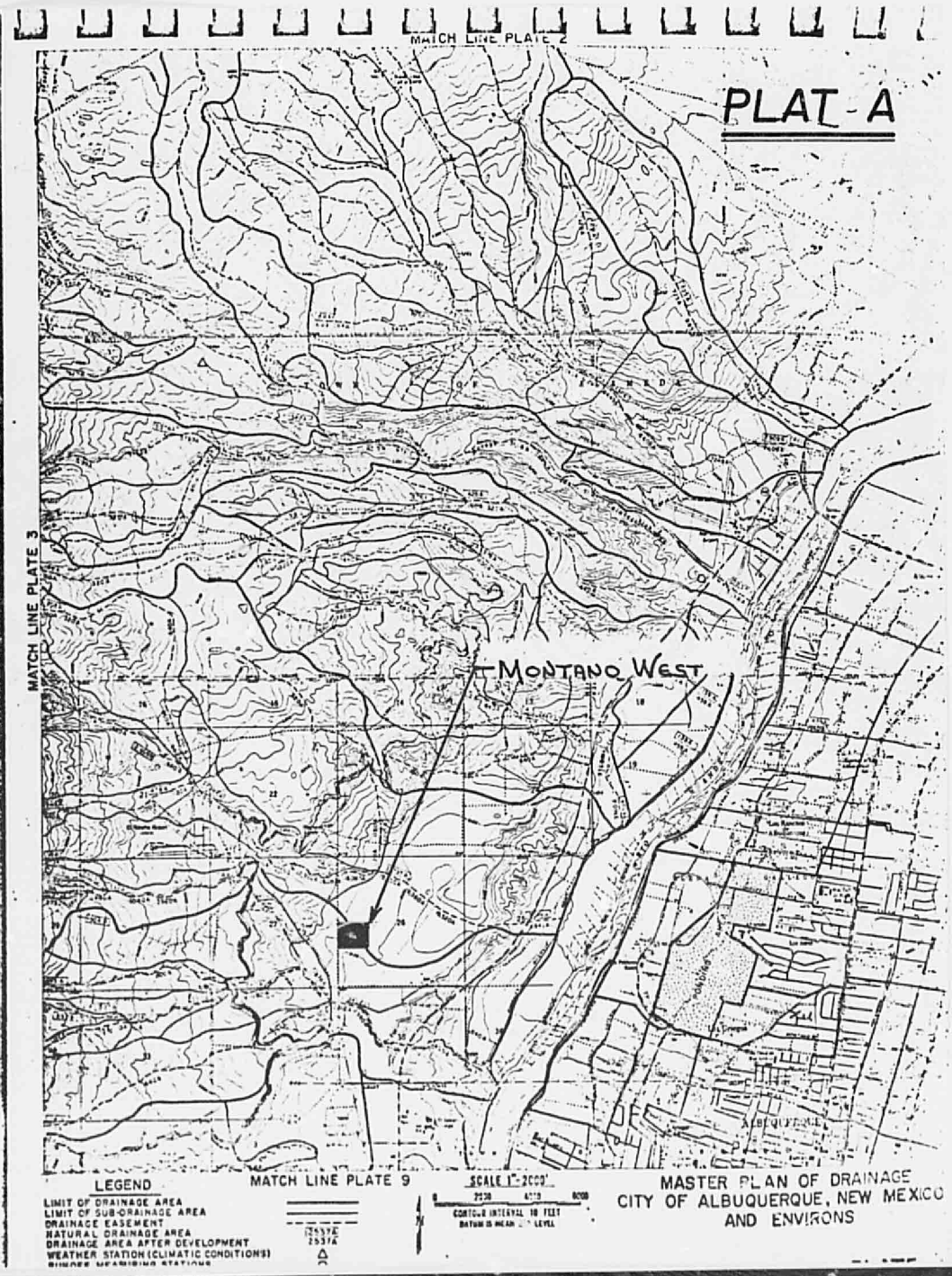
GORDON HERKENHOFF & ASSOC
CONSULTING ENGINEERS
ALBUQUERQUE, NEW MEXICO

CHART
1



by the Geological Survey.

THIS MICROIMAGE IS THE BEST POSSIBLE REPRODUCTION DUE TO THE POOR QUALITY OF THE ORIGINAL DOCUMENT.



THIS MICROIMAGE IS THE BEST POSSIBLE REPRODUCTION DUE TO THE POOR QUALITY OF THE ORIGINAL DOCUMENT.

MONTANO WEST ~ UNDEVELOPED FORM

GIVEN ~ H = 13' (37.24)
L = 1300'

CHARTS ~ Tc = 11.4 MIN.
I = 5.19 "/HR

SOLUTION ~

A = 30.3 ACRES

R = 0.40

Q = AIR = (30.3)(5.19)(0.40)

= 62.93 cfs.

MONTANO WEST ~ AREA A (SEE PLAT B)

GIVEN ~ H = 2' (34-32)

L = 260'

CHARTS ~ Tc = 3.8 MIN

I = 5.4 "/HR (Tc = 10 MIN)

SOLUTION ~

A = 0.9068 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (0.9068)(5.40)(0.74)

= 3.62 c.f.s.

MONTANO WEST ~ AREA B (SEE PLAT B)

GIVEN ~ H = 1' (33-32)
L = 50'

CHARTS ~ Tc = 1.2 min
I = 5.4"/HR (Tc = 10 min)

SOLUTION ~

A = 0.0964 Acres
R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (0.0964)(5.4)(0.74)
= 0.39 cfs.

MONTANO WEST ~ AREA C (SEE PLAT B)

GIVEN ~ H = 1' (33-32)

L = 90'

CHARTS ~ Tc = 1.4 MIN

I = 5.4"/HR (Tc = 10 MIN)

SOLUTION ~

A = 0.1331 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (0.1331)(5.4)(0.74)

= 0.53 cfs

MONTANO WEST ~ AREA D (SEE PLAT B)

GIVEN ~ H = 1' (33-32)
L = 120'

CHARTS ~ Tc = 1.8 min
I = 5.4 "/HR (Tc = 10 MIN)

SOLUTION ~

A = 0.2410 ACRES
R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (0.2410)(5.4)(0.74)
= 0.96 c.f.s.

MONTANO WEST ~ AREA E (SEE PLAT B)

GIVEN ~ H = 8' (33-25)

L = 510'

CHARTS ~ Tc = 4.8 MIN

I = 5.4"/HR (Tc = 10 MIN)

SOLUTION ~

A = 1.4394 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (1.4394)(5.4)(0.74)

= 5.75 c.f.s.

MONTANO WEST ~ AREA F (SEE PLAT B)

GIVEN ~ H = 4' (34-30)

L = 755'

CHARTS ~ Tc = 9.0 MIN

I = 5.4"/HR (Tc = 10 MIN)

SOLUTION ~

A = 2.0661 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (2.0661)(5.4)(0.74)

= 8.26 c.f.s.

MONTANO WEST ~ AREA G (SEE PLAT B)

GIVEN ~ H = 3' (32-29)
L = 740'

CHARTS ~ Tc = 10.2 MIN
I = 5.37 "/HR.

SOLUTION ~
A = 2.0294
R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (2.0294)(5.37)(0.74)
= 8.06 c.f.s.

MONTANO WEST ~ AREA H (SEE PLAT B)

GIVEN ~ H = 5.5' (32 - 26.5)

L = 715'

CHARTS ~ Tc = 8 MIN

I = 5.4 (Tc = 10 MIN)

SOLUTION ~

A = 1.9972 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (1.9972)(5.4)(0.74)

= 7.98 c.f.s.

MONTANO WEST ~ AREA I (SEE PLAT B)

GIVEN ~ H = 5' (29.24)

L = 930'

CHARTS ~ Tc = 11 MIN

I = 5.25 "/HR

SOLUTION ~

A = 2.4334 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (2.4334)(5.25)(0.74)

= 9.45 c.f.s.

MONTANO WEST ~ AREA J (SEE PLAT B)

GIVEN ~ H = 5.75 (31 - 25.25)

L = 820'

CHARTS ~ Tc = 9.2 MIN

I = 5.4"/HR (Tc = 10 MIN)

SOLUTION ~

A = 1.9513 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (1.9513)(5.4)(0.74)

= 7.80 c.f.s.

MONTANO WEST ~ AREA K (SEE PLAT B)

GIVEN ~ H = 4.5' (30.5 - 26.0)

L = 640'

CHARTS Tc = 7.8 MIN

I = 5.4 "/HR (Tc = 10 MIN)

SOLUTION ~

A = 1.8916 AC ES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (1.8916)(5.4)(0.74)

= 7.56 c.f.s

MONTANO WEST ~ AREA L (SEE PLAT B)

GIVEN ~ H = 2' (26-24)
L = 130'

CHARTS ~ Tc = 1.6 MIN
I = 5.4 in/HR (Tc = 10 MIN)

SOLUTION ~
A = 0.1837
R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (0.1837)(5.4)(0.74)
= 0.73 c.f.s.

MONTANO WEST ~ AREA M (SEE PLAT B)

GIVEN ~ H = 2' (28-26)

L = 215'

CHARTS ~ Tc = 2.8 MIN

I = 5.4 "/HR (Tc = 10 MIN)

SOLUTION ~

A = 0.3926 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (0.3926)(5.4)(0.74)

= 1.57 c.f.s.

MONTANO WEST ~ AREA N (SEE PLAT B)

GIVEN ~ H = 5' (25-23)

L = 240'

CHARTS ~ Tc = 2.4 MIN

I = 5.4"/HR (Tc = 10 MIN)

SOLUTION ~

A = 0.5280 ACRES

R = 0.74 (COMPOSITE FACTOR)

Q = AIR = (0.5280)(5.4)(0.74)

= 2.11 c.f.s.

MONTANO WEST ~ AREA O (SEE PLAT B)

GIVEN ~ H = 1' (31-30)

L = 50'

CHARTS ~ Tc = 1.2 MIN

I = 5.4"/HR (Tc = 10 MIN)

SOLUTION ~

A = 0.1148 ACRES

R = 0.74 COMPOSITE FACTOR

Q = AIR = (0.1148)(5.4)(0.74)

= 0.46 c.f.s.

MONTANO WEST ~ SUMMARY

AREA	A	=	3.62 c.f.s.
"	B	=	0.39 c.f.s.
"	C	=	0.53 c.f.s.
"	D	=	0.96 c.f.s.
"	E	=	5.75 c.f.s.
"	F	=	8.26 c.f.s.
"	G	=	8.06 c.f.s.
"	H	=	7.98 c.f.s.
"	I	=	9.45 c.f.s.
"	J	=	7.80 c.f.s.
"	K	=	7.56 c.f.s.
"	L	=	0.73 c.f.s.
"	M	=	1.57 c.f.s.
"	N	=	2.11 c.f.s.
"	O	=	0.46 c.f.s.

MONTANO WEST ~ Q'S AT PT'S 1, 2 & 3
(SEE PLAT B)

POINT 1 ~ Q = 5.75 cfs (SEE PAGE 6)

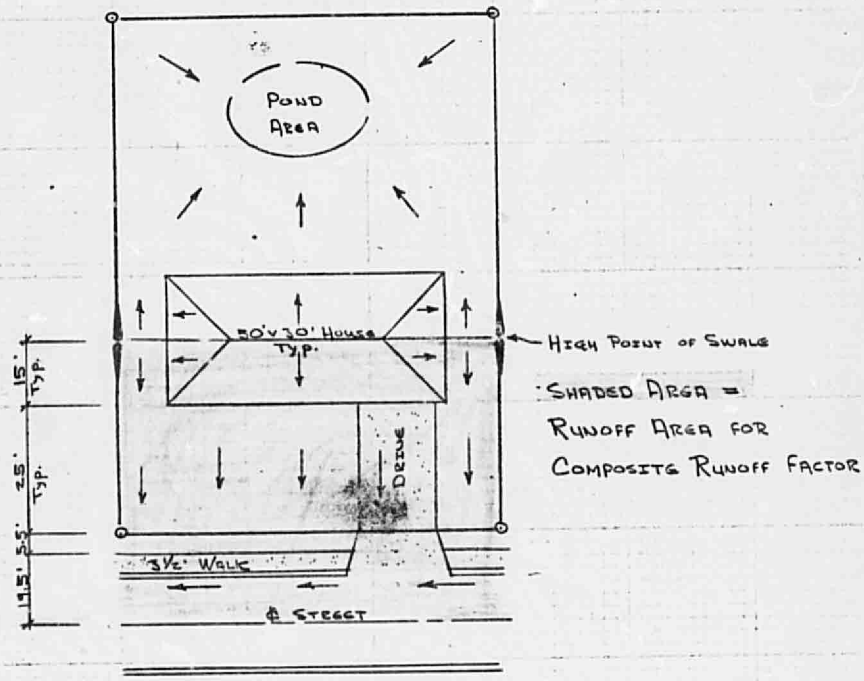
POINT 2 ~ H = 11' (34-23)
L = 1910'
Tc = 19 MIN
I = 4.30 "/HR
A = 12.2863 ACRES
R = 0.74
Q = AIR = (12.2863)(4.30)(0.74)
= 39.10 c.f.s.

POINT 3 ~ H = 6.5' (30.5-24)
L = 640'
Tc = 6.8 MIN
I = 5.4 "/HR (Tc = 10 MIN)
A = 2.4679 ACRES
R = 0.74
Q = AIR = (2.4679)(5.4)(0.74)
= 9.86 c.f.s

TOTAL Q RUNOFF AFTER DEVELOPMENT = 54.71 c.f.s.
TOTAL Q RUNOFF BEFORE DEVELOPMENT = 62.93 c.f.s.

MONTANO WEST ~ TYPICAL LOT (60'x100') DRAINAGE

FIGURE A



R = 0.95

STREET & WALK AREA (19.5'x60') = 1170 ft²
ROOF AREA (15.0'x50') = 750 "
DRIVEWAY (30.5'x15') = 458 "
Σ = 2378 ft² @ 0.95 (R) = 0.61% AREA
(0.05459 Ac.)

R = 0.40

FRONT & SIDE YARD AREA-MINUS DRIVEWAY & ½ ROOF AREA
(45.5'x60') - 1208 ft² = 1522 ft² @ 0.40 (R) = 0.39% AREA
(0.03494 Ac.)

COMPOSITE RUNOFF FACTOR = 0.74

Ex - R = 0.95 AREA Q = AIR = (0.05459)(5.4)(0.95) = 0.280
R = 0.40 AREA Q = AIR = (0.03494)(5.4)(0.40) = 0.075 } TOTAL = 0.355 cfs.
Comp. R = 0.74 AREA Q = AIR = (0.08953)(5.4)(0.74) = 0.358 cfs.

CHAMBERS, CAMPBELL, ISAACSON & CHAPLIN
ENGINEER-ARCHITECT-PLANNERS
ALBUQUERQUE, NEW MEXICO

SUBJECT MONTANO WEST SUBDIVISION
CLIENT _____ JOB NO. ____
BY _____ DATE 2-73 SHEET NO. 19 OF 19

THIS MICROIMAGE IS THE BEST POSSIBLE REPRODUCTION DUE TO THE POOR QUALITY OF THE ORIGINAL DOCUMENT.

TABLE IV

STREET CARRYING CAPACITIES
(CFS)

Slope	32' Street 6" Crown at center line or 6" sidehill with no crown	32' Street Flat Cross-section	32' Street 6" Inverted crown at center line	32' Street with 8" sidehill with no crown	32' Street with 12" sidehill with no crown	40' Street 6" Crown at center-line or 6" sidehill with no crown	44' Street 6" Crown at center-line or 6" sidehill with no crown	48' Street 6" Crown at center-line or 6" sidehill with no crown
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0.0500	167	350	598	113	74	208	230	251

Coefficient of Roughness = n = 0.015 for all streets.
Carrying Capacity Given in Cubic Feet per Second (C.F.S.)
Arterial Design (Stage & Final) has a +2% Slope from the Top of Curb to the top of Median Curb.
Curb Height = 8"

HYDROLOGY E11/D6 MONTANO WEST SUBDIVISION 2 OF 2

Cities Eng.

Supplement to Montano West Drainage Report --

Subject: The runoff flow from Montano West Subdivision, after development, will be concentrated in three areas, points 1, 2, and 3 (see Plat B). Although the slopes of the streets in the subdivision and of the undeveloped lands surrounding the subdivision are minimal, there arises a need to control the runoff once it leaves Montano West proper. Therefore, the purpose of this supplement is to insure the mutual cooperation of all parties involved in order to best remove said runoff into its natural channels. The best approach appears to be the construction of temporary channels from points 1, 2, and 3, to the natural drainage flow line which is Southeast of the subdivision.

Statement:

We, the undersigned owners of the land adjoining the South boundary of Montano West Subdivision, hereby agree to allow the developer, National Housing Industry, to construct temporary drainage channels from points 1 and 2 (see Plat B) to the natural drainage channel Southeast of the subdivision.

La Joya Investments Inc.
Steve Steele, Pres.

Statement:

We, the undersigned owners of the land adjoining the East boundary of Montano West Subdivision, hereby agree to allow the developer, National Housing Industry, to construct temporary drainage channels from point 3 (see Plat B) to the natural drainage channel Southeast of the subdivision.

Dale Bellamah Land Co. Inc.
By Ormie B. Shaw Co. V.P.

MONTANO WEST SUBDIVISION

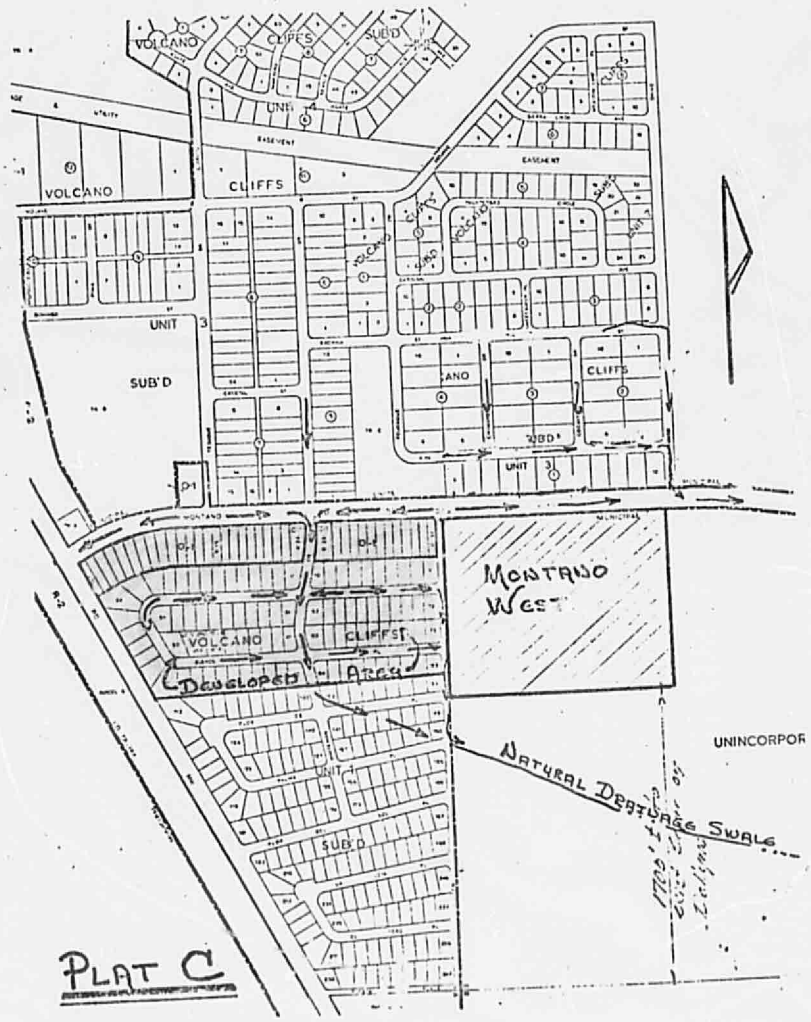
DRAINAGE REPORT
SUPPLEMENT NO. 2

The purpose of this supplement is to answer the questions raised by Mr. Robert concerning the ability of Montano Road and Golden Avenue to carry the offsite drainage around Montano West Subdivision.

Volcano Cliffs Subdivision, south of Montano Road, is the only developed area at present. The drainage from the north is funneled onto Whiteman Drive with Montano Road serving as a collector (see Plat C), Whiteman Drive then serves as the main collector through the developed area to the natural drainage swale to the south. The two streets connecting Whiteman and Golden have minimum gradients and do not relieve Whiteman Drive of its collector status. Therefore, the only flow reaching Golden Avenue will be from the east area of Volcano Cliffs Subdivision between Golden and Whiteman Drive. The most natural direction of flow on Golden from this area, would be to the south to the natural drainage swale, rather than through Montano West Subdivision. The existing topography of Montano West Subdivision adjoining Golden is three to four feet higher than the proposed finished grade of Golden (as shown on Special Assessment District No. 182, P & P sheets by Wilson & Co., Engineers). It would be uneconomical to lower the subdivision street grades that much to accomodate this small flow through the subdivision.

On the north boundary of Montano West Subdivision, Montano Road, which is paved with drainage ditches on each side, intercepts all the flow from the north. This flow is carried to the east to a point well past the northeast corner of the subdivision before it resumes its southeasterly direction. Once Volcano Cliffs Unit No. 3 is developed (see Plat C), the only flow on Montano Road east of Golden Avenue will come from direct rainfall on Montano Road. Again, it would be uneconomical to lower Montano West street grades to accomodate this small flow through the subdivision.

The park area in Montano West Subdivision will be used as a ponding area with controlled inlets on the west side and controlled over-flow outlets on the east side. This will help reduce the concentrated flow at point 2 (see Plat B).



○ ~ DEVELOPED AREA

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HERKENHOFF, GORDON, & ASSOCIATES, "MASTER PLAN OF DRAINAGE, CITY OF ALBUQUERQUE, NEW MEXICO AND ENVIRONS, 1963," ALBUQUERQUE: GORDON, HERKENHOFF & ASSOCIATES, CONSULTING ENGINEERS.

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