HYDROLOGY E18/D23 THREE PLANS

E18/D23

3 PLANS

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RECEIVED
JUL 05 1979
CITY ENGINEER

July 2, 1979

Mr. Kenneth A. Hunt
Attorney
130 Louisiana Boulevard, NE
Albuquerque, N.M. 87108

E18-D23b

Dear Mr. Hunt:

Reference your letter dated June 27, 1979, Re: Villa Encantada.

Per your request I have reviewed the plans.

Based on your Engineer's report and a personal inspection last year, it appears that the proposed scheme will solve the problem. Also, in view of City's non-objection, I authorize you to make the modifications outlined.

Sincerely,

Richard E Leonard

Richard E. Leonard
Executive Engineer

REL:ic
cc: Mr. Conegliano

RALPH K. HICKS and Associates, Inc.
REGISTERED LAND SURVEYORS
1504-B WYOMING BLVD., N.E. • PHONE (505) 296-0739 • ALBUQUERQUE, NEW MEXICO 87112

REVISED
STORM DRAINAGE STUDY
FOR
VILLA ENCANTADA

FEBRUARY 1973

GENERAL

This report presents the calculated probable storm drainage runoff from a 100 year storm of this proposed development of Villa Encantada.

LOCATION

Villa Encantada is bounded on the East by Burlison Drive, N.E.; on the North by a concrete lined drainage channel; on the West by Marcheta Avenue, N.E.; and on the South by Academy Boulevard, N.E. It is situated in the Southwest Quarter (SW/4) of the Northeast Quarter (NE/4) of Section 25, Township 11 North, Range 3 East, N.M.P.M.

EXISTING DRAINAGE

The present topography shows a fairly consistant slope to the Southwest of 2% mainly as sheet flow. There are no outside contributing areas involved with this site.
Drainage from the Northeast is diverted thru the concrete lined channel and along Burlison Drive, N.E.

PROPOSED DRAINAGE PLANS

In order to reduce runoff, limiting street grades have been used to reduce velocities and overland flow on grassed area with ponding in open areas. The drainage has been divided into several areas to prevent concentration at one point. The streets are designed to carry all runoff without over topping.

RUNOFF QUANTITIES

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

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

Intensity Duration Frequency Curves (Chart 1) for the Albuquerque Area, "Master Plan of Drainage - City of Albuquerque, New Mexico and Environs," 1963, prepared by Gordon Herkenhoff and Associates, Consulting Engineers, together with the expected accumulation of runoff from each of the areas. The total accumulation times are determined by a combination of Yarnell's Method and probable future streets and drainage channel alignments and grades, as shown; assuming overland flows to cross grass surfaces, depending upon the probable type of development in each area and estimating the probable type of grading to be done in each area. the coefficient of runoff (C) was determined by using percentage of area covered by grass, buildings and paving, using respective runoff factors from the Master Plan of Drainage.

STREET DRAINAGE

Street capacities are based on Manning's Equation, Q=AV, where $V=\frac{1.486}{n} R^{2/3} S^{1/2}$ when A=cross-sectional area of the channel or structure; R=hydraulic radius of channel or area divided by wetted perimeter; S=slope of channel or facility in feet per foot; and "n" values of 0.015 for concrete and asphalt surfaces.

CONCLUSIONS

The computations indicate that the proposed design is adequate to satisfactorly handle a 100 year storm.

Wm. J. McDermott

Wm. J. McDermott
P.E. & L.S. No. 1855

RUNOFF COMPUTATIONS

Sheet No. _____

Job No. _____

Drainage Area No. 1 A, B, C

Area = 2.92 acres

Maximum Overland Flow: L = 150 S = 2%

Maximum Channel Flow:

Channel No. 1 L = 1000 S = 2%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 4 min.

Channel No. 1 Flow:

Velocity= 2 ft/sec; Time= $\frac{1000}{2 \times 60}$ = 8.3 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 12.3 min.

$I = \frac{189}{T+25} = \frac{189}{37.3} = 5.06$

$Q = CIA = (.60)(5.06)(2.92) = 8.9$ c.f.s.

Date: _____

Comp. by: _____

Checked by: _____

REVISED

PONDING COMPUTATIONS

VILLA ENCALITADA

Sheet No. _____

Drainage Area No. 2

Area = 0.379 acres

A x 43,560 x $\frac{1.92}{12}$ = 2640 cubic feet required

Pond Area x Depth x .33 = volume cubic feet

5150 x 2 x .33 = 3400 cubic feet

PONDING COMPUTATIONS

VILLA ENCANTADA

Sheet No. _____

Drainage Area No. 3

Area = 0.743 acres

A x 43,560 x $\frac{1.92}{12}$ = 5178 cubic feet required

Pond Area x Depth x .55 = volume cubic feet

5040 x 3 x .55 = 4990 cubic feet

188 TO 6

PONDING COMPUTATIONS

VILLA ENCANTADA

Sheet No. _____

Drainage Area No. 4

Area = 0.481 acres

A x 43,560 x 1.92 / 1. = 3350 cubic feet required

Pond Area x Depth x .33 = volume cubic feet

1600 x 1.1 x .33 = 580 cubic feet

1840 x 1.4 x .33 870

1040 x 1.4 x .33 475

1425 C.F. TO 5, 6, 7

ONDING COMPUTATIONS

VILLA ENCANTADA

Sheet No._____

Drai age Area No. 5

Area = 1.000 acres

A x 43,560 x $\frac{1.0}{12}$ = 6970 cubic feet required

Pond Area x Depth x .33 = volume cubic feet

7200 x 2.1 x .33 = 4880 cubic feet

3443 1.0

1062

1008 TO 6.

PONDING COMPUTATIONS

VILLA ENCANTADA

Sheet No. _____

Drainage Area No. 6

Area = 0.209 acres

A x 43,560 x $\frac{1.92}{12}$ = 1456 cubic feet required

Pond Area x Depth x .35 = volume cubic feet

2880 x 3.8 x .35 = 3801 cubic feet

2621 FROM 3, 4, 5

376 TO 7

PONDING COMPUTATIONS

VILLA ENCANTADA

Sheet No. _____

Drainage Area No. 7

Area = 0.220 acres

A x 43,560 x $\frac{1.92}{12}$ = 1530 cubic feet required

Pond Area x Depth x .33 = volume cubic feet

4480 x 1.0 x .33 = 4356 cubic feet

276 CF FROM 6

ONDING COMPUTATIONS

VILLA ENCANTADA

Sheet No. _____

Drainage Area No. 8

Area = 1.631 acres

A x 43,560 x $\frac{1.32}{12}$ = 11367 cubic feet required

Pond Area x Depth x .33 = volume cubic feet

5520 x 3 x .33 = 5480 cubic feet

7360 x 2.5 6075

11555

RUNOFF COMPUTATIONS

Sheet No. _____

Job No. _____

Drainage Area No. 9

Area = 3.031 acres

Maximum Overland Flow: L = 240' S = 1%

Maximum Channel Flow:

Channel No. 1 L = 900' S = 1%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 4 min.

Channel No. 1 Flow:

Velocity= 2 ft/sec; Time= $\frac{900}{2 \times 60}$ = 9 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 13 min.

$I = \frac{109}{T+25} = \frac{189}{13+25} = 4.97$

$Q = CIA = (.60)(4.97)(3.031) =$ 9.04 cfs c.f.s.

Date: _____

Comp. by: _____

Checked by: _____

RUNOFF COMPUTATIONS

Sheet No. _____

Job No. _____

Drainage Area No. 10

Area = .627 acres

Maximum Overland Flow: L = 200 S = _____

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 3 min.

Channel No. 1 Flow:

Velocity= 2.5 ft/sec; Time= $\frac{150}{2.5 \times 60}$ = 1 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 4 min.

$I = \frac{189}{T+25} = \frac{189}{29} = 6.52$

$Q = CIA = (.50)(6.52)(.627) = 2.04$ c.f.s.

Date: _____

Comp. by: _____

Checked by: _____

PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
PARKWOOD VILLAGE

CAMPBELL-HICKS ASSOCIATES, INC.
ALBUQUERQUE, NEW MEXICO

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PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
PARKWOOD VILLAGE
ALBUQUERQUE, NEW MEXICO

AUGUST 1972

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PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
PARKWOOD VILLAGE

I. GENERAL

The purpose of this report is to present findings pertinent to estimating and handling of runoff for use in the master planned development of PARKWOOD VILLAGE and to describe a proposed method for providing adequate storm drainage in the area.

II. LOCATION

PARKWOOD VILLAGE is bounded on the west by Academy Acres, Unit 2 (Wood Brothers' showcase homes); on the north by Academy Acres, Unit 1; on the east by Burlison Drive, N.E.; and on the south by Academy Blvd., N.E. It is situated mainly in the southeast one-quarter (SE 1/4) of Section 25, Township 11 North, Range 3 East, N.M.P.M.

III. EXISTING DRAINAGE CONDITIONS

A. General

This area is generally located between McKinney Drive, N.E. on the west and Burlison Drive, N.E. on the east, north of Academy Blvd., N.E. and south of Academy Acres, Unit 1.

B. Topography

The area of the proposed development is in a semi-arid climate. It is marked by minor arroyos as shown in Exhibit "A", Location Map. Vegetation is sparce.

C. Drainage Areas and Channels

Presently the drainage area to the east is limited to Burlison Drive, N.E., as shown on Exhibit "C", Plan of Drainage. The runoff within the development itself can be carried by planning streets in such a manner (set property lines high enough and adjust grades on streets within the development) as to carry water across the development.

IV. PROPOSED DRAINAGE PLANS

A. General

In order to provide an adequate system of storm

drainage for this proposed development, it was necessary to:

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

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

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

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

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

B. Drainage Areas

A study of the photography, Exhibit "A", to determine the areas which could conceivably contribute runoff to the proposed development was made first. Then the Plan of Drainage, Exhibit "C", was prepared showing the entire area with directions of flow as well as runoff quantities. Exhibit "B", a combined master plan after complete development, shows the entire area between Wyoming and San Mateo, north of Academy Blvd. and south of San Antonio Drive, N.E.

C. Runoff Quantities

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

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

The intensity of rainfall (I) was determined by assuming a 100 year frequency rainfall and then utilizing

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

The coefficient of runoff (C) was determined by assuming the maximum possible development in the areas under consideration. A coefficient of 0.65 is used for areas where dense residential development was most probable. A coefficient of 0.75 should be used for commercial areas or where a large amount of the exposed surface is impermeable.

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

D. Drainage Channels and Facilities

All existing structure capacities as well as any proposed future structures were verified from computer output sheets and are based on Manning's Equation, $Q=AV$, where $V=\frac{1.486}{n} R^{2/3} S^{1/2}$ when A=cross-sectional area of the channel or structure; R=hydraulic radius of channel or area divided by wetted perimeter; S= slope of channel or facility in feet per foot; and "n" values of 0.015 for concrete and asphalt surfaces, 0.013 for concrete pipes, 0.0225 for dirt lined channels or a composite "n" value based on proportional wetted surfaces with different values.

V. CONCLUSIONS AND RECOMMENDATIONS

On the basis of this study and its computations, it is concluded that the development of this area can be accomplished satisfactorily provided adequate storm drainage is done.

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

The storm sewer on Academy Blvd., as shown on Exhibits "B" and "C", may be designed using Exhibit "F", Concrete Storm Sewer Carrying Capacities.

If all of the above conclusions and recommendations are followed, this plan of handling drainage should provide the necessary requirements to make this a very satisfactory development.

Respectfully submitted,

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

EXHIBIT "A"

Location Map
Academy Acres.

Campbell-Hicks & Associates, Inc
Albuquerque, New Mexico

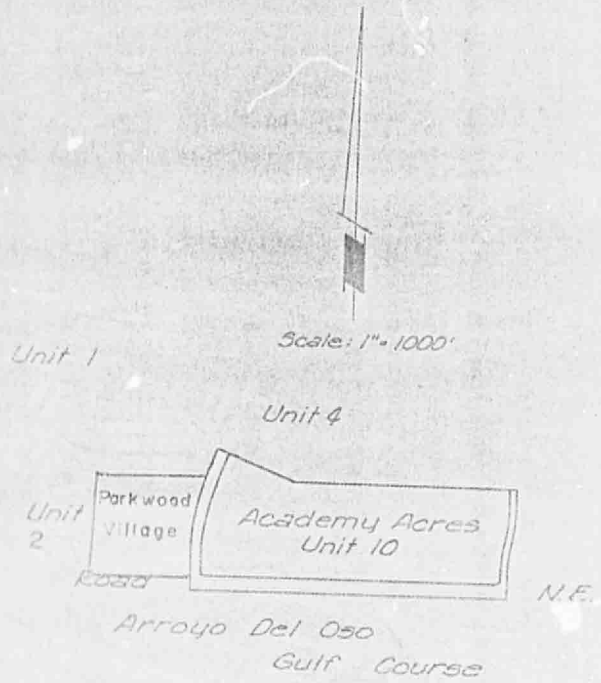

EXHIBIT "D"

SUMMARY OF RUNOFF COMPUTATIONS

SHEET NO.	AREA NUMBER	AREA (IN ACRES)	EXPECTED RUNOFF (IN C.F.S.) INDIVIDUAL	TOTAL
1	A-1	1.7	7	
2	A-2	1.9	7	14
3	B-1	1.1	5	
4	B-2	0.9	3	8
5	B-3	2.1	10	18
6	C-1	0.7	4	
7	C-2	1.7	7	1[illegible]
8	C-3	0.1	1	30
9	C-4	0.2	1	45
10	D-1	0.6	1	

RUNOFF COMPUTATIONS

Sheet No. 1

Job No. P.V.

Drainage Area No. A-1

Area = 1.7 acres

Maximum Overland Flow: L = 50' S = 2.1 %

Maximum Channel Flow:

Channel No. 1 L = 105' S = 1.5 %

Channel No. 2 L = 392' S = 2.3%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 5.0 min.

Channel No. 1 Flow:

Velocity= 1.46 ft/sec; Time= $\frac{105}{1.46 \times 60}$ = 1.2 min.

Channel No. 2 Flow:

Velocity= 2.86 ft/sec; Time= $\frac{392}{2.86 \times 60}$ = 2.3 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 8.5 min.

$I = \frac{189}{T+25} = \frac{189}{8.5+25} = 5.64$

Q = CIA = (0.75)(5.64)(1.7) = 7 c.f.s.

Date: 9-12-72

Comp. by: ZEB

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 2

Job No. P.V.

Drainage Area No. A-2

Area = 1.9 acres

Maximum Overland Flow: L = 40' S = 2.5 %

Maximum Channel Flow:

Channel No. 1 L = 166' S = 2.6 %

Channel No. 2 L = 555' S = 0.75 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 11.0 min.

Channel No. 1 Flow:

Velocity= 2.98 ft/sec; Time= $\frac{166}{2.98 \times 60}$ = 0.9 min.

Channel No. 2 Flow:

Velocity= 2.56 ft/sec; Time= $\frac{555}{2.56 \times 60}$ = 3.6 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 15.5 min.

$I = \frac{189}{T+25} = \frac{189}{15.5+25} = 4.67$

Q = CIA = (0.75)(4.67)(1.9) = 7 c.f.s.

Date: 9-13-72

Comp. by: HEP

Checked by: JEB

Totals

Acres: 1.7 + 1.9 = 3.6

C.F.S.: 7 + 7 = 14

RUNOFF COMPUTATIONS

Sheet No. 3

Job No. P.V.

Drainage Area No. B-1

Area = 1.1 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 590' S = 1.0%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 1.89 ft/sec; Time= $\frac{590}{1.89 \times 60}$ = 5.2 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 5.2 min.

$$I = \frac{1.89}{T+25} = \frac{1.89}{5.2+25} = 6.26$$

$$Q = CIA = (0.75)(6.26)(1.1) = 5 \text{ c.f.s.}$$

Date: 9-13-72

Comp. by: BEB

Checked by: HAP

RUNOFF COMPUTATIONS

Sheet No. 4

Job No. P.V.

Drainage Area No. B-2

Area = 0.9 acres

Maximum Overland Flow: L = 40' S = 1.3 %

Maximum Channel Flow:

Channel No. 1 L = 156' S = 2.2 %

Channel No. 2 L = 177' S = 1.1 %

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 12.6 min.

Channel No. 1 Flow:

Velocity= 2.80 ft/sec; Time= $\frac{156}{2.80 \times 60}$ = 0.9 min.

Channel No. 2 Flow:

Velocity= 2.59 ft/sec; Time= $\frac{177}{2.59 \times 60}$ = 1.1 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 14.6 min.

$$I = \frac{189}{T+25} = \frac{189}{14.6+25} = 4.77$$

$$Q = CIA = (0.75)(4.77)(0.9) = 3 \text{ c.f.s.}$$

Date: 9-13-72

Comp. by: [illegible]

Checked by: [illegible]

Totals

Acres: 1.1 + 0.9 = 2.0

C.F.S.: 5 + 3 = 8

RUNOFF COMPUTATIONS

Sheet No. 5

Job No. P.V.

Drainage Area No. B-3

Area = 2.1 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 155' S = 1.0 %

Channel No. 2 L = 205' S = 0.5 %

Channel No. 3 L = 465' S = 2.1 %

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 1.89 ft/sec; Time= $\frac{155}{1.89 \times 60}$ = 1.4 min.

Channel No. 2 Flow:

Velocity= 1.34 ft/sec; Time= $\frac{205}{1.34 \times 60}$ = 2.5 min.

Channel No. 3 Flow:

Velocity= 3.58 ft/sec; Time= $\frac{465}{3.58 \times 60}$ = 2.2 min.

Total Accumulation Time: T = 6.1 min.

$I = \frac{189}{T + 25} = \frac{189}{6.1 + 25} = 6.08$

Q = CIA = (0.75)(6.08)(2.1) = 10 c.f.s.

Date: 9-13-72

Comp. by: ZEB

Checked by: THP

Totals

Acres: 2.0 + 2.1 = 4.1

C.F.S.: 8 + 10 = 18

RUNOFF COMPUTATIONS

Sheet No. 6

Job No. P.V.

Drainage Area No. C-1

Area = 0.7 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 218' S = 2.3%

Channel No. 2 L = 100' S = 0.5%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 1.80 ft/sec; Time= $\frac{218}{1.80 \times 60}$ = 2.0 min.

Channel No. 2 Flow:

Velocity= 1.34 ft/sec; Time= $\frac{100}{1.34 \times 60}$ = 1.2 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 3.2 min.

$$I = \frac{189}{T+25} = \frac{189}{3.2+25} = 6.70$$

$$Q = CIA = (0.75)(6.70)(0.7) = 4 \text{ c.f.s.}$$

Date: 9-13-72

Comp. by: JEB

Checked by: JRP

RUNOFF COMPUTATIONS

Sheet No. 7

Job No. P.V.

Drainage Area No. C-2

Area = 1.7 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 514' S = 0.75 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 2.12 ft/sec; Time= $\frac{514}{2.12 \times 60}$ = 4.0 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 4.0 min.

$I = \frac{189}{T+25} = \frac{189}{4.0+25} = 6.52$

Q = CIA = (0.65)(6.52)(1.7) = 7 c.f.s.

Totals

Acres: 0.7 + 1.7 = 2.4

C.F.S.: 4 + 7 = 11

Date: 9-13-72

Comp. by: SEB

Checked by: ZEP

RUNOFF COMPUTATIONS

Sheet No. 8

Job No. P.V.

Drainage Area No. C-3

Area = 0.1 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 91' S = 2.0 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 4.24 ft/sec; Time= $\frac{91}{4.24 \times 60}$ = 0.4 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 0.4 min.

$I = \frac{189}{T+25} = \frac{189}{0.4+25} = 7.44$

Q = CIA = (0.75)(7.44)(0.1) = 1 c.f.s.

Totals

Acres: 4.1 + 2.4 + 0.1 = 6.6

C.F.S.: 18 + 11 + 1 = 30

Date: 9-13-72

Comp. by: JEB

Checked by: HEP

RUNOFF COMPUTATIONS

Sheet No. 9

Job No. P.V.

Drainage Area No. C-4

Area = 0.2 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 120' S = 3.5 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 5.61 ft/sec; Time= $\frac{120}{5.61 \times 60}$ = 0.4 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 0.4 min.

$I = \frac{189}{T+25} = \frac{189}{0.4+25} = 7.44$

Q = CIA = (0.75)(7.44)(0.2) = 1 c.f.s.

Totals

Acres: 3.6 + 6.6 + 0.2 = 10.4

C.F.S.: 14 + 30 + 1 = 45

Date: 9-13-72

Comp. by: BBB

Checked by: HEP

RUNOFF COMPUTATIONS

Sheet No. 10

Job No. P.V.

Drainage Area No. D-1

Area = 0.6 acres

Maximum Overland Flow: L = 620' S = 2.4 %

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 34.5 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 = 34.5 min.

$$I = \frac{189}{T+25} = \frac{189}{34.5+25} = 3.18$$

$$Q = CIA = (0.75)(3.18)(0.6) = 1 \text{ c.f.s.}$$

Date: 9-13-72

Comp. by: ZEB

Checked by: ZEP

EXHIBIT "E"

STREET CARRYING CAPACITIES AT VARIOUS GRADES IN C.F.S.

n(conc)=.015 Curb ht.=0"

R/W	ST WD	INVERT DEPTH	.0050	.0100	.0150	.0200	.0250	.0300	.0350	.0400
40	25	2"	1.75	2.48	3.03	3.51	3.92	4.30	4.64	4.96
		4"	5.57	7.87	9.64	11.14	12.45	13.64	14.73	15.75
		6"	10.94	15.48	18.95	21.89	24.47	26.80	28.95	30.95
		8"	17.67	24.99	30.61	35.34	39.51	43.28	46.75	49.98

MANNING FORMULA COMPUTATIONS

WIDTH = 25.0' DEPTH = 2.0"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	2.0833	50.0022	.0050	.0707	.0417	.1202	.8419	1.7540
.0150	2.0833	50.0022	.0100	.1000	.0417	.1202	1.1906	2.4805
.0150	2.0833	50.0022	.0150	.1225	.0417	.1202	1.4582	3.0379
.0150	2.0833	50.0022	.0200	.1414	.0417	.1202	1.6838	3.5079
.0150	2.0833	50.0022	.0250	.1581	.0417	.1202	1.8825	3.9220
.0150	2.0833	50.0022	.0300	.1732	.0417	.1202	2.0622	4.2963
.0150	2.0833	50.0022	.0350	.1871	.0417	.1202	2.2274	4.6405
.0150	2.0833	50.0022	.0400	.2000	.0417	.1202	2.3812	4.9609

WIDTH = 25.0' DEPTH = 4.0"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	4 1667	50.0089	.0050	.0707	.0833	.1908	1.3363	5.5680
.0150	4.1667	50.0089	.0100	.1000	.0833	.1908	1.8898	7.8743
.0150	4.1667	50.0089	.0150	.1225	.0833	.1908	2.3146	9.6440
.0150	4.1667	50.0089	.0200	.1414	.0833	.1908	2.6726	11.1359
.0150	4.1667	50.0089	.0250	.1581	.0833	.1908	2.9881	12.4503
.0150	4.1667	50.0089	.0300	.1732	.0833	.1908	3.2733	13.6386
.0150	4.1667	50.0089	.0350	.1871	.0833	.1908	3.5355	14.7314
.0150	4.1667	50.0089	.0400	.2000	.0833	.1908	3.7797	15.7486

WIDTH = 25.0' DEPTH = 6.0"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	6.2500	50.0200	.0050	.0707	.1250	.2499	1.7508	10.9425
.0150	6.2500	50.0200	.0100	.1000	.1250	.2499	2.4760	15.4750
.0150	6.2500	50.0200	.0150	.1225	.1250	.2499	3.0325	18.9530
.0150	6.2500	50.0200	.0200	.1414	.1250	.2499	3.5016	21.8850
.0150	6.2500	50.0200	.0250	.1581	.1250	.2499	3.9149	24.4682
.0150	6.2500	50.0200	.0300	.1732	.1250	.2499	4.2886	26.8036
.0150	6.2500	50.0200	.0350	.1871	.1250	.2499	4.6322	28.9512
.0150	6.2500	50.0200	.0400	.2000	.1250	.2499	4.9520	30.9501

WIDTH = 25.0' DEPTH = 8.0"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	8.3333	50.0355	.0050	.0707	.1665	.3027	2.1205	17.6709
.0150	8.3333	50.0355	.0100	.1000	.1665	.3027	2.9988	24.9904
.0150	8.3333	50.0355	.0150	.1225	.1665	.3027	3.6728	30.6069
.0150	8.3333	50.0355	.0200	.1414	.1665	.3027	4.2410	35.3418
.0150	8.3333	50.0355	.0250	.1581	.1665	.3027	4.7416	39.5133
.0150	8.3333	50.0355	.0300	.1732	.1665	.3027	5.1942	43.2846
.0150	8.3333	50.0355	.0350	.1871	.1665	.3027	5.6103	46.7527
.0150	8.3333	50.0355	.0400	.2000	.1665	.3027	5.9977	49.9808

EXHIBIT "F"

CONCRETE STORM SEWER PIPE.....DIAMETER = 18"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	1.7671	4.7124	.0050	.0707	.3750	.5200	3.6428	6.4373
.0150	1.7671	4.7124	.0100	.1000	.3750	.5200	5.1517	9.1038
.0150	1.7671	4.7124	.0150	.1225	.3750	.5200	6.3095	11.1498
.0150	1.7671	4.7124	.0200	.1414	.3750	.5200	7.2856	12.8747
.0150	1.7671	4.7124	.0250	.1581	.3750	.5200	8.1455	14.3943
.0150	1.7671	4.7124	.0300	.1732	.3750	.5200	8.9230	15.7682
.0150	1.7671	4.7124	.0350	.1871	.3750	.5200	9.6379	17.0316
.0150	1.7671	4.7124	.0400	.2000	.3750	.5200	10.3033	18.2075
.0150	1.7671	4.7124	.0450	.2121	.3750	.5200	10.9284	19.3120
.0150	1.7671	4.7124	.0500	.2236	.3750	.5200	11.5195	20.3566
.0150	1.7671	4.7124	.0550	.2345	.3750	.5200	12.0817	21.3502
.0150	1.7671	4.7124	.0600	.2449	.3750	.5200	12.6190	22.2996
.0150	1.7671	4.7124	.0650	.2550	.3750	.5200	13.1342	23.2101
.0150	1.7671	4.7124	.0700	.2646	.3750	.5200	13.6300	24.0863
.0150	1.7671	4.7124	.0750	.2739	.3750	.5200	14.1084	24.9317
.0150	1.7671	4.7124	.0800	.2828	.3750	.5200	14.5711	25.7493
.0150	1.7671	4.7124	.0850	.2915	.3750	.5200	15.0196	26.5418
.0150	1.7671	4.7124	.0900	.3000	.3750	.5200	15.4550	27.3113
.0150	1.7671	4.7124	.0950	.3082	.3750	.5200	15.8785	28.0597
.0150	1.7671	4.7124	.1000	.3162	.3750	.5200	16.2910	28.7886

CONCRETE STORM SEWER PIPE.....DIAMETER = 24"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	3.1416	6.2832	.0050	.0707	.5000	.6300	4.4129	13.8636
.0150	3.1416	6.2832	.0100	.1000	.5000	.6300	6.2408	19.6061
.0150	3.1416	6.2832	.0150	.1225	.5000	.6300	7.6434	24.0124
.0150	3.1416	6.2832	.0200	.1414	.5000	.6300	8.8258	27.7272
.0150	3.1416	6.2832	.0250	.1581	.5000	.6300	9.8676	30.9999
.0150	3.1416	6.2832	.0300	.1732	.5000	.6300	10.8094	33.9587
.0150	3.1416	6.2832	.0350	.1871	.5000	.6300	11.6755	36.6796
.0150	3.1416	6.2832	.0400	.2000	.5000	.6300	12.4816	39.2122
.0150	3.1416	6.2832	.0450	.2121	.5000	.6300	13.2388	41.5908
.0150	3.1416	6.2832	.0500	.2236	.5000	.6300	13.9549	43.8405
.0150	3.1416	6.2832	.0550	.2345	.5000	.6300	14.6360	45.9803
.0150	3.1416	6.2832	.0600	.2449	.5000	.6300	15.2868	48.0249
.0150	3.1416	6.2832	.0650	.2550	.5000	.6300	15.9110	49.9859
.0150	3.1416	6.2832	.0700	.2646	.5000	.6300	16.5116	51.8728
.0150	3.1416	6.2832	.0750	.2739	.5000	.6300	17.0912	53.6935
.0150	3.1416	6.2832	.0800	.2828	.5000	.6300	17.6517	55.4544
.0150	3.1416	6.2832	.0850	.2915	.5000	.6300	18.1949	57.1611
.0150	3.1416	6.2832	.0900	.3000	.5000	.6300	18.7224	58.8182
.0150	3.1416	6.2832	.0950	.3082	.5000	.6300	19.2355	60.4300
.0150	3.1416	6.2832	.1000	.3162	.5000	.6300	19.7352	61.9999

CONCRETE STORM SEWER PIPE.....DIAMETER = 30"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	4.9087	7.8540	.0050	.0707	.6250	.7310	5.1207	25.1364
.0150	4.9087	7.8540	.0100	.1000	.6250	.7310	7.2418	35.5482
.0150	4.9087	7.8540	.0150	.1225	.6250	.7310	8.8694	43.5375
.0150	4.9087	7.8540	.0200	.1414	.6250	.7310	10.2415	50.2727
.0150	4.9087	7.8540	.0250	.1581	.6250	.7310	11.4503	56.2066
.0150	4.9087	7.8540	.0300	.1732	.6250	.7310	12.5432	61.5713
.0150	4.9087	7.8540	.0350	.1871	.6250	.7310	13.5482	66.5046
.0150	4.9087	7.8540	.0400	.2000	.6250	.7310	14.4836	71.0964
.0150	4.9087	7.8540	.0450	.2121	.6250	.7310	15.3622	75.4091
.0150	4.9087	7.8540	.0500	.2236	.6250	.7310	16.1932	79.4882
.0150	4.9087	7.8540	.0550	.2345	.6250	.7310	16.9836	83.3679
.0150	4.9087	7.8540	.0600	.2449	.6250	.7310	17.7388	87.0749
.0150	4.9087	7.8540	.0650	.2550	.6250	.7310	18.4631	90.6305
.0150	4.9087	7.8540	.0700	.2646	.6250	.7310	19.1600	94.0517
.0150	4.9087	7.8540	.0750	.2739	.6250	.7310	19.8325	97.3527
.0150	4.9087	7.8540	.0800	.2828	.6250	.7310	20.4830	100.5455
.0150	4.9087	7.8540	.0850	.2915	.6250	.7310	21.1133	103.6399
.0150	4.9087	7.8540	.0900	.3000	.6250	.7310	21.7255	106.6446
.0150	4.9087	7.8540	.0950	.3082	.6250	.7310	22.3208	109.5669
.0150	4.9087	7.8540	.1000	.3162	.6250	.7310	22.9006	112.4132

CONCRETE STORM SEWER PIPE.....DIAMETER = 36"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	7.0686	9.4248	.0050	.0707	.7500	.8255	5.7826	40.8745
.0150	7.0686	9.4248	.0100	.1000	.7500	.8255	8.1778	57.8053
.0150	7.0686	9.4248	.0150	.1225	.7500	.8255	10.0157	70.7967
.0150	7.0686	9.4248	.0200	.1414	.7500	.8255	11.5651	81.7490
.0150	7.0686	9.4248	.0250	.1581	.7500	.8255	12.9302	91.3982
.0150	7.0686	9.4248	.0300	.1732	.7500	.8255	14.1643	100.1217
.0150	7.0686	9.4248	.0350	.1871	.7500	.8255	15.2992	108.1438
.0150	7.0686	9.4248	.0400	.2000	.7500	.8255	16.3555	115.6105
.0150	7.0686	9.4248	.0450	.2121	.7500	.8255	17.3477	122.6235
.0150	7.0686	9.4248	.0500	.2236	.7500	.8255	18.2861	129.2565
.0150	7.0686	9.4248	.0550	.2345	.7500	.8255	19.1786	135.5654
.0150	7.0686	9.4248	.0600	.2449	.7500	.8255	20.0314	141.5934
.0150	7.0686	9.4248	.0650	.2550	.7500	.8255	20.8493	147.3751
.0150	7.0686	9.4248	.0700	.2646	.7500	.8255	21.6364	152.9384
.0150	7.0686	9.4248	.0750	.2739	.7500	.8255	22.3958	158.3063
.0150	7.0686	9.4248	.0800	.2828	.7500	.8255	23.1302	163.4980
.0150	7.0686	9.4248	.0850	.2915	.7500	.8255	23.8421	168.5299
.0150	7.0686	9.4248	.0900	.3000	.7500	.8255	24.5333	173.4158
.0150	7.0686	9.4248	.0950	.3082	.7500	.8255	25.2056	178.1678
.0150	7.0686	9.4248	.1000	.3162	.7500	.8255	25.8604	182.7963

CONCRETE STORM SEWER PIPE.....DIAMETER = 42"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	9.6211	10.9956	.0050	.0707	.8750	.9148	6.4084	61.6563
.0150	9.6211	10.9956	.0100	.1000	.8750	.9148	9.0629	87.1951
.0150	9.6211	10.9956	.0150	.1225	.8750	.9148	11.0997	106.7918
.0150	9.6211	10.9956	.0200	.1414	.8750	.9148	12.8168	123.3125
.0150	9.6211	10.9956	.0250	.1581	.8750	.9148	14.3297	137.8676
.0150	9.6211	10.9956	.0300	.1732	.8750	.9148	15.6974	151.0264
.0150	9.6211	10.9956	.0350	.1871	.8750	.9148	16.9551	163.1271
.0150	9.6211	10.9956	.0400	.2000	.8750	.9148	18.1258	174.3903
.0150	9.6211	10.9956	.0450	.2121	.8750	.9148	19.2253	184.9688
.0150	9.6211	10.9956	.0500	.2236	.8750	.9148	20.2652	194.9742
.0150	9.6211	10.9956	.0550	.2345	.8750	.9148	21.2543	204.4907
.0150	9.6211	10.9956	.0600	.2449	.8750	.9148	22.1994	213.5836
.0150	9.6211	10.9956	.0650	.2550	.8750	.9148	23.1059	222.3048
.0150	9.6211	10.9956	.0700	.2646	.8750	.9148	23.9781	230.6966
.0150	9.6211	10.9956	.0750	.2739	.8750	.9148	24.8197	238.7937
.0150	9.6211	10.9956	.0800	.2828	.8750	.9148	25.6337	246.6251
.0150	9.6211	10.9956	.0850	.2915	.8750	.9148	26.4226	254.2153
.0150	9.6211	10.9956	.0900	.3000	.8750	.9148	27.1886	261.5854
.0150	9.6211	10.9956	.0950	.3082	.8750	.9148	27.9337	268.7534
.0150	9.6211	10.9956	.1000	.3162	.8750	.9148	28.6593	275.7352

CONCRETE STORM SEWER PIPE.....DIAMETER = 48"

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	12.5664	12.5664	.0050	.0707	1.0000	1.0000	7.0051	88.0283
.0150	12.5664	12.5664	.0100	.1000	1.0000	1.0000	9.9067	124.4908
.0150	12.5664	12.5664	.0150	.1225	1.0000	1.0000	12.1331	152.4695
.0150	12.5664	12.5664	.0200	.1414	1.0000	1.0000	14.0101	176.0566
.0150	12.5664	12.5664	.0250	.1581	1.0000	1.0000	15.6638	196.8373
.0150	12.5664	12.5664	.0300	.1732	1.0000	1.0000	17.1589	215.6245
.0150	12.5664	12.5664	.0350	.1871	1.0000	1.0000	18.5337	232.9010
.0150	12.5664	12.5664	.0400	.2000	1.0000	1.0000	19.8133	248.9817
.0150	12.5664	12.5664	.0450	.2121	1.0000	1.0000	21.0152	264.0850
.0150	12.5664	12.5664	.0500	.2236	1.0000	1.0000	22.1520	278.3700
.0150	12.5664	12.5664	.0550	.2345	1.0000	1.0000	23.2332	291.9569
.0150	12.5664	12.5664	.0600	.2449	1.0000	1.0000	24.2663	304.9390
.0150	12.5664	12.5664	.0650	.2550	1.0000	1.0000	25.2571	317.3906
.0150	12.5664	12.5664	.0700	.2646	1.0000	1.0000	26.2106	329.3718
.0150	12.5664	12.5664	.0750	.2739	1.0000	1.0000	27.1305	340.9322
.0150	12.5664	12.5664	.0800	.2828	1.0000	1.0000	28.0203	352.1133
.0150	12.5664	12.5664	.0850	.2915	1.0000	1.0000	28.8826	362.9501
.0150	12.5664	12.5664	.0900	.3000	1.0000	1.0000	29.7200	373.4725
.0150	12.5664	12.5664	.0950	.3082	1.0000	1.0000	30.5344	383.7066
.0150	12.5664	12.5664	.1000	.3162	1.0000	1.0000	31.3276	393.6746

EXHIBIT "G"

STREETS AND MAXIMUM RUNOFFS

STREET DESCRIPTION & LOCATION	MAXIMUM RUNOFFS (in c.f.s.)
Street #1, 25' face to face	9
Street #2, 25' face to face	4
Street #3, 25' face to face	30
Street #4, 25' face to face	45
Academy Blvd., NE, 106' R/W, two 25' face to face lanes with 36' median	

REFERENCES

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

2. Design by E.E. Seelye, 1945.

3. Miscellaneous Publication No. 204 by David L. Yarnell, U.S. Department of Agriculture, 1961.

4. "Storm Drainage Conditions Relative to the Development of Academy Acres Subdivision, Bernalillo County, New Mexico" by Basil Smith Engineering Company, 1971.

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

6. "Plan of Drainage, Bear Canyon Village" by Mossman Gladden, Inc., revised.

7. "Drainage Study Relative to the Development of Academy Acres, Unit 10" by Campbell-Hicks Associates, Inc, August 1972.

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