HYDROLOGY F18/D6 TWO PLAN

F 18-D6

2 PLANS

CAMPBELL-~~HICKS~~ and ASSOCIATES, Inc.
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PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
HIGHLAND NORTH ADDITION
TRACT A

NOVEMBER 1972

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PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
HIGHLAND NORTH ADDITION
TRACT A

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 Highland North Addition, Tract A and to describe a proposed method for providing adequate storm drainage in the area.

II. LOCATION

Highland North Addition, Tract A is bounded on the east by Louisiana Blvd., N.E.; on the south by the Elena Gallegos Grant boundary; on the west by Desert Terrace Addition and Highland North Addition; and on the north by Highland North Addition. It is situated mainly in the southeast one-quarter (SE 1/4) of Section 36, Township 11 North, Range 3 East, N.M.P.M.

III. EXISTING DRAINAGE CONDITIONS

A. General

This area is generally located between Louisiana Blvd., N.E. on the east and Highland North Addition on the west. It is crossed by small arroyos in a general northeast-southwest direction.

B. Topography

Highland North Addition, Tract A lies between Louisiana Blvd., N.E. and Highland North Addition, north of the south boundary of the Elena Gallegos Grant. It is crossed by minor drainage areas with the contributing drainage area limits in the east at Louisiana Blvd,N.E. Through field investigation, it is considered that the 1" = 400' photograph prepared by Bohannan Westman Huston and Associates, Exhibit "A", is satisfactory for the purpose of determining the original division lines.

C. Drainage Areas and Channels

The residential area to the east of Highland North Addition, Tract A is the only area that contributes runoff. Exhibit "A" outlines the contributing areas. It further shows the total runoff that enters the proposed development from the Louisiana Blvd., N.E. and Carriage Road, N.E. intersection. A drainage easement is required across

the southeast corner of this development to carry the runoff from the contributing drainage areas east of the development (Exhibit "B"). The runoff within the proposed development can be carried by planning the streets in such a manner (set property lines high enough and adjust grades on streets) as to carry water across the development.

IV. PROPOSED DRAINAGE PLANS

A. General

In order to provide adequate storm drainage for this proposed development, it was necessary to:

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

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

(3) Prepare a table of street carrying capacities for use in sizing streets and overflow sections (section above high curb to property line).

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

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

(6) Determine the ability of the drainage channels, streets plus overflow sections, and structures to handle the runoff that may concentrate on them.

(7) 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 and for which a copy of computations is contained in Exhibit "C" of this report. The Plan of Drainage, Exhibit "B", was prepared showing the direction of flows as well as runoff quantities for the Louisiana Planned Unit Development.

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 separate 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 drainage channel alignments and grades, as ahown; assuming overland flows to cross either dense 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 (6"), 3/4 crown (4.5"), or 1/2 crown (3"). These times of flow were calculated by use of tables on pages 5.00, 5.04 and 5.05 of Design by E. E. Seelye.

The coefficient of runoff (C) was determined by assuming the maximum possible development in the areas under consideration. A coefficient of 0.7 is used for this condomimium development.

The quantities of runoff are shown along with the areas after development on Exhibit "B", 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 form computer output sheets which form a part of Exhibit "D" 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 calculations, it is concluded that the development of this area can be satisfactorily accomplished provided adequate storm drainage is done.

(1) Design streets to carry maximum runoffs contained in Exhibit "E" through use of tables in Exhibit "D".

(2) The drainage easement across the southeast corner of Los Trechos Subdivision is required.

(3) The paved parabolic parking lot will have no trouble carrying the runoff from the drainage easement to the northeast. However, an energy dissipater should be built at the west end of parking lot to reduce the channel velocity.

(4) All the fences built within the subdivision should provide for drainage.

If all of the above recommendations and conclusions 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

THIS MICROIMAGE IS THE BEST POSSIBLE
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OF THE ORIGINAL DOCUMENT

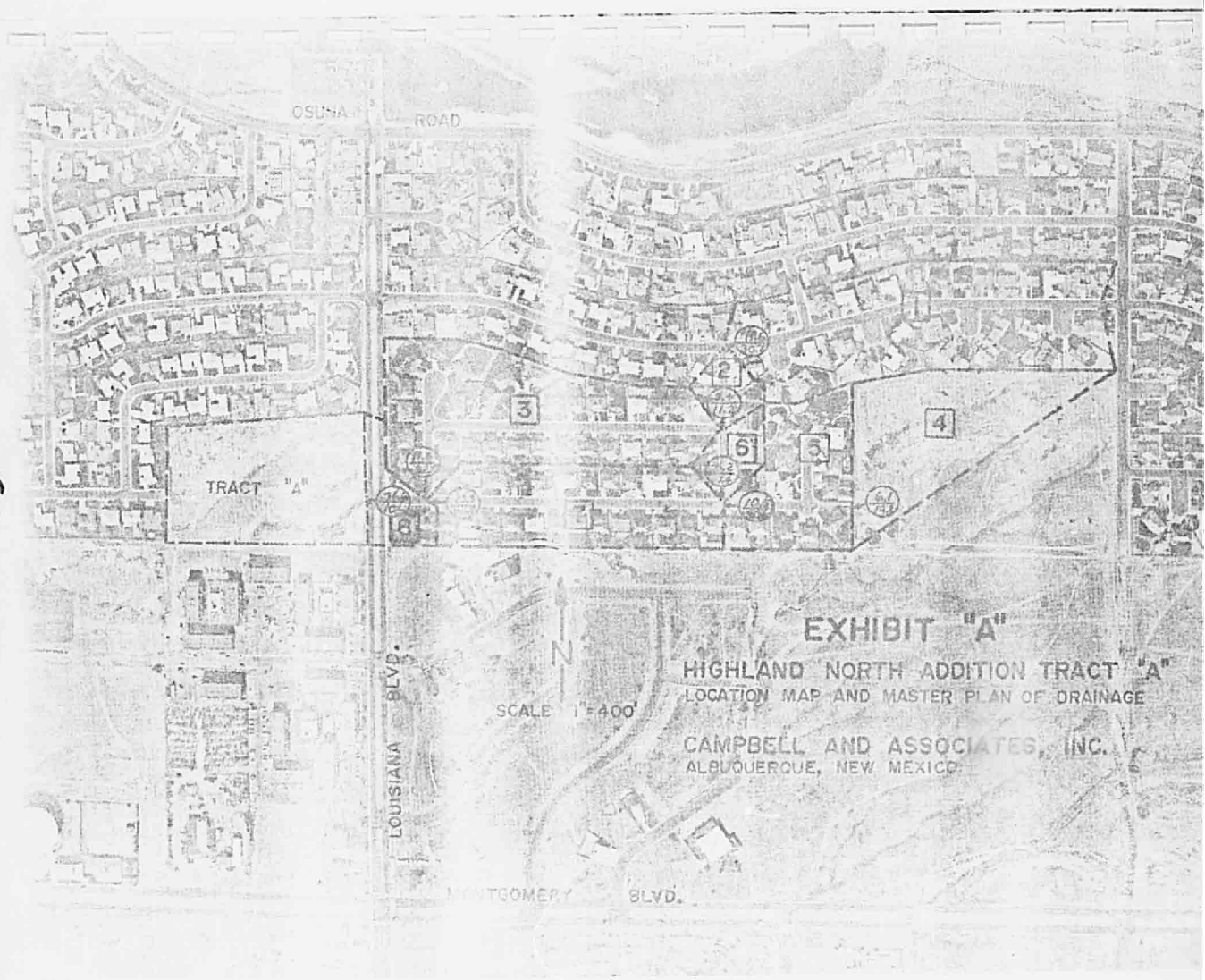

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EXHIBIT C

SUMMARY OF RUNOFF COMPUTATIONS

SHEET NO.	AREA NUMBER	AREA (IN ACRES)	EXPECTED RUNOFF (IN C.F.S.) INDIVIDUAL	TOTAL
1	1	11.6	30.7	
2	2	0.9	4.6	11.2
3	3	9.7	26.3	32.7
4	4	6.1	19.2	
5	5	4.4	11.4	30.6
6	6	1.2	3.4	17.4
7	7	6.6	18.2	66.2
8	8	1.7	4.9	103.8
9	~~3~~ A-1	2.4	~~6.8~~ 4.8	
10	~~A-1~~ A-2	0.8	~~2.0~~ 1.1	
11	~~A-2~~ A-3	~~0.7~~ 0.8	~~2.2~~ 1.8	~~11.0~~ 7.7
12	A-4	~~0.2~~ 0.1	~~0.7~~ 0.3	~~11.7~~
13	B-1	0.4	1.0	
14	B-2	~~0.4~~ 0.7	~~1.4~~ 1.1	12.7
15	B-3	~~0.9~~ 1.3	2.8	~~5.3~~ 11.5
16	C-1	0.5	~~2.6~~ 1.5	~~106.4~~ 105.3
17	~~D-1~~ E-1	~~0.4~~ 0.2	~~1.2~~ 0.4	
18	~~D-2~~ I	~~0.3~~ 3.1	~~0.9~~ 15.8	~~2.0~~ 133.8
~~19~~	~~E-1~~	~~0.2~~	~~0.6~~	

RUNOFF COMPUTATIONS

Sheet No. 1

Job No. Highlands North Addition, Tract A

Drainage Area No. 1

Area = 11.6 acres

Maximum Overland Flow: L = 146' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 1258' S = 2.0%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 20.8 min.

Channel No. 1 Flow:

Velocity= 5.00 ft/sec; Time= $\frac{1258}{5.00 \times 60}$ = 4.2 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 = 25.0 min.

$I = \frac{189}{T+25} = \frac{189}{25.0+25} = 3.78$

Q = CIA = (0.7)(3.78)(11.6) = 30.7 c.f.s.

Note: Area 1 splits

A. ½ goes out of drainage study

B. ½ splits between 1.5% + 2.0% grades.

Date: 10-17-72

Comp. by: EP

Checked by: ZEB

B-split $\begin{cases} \frac{1.5}{3.5} = 0.429 \rightarrow \text{goes to Area 2} \\ \frac{2.0}{3.5} = 0.571 \rightarrow \text{goes out of drainage study.} \end{cases}$

RUNOFF COMPUTATIONS

Sheet No. 2

Job No. Highlands North Addition, Tract A

Drainage Area No. 2

Area = 0.9 acres

Maximum Overland Flow: L = - S = -

Maximum Channel Flow:

Channel No. 1 L = 264' S = 1.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 4.33 ft/sec; Time= $\frac{264}{4.33 \times 60}$ = 1.0 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 1.0 min.

$I = \frac{189}{T+25} = \frac{189}{1.0+25} = 7.27$

Q = CIA = (0.7)(7.27)(0.9) = 4.6 c.f.s.

Note: Area 2 splits between Area 3 (2.0% grade) & Area 6 (1.5% grade).

Area 3 = $\frac{2.0}{3.5}$ = 0.571

Area 6 = $\frac{1.5}{3.5}$ = 0.429

Date: 10-17-72

Comp. by: EP

Checked by: ZEB

Totals

Area: 5.8 (0.429) + 0.9 = 3.4 acres

Runoff: 16.4 (0.429) + 4.6 = 11.2 CFS.

RUNOFF COMPUTATIONS

Sheet No. 3

Job No. Highlands North Addition, Tract A

Drainage Area No. 3

Area = 9.7 acres

Maximum Overland Flow: L = 130' S = 1.5 %

Maximum Channel Flow:

Channel No. 1 L = 960' S = 2.0%

Channel No. 2 L = 235' S = 1.4%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 19.8 min.

Channel No. 1 Flow:

Velocity= 5.00 ft/sec; Time= $\frac{960}{5.00 \times 60}$ = 3.2 min.

Channel No. 2 Flow:

Velocity= 5.47 ft/sec; Time= $\frac{235}{5.47 \times 60}$ = 0.7 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 23.7 min.

$I = \frac{189}{T+25} = \frac{189}{23.7+25} = 3.88$

Q = CIA = (0.7)(3.88)(9.7) = 26.3 c.f.s.

Date: 10/17/72

Comp. by: EP

Checked by: JEB

Totals

Area = 3.4(0.571) + 9.7 = 11.6 acres

Runoff = 11.2(0.571) + 26.3 = 32.7 cfs.

RUNOFF COMPUTATIONS

Sheet No. 4

Job No. Highlands North Addition, Tract A

Drainage Area No. 4

Area = 6.1 acres

Maximum Overland Flow: L = 960' S = 2.5%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 17.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 17.0 min.

$I = \frac{189}{T+25} = \frac{189}{17+25} = 4.50$

Q = CIA = (0.7)(4.50)(6.1) = 19.2 c.f.s.

Date: 10-17-72

Comp. by: GP

Checked by: JEB

RUNOFF COMPUTATIONS

Sheet No. 5

Job No. Highlands North Addition, Tract A

Drainage Area No. 5

Area = 4.4 acres

Maximum Overland Flow: L = 235' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 216' S = 1.5%

Channel No. 2 L = 274' S = 2.0%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 24.5 min.

Channel No. 1 Flow:

Velocity= 4.33 ft/sec; Time= $\frac{216}{4.33 \times 60}$ = 0.8 min.

Channel No. 2 Flow:

Velocity= 5.00 ft/sec; Time= $\frac{274}{5.00 \times 60}$ = 0.9 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 26.2 min.

$I = \frac{189}{T+25} = \frac{189}{26.2+25} = 3.69$

Q = CIA = (0.7)(3.69)(4.4) = 11.4 c.f.s.

Date: 10/17/72

Comp. by: EP

Checked by: JEB

Totals

Area = 6.1 + 4.4 = 10.5 acres

Runoff = 19.2 + 11.4 = 30.6 cfs.

RUNOFF COMPUTATIONS

Sheet No. 6

Job No. Highlands North Addition, Tract A

Drainage Area No. 6

Area = 1.2 acres

Maximum Overland Flow: L = 155' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 245' S = 1.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 21.1 min.

Channel No. 1 Flow:

Velocity= 4.33 ft/sec; Time= $\frac{245}{4.33 \times 60}$ = 0.9 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 = 22.0 min.

$I = \frac{189}{T+25} = \frac{189}{22.0+25} = 4.02$

Q = CIA = (0.7)(4.02)(1.2) = 3.4 c.f.s.

Date: 10/17/72

Comp. by: EP

Checked by: [illegible]

Rev. 8/7/73

Totals

Area = ~~1.6(0.429)~~ (3.4 ~~+ 1.4~~ 1.8)(.429) + 1.2 = ~~6.2~~ 2.7 acres

Runoff = 32.7(0.429) + 3.4 = 17.4 cfs.

RUNOFF COMPUTATIONS

Sheet No. 7

Job No. Highlands North Addition, Tract A

Drainage Area No. 7

Area = 6.6 acres

Maximum Overland Flow: L = 144' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 557' S = 1.4%

Channel No. 2 L = 403' S = 2.7%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 20.3 min.

Channel No. 1 Flow:

Velocity= 5.47 ft/sec; Time= $\frac{557}{5.47 \times 60}$ = 1.7 min.

Channel No. 2 Flow:

Velocity= 7.60 ft/sec; Time= $\frac{403}{7.60 \times 60}$ = 0.9 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 22.9 min.

$I = \frac{189}{T+25} = \frac{189}{22.9+25} = 3.95$

Q = CIA = (0.7)(3.95)(6.6) = 18.2 c.f.s.

Date: 10/17/72

Comp. by: EP

Checked by: [illegible]

Rev. 8/15/73

Totals ✓ 2.7 19.8

Area = 10.5 + 6.2 + 6.6 = 23.3 acres

Runoff = 30.6 + 17.4 + 18.2 = 66.2 cfs.

RUNOFF COMPUTATIONS

Sheet No. 8

Job No. Highlands North Addition, Tract A

Drainage Area No. 8

Area = 1.7 acres

Maximum Overland Flow: L = 144' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 202' S = 2.7%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 20.3 min.

Channel No. 1 Flow:

Velocity= 9.21 ft/sec; Time= $\frac{202}{9.21 \times 60}$ = 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 = 20.7 min.

$I = \frac{189}{T+25} = \frac{189}{20.7+25} = 4.14$

Q = CIA = (0.7)(4.14)(1.7) = 4.9 c.f.s.

Date: 10/17/72

Comp. by: EP

Checked by: GB

REV 8/15/73

Totals

Area: 11.6 + ~~23.3~~ 20.1 + 1.7 = ~~36.6~~ 33.4 acres

Runoff: 32.7 + 66.2 + 4.9 = 103.8 cfs.

RUNOFF COMPUTATIONS

Sheet No. 9

Job No. Highlands North Add. Tow. Tract A

Drainage Area No. A-1

Area = 2.4 acres

Maximum Overland Flow: L = 188' S = 3.0%

Maximum Channel Flow:

Channel No. 1 L = 430' S = 2.3%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 20.0 min.

Channel No. 1 Flow:

Velocity= 5.35 ft/sec; Time= $\frac{430}{5.35 \times 60}$ = 1.3 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 = 21.3 min.

$I = \frac{189}{T+25} = \frac{189}{21.3+25} = 4.08$

$Q = CIA = (0.5)(4.08)(2.4) =$ ~~6.8~~ 4.8 c.f.s.

2.4
2.04
4.08

Date: ~~11-15-72~~ 12-20-72

Comp. by: ~~RPC~~

Checked by: ~~RTP~~

RUNOFF COMPUTATIONS

Sheet No. 10

Job No. Highlands North Addition, Tract A

Drainage Area No. A-2

Area = 0.8 acres

Maximum Overland Flow: L = 514' 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: 29.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 29.0 min.

$I = \frac{189}{T+25} = \frac{189}{29.0+25} = 3.50$

$Q = CIA = (\ 0.4\ )(\ 3.50\ )(\ 0.8\ ) = 1.1$ c.f.s.

Date: 11-15-72

Comp. by: E/P

Checked by: E/P

RUNOFF COMPUTATIONS

Sheet No. 11

Job No. Highlands North Addition, Tract A

Drainage Area No. A-3

Area = 0.7 acres

Maximum Overland Flow: L = 111' S = 2.0%

Maximum Channel Flow:

Channel No. 1 L = 170' S = 2.3%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 17.5 min.

Channel No. 1 Flow:

Velocity= 5.35 ft/sec; Time= $\frac{170'}{5.35 \times 60}$ = 0.5 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 18.0 min.

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

$Q = CIA = (0.5)(4.40)(0.8) = 1.8$ c.f.s.

Totals

Area = 2.4 + 0.8 + 0.7 = 4.0 acres

Runoff = 1.1 + 1.5 + 1.8 = 7.7 cfs.

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 12

Job No. Highlands North Addition, Tract A

Drainage Area No. 17.4

Area = 0.1 acres

Maximum Overland Flow: L = 105' S = 5.7%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 14.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 14.0 min.

$I = \frac{189}{T+25} = \frac{189}{14.0+25} = 4.85$

Q = CIA = (0.6)(4.85)(0.1) = 0.3 c.f.s.

~~Total~~

~~Area = 3.9 + 0.2 = 4.1~~

~~Runoff = 4.1 × 0.7 = 11.70 cfs~~

Date: ~~11-15-72~~ 12-20-72

Comp. by: SLP

Checked by: SLP

RUNOFF COMPUTATIONS

Sheet No. 13

Job No. Highlands North Addition, Tract A

Drainage Area No. B-1

Area = 0.4 acres

Maximum Overland Flow: L = 200' S = 2.4%

Maximum Channel Flow:

Channel No. 1 L = 135' S = 0.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 21.0 min.

Channel No. 1 Flow:

Velocity= 2.50 ft/sec; Time= $\frac{135}{2.50 \times 60}$ = 0.9 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 = 21.9 min.

$I = \frac{189}{T+25} = \frac{189}{21.9+25} = 4.03$

Q = CIA = (0.9)(4.03)(0.4) = 1.0 c.f.s.

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 14

Job No. Highlands North Addition, Tract A

Drainage Area No. B-2

Area = 0.7 acres

Maximum Overland Flow: L = 312' S = 1.8%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 35.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 35.0 min.

$I = \frac{189}{T+25} = \frac{189}{35.0+25} = 3.15$

$Q = CIA = (0.5)(3.15)(0.7) = 1.1$ c.f.s.

TOTAL AREA = 0.4 + 4.0 + 1.3 + 0.7 = 6.4 ACRES

RUNOFF = 1.0 + 7.7 + 2.8 + 1.1 = 12.6 CFS

Date: 12-20-72

Comp. by: ERP

Checked by: ERP

RUNOFF COMPUTATIONS

Sheet No. 15

Job No. Highlands North Addition, Tract A

Drainage Area No. B-3

Area = 1.3 acres

Maximum Overland Flow: L = 82' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 570' S = 2.0%

Channel No. 2 L = 110' S = 1.1%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 16.0 min.

Channel No. 1 Flow:

Velocity= 4.14 ft/sec; Time= 570 / 4.14 X 60 = 2.3 min.

Channel No. 2 Flow:

Velocity= 2.00 ft/sec; Time= 110 / 2.00 X 60 = 0.9 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 18.9 min.

$I = \frac{189}{T+25} = \frac{189}{18.9+25} = 4.24$

$Q = CIA = (0.5)(4.24)(1.3) = 2.8$ c.f.s.

Totals

Area 0.4 + 0.9 = 1.3 acres

Runoff 1.2 + 2.8 = 4.0 cfs.

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 16

Job No. Highlands North Addition, Tract A

Drainage Area No. C-1

Area = 0.5 acres

Maximum Overland Flow: L = - S = -

Maximum Channel Flow:

Channel No. 1 L = 235' S = 2.7%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: - min.

Channel No. 1 Flow:

Velocity= 10.37 ft/sec; Time= 235 / (10.37 X 60) = 0.4 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 = 0.4 min.

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

Q = CIA = (0.4)(7.44)(0.5) = ~~2.6~~ 1.5 c.f.s.

Totals

Area 33.1 + 0.5 = 33.6 acres

Runoff 103.5 + ~~2.6~~ 1.5 = ~~105.4~~ 105.3 cfs

Date: ~~12-29-72~~ 4-15-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 17

Job No. Highlands North Addition, Tract A

Drainage Area No. D-1

Area = 0.3 acres

Maximum Overland Flow: L = 249' S = 1.9%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 11.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 11.0 min.

$$I = \frac{189}{T+25} = \frac{189}{11.0+25} = 5.25$$

$$Q = CIA = (\ 0.7\ )(\ 5.25\ )(\ 0.3\ ) = 1.1 \text{ c.f.s.}$$

Date: 11-15-72

Comp. by: EJP

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 18

Job No. Highlands North Addition, Tract A

Drainage Area No. ~~D-2~~ I

Area = ~~0.4~~ 3.1 acres

Maximum Overland Flow: L = ~~151~~ S = ~~1.0%~~

Maximum Channel Flow:

Channel No. 1 L = ~~163'~~ 680 S = ~~2.2%~~ 2.5%

Channel No. 2 L = ~~87'~~ S = ~~1.1%~~

Channel No. 3 L = S =

Accumulation Time

Overland Flow: ~~16.5~~ min.

Channel No. 1 Flow:

Velocity = ~~4.33~~ 12.83 ft/sec; Time = ~~163'~~ 680 / ~~4.33~~ 12.83 X 60 = ~~0.6~~ 0.9 min.

Channel No. 2 Flow:

Velocity = ~~9.47~~ ft/sec; Time = ~~87'~~ / ~~4.02~~ X 60 = ~~0.2~~ min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = ~~17.3~~ 0.9 min.

I = 189 / T+25 = 189 / ~~17.3~~ 0.9 + 25 = ~~4.47~~ 7.30

Q = CIA = (0.7)(~~4.47~~ 7.30)(~~0.4~~ 3.1) = ~~1.2~~ 15.8 c.f.s.

5.11

43.1 ✓

Date: ~~11-15-72~~ 12-21-72

Comp. by: EJP

Checked by: EJP

TOTALS

AREA = 3.1 + ~~0.4~~ 6.4 + ~~87.1~~ 33.6 = ~~40.6~~ 43.1 ACRES

RUNOFF = 15.8 + 12.7 + 105.3 = 133.8 CFS

REV. 1/16/73

RUNOFF COMPUTATIONS

Sheet No. 19

Job No. Highlands North Addition, Tract A

Drainage Area No. E-1

Area = 0.2 acres

Maximum Overland Flow: L = 162' S = 2.5%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 19.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 19.0 min.

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

$$Q = CIA = (0.50)(4.30)(0.2) = 0.4 \text{ c.f.s.}$$

Date: 11-15-72

Comp. by: EJP

Checked by: ZHP

EXHIBIT D

FACE-TO-FACE = 28 FT. CURB = 6 IN. CROWN = 6.0 IN.

N	A	P	S	S1/2	R	R2/3	V	Q
0.0150	4.6667	29.0238	0.0050	0.0707	0.1608	0.2957	2.0713	9.7
0.0150	4.6667	29.0238	0.0100	0.1000	0.1608	0.2957	2.9293	13.7
0.0150	4.6667	29.0238	0.0150	0.1225	0.1608	0.2957	3.5876	16.7
0.0150	4.6667	29.0238	0.0200	0.1414	0.1608	0.2957	4.1426	19.3
0.0150	4.6667	29.0238	0.0250	0.1581	0.1608	0.2957	4.6316	21.6
0.0150	4.6667	29.0238	0.0300	0.1732	0.1608	0.2957	5.0737	23.7
0.0150	4.6667	29.0238	0.0350	0.1871	0.1608	0.2957	5.4802	25.6
0.0150	4.6667	29.0238	0.0400	0.2000	0.1608	0.2957	5.8586	27.3
0.0150	4.6667	29.0238	0.0450	0.2121	0.1608	0.2957	6.2140	29.0
0.0150	4.6667	29.0238	0.0500	0.2236	0.1608	0.2957	6.5501	30.6

FACE-TO-FACE = 28 FT. CURB = 6 IN. CROWN = 4.5 IN.

N	A	P	S	S1/2	R	R2/3	V	Q
0.0150	7.0000	29.0134	0.0050	0.0707	0.2413	0.3876	2.7148	19.0
0.0150	7.0000	29.0134	0.0100	0.1000	0.2413	0.3876	3.8394	26.9
0.0150	7.0000	29.0134	0.0150	0.1225	0.2413	0.3876	4.7023	32.9
0.0150	7.0000	29.0134	0.0200	0.1414	0.2413	0.3876	5.4297	38.0
0.0150	7.0000	29.0134	0.0250	0.1581	0.2413	0.3876	6.0706	42.5
0.0150	7.0000	29.0134	0.0300	0.1732	0.2413	0.3876	6.6500	46.5
0.0150	7.0000	29.0134	0.0350	0.1871	0.2413	0.3876	7.1828	50.3
0.0150	7.0000	29.0134	0.0400	0.2000	0.2413	0.3876	7.6788	53.8
0.0150	7.0000	29.0134	0.0450	0.2121	0.2413	0.3876	8.1445	57.0
0.0150	7.0000	29.0134	0.0500	0.2236	0.2413	0.3876	8.5851	60.1

FACE-TO-FACE = 28 FT. CURB = 6 IN. CROWN = 3.0 IN.

N	A	P	S	S1/2	R	R2/3	V	Q
0.0150	9.3333	29.0060	0.0050	0.0707	0.3218	0.4696	3.2894	30.7
0.0150	9.3333	29.0060	0.0100	0.1000	0.3218	0.4696	4.6519	43.4
0.0150	9.3333	29.0060	0.0150	0.1225	0.3218	0.4696	5.6974	53.2
0.0150	9.3333	29.0060	0.0200	0.1414	0.3218	0.4696	6.5787	61.4
0.0150	9.3333	29.0060	0.0250	0.1581	0.3218	0.4696	7.3552	68.6
0.0150	9.3333	29.0060	0.0300	0.1732	0.3218	0.4696	8.0573	75.2
0.0150	9.3333	29.0060	0.0350	0.1871	0.3218	0.4696	8.7028	81.2
0.0150	9.3333	29.0060	0.0400	0.2000	0.3218	0.4696	9.3037	86.8
0.0150	9.3333	29.0060	0.0450	0.2121	0.3218	0.4696	9.8681	92.1
0.0150	9.3333	29.0060	0.0500	0.2236	0.3218	0.4696	10.4019	97.1

FACE-TO-FACE = 28 FT. CURB = 6 IN. CROWN = 1.5 IN.

N	A	P	S	S1/2	R	R2/3	V	Q
0.0150	11.6667	29.0015	0.0050	0.0707	0.4023	0.5449	3.8174	44.5
0.0150	11.6667	29.0015	0.0100	0.1000	0.4023	0.5449	5.3986	63.0
0.0150	11.6667	29.0015	0.0150	0.1225	0.4023	0.5449	6.6119	77.1
0.0150	11.6667	29.0015	0.0200	0.1414	0.4023	0.5449	7.6347	89.1
0.0150	11.6667	29.0015	0.0250	0.1581	0.4023	0.5449	8.5359	99.6
0.0150	11.6667	29.0015	0.0300	0.1732	0.4023	0.5449	9.3506	109.1
0.0150	11.6667	29.0015	0.0350	0.1871	0.4023	0.5449	10.0998	117.8
0.0150	11.6667	29.0015	0.0400	0.2000	0.4023	0.5449	10.7971	126.0
0.0150	11.6667	29.0015	0.0450	0.2121	0.4023	0.5449	11.4521	133.6
0.0150	11.6667	29.0015	0.0500	0.2236	0.4023	0.5449	12.0716	140.8

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 8

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	7.1111	33.3703	.0050	.0707	.2131	.3568	2.4992	17.7719
.0150	7.1111	33.3703	.0100	.1000	.2131	.3568	3.5344	25.1333
.0150	7.1111	33.3703	.0150	.1225	.2131	.3568	4.3287	30.7819
.0150	7.1111	33.3703	.0200	.1414	.2131	.3568	4.9984	35.5439
.0150	7.1111	33.3703	.0250	.1581	.2131	.3568	5.5883	39.7392
.0150	7.1111	33.3703	.0300	.1732	.2131	.3568	6.1217	43.5322
.0150	7.1111	33.3703	.0350	.1871	.2131	.3568	6.6122	47.0201
.0150	7.1111	33.3703	.0400	.2000	.2131	.3568	7.0687	50.2666

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 6

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	10.6667	33.3542	.0050	.0707	.3198	.4676	3.2759	34.9430
.0150	10.6667	33.3542	.0100	.1000	.3198	.4676	4.6328	49.4169
.0150	10.6667	33.3542	.0150	.1225	.3198	.4676	5.6740	60.5231
.0150	10.6667	33.3542	.0200	.1414	.3198	.4676	6.5518	69.8860
.0150	10.6667	33.3542	.0250	.1581	.3198	.4676	7.3252	78.1350
.0150	10.6667	33.3542	.0300	.1732	.3198	.4676	8.0243	85.5926
.0150	10.6667	33.3542	.0350	.1871	.3198	.4676	8.6672	92.4505
.0150	10.6667	33.3542	.0400	.2000	.3198	.4676	9.2657	98.8338

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 4

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	14.2222	33.3426	.0050	.0707	.4265	.5666	3.9694	56.4537
.0150	14.2222	33.3426	.0100	.1000	.4265	.5666	5.6136	79.8375
.0150	14.2222	33.3426	.0150	.1225	.4265	.5666	6.8752	97.7806
.0150	14.2222	33.3426	.0200	.1414	.4265	.5666	7.9388	112.9073
.0150	14.2222	33.3426	.0250	.1581	.4265	.5666	8.8758	126.2342
.0150	14.2222	33.3426	.0300	.1732	.4265	.5666	9.7230	138.2827
.0150	14.2222	33.3426	.0350	.1871	.4265	.5666	10.5020	149.3623
.0150	14.2222	33.3426	.0400	.2000	.4265	.5666	11.2272	159.6751

FACE TO FACE = ? 32
CURB = ? 8
CROWN = ? 2

N	A	P	S	S1/2	R	R2/3	V	Q
.0150	17.7778	33.3356	.0050	.0707	.5333	.6576	4.6067	81.8972
.0150	17.7778	33.3356	.0100	.1000	.5333	.6576	6.5149	115.8201
.0150	17.7778	33.3356	.0150	.1225	.5333	.6576	7.9791	141.8501
.0150	17.7778	33.3356	.0200	.1414	.5333	.6576	9.2134	163.7944
.0150	17.7778	33.3356	.0250	.1581	.5333	.6576	10.3009	183.1277
.0150	17.7778	33.3356	.0300	.1732	.5333	.6576	11.2841	200.6064
.0150	17.7778	33.3356	.0350	.1871	.5333	.6576	12.1882	216.6796
.0150	17.7778	33.3356	.0400	.2000	.5333	.6576	13.0298	231.6403

FACE

FEBRUARY 5, 1972

ACADEMY ACRES MANNING FORMULA COMPUTATIONS

(10' LINED CHANNEL) 8'6" WIDTH WATER DEPTH = 8" OVERALL DEPTH = 1'0"

N	A	P	R	R2/3
.0150	5.6670	9.8300	.5765	.6926

S	S1/2	V	Q
.005	.0707	4.8522	27.4978
.010	.1000	6.8621	38.8878
.015	.1224	8.4043	47.6276
.020	.1414	9.7045	54.9957
.025	.1581	10.8500	61.4870
.030	.1732	11.8856	67.3557
.035	.1870	12.8379	72.7524
.040	.2000	13.7243	77.7756
.045	.2121	14.5568	82.4935
.050	.2236	15.3442	86.9558

KAP KOMP KAP KOMP KAP KOMP

EXHIBIT E

STREETS AND MAXIMUM RUNOFFS

STREET DESCRIPTION & LOCATION	MAXIMUM RUNOFF (IN CFS)
Baker Street, 50' R/W, 32' face to face, 8" crown	12
Los Trechos Court, 35' R/W, 28' face to face, 6" crown	2

REFERENCES

1. Design by E.E. Seelye, 1945.

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

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

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

ADDENDUM

TO

PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
HIGHLAND NORTH ADDITION
TRACT A

As a result of a joint meeting with the Developer and the Albuquerque Metropolitan Arroyo Flood Control Authority, the following Addendum is offered as an alternative solution to drainage in the subject area.

On page 3, Section IV., C., next to the last paragraph, add the following sentence:

> Coefficients of from 0.4 to 0.6, depending on filters and pond size, may be used when development plans call for ponding with infiltration areas with details shown thereon.

On page 4, Section V., (4), add the following sentence:

> An alternative solution when individual ownership is contemplated might be ponding and providing for infiltration areas. This solution should incorporate provisions for maintenance of infiltration areas in proper working order.

Add the following pages 5A - 7A and 16A - 25A at the end of the report. All of these additions are those recommended by the Executive Engineer and agreed to by the Developer as being required to comply with A.M.A.F.C.A. Resolution No. 2, 1972.

Respectfully submitted,

Donald L. Campbell

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

December 1972

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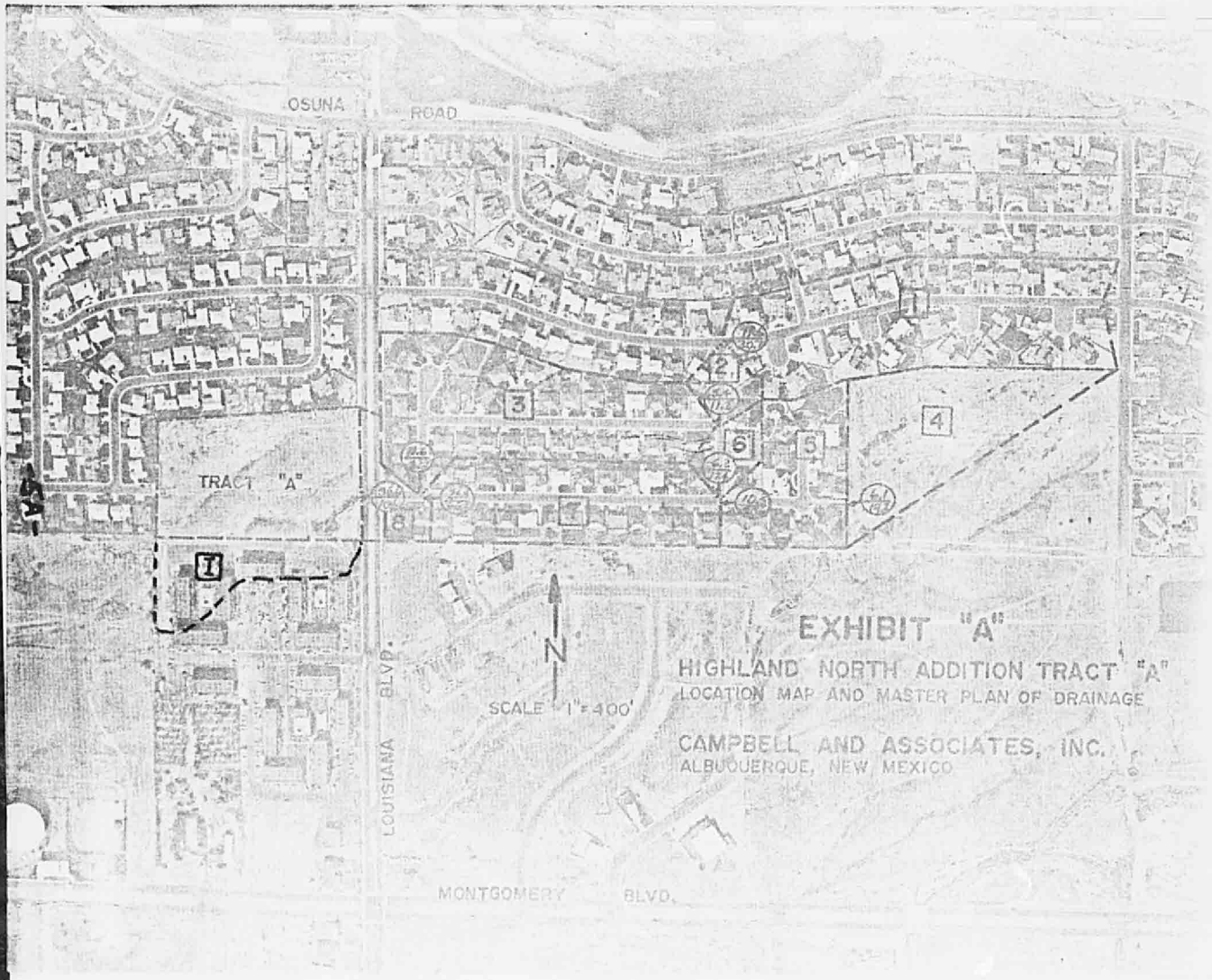

EXHIBIT C

SUMMARY OF RUNOFF COMPUTATIONS

SHEET NO	AREA NUMBER	AREA (IN ACRES)	EXPECTED RUNOFF (IN C.F.S.) INDIVIDUAL	TOTAL
1	1	11.6	30.7	
2	2	0.9	4.6	11.2
3	3	9.7	26.3	32.7
4	4	6.1	19.2	
5	5	4.4	11.4	30.6
6	6	1.2	3.4	17.4
7	7	6.6	18.2	66.2
8	8	1.7	4.9	103.8
9	A-1	2.4	4.8	
10	A-2	0.8	1.1	
11	A-3	0.8	1.8	7.7
12	A-4	0.1	0.3	
13	B-1	0.4	1.0	
14	B-2	0.7	1.1	12.7
15	B-3	1.3	2.8	11.5
16	C-1	0.5	1.5	105.3
17	E-1	0.2	0.4	
18	I	3.1	15.8	133.8

RUNOFF COMPUTATIONS

Sheet No. 9 (~~Ground~~)

Job No. Highlands North Addition, Tract A

Drainage Area No. A-1

Area = 2.4 acres

Maximum Overland Flow: L = 188' S = 3.0 %

Maximum Channel Flow:

Channel No. 1 L = 430' S = 2.3 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 20.0 min.

Channel No. 1 Flow:

Velocity= 5.35 ft/sec; Time= $\frac{430}{5.35 \times 60}$ = 1.3 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 = 21.3 min.

$$I = \frac{189}{T+25} = \frac{189}{21.3+25} = 4.08$$

Q = CIA = (0.5)(4.08)(2.4) = 4.8 c.f.s.

Date: 12-20-72

Comp. by: [illegible]

Checked by: HEP

RUNOFF COMPUTATIONS

Sheet No. 10 (~~Grounwood~~)

Job No. Highland North Addition, Tract A

Drainage Area No. A-2

Area = 0.8 acres

Maximum Overland Flow: L = 514' 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: 29.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 29.0 min.

$I = \frac{189}{T+25} = \frac{189}{29.0+25} = 3.50$

$Q = CIA = (0.4)(3.50)(0.8) = 1.1$ c.f.s.

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 11 (~~[illegible]~~)

Job No. Highland North Addition, Tract A

Drainage Area No. A-3

Area = 0.8 acres

Maximum Overland Flow: L = 111' S = 2.0%

Maximum Channel Flow:

Channel No. 1 L = 170' S = 2.3%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 17.5 min.

Channel No. 1 Flow:

Velocity= 5.35 ft/sec; Time= $\frac{170}{5.35 \times 60}$ = 0.5 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 18.0 min.

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

Q = CIA = (0.5)(4.40)(0.8) = 1.8 c.f.s.

Totals

Area = 2.4 + 0.5 + 0.8 = 4.0 Acres

Runoff = 4.8 + 1.1 + 1.8 = 7.7 c.f.s.

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 12 (Revised)

Job No. Highland North Addition, Tract A

Drainage Area No. A-4

Area = 0.1 acres

Maximum Overland Flow: L = 105' S = 5.7 %

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 14.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 14.0 min.

$$I = \frac{189}{T+25} = \frac{189}{14.0+25} = 4.85$$

Q = CIA = (0.6)(4.85)(0.1) = 0.3 c.f.s.

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 13 (Revised)

Job No. Highland North Addition, Tract A

Drainage Area No. B-1

Area = 0.4 acres

Maximum Overland Flow: L = 200' S = 2.4%

Maximum Channel Flow:

Channel No. 1, L = 135' S = 2.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time 21.0 min.

Overland Flow:

Channel No. 1 Flow:

Velocity = 2.50 ft/sec; Time = $\frac{135}{2.50 \times 60}$ = 0.9 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 = 21.9 min.

$$I = \frac{189}{T+25} = \frac{189}{21.9+25} = 4.03$$

$$Q = CIA = (0.6)(4.03)(0.4) = 1.0 \text{ c.f.s.}$$

Date: 12-20-72

Comp. by: [illegible]

Checked by: HCP

RUNOFF COMPUTATIONS

Sheet No. 14

Job No. Highland North Addition Tract A

Drainage Area No. B-2

Area = 0.7 acres

Maximum Overland Flow: L = 540' S = 1.8%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 35.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 35.0 min.

$$I = \frac{189}{T+25} = \frac{189}{35.0+25} = 3.15$$

$$Q = CIA = (0.5)(3.15)(0.7) = 1.1 \text{ c.f.s.}$$

Totals

Area = 0.4 + 4.0 + 1.3 + 0.7 = 6.4 Acres

Runoff = 1.0 + 7.7 + 2.8 + 1.1 = 12.7 C.F.S

Date: 12-20-72

Comp. by: DAC

Checked by: JKP

RUNOFF COMPUTATIONS

Sheet No. 15

Job No. Highland North Addition, Tract A

Drainage Area No. B-3

Area = 1.3 acres

Maximum Overland Flow: L = 82' S = 1.5%

Maximum Channel Flow:

Channel No. 1, L = 570 S = 2.0%

Channel No. 2 L = 110 S = 1.1%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 16.0 min.

Channel No. 1 Flow:

Velocity= 4.14 ft/sec; Time= $\frac{570}{4.14 \times 60}$ = 2.3 min.

Channel No. 2 Flow:

Velocity= 7.17 ft/sec; Time= $\frac{110}{7.17 \times 60}$ = 0.3 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 18.6 min.

$I = \frac{189}{T+25} = \frac{189}{18.6 + 25} = 4.24$

Q = CIA = (0.5)(4.24)(1.3) = 2.8 c.f.s.

Totals

Area = 0.4 + 4.0 + 1.3 = 5.7 Acres

Runoff = 1.0 + 7.7 + 2.8 = 11.5 c.f.s

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 16

Job No. Highland North Addition, Tract A

Drainage Area No. C-1

Area = 0.5 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 235' S = 2.7%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 10.37 ft/sec; Time= $\frac{235}{10.37 \times 60}$ = 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 = (0.4)(7.44)(0.5) = 1.5 c.f.s.

Totals

Area = ~~33.6~~ 33.1 + 0.5 = ~~33.1~~ 33.6 Acres

Runoff = 103.8 + 1.5 = 105.3 c.f.s.

Date: 12-20-72

Comp. by: [illegible]

Checked by: HEP

Rev. 8/15/73 [illegible]

RUNOFF COMPUTATIONS

Sheet No. 17

Job No. Highlands North Addition, Tract A

Drainage Area No. E-1

Area = 0.2 acres

Maximum Overland Flow: L = 162' S = 2.5%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 19.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 19.0 min.

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

Q = CIA = (0.5)(4.30)(0.2) = 0.4 c.f.s.

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 18

Job No. Highlands North Addition, Tract A

Drainage Area No. I

Area = 3.1 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 680' S = 2.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 12.83 ft/sec; Time= $\frac{680}{12.83 \times 60}$ = 0.9 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 = 0.9 min.

$I = \frac{189}{T+25} = \frac{189}{0.9+25} = 7.30$

Q = CIA = (0.7)(7.30)(3.1) = 15.8 c.f.s.

Totals

Area = 3.1 + ~~6.4~~ + ~~37.1~~ = ~~46.6~~ 33.6 42.6

Runoff = 15.8 + 12.7 + 105.3 = 133.8 c.f.s

Date: 12-20-72

Comp. by: DRC

Checked by: HSP RRC

Rev. 8/15/73

ADDENDUM

TO

PRELIMINARY DRAINAGE STUDY
RELATIVE TO THE DEVELOPMENT OF
HIGHLAND NORTH ADDITION
TRACT A

As a result of a joint meeting with the Developer and the Albuquerque Metropolitan Arroyo Flood Control Authority, the following Addendum is offered as an alternative solution to drainage in the subject area.

On page 3, Section IV., C., next to the last paragraph, add the following sentence:

> Coefficients of from 0.4 to 0.6, depending on filters and pond size, may be used when development plans call for ponding with infiltration areas with details shown thereon.

On page 4, Section V., (4), add the following sentence:

> An alternative solution when individual ownership is contemplated might be ponding and providing for infiltration areas. This solution should incorporate provisions for maintenance of infiltration areas in proper working order.

Add the following pages 5A - 7A and 16A - 25A at the end of the report. All of these additions are those recommended by the Executive Engineer and agreed to by the Developer as being required to comply with A.M.A.F.C.A. Resolution No. 2, 1972.

Respectfully submitted,

Donald L. Campbell

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

December 1972

REGISTERED PROFESSIONAL ENGINEER AND LAND SURVEYOR No. 3633 NEW MEXICO DONALD L. CAMPBELL

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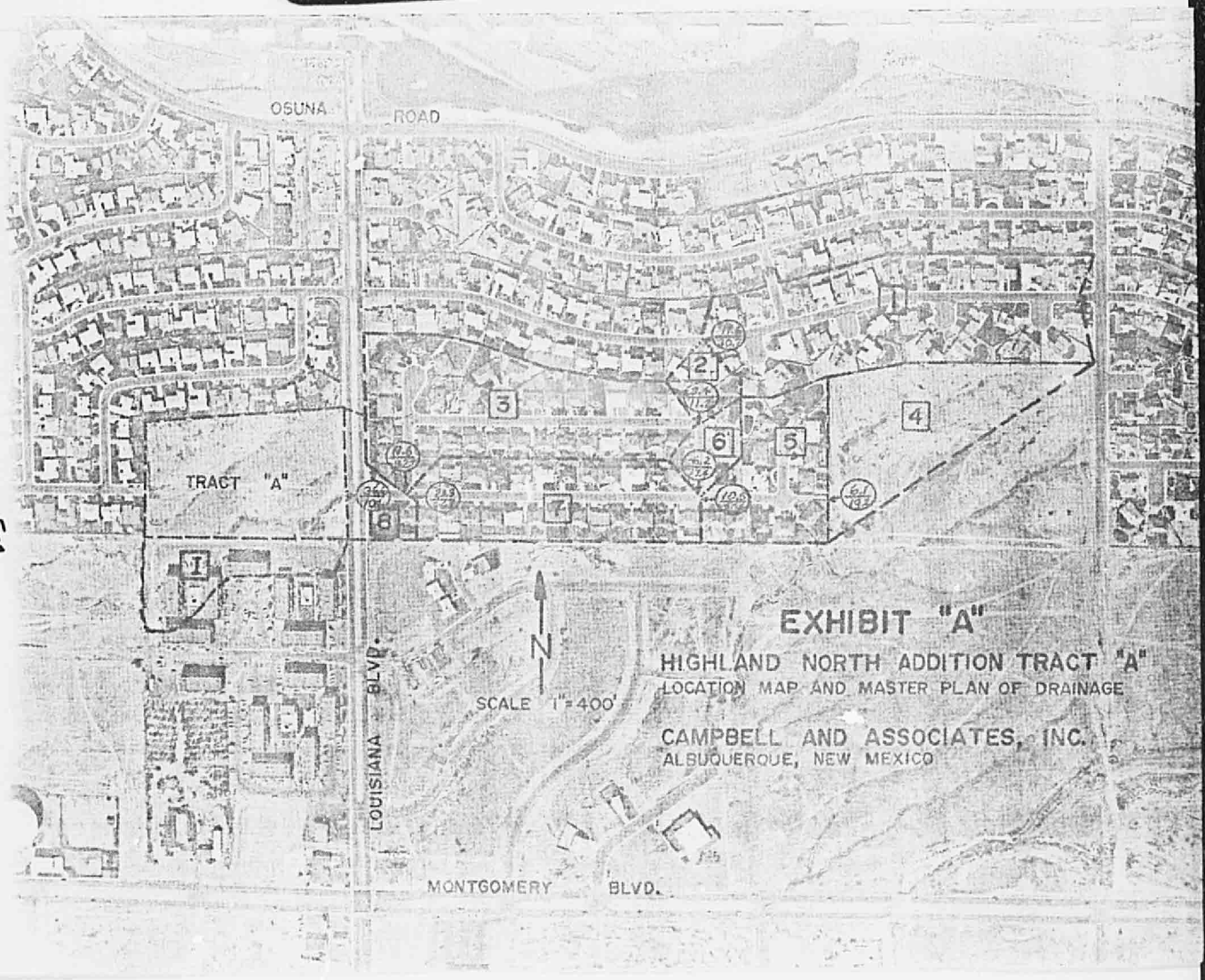


5-4

EXHIBIT C

SUMMARY OF RUNOFF COMPUTATIONS

SHEET NO	AREA NUMBER	AREA (IN ACRES)	EXPECTED RUNOFF (IN C.F.S.) INDIVIDUAL	TOTAL
1	1	11.6	30.7	
2	2	0.9	4.6	11.2
3	3	9.7	26.3	32.7
4	4	6.1	19.2	
5	5	4.4	11.4	30.6
6	6	1.2	3.4	17.4
7	7	6.6	18.2	66.2
8	8	1.7	4.9	103.8
9	A-1	2.4	4.8	
10	A-2	0.8	1.1	
11	A-3	0.8	1.8	7.7
12	A-4	0.1	0.3	
13	B-1	0.4	1.0	
14	B-2	0.7	1.1	12.7
15	B-3	1.3	2.8	11.5
16	C-1	0.5	1.5	105.3
17	E-1	0.2	0.4	
18	I	3.1	15.8	133.8

RUNOFF COMPUTATIONS

Sheet No. 9 (~~Grouped~~)

Job No. Highlands North Addition, Tract A

Drainage Area No. A-1

Area = 2.4 acres

Maximum Overland Flow: L = 188' S = 3.0 %

Maximum Channel Flow:

Channel No. 1 L = 430' S = 2.3 %

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 20.0 min.

Channel No. 1 Flow:

Velocity= 5.35 ft/sec; Time= $\frac{430}{5.35 \times 60}$ = 1.3 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 = 21.3 min.

$$I = \frac{189}{T+25} = \frac{189}{21.3+25} = 4.08$$

$$Q = CIA = (0.5)(4.08)(2.4) = 4.8 \text{ c.f.s.}$$

Date: 12-20-72

Comp. by: [illegible]

Checked by: HEP

RUNOFF COMPUTATIONS

Sheet No. 10 (~~Continued~~)

Job No. Highland North Addition, Tract A

Drainage Area No. A-2

Area = 0.8 acres

Maximum Overland Flow: L = 514' 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: 29.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 29.0 min.

$$I = \frac{189}{T+25} = \frac{189}{29.0+25} = 3.50$$

$$Q = CIA = (0.4)(3.50)(0.8) = 1.1 \text{ c.f.s.}$$

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 11 (~~[illegible]~~)

Job No. Highland North Addition, Tract A

Drainage Area No. A-3

Area = 0.8 acres

Maximum Overland Flow: L = 111' S = 2.0%

Maximum Channel Flow:

Channel No. 1 L = 170' S = 2.3%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 17.5 min.

Channel No. 1 Flow:

Velocity= 5.35 ft/sec; Time= $\frac{170}{5.35 \times 60}$ = 0.5 min.

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 18.0 min.

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

$$Q = CIA = (0.5)(4.40)(0.8) = 1.8 \text{ c.f.s.}$$

Totals

Date: 12-20-72

Area = 2.4 + 0.8 + 0.8 = 4.0 Acres

Comp. by: [illegible]

Runoff = 4.8 + 1.1 + 1.8 = 7.7 c.f.s.

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 12 (Revised)

Job No. Highland North Addition, Tract A

Drainage Area No. A-4

Area = 0.1 acres

Maximum Overland Flow: L = 105' S = 5.7 %

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 14.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 14.0 min.

$$I = \frac{189}{T+25} = \frac{189}{14.0+25} = 4.85$$

$$Q = CIA = (0.6)(4.85)(0.1) = 0.3 \text{ c.f.s.}$$

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 13 (Revised)

Job No. Highland North Addition, Tract A

Drainage Area No. B-1

Area = 0.4 acres

Maximum Overland Flow: L = 200' S = 2.4%

Maximum Channel Flow:

Channel No. 1 L = 135' S = 0.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 21.0 min.

Channel No. 1 Flow:

Velocity= 2.50 ft/sec; Time= $\frac{135}{2.50 \times 60}$ = 0.9 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 = 21.9 min.

$I = \frac{189}{T+25} = \frac{189}{21.9+25} = 4.03$

$Q = CIA = (0.6)(4.03)(0.4) = 1.0$ c.f.s.

Date: [illegible]

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 14

Job No. Highland North Addition Tract A

Drainage Area No. B-2

Area = 0.7 acres

Maximum Overland Flow: L = 540' S = 1.8%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 35.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 35.0 min.

$$I = \frac{189}{T+25} = \frac{189}{35.0+25} = 3.15$$

Q = CIA = (0.5)(3.15)(0.7) = 1.1 c.f.s.

Totals

Area = 0.4 + 4.0 + 1.3 + 0.7 = 6.4 Acres

Runoff = 1.0 + 7.7 + 2.8 + 1.1 = 12.7 C.F.S

Date: 12-20-72

Comp. by: DAC

Checked by: JKP

RUNOFF COMPUTATIONS

Sheet No. 15

Job No. Highland North Addition, Tract A

Drainage Area No. B-3

Area = 1.3 acres

Maximum Overland Flow: L = 82' S = 1.5%

Maximum Channel Flow:

Channel No. 1 L = 570 S = 2.0%

Channel No. 2 L = 110 S = 1.1%

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 16.0 min.

Channel No. 1 Flow:

Velocity= 4.14 ft/sec; Time= $\frac{570}{4.14 \times 60}$ = 2.3 min.

Channel No. 2 Flow:

Velocity= 7.17 ft/sec; Time= $\frac{110}{7.17 \times 60}$ = 0.3 min.

Channel No. 3 Flow:

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

Total Accumulation Time: T = 18.6 min.

$I = \frac{189}{T+25} = \frac{189}{18.6 + 25} = 4.24$

Q = CIA = (0.5)(4.24)(1.3) = 2.8 c.f.s.

Totals

Area = 0.4 + 4.0 + 1.3 = 5.7 Acres

Runoff = 1.0 + 7.7 + 2.8 = 11.5 c.f.s

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 16

Job No. Highland North Addition, Tract A

Drainage Area No. C-1

Area = 0.5 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 235' S = 2.7%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 10.37 ft/sec; Time= $\frac{235}{10.37 \times 60}$ = 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 = (0.4)(7.44)(0.5) = 1.5 c.f.s.

Totals

Area = 36.6 + 0.5 = 37.1 Acres

Runoff = 103.8 + 1.5 = 105.3 c.f.s.

Date: 12-20-72

Comp. by: DHC

Checked by: HEP

RUNOFF COMPUTATIONS

Sheet No. 17

Job No. Highlands North Addition, Tract A

Drainage Area No. E-1

Area = 0.2 acres

Maximum Overland Flow: L = 162' S = 2.5%

Maximum Channel Flow:

Channel No. 1 L = _____ S = _____

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: 19.0 min.

Channel No. 1 Flow:

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

Channel No. 2 Flow:

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

Channel No. 3 Flow:

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

Total Accumulation Time: T = 19.0 min.

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

$$Q = CIA = (0.5)(4.30)(0.2) = 0.4 \text{ c.f.s.}$$

Date: 12-20-72

Comp. by: [illegible]

Checked by: [illegible]

RUNOFF COMPUTATIONS

Sheet No. 18

Job No. Highlands North Addition, Tract A

Drainage Area No. I

Area = 3.1 acres

Maximum Overland Flow: L = _____ S = _____

Maximum Channel Flow:

Channel No. 1 L = 680' S = 2.5%

Channel No. 2 L = _____ S = _____

Channel No. 3 L = _____ S = _____

Accumulation Time

Overland Flow: _____ min.

Channel No. 1 Flow:

Velocity= 12.83 ft/sec; Time= $\frac{680}{12.83 \times 60}$ = 0.9 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 = 0.9 min.

$I = \frac{189}{T+25} = \frac{189}{0.9+25} = 7.30$

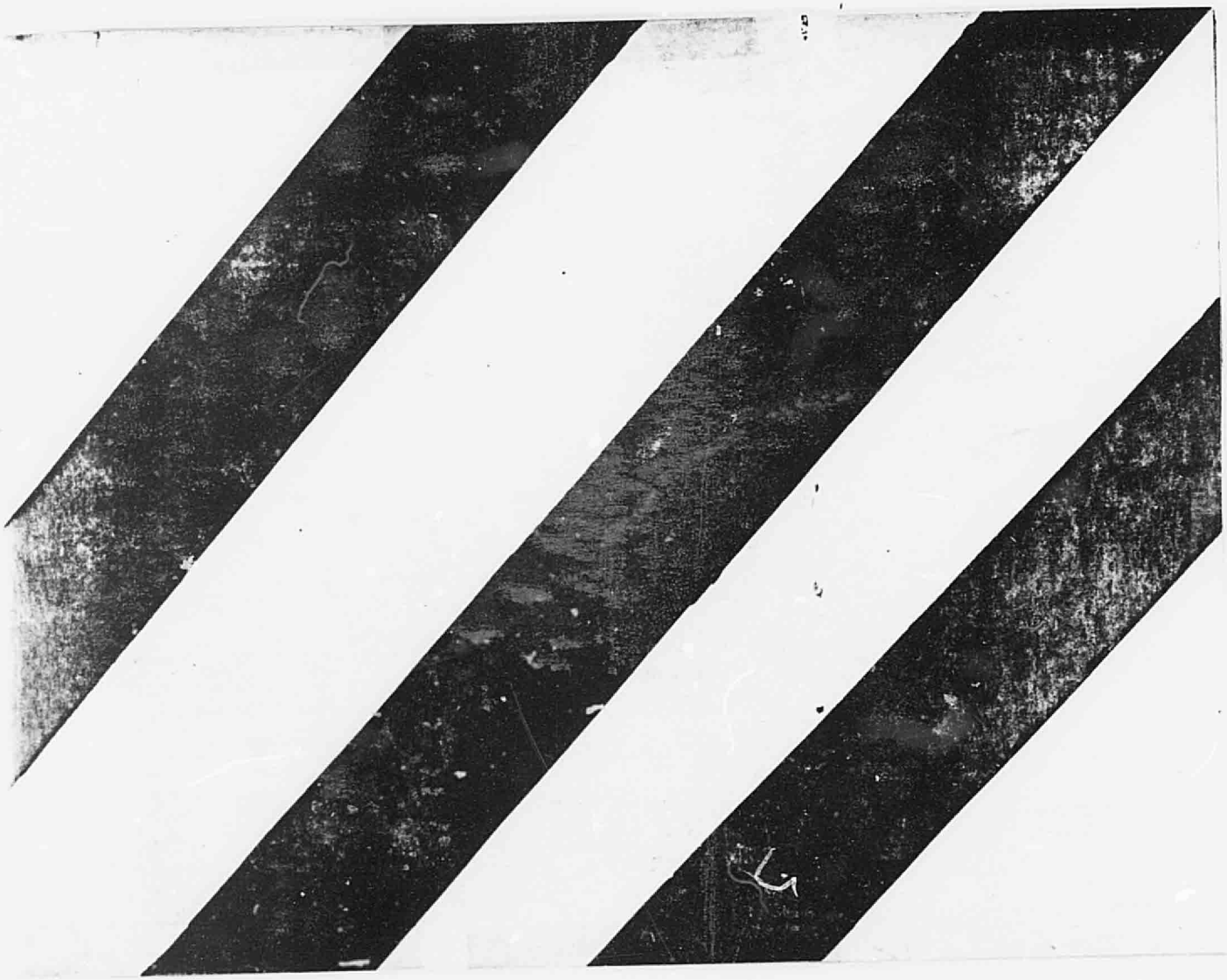
Q = CIA = (0.7)(7.30)(3.1) = 15.8 c.f.s.

Totals

Area = 3.1 + 6.4 + 37.1 = 46.6

Runoff = 15.8 + 12.7 + 105.3 = 133.8 C.F.S.

Date: 12-20-72

Comp. by: [illegible]

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