M9/D10

H PLANS

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

M9-D10

September 8, 1981

Mr. Fred Arfman
Isaacson & Arfman, PA
2727 San Pedro N.E., Suite 114A
Albuquerque, New Mexico 87110

Re: WESTGATE HEIGHTS, UNIT 5 DRAINAGE REPORT

Dear Fred:

The referenced drainage report is hereby approved based on the following modifications to the original drainage plan:

1. An inlet system will be located at the T-Intersection of Ladrones Pl. Special attention will be given to erosion protection at the conduit's outfall located in the AMAFCA channel.

2. A 20 ft. concrete rundown will be located at Ladrones Road to convey runoff to the AMAFCA channel. Special attention will be given to erosion protection at the conduit's outfall.

3. Mr. Charles Easterling, Principal Assistant City Engineer/ Hydrology, concurs with utilizing Del Ray Road for conveying the 205 cfs to the Amole Channel.

4. A tumbling flow energy dissipator will be used at the confluence of Del Ray Road and the Amole Channel.

Please supply this office a set of construction plans for review of the proposed drainage system and structures outlined in #1, #2 and #4 above.

This office wishes to extend its appreciation for your cooperation throughout the course of the project. If we can be of further help on this or other matters, please call.

Very truly yours,

Brian G. Burnett

Brian G. Burnett
Civil Engineer/Hydrology

BGB/fs

ISAACSON & ARFMAN, P.A.
CONSULTING ENGINEERING ASSOCIATES

2727 SAN PEDRO N.E. SUITE 114A
ALBUQUERQUE, NEW MEXICO 87110
TELEPHONE - 883-2800

August 20, 1981

Engineering Division-Hydrology
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Attn: Brian Burnett

Re: WESTGATE HEIGHTS, UNIT 5

Dear Brian,

Enclosed you will find additional information and data that cover the three concerns that were brought up earlier. The three include, the handling of storm water flows at the East end of Ladrones Pl., the storm drainage channel entrance characteristics and drainage rundown into the Amole.

Please incorporate this information into the project's drainage file.

Hopefully, you will find everything in order.

Very truly yours,

Fred C. Arfman

Fred C. Arfman, P.E.

FCA/klr

RECEIVED
AUG 24 1981
CITY ENGINEER

ISAACSON & ARFMAN, P.A.
CONSULTING ENGINEERING ASSOCIATES

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FCA/klr

RECEIVED
AUG 24 1981
CITY ENGINEER

COMBINATION INLETS

A triple combination inlet system will be utilized to intercept flows that would come down the North side of Ladrones Pl. This inlet system would have a 30 cfs acceptance capacity and would require a 24" dia. pipe to transfer the storm waters approximately 140 ft. to the AMAFCA Channel. The conduit must have a 2.5% min. slope to avoid a pressure flow situation. Also, the conduit's exit must have special consideration for erosion control.

DESIGN

I. Special Conditions - The inlet system is located at a tee intersection, more precisely, the inlets would be located at the point of intersection of the east curb line the center of flow coming down Ladrones Pl. on the north side. Such positioning allows flows to enter the inlet system perpendicular to the inlets face (see attachment). Secondly, the inlets are to be designed having a 2" sump condition for greater flow management characteristics.

II. Solution - The inlet system has the following physical conditions:

Total curb opening	= 9'-0"
Curb opening height	= 6"
Grate clear opening	= 9 sq. ft.
Allowable ponding depth over grate	= 8" (curb)+2" (sump)-2" (draw down) = 8"

Now grate capacity = 9ft. x 3.8 $^{cfs}/ft^{2}$ = 34.2 cfs
(3.8 $^{cfs}/ft$ factor is found on Fig. 4-1, capacity of Grated Inlets in Sump, Drainage Criteria Manual, Denver Regional Council of Governments)

Secondly, curb opening capacity = 9'-0"x1.25 $^{cfs}/ft$ = 11.25 cfs
(Note: the 1.25 $^{cfs}/ft$ factor is a 67% increase over the accepted 0.75 $^{cfs}/ft$ due to the direction of flow that enters into the inlets, perpendicualr vs. parallel).
Therefore the total theoretical capacity of the inlet system is:

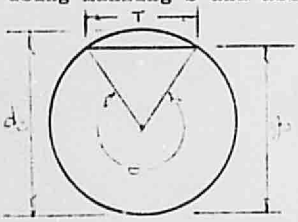
34.2
11.25
45.45 cfs

Applying the reduction factor for combination inlets x 0.65
Capacity =29.54-use 30cfs

PIPE FLOW

A conduit must be sized to carry storm water collected at the inlets. The rate of transfer must not be less than 30 cfs. Gravity flow is desired.

Try 24" conduit that has a h of 0.015 and a slope of 2.5%. Once again using Manning's and assuming pipe is flowing at 0.90, then;



$A = 1/8\ (\theta - \sin\theta)\ do^2 = 2.98$ sq. ft.

$P = 1/2\ \theta\ do = 4.996$

$R = A/P = 0.59647$

$R^{2/3} = 0.707$

$Q = 33$ cfs > 30 - good.

$\theta = 286.26°$

$= 4.996$ radius

Conclusion: It is understood that provisions must be made to provide channel protection at the point of discharge. This feature shall be designed to satisfy AMAFCA criteria and the Authority shall be consulted.

STREET FLOW

A street flow analysis is required in order to aid in the understanding of how these flows behave at the intersection point.
The remaining flows not captured by the triple combo-inlet are assumed to be equally divided on both sides of the street. The street has the following physical dimensions:

Curb height = 8"
Width (f-F) = 32'
Crown = 4"
Slope = 0.5%

By Manning's $Q = \frac{1.49}{h} (AR)^{2/3} (S)^{1/2}$ where h = 0.015
Q = 24 cfs

Then Y = 0.43'

$V = \frac{Q}{A}$ where A = 8.48 sq. ft.

V = 2.83 fps

Check $F = \frac{V}{gb}$

$F = \frac{2.83}{3.72} = 0.7621$ Subcritical Flow

Now, for flows coming from the west on a 2.3% slope at a Q = 24 cfs.

Then: depth = 0.33 @ cutter 0.0 at crown

V = 4.545 fps

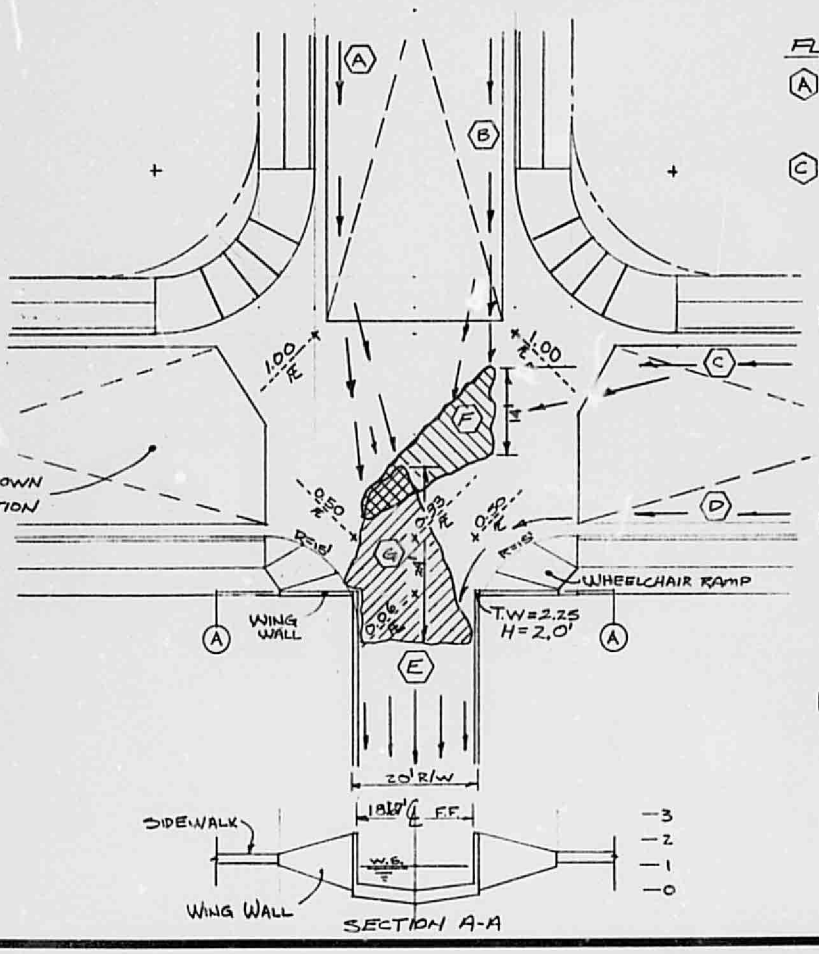
Check $F = \frac{V}{gb} \rightarrow 1.39$ Subcritical Flow

INTERSECTION/CHANNEL ENTRANCE CHARACTERISTICS

As stated under the street flow analysis, flows are converging from the north and west. Flow characteristics from both directions are similar with respect to that they are divided by the street's crown. Therefore, two channels from each direction are intersecting, as shown: (See drawing on following page)

CONSCLUSION:

As the four channel flow approach intersection, they flatten out due to the lack of the street crown. The intersecting flows create 2 hydraulic jumps, the first occuring as shown by F . Its length is 14 feet. The second jump G has a length of 24 feet that extends into the drainage channel. Flows are channelized by the use of 15 foot entrance radii and the channel's wingwalls. These two features guarantee that the flow will be contained within the public R.O.W.



FLOWS:

(A) & (B); 12 cfs (SUPERCRITICAL), d=0.33/0.20
V=4.55 fps
S= 2.2 %

(C) & (D); 12 cfs (SUBCRITICAL)
V=2.83 fps
S= 0.5%
d = 0.43 (CROWN SEC)
= 0.25 (NO CROWN

(E); 48 cfs (SUPERCRITICAL)
V= 8 fps
S = 2.5%
$d_{F=1}$ = 0.5899'
d_{F_c} = 0.32'
F=2.54

(F) LIMITS OF HYDRAULIC JUMP: L_{MAX} = 14'
JUMP ROLLER @ 45°
d= 0.42' + $d_{@}$
= 0.42' + 0.25 = 0.67'

(G) LIMITS OF HYDRAULIC JUMP; L_{MAX} = 24'
JUMP ROLLER @ ~60°
d = 0.5'@ + 0.42' = 0.92'

d' (@ ENTRANCE)
$d' = \frac{15}{24}(0.92 - 0.32) = 0.7'$

Isaacson Arfman, P.A.
Consulting Engineering Associates

SUBJECT WESTGATE HEIGHTS #5 - DRAINAGE JOB NO.
BY FCA DATE 8/81 SHEET NO. OF

STREET/CHANNEL OUTFALL TO AMOLE ARROYO

Where $Q = 205$ cfs
$S = 0.033\ ^{1}/1$
$W = 40'$

Flows from street to channel entrance are confined within the limits of the street. The channel is a continuance of the street, i.e. width and alignment are the same.
An energy dissipator is needed to prevent erosion in the accepting arroyo. Due to economical constraints, a dissipator that induces a tumbling flow will be used.

For roughness elements of square = cross-section

$$h = \frac{1}{(3-3.75)\ 2/3}\ Dc \qquad \text{Where } Dc = 0.93$$
$$S = 0.033\ ^{1}/1$$

$h = 0.46'$
It is recommended that the $\frac{\lambda}{h}$ ratio 10.
therefore, $\lambda = 5'$ is satisfactory.

The above sized and spaced elements will adequately establish uniform tumbling flow.

Since the channel is 120' long, a single large loading element followed by five normal elements at the outlet and will provide the same results. The large leading element is sized as follows:

$$h_1 = \left[\left(\frac{2}{(1-0.033)^2}\left(\frac{(0.93)}{(0.43)}\right)\right)^{1/2} - \left(1-0.033\right)^2\right]0.93$$

$h_1 = 1.13'$

In Summary: For the channel having a 40' width and a slope of 3.3%, one large element ($h = 1.13'$) followed every 5 feet with a normal element of $h = 0.46'$ is adequate to serve as an energy dissipator.

ISAACSON & ARFMAN, P.A.
CONSULTING ENGINEERING ASSOCIATES

2727 SAN PEDRO N.E. SUITE 114A
ALBUQUERQUE, NEW MEXICO 87110
TELEPHONE – 883-2800

RECEIVED
JUN 25 1981
CITY ENGINEER

June 25, 1981

City Engineer/Hydrology
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: WESTGATE HEIGHTS SUBDIVISION, UNIT 5

Dear Sirs,

I am submitting to your department this final drainage report addendum in response to your letter of June 10, 1981. Attached are hydraulic computations and/or written narratives covering the four intersections and rundowns in question.

Please incorporate this letter and the attachments to the drainage file. Hopefully, all is in order and I will be available to assist if any other problems arise.

Very Truly Yours,

Fred C. Arfman

Fred C. Arfman,
Vice President

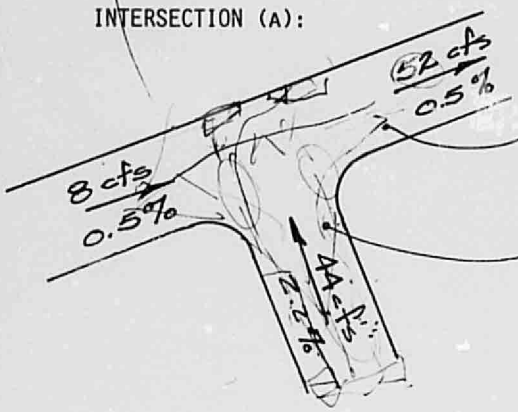
FCA/klr
Attachments

COMPUTATIONS

REFERENCE SOURCES USED IN THE FOLLOWING ANALYSIS WERE: HANDBOOK OF HYDRAULICS, BY HORACE KING AND OPEN-CHANNEL HYDRAULICS, BY VEN TE CHOW.

CONSERVATIVE ASSUMPTIONS MUST BE MADE TO PROPERLY ANALYZE THE TEE INTERSECTIONS, FOR THE FORMULAS FOR FLOWS IN CHANNELS OF NON-LINEAR ALIGNMENT CAN NOT BE USED. THEREFORE, WE MUST ASSUME THAT THE FLOWS ENTERING PERPENDICULAR TO THE THROUGH STREET WILL STOP UNTIL A SUFFICIENT HEAD IS DEVELOPED THAT WOULD ALLOW FOR THE PLANNED DISCHARGE. SECONDLY, FLOWS ENTERING PARALLEL TO THE DISCHARGE TANGENT WOULD AID IN THE TURNING, BUT SHALL NOT BE USED IN THE ANALYSIS.

INTERSECTION (A):



STREET CAPACITIES	100 YEAR STORM CONDITIONS
63 CFS @ 4.1 FPS	52 CFS 7" FLOW DEPTH
132 CFS @ 8.7 FPS	44 CFS 5½" FLOW DEPTH

AS STATED, ASSUME THE 8 CFS DOES NOT ASSIST IN TURNING THE 44 CFS FLOW. USING THE FORMULA FOR A BROAD CRESTED WEIR WITH SLOPING CREST AND NO ENTRANCE LOSS (FLAT SLOPE).

$Q = 3.087\ LH^{3/2}$; WHERE $L = 32'$

$Q = 44'$

$H = \left(\frac{Q}{3.087\ L}\right)^{2/3}$

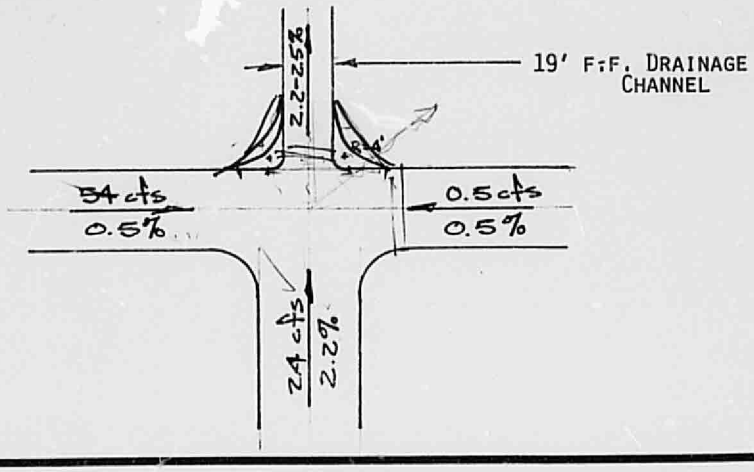
$H = \left(\frac{44}{98.75}\right)^{2/3}$

$= (0.45)^{2/3}$

$= 0.59 = \sim 7'' < 8''$ CURB HEIGHT

FLOWS WOULD THEN FLOW SOUTHWARD AT THE SAME DEPTH WHEN CONSIDERING THE TOTAL Q OF 52 CFS.

INTERSECTION (B):



AS BEFORE: $Q = 3.087\ LH^{3/2}$

L = 27' DUE TO CHANNEL ENTRANCE CONSIDERATION, CHANNEL SHALL HAVE FOUR (4) FOOT ENTRANCE RADII.

Q = 54 CFS

$$H = \left(\frac{54}{3.087\,(27)}\right)^{2/3} = 0.75' = 9''$$

BASED ON THE ABOVE CALCULATION, IT APPEARS THAT THE CURBS WOULD OVERFLOW. BUT SINCE THE HEAD (H) IS AT ITS MAXIMUM A DISTANCE OF 2.5 (H) AWAY FROM THE CHANNEL ENTRANCE, MINOR OVERFLOW WOULD BE EXPECTED.

INTERSECTION (C):

SAME STREET CONDITIONS OCCUR HERE AS THOSE OF INTERSECTION (A), AND SINCE TURNING ONLY 19 CFS, WE MUST ASSUME THAT THERE SHALL BE NO DIFFICULTY.

INTERSECTION (D):

NO ANALYSIS IS NECESSARY DUE TO THE LOW RATE OF FLOW (Q = 4 CFS) THAT WOULD HAVE TO BE TURNED WITHIN THE CONFINES OF A 32' F-F STREET WITH STANDARD CURB AND GUTTER.

CHANNEL ANALYSIS

CHANNEL (I)

KNOWN: Q = 79 CFS W = b = 19'

S = 2.5% N = 0.014

CHANNEL SHALL BE IN ACCORDANCE WITH CITY'S STANDARD DRAWING, K-10.

ANALYSIS: DEPTH OF FLOW (d) = 5¼"

A = 8.36 SQ. FT.

V = 9.42 FPS.

CHANNEL (II)

RUNDOWN ANALYSIS AT SUBDIVISIONS ENTRANCE - REDONDO ROAD AND AMAFCA CHANNEL.

SINCE THERE ARE NO PUBLIC AUTHORITIES' FUNDS AVAILABLE FOR A CROSSING STRUCTURE IN THE NEAR FUTURE, CITY ENGINEERS HAVE ASKED THE DEVELOPER TO CONSTRUCT A TEMPORARY CROSSING. THIS CROSSING SHOULD BE A DIP THAT FOLLOWS THE CHANNELS CROSS-SECTION AS MUCH AS POSSIBLE. FLOW WOULD THEREFORE BE INTERCEPTED BY THE CHANNEL AND CARRIED SOUTHWARD. THE TEMPORARY CROSSING STRUCTURE WOULD IN ALL LIKELIHOOD WASH OUT IF A 100-YEAR STORM WERE TO PASS THROUGH THE AREA.

CHANNEL (III)

Q = 201 CFS (SEE DRAINAGE REPORT, PAGE A-8)

S = 10%

USING A 40' CHANNEL BOTTOM WITH VERTICAL WALLS, THE FOLLOWING WOULD HOLD:

D = 0.34' = 4"

A = 13.6 SQ. FT.

V = 15.1 FPS.

THIS CHANNEL WOULD BE A CONTINUATION OF THE STREET CROSS SECTION.

BUT, DUE TO THE HIGH VELOCITY DEVELOPED, A TRAPEZOIDAL RIP-RAP DESIGN MAY BE DESIRABLE.

W = 40' TOP, 80' BOTTOM, N = 0.05

GIVES D = 0.71	TOP	BOTTOM
A =	28.4	36.8
V =	7.31	5.56 ←

EFFECTIVELY REDUCES THE VELOCITY FROM 15.1 TO 5.56 FPS.

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

June 10,1981

Mr. Fred Arfman
Isaacson-Arfman Consulting Engineers, Inc.
2727 San Pedro N.E., Suite 114
Albuquerque, N.M. 87110

RE: WESTCAGE HEIGHTS SUBDIVISION, UNIT 5

Dear Fred:

This letter is a follow-up of our conversation on June 10, 1981. Please provide the following information concerning the referenced site:

1. Hydraulic analysis of flows at the intersections indicated on the enclosed sheet.

2. Hydraulic analysis and details of conditions at the proposed rundowns marked on the enclosed sheet.

If you have any further questions, please feel free to call me.

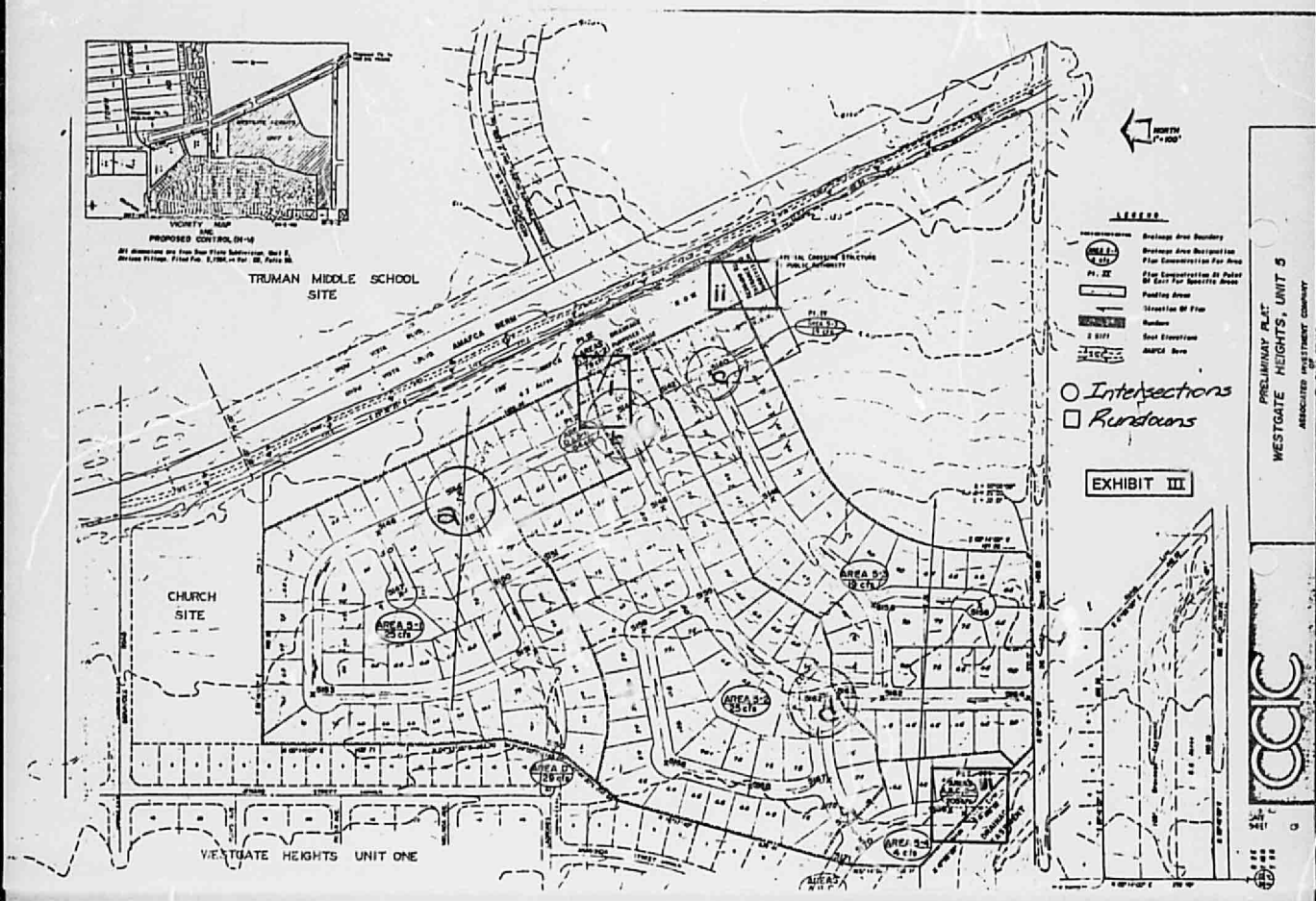
Very truly yours,

Brian G. Burnett

Brian G. Burnett
Civil Engineer/Hydrology

BGB/tsl

Enclosures


VICINITY MAP
PROPOSED CONTROL (N-14)
TRUMAN MIDDLE SCHOOL SITE
CHURCH SITE
WESTGATE HEIGHTS UNIT ONE
AMAFCA BERM
NORTH
LEGEND
Intersections
Rundowns
EXHIBIT III
PRELIMINARY PLAT
WESTGATE HEIGHTS, UNIT 5
ASSOCIATED INVESTMENT COMPANY

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

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Brian G. Burnett
Civil Engineer/Hydrology

BGB/tsl

Enclosures

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

June 10, 1981

Mr. Richard Bray
C.C.I.C.
3500 Indian School Rd. NE
Albuquerque, N.M. 87106

RE: DRAINAGE REPORT APPROVAL FOR LA QUINTA MOTOR INN

Dear Mr. Bray:

Fred Arfman requested that you receive a copy of the approval letter for your files.

If you have any further questions, please feel free to call me.

Very truly yours,

Brian G. Burnett
Civil Engineer/Hydrology

BGB/tsl

Attachment

D19-D1
Westgate Heights
6.4.81
Brian Burnett

Meeting with Fred Arfman

The following items were discussed concerning Westgate Heights:

1. I questioned how the % splits for the different road intersections were determined (page 3 Table II). Fred said it was a visual inspection after the an elevation was determined at each corner. He indicated that the figures were conservative.

2. More detail of contouring and hydraulics is needed at the Anole channel and the 20' rundown into the AMAFCA channel. Fred will be supplying this information.

3. Some future decisions will be made concerning the crossing structure at Redondo Dr. and the AMAFCA

channel. Pending those solutions temporary facilities will be constructed to divert the 19cfs to the AMAFCA channel.

Note: AMAFCA has guaranteed no money for the crossing structure and at the present time the City has no funds for such ~~proposals~~ projects.

Westgate Height
Discussion List

1. Verification of % splits page 3 Table II

2. Additional info at Awole channel and 20' rundown

   a. Contouring & hydraulic analysis

3. Construction sequence of Redondo & subdivision.

Brian Burnett
6-81

Brian D. Burnett

Points that must be clarified before approval is sent:

1. Verify % splits at various intersections (Table II) page 3.

2. Some added detail of rundowns at the Amole Channel and the AMAFCA Drainage R.O.W.

   a. At point III of the analysis it appears that water will not negotiate the 90° bend. There made need to be some commitment concerning storm sewers.

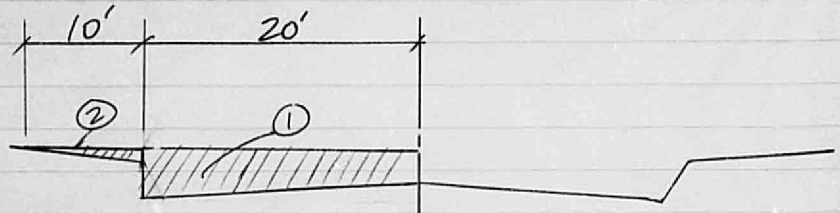
   b. Some additional information is needed to assume that the cul-de-sac will drain into the channel. Assuming a broad crested weir at the outfall, and a 30' drainage channel. 1.8' of head will be required for the water to pass over the weir. From street capacity calculations, and the fact that the flow depth will decrease as the water enters the cul-de-sac, obtaining the

required head does not
seem possible.

3. The is definitely some question
concerning the crossing structure.
Some time schedule must
be set to define the
building of the road and
the subdivision. If subdivision
comes first - temporary solutions
must be made to contain
19 cfs.

Additional Comments
Westgate Heights
6-1-81 BGB

Check of Street Carring Capacity



Typical Cross-Section

Conditions: 40 FF
4" Crown
0.2' Overflow

Area 1; $\left[\frac{(0.67 + 0.2)}{2} + (.87 - .33)\right] \times 20$

$= 14.10$ sq. ft.

Area 2; $\frac{1}{2} \times 10' \times 0.20'$

$= 1.0$ sq ft

Total a1 + a2

$= 15.1$ sq. ft.

Total Street Capacity =

$= 30.2$ sq ft. ✓

BGB 6-1-81

Check of Drainage Channel Width

Assume broad crested weir at drainage channel.

Use $Q = CLH^{1.5}$.

$C = 2.86$
$L = 20'$
$Q = 79$ cfs

$$H = \left(\frac{Q}{CL}\right)^{.67}$$

$$H = \left[\frac{79}{(2.86)(20)}\right]^{.67}$$

$$H = 1.24'$$

It appears that there may be be problems in water entering drainage channel.

GRADING PLAN CHECKLIST

DATE 5/29/81 ZONE ATLAS PAGE NO. 79-D10

PROJECT TITLE (ADDRESS) Westgate Heights

SUBDIVISION Unit #5 LOT ____ BLOCK ____

ENGINEER Issacson-Arfman CONTACT Fred Arfman

ADDRESS ____ PHONE 883-2800

ARCHITECT/SURVEYOR ____ CONTACT ____

ADDRESS ____ PHONE ____

YES	NO	NA	ITEM
✓			Vicinity map with zone atlas page and legal description (or plat).
	✓		Reference bench mark description.
	✓		Drawn to standard engineering scale (1"=10' for sites less than one acre; 1" = 20 for sites less than five acres: 1" = 50' for sites greater than 5 acres). 1"=100'
✓			Ground elevation on the site based on mean sea level datum as established by the U.S. Coast and Geodetic Survey (North American Datum 1929).
✓			Existing contours extending a minimum of 10 feet beyond the property line.
	✓		Proposed contours at one foot intervals and proposed spot elevations at key points. Spot elevations
		✓	Finish building floor elevation(s) with mean sea level designation.
✓			Notes defining property line, asphalt sidewalks, planting areas, ponding areas, and all other areas whose definition would increase clarity.
		✓	Slopes (cut or fill) with height of less than 18", 2:1 minimum. Slopes with height greater than 18", 3:1 minimum.
		✓	Elevation of property line at least 0.33 ft. above top of curb.
		✓	Retaining wall required when a vertical grade change greater than 18" is anticipated.
		✓	Proposed street and alley grades if property abuts a dedicated unpaved street or alley. These grades are available, at no charge, from the City Engineer's Office. An advance request will expedite your project. (Note: At present there is a 3 month wait to have the City Engineer supply grades. However, to expedite the plans, the City Engineer may accept grades provided by an engineer).

COMMENTS ____

BY Bua Burnett

GRADING PLAN CHECKLIST

DATE 5/29/81 ZONE ATLAS PAGE NO. 79-D10

PROJECT TITLE (ADDRESS) Westgate Heights

SUBDIVISION Unit #5 LOT ____ BLOCK ____

ENGINEER Issacson-Arfman CONTACT Fred Arfman

ADDRESS ____ PHONE 883-2800

ARCHITECT/SURVEYOR ____ CONTACT ____

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COMMENTS ____

BY Bua Burnett

YES	NO	N/A	
✓			Internal contributory drainage areas, including roof areas, outlined on the plan.
✓			Direction and location of roof drainage including canales, gutters, and downspouts.
✓			Flow lines defined by arrows and spot elevations.
✓			Details of ponds, swales, rundowns, curb cuts, water blocks, and all other significant drainage structures with contours, cross-sections and spot elevations when appropriate. ALL CROSS-SECTIONS MUST BE DRAWN TO STANDARD ENGINEERING SCALE. (Note: All proposed construction within the public way must be approved by the Assistant City Engineer/Design).
		✓	Standard City drivepad with elevation shown.
		✓	Standard City curb cut.

COMMENTS _____

BY: Brian Burnett

APPROVED BY: _____ DATE _____

DRAINAGE REPORT CHECKLIST

DATE 5-29-81 ZONE ATLAS PAGE NO. 199-D10

PROJECT TITLE (ADDRESS) Westgate Heights

SUBDIVISION Unit #5 LOT ____ BLOCK ____

ENGINEER Issacson & Arfman CONTACT Fred Arfman

ADDRESS ____ PHONE 883-2800

OWNER Associated Investment of El Paso CONTACT ____

ADDRESS ____ PHONE ____

ARCHITECT/SURVEYOR ____ CONTACT ____

ADDRESS ____ PHONE ____

GENERAL:

YES	NO	NA	
✓			Professional Engineer's stamp signature and dated.
✓			North arrow and standard engineering scales used.
✓			Planning and zoning action history.

OFF-SITE FLOWS:

YES	NO	NA	
	✓		Delineation of off-site contributing watersheds on SCS Bernalillo County Soil Survey Maps.
	✓		Delineation of off-site contributing watersheds on City of Albuquerque Ortho-Topo Area Maps (Scale 1"=500' or 1"=200').
	✓		Quantification of off-site rates of flow caused by contributing watersheds for the 10 and 100 year storm frequency.
	✓		Off-site flow velocities and depths determined and locations indicated.
✓			Discussion of any other local conditions that affect site drainage.
	✓		Delineation of site and contributing off-site watersheds on pertinent Flood Hazard Boundary Map.
			Adequate treatment of offsite flows.

only 100yr.

ON-SITE FLOWS:

YES	NO	NA	
✓			Calculations showing on-site developed and undeveloped flow volumes and rates.
	✓		On-site flow velocities and depths determined and locations indicated.
✓			Pond volume calculations.
		✓	Positive discharge of ponds with required rate and outlet calculations.
		✓	Pond emergency spillway calculations.
		✓	Pond safety protection (fencing for pond depths greater than 18".)
		✓	Pond landscaping provisions and commitments.
		✓	Pond maintenance provisions and commitments.
		✓	Soils investigation report for ponding within 15' of any structure.

PLAN DRAWINGS:

YES	NO	NA	
			Adequate grading plan provided (See Grading Plan Checklist).
✓			Vicinity map with Zone Atlas designation.
✓			Indication of all easements and right-of-ways on, or adjacent to, the site with dimensions and purpose shown.

By: Brian Burnett 6/1/81

Comments on Westgate Heights

$t_c = \frac{L}{3600 v}$

$v = \frac{L}{3600 t_c}$

1. Page 3 - % splits of flow? How determined?

80-15 2. Offsite flows delineated from Subdivision to the west? (Topography verified).

3. ~~Using value of C=0.12? Should it be higher? Also, C=0.20 is used on page A-3 to.~~ OK

4. Sheet A-5 & Runoff Computations - Sheet No. A-5. How are velocities computed? (SCS method?) Chronology of method on each drainage area.

5. Sheet No. A-5:

Accumulation time for C=0.50 & 100' at 0.02 I read from chart 9 min. This changes total accumulation time (assuming "channel flow velocity" is correct) to be 14 min ⇒ I=4.85 & Q=89 cfs.

6. Recommendations (p.6)

a. Need detail of Del Ray road superelevation.

b. Need detail & contouring of drainage rundown into Arole Arroyo.

c. Item #4 - "10' wide drainage rundown on Ladrones Rd." - Plans call for 20' rundown?

d. Unsure of ramifications of statement #5. As I understand it, there is no money to construct vehicular access. ⇨ Where will 19 cfs flows go?

Comments by Chuck on 6/1/81:

1. Need proposed lot grading - Recommends that pond be graded differently; made larger.

2. Adequate slope protection at rundowns should be addressed (approval from AMAFCA).

3. Water surface profile conditions evaluated at indicated points. (ie. How will water turn 90° at proposed channel).

4 Flat roof homes? If so, grade entire lot to drain to street.

Phone Conversation - 6·1·81
with Fred Arfman 883-2800

Concerning Crossing - No committment from AMAFCA.

Details on Construction Plans.-?

Construction Schedule - water committment

Details of pond -

S.R.B.

CITY OF ALBUQUERQUE
PLANNING DEPARTMENT

ADMINISTRATIVE REVIEW BOARD
December 16, 1977
S-1016-6-1

S-1016-6-1 J. D. Fulmer, agent for Associated Investment Company of El Paso, requests approval of the proposed Westgate Heights, Unit 5, located on the west side of Snow Vista Boulevard, S. W., between Benavides Road and DeAnza Drive, containing approximately 53 acres.

PL Map No.: M-9

Material: Report, Plat

COMMENTS FROM OTHER DEPARTMENTS:

City Engineer: "1. Require drainage study prior to approval of plat.
2. Paving of De Anza Drive must be indicated as part of this approval. Also, recommend that the full width of the R/W for De Anza Drive be dedicated fo public use."

Water Engineer: "Master Plan water & sanitary sewer line extension will be necessary to service subject subdivision. Design of extensions should be coordinated with Engineering Division, Water Resources Department."

Traffic Engineer: "Zoning - no comments.
Plat - lack of paved, major street access (via Snow Vista) is a serious problem. Not only are there financing problems in improving Snow Vista, there is a right-of-way problem at Gibson."

Liquid Waste Engineer: "See comments by Water Engineer."

Parks & Recreation: "Under ordinance 7-1976 the developer is required to pay $12,714 (163 units x $78.00)."

Environmental Health: "All roads and access roads should be paved prior to construction of homes to prevent the fugitive dust problem caused by construction vehicles. A top soil permit is required prior to any earth work in the area."

City Real Estate Officer: "No comment."

Fire Dept. "Will not affect our operation."

Public Service Co. "No objection."

Gas Co. of N.M. " "

Mountain Bell: " "

PLANNING DEPARTMENT COMMENTS 12-16-77:

Under review is Unit #5, Westgate Heights, which consists of 163 lots on a 57.3 acre parcel bounded by DeAnza Drive on the south and Snow Vista Boulevard on the east.

The proposed subdivision abuts existing platting on the east side of Jenoro Street and a 14.5 acre C-2 zoned parcel at its southeasterly boundary. With respect to street layout, the staff finds no objection; however, it should be made clear that the paving of Snow Vista Boulevard and DeAnza Drive are required as a condition of plat approval since local street access is totally inadequate. Such paving can proceed only if complete intersection right of way is dedicated at Gibson Boulevard and Snow Vista Boulevard.

The subject plat indicates the de-emphasis of Redondo Drive from a major collector to lesser utilized street. Redondo Drive will be proposed to service the C-2 zoned triangular parcel instead of being continued as originally planned. Such a "shrinking" in design is consistent with the Westgate Heights Master Plan Revision as approved earlier this year.

All water and sewer connections are to be at the developer's expense and a detailed drainage study is required by the City Engineer and A.M.A.F.C.A. The City cannot accept the proposed 5.6 acre park since it is situated in a drainage area. In all other respects, the plat is consistent with the Subdivision Ordinance.

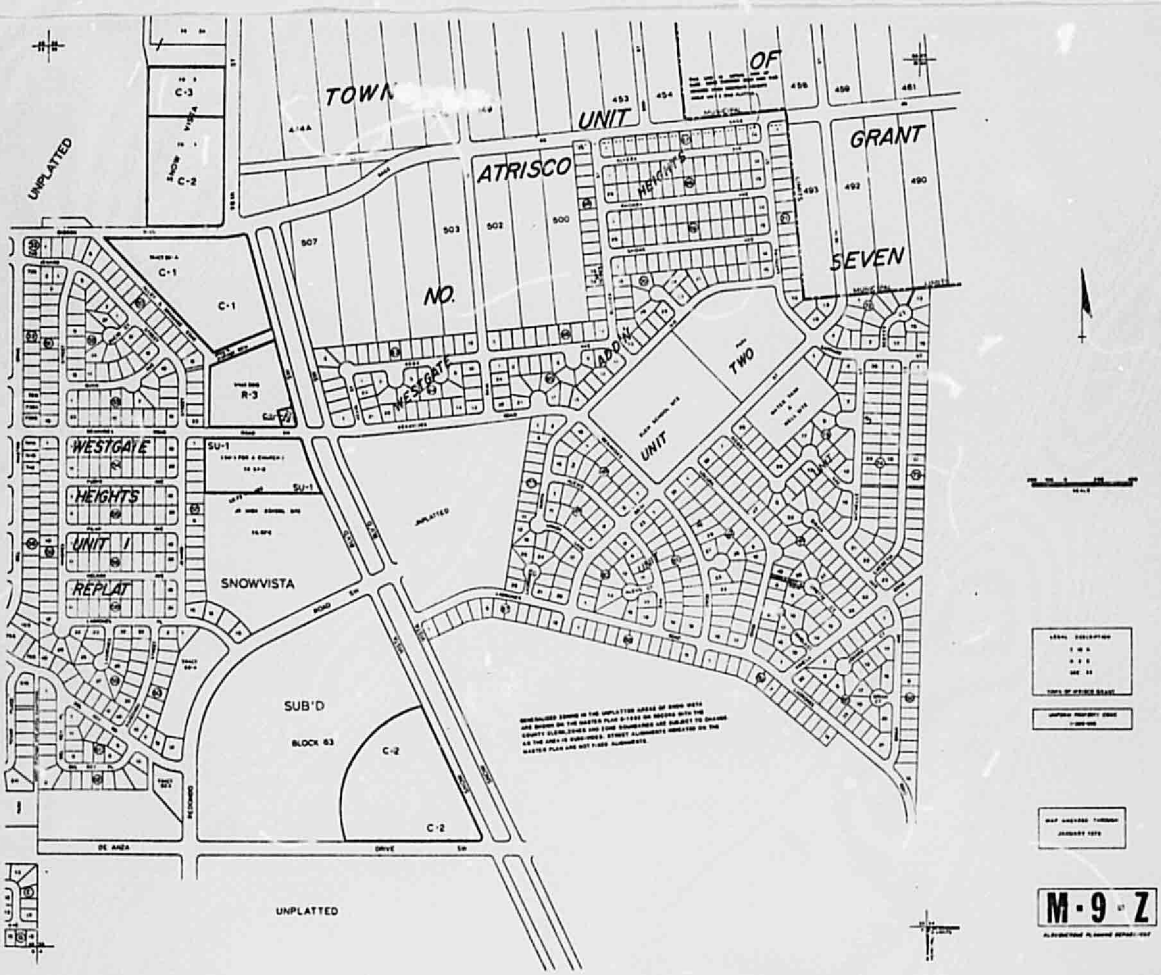
FINDINGS:
1. The plat is satisfactory with respect to layout and street design.
2. The paving of Snow Vista Boulevard and DeAnza Drive should be a condition of final approval.
3. The future realignment of Redondo Drive is acceptable and is consistent with the Westgate Heights Master Plan.
4. Compliance with the park dedication requirements is mandatory.
5. A detailed drainage study is required by the City Engineer and A.M.A.F.C.A. prior to plat sign-off.
6. Staff cannot accept the plat as final in view of the many unresolved questions.

RECOMMENDATION: APPROVAL OF S-1016-1 IS RECOMMENDED AS A PRELIMINARY PLAT ONLY.

Theodore Pochter
Theodore Pochter
Planner

TP:sc

cc: Associated Investment Company of El Paso, 2727 San Pedro, N.E.; 87110 ATTENTION: J. D. Fulmer


TOWN
OF
UNIT
GRANT
ATRISCO
HEIGHTS
SEVEN
NO.
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WESTGATE
HEIGHTS
UNIT I
REPLAT
SNOWVISTA
SUB'D
BLOCK 63
UNPLATTED
UNPLATTED
UNPLATTED
C-1
C-2
C-3
R-3
SU-1
DE ANZA
DRIVE
M-9-Z

DRAINAGE REPORT

FOR

WESTGATE HEIGHTS SUBDIVISION, UNIT 5

FRED C. ARFMAN
NEW MEXICO
7322
REGISTERED PROFESSIONAL ENGINEER

Prepared by:

Isaacson & Arfman, P.A.
2727 San Pedro Dr. N.E.
Suite 114
Albuquerque, New Mexico
87110

RECEIVED
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CITY ENGINEER

April, 1981

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FIGURE 1 - INTENSITY DURATION FREQUENCY CURVE

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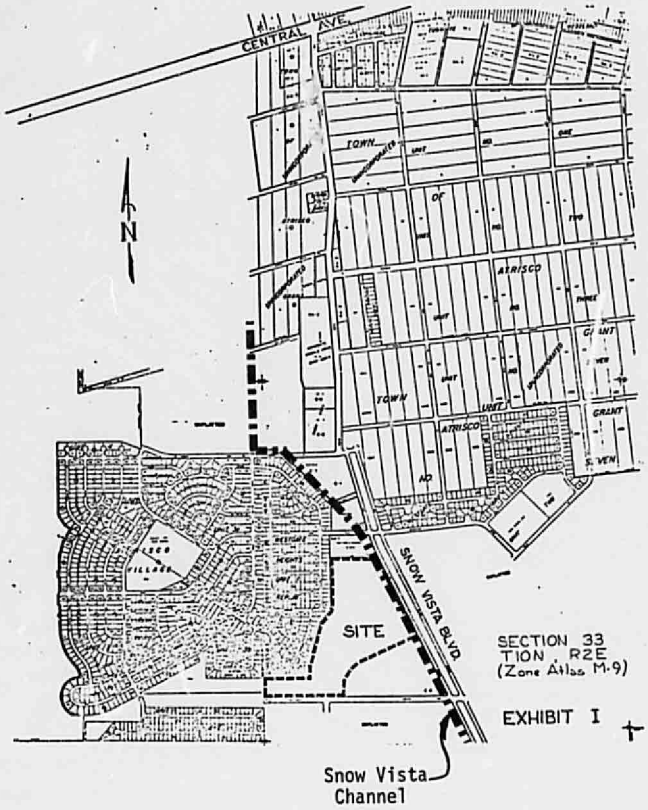
INTRODUCTION

This drainage report will analyze the drainage characteristics of Westgate Heights, Unit 5. The site is located south of Central Avenue, on the West Mesa, with Snow Vista Boulevard forming the eastern boundary and Redondo Road the southern boundary. More particularly, the site is located within Section 33, T10N, R2E. (Zone Atlas M-9) (Exhibit I).



UNDEVELOPED DRAINAGE CHARACTERISTICS

The site covers 43.8 acres of sandy soil at a 2.2% eastward slope. A C-value of 0.30 will be used for all undeveloped flows.

Area = 43.8 acres

C = 0.30, tc = 11 min.

$$I = \frac{189}{tc + 25} = \frac{189}{36} = 5.25$$

Q = CIA = (0.30)(5.25)(43.8) = 69 cfs.

These sheet and channel flows will exit the site at its eastern boundary and flow into a 135 foot AMAFCA Drainage R.O.W. Then flows are diverted eastward by an earthen berm.

As a condition of platting, the owners of Westgate Heights, Unit 5 are complying with AMAFCA and are dedicating a 135 foot wide parcel of land for the proposed Snow Vista Channel (see the attached drainage plan). The channel is to be built in a four phase construction sequence. The section of channel which abuts Unit 5 is part of Phase II. All four phases are being or are to be designed by Gordon Herkenhoff & Associates, Inc. The Authority has guarenteed that the 135' is workable and will not hold out for any additional right of way. Now that this has been determined, we can now finalize our drainage report and proceed to the next phase.

DEVELOPED DRAINAGE CHARACTERISTICS

Offsite:

The existing, fully developed area to the west will contribute runoff in the form of channel flow at two locations, Ladrones Pl. and Del Ray Road.

The following Table summarizes the developed offsite flow rates for the residential area to the west.

TABLE I

WESTGATE HEIGHTS - UNIT 5

ESTIMATED FLOWS - OFFSITE

Drainage* Area No.	Area	C	I	Q	Discharge
A	36.7	0.50	4.5	83	Benavides and Del Ray Road
B	69.0	0.50	4.2	145	Del Ray Road and Del Mastro
C	19.8	0.50	4.61	46	Del Ray Road and West Boundary
D	11.8	0.50	4.85	29	Ladrones Pl. and West Boundary

*See Exhibit II for offsite drainage sub-areas and flow direction.

The following table is a breakdown of the offsite, sub-drainage area flows. This is necessary since flows are split at two intersections and diverted northward.

TABLE II

OFFSITE FLOW SEPARATION

Drainage Area No.	Q (cfs)	x % - Split	= Q (cfs)	Flow Route
A	83	.60 .40	50 33	Del Ray Road. Benavides Road
B	145	.80 .20	116 29	Del Ray Road Del Mastro
C	46	1.00	46	Del Ray Road
D	29	1.00	29	Ladrones Pl.

Flow Totals:

$$tc = \frac{Q_A \times tc_A + Q_B \times tc_B + Q_C \times tc_C}{Q_A + Q_B + Q_C}$$

$$= \frac{[(83 \times .60 \times .80) \times 17] + [(145 \times .80) \times 20] + (46 \times 16)}{(83 \times .80 \times .60) + (145 \times .80) + 46} = 18.5$$

$$I = \frac{189}{18.5 + 25} = 4.34$$

$$Q = CIA = (0.50)(4.34)(92.6) = 201 \text{ cfs.}$$

This flow of 201 cfs will enter the proposed site at its western boundary and Del Ray Road.

Additionally, 29 cfs will enter at Ladrones Pl. on the west boundary.

TABLE III

POST-DEVELOPMENT RUNOFF

Study Pt.	Area Contr. Runoff & %	C	tc (min)	I (11/hr)	A(ac)	Q	Discharge Pt.
I	A (48%)						
	B (80%)						
	C (100%)						
	5-4 (100%)	0.50	18.6	4.33	94	205 204 cfs	Del Ray Rd. and Drainage Easement
II	D (100%)						
	5-1 (100%)	0.49	14	4.85	22.6	54 cfs	60' Row St. through site
III	D (100%)						
	5-1 (100%)						
	5-2 (100%)	0.50	14	4.85	32.8	79 cfs	@ Ladrones Rd. AMAFCA Drainage R.O.W.
IV	5-3 (100%)	0.50	13	4.97	7.5	19 cfs	86' R.O.W. - Redondo Rd. @ easterly most point of subdivision

Wooden fence
Amole
Del Rey
Rio Puerco
Schools

RECOMMENDATIONS

1. Read yard ponding in this subdivision is suggested due to the high percolation rate found in the native sandy soils. Rear yard ponding will require a minimum depth of 0.5 feet. The limits of the ponded waters should be kept a minimum distance of 5 feet away from any walls and 15 feet from house foundations. These are general recommendations and are intended to call to the developer's attention the possibility of settlement problems in the area. A qualified soils engineers should prepare specific guidelines for ponding waters around structures.

2. Where the offsite flows are accepted from Del Ray Road, a street should be platted and designed to handle the 201 cfs of storm water flow generated from the land area to the west. This street should be superelevated with approach transition and empty into the Amole Arroyo. See Exhibit III and Appendix for Turning Channel Flows.

3. A drainage rundown from the proposed street mentioned in the recommendation above to the Amole should be designed and constructed in accordance with City Std. Drwg K-10.

4. A ten foot wide drainage rundown should be designed to handle the flows from the subdivision that exit at Ladrones Road. Design in accordance with City Std. Drwg K-10.

5. All other flows from the subdivision that don't exit by way of the two previously mentioned rundowns, shall exit at the point of vehicular access. This shall be known as Redondo Road which has been classified as an arterial street, (86' R.O.W.). In accordance with AMAFCA Resolution 80-15, Section 12, "Subject to availability of funds, public authority shall pay for major detention dams, major diversions, and crossing structures for major arterials and collection streets. Additionally, public authority may elect to pay for or cost-share other selected features of drainage management plans. Therefore, the owner of the subdivision shall be seeking financial cooperation from the city authority in order to construct the crossing structure at Redondo Road.

APPENDIX

DESIGN CRITERIA

In analyzing the storm runoff to determine the runoff basis of the undeveloped and developed site, the Rational formula, Q = CIA, was used.

Where:

Q = Runoff quantity in cubic feet/second

A = Contributing area in acres

I = Intensity in inches/hour

For duration equal to the time of accumulation (duration) measured in minutes and obtained from Figure II - Intensity Duration Frequency Curve (Albuquerque Area - 1961). (Note: where a Time of Concentration (tc) is less than 10 minutes, the intensity value of 10 minutes was used as shown on the curve for a 100 year storm.)

C = Runoff coefficient (no unit). This coefficient represents the integrated effects of infiltration detention storage, evaporation, retention, flow routing, and interception which all affect the time distribution and peak rate of runoff.

For the proposed developed areas, it was desirable to develop a composite runoff coefficient based on the percentage of different types of surface in each sub-drainage area. Different coefficients wtih respect to surface types are as follows:[1] (From Table IV)

Street, walks and driveways	C = 0.90
Roofs	C = 0.90
Lawn, Sandy Soils, Flat 2%	C = 0.12

---

[1]Table 3.2, Urban Storm Drainage Criteria Manual, Volume I, Denver Regional Council of Governments.

TABLE IV

RATIONAL METHOD RUNOFF COEFFICIENTS FOR COMPOSITE ANALYSIS

Character of Surface	Runoff Coefficients
Streets:	
Asphaltic	0.70 to 0.95
Concrete	0.80 to 0.95
Drives and Walks	0.75 to 0.85
Roofs	0.75 to 0.95
Lawns, Sandy Soil:	
Flat, 2%	0.05 to 0.10
Average, 2 to 7%	0.10 to 0.15
Steep, 7%	0.15 to 0.20
Lawns, Heavy Soil:	
Flat, 2%	0.15 to 0.20
Average, 2 to 7%	0.20 to 0.25
Steep, 7%	0.25 to 0.35

The coefficients in these two tabulations are applicable for storms of 5-year to 10-year frequencies. Less frequent higher-intensity storms will require modification of the coefficient because infiltration and other losses have a proportionally smaller effect on runoff, as given in the following section.

TABLE

FREQUENCY FACTORS FOR RATIONAL FORMULA

Recurrence Interval (years)	C_f
2 to 10	1.0
25	1.1
50	1.2
100	1.25

TABLE V
COMPOSITE "C"

Drainage Area Section	Area Acres	By Area C = 0.20 Acres	By Area C = 0.90 Acres	Composite "C" Factor (No Units)
5-1	11.1	6.8	4.3	0.48
5-2	10.2	5.9	4.3	0.50
5-3	7.5	4.3	3.2	0.50
5-4	1.3	0.8	0.5	0.54

POST DEVELOPMENT RUNOFF

Section	C	tc (min)	I (11/hr)	A(acre)	Q(cfs)
5-1	0.47	14	4.85	11.1	25 26
5-2	0.50	14	4.85	10.2	25
5-3	0.50	13	4.97	7.5	19
5-4	0.54	10	5.4	1.3	4

TABLE VI

RATIONAL METHOD RUNOFF COEFFICIENTS

Description of Area	Runoff Coefficients
Business:	
Downtown areas	0.70 to 0.95
Neighborhood areas	0.50 to 0.70
Residential:	
Single-family areas	0.35 to 0.50
Multi units, detached	0.40 to 0.60
Multi units, attached	0.60 to 0.75
Residential (1/2 acre lots or more)	0.30 to 0.45
Apartment dwelling areas	0.50 to 0.70
Industrial:	
Light areas	0.50 to 0.80
Heavy areas	0.60 to 0.90
Parks, cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard areas	0.20 to 0.40
Unimproved areas	0.10 to 0.30

It is often desirable to develop a composite runoff coefficient based on the percentage of different types of surface in the drainage area. This procedure is often applied to typical "sample" blocks as a guide to selection of reasonable values of the coefficient for an entire area. Suggested coefficients with respect to surface type are given in Table 3-2. See the Storm Sewers Part of this Manual for a discussion of the use of the Rational Method in conjunction with the use of on site ponding and roof ponding.

TURNING CHANNEL FLOWS

PROBLEM: THE SUBDIVISION MUST ACCEPT 201 CFS OF OFFSITE FLOWS FROM DEL RAY RD. THE STORM WATERS MUST BE TURNED SOUTHWARD 60° SUCH THAT THEY ENTER INTO THE AMOLE CHANNEL/ ARROYO.

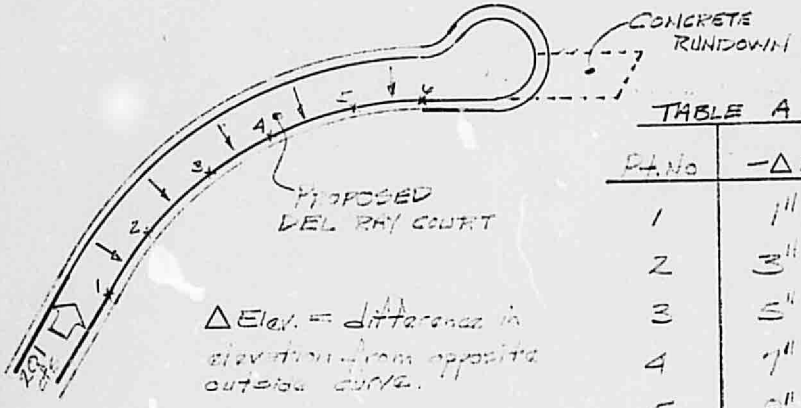


TABLE A

Pt. No	−Δ Elev.
1	1"
2	3"
3	5"
4	7"
5	9"
6	10"

Δ Elev. = difference in elevation from opposite outside curve.

GIVEN: 201 cfs
2.1 FPS
2.2 ft
60° degree of curve

SOLUTION: $\Delta_h = 2.30 \frac{V_2^2}{g} \log \frac{r_2}{r_1}$

$= 2.30 \frac{(2.1)^2}{32.2} \log \frac{200}{160}$

$= 2.30 (0.1677)(0.096910)$

$= 0.37' = 4.4'$

$S_h = \frac{V_2^2}{gr_2} = \frac{(2.1)^2}{32.2(200)} = 0.0092 = 0.92\%$

∴ for a 40' wide street

$0.0092 \times 40 = 0.37' = 4.4"$

$2(0.0092)(40) = 0.74' = \sim 9"$

Isaacson & Arfman, P.A.
Consulting Engineering Associates

SUBJECT WESTGATE UNIT 5 JOB NO.
BY FLH DATE 2-81 SHEET NO A-5 OF

THE LAST STEP WILL OVERCOMPENSATE FOR Δh BY A FACTOR OF 2. THE RESULT WILL FORCE THE MAXIMUM VELOCITY FLOW LINE TOWARD THE INSIDE RADIUS WHICH WOULD EFFECTIVELY AID IN FORCING THE STORM WATER FLOWS DOWN THE CONCRETE RUNDOWN TO THE ARROYO.

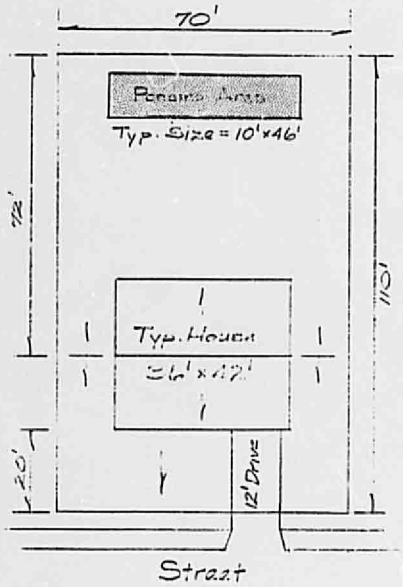
REFERENCES:

1. VEN TE CHOW: OPEN CHANNEL HYDRAULICS, CHAPTER 16, 1959.

2. ROBERT T. KNAPP: DESIGN OF CHANNEL CURVES FOR SUPERCRITICAL FLOW, 2d PAPER IN HIGH-VELOCITY FLOWS IN OPEN CHANNELS. A SYMPOSIUM, TRANSACTION, ASCE, Vol 116 pp 296-325, 1951.

REAR YARD POND CALCULATIONS

Typical Lot Size = 70' x 110'



Area Drainage to Rear Yard

70' x 72'	= 5040 sq. ft.
Roof Area	= 18 ft. x 42 ft.
	= 756 sq. ft.
Patio (typ.)	= 100 sq. ft.
	856 sq. ft.

Composite "C"

$0.9 \left(\frac{856}{5040}\right) = .15$

$0.12 \left(\frac{4184}{5040}\right) = .10$

.25

Volume of Runoff*

(Area)(2.2 in.)(C)(1/12)
(5040)(2.2 in.)(.25)(1/12) = 231 cu. ft.

At 0.5' in depth,
Pond Surface Area Required = 462 sq. ft.

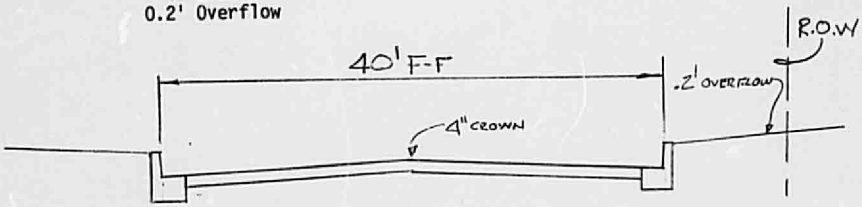
% of Area = $\frac{462}{5040}$ (100) = 9%

*Precipitation for 100 year - 6-hour storm = 2.2 in.

STREET CARRYING CAPACITY

60' R/W

St. Section 40 FF.
4" Crown
0.2' Overflow



Areas 1) A-1 = 10 x 0.2 x 1/2 = 1.0 SF

A-2 = 20 x $\frac{.54 \times .87}{2}$ = 14.1 SF

15.1 (1/2 ST)

x 2 = 30.2 SF

W.P. = 60 + 2(.67) = 61.34'

r = $\frac{30.2}{61.34}$ = .49

$r^{2/3}$ = $(0.49)^{2/3}$ = .62

Q = $\frac{1.486}{n} A\, r^{2/3}\, s^{1/2}$ n = 0.015, Q = $\frac{1.486}{0.015}$ (30.2)(.62)(.15) = 278 cfs.

RUNOFF COMPUTATIONS

Sheet No. A-5

Ottawa-Wastonto #5
PROJECT

Drainage Area No. A

Area = 36.7 Acres

C = 0.50 (Table VI)

Maximum Overland Flow: L = 100 feet S = 0.02

H = 2 feet

Maximum Channel Flow: L = 2900 feet S = 0.03

H = 87 feet

Accumulation Time

Overland Flow: (Figure 2) = 12 min.

Channel Flow:

Velocity = 10.2 ft/sec Time = $\frac{2900 \text{ feet}}{10.2 \text{ feet/sec} \times 60}$ = 5 min.

Total Accumulated Time = 17 min

I = $\frac{137}{\pm 2.3}$ = $\frac{137}{17+2.5}$ = 4.5 "/hr.

Q = CIA = (0.50)(4.5)(36.7) = 83 cfs

Date

Com. by CLW Ck. by

RUNOFF COMPUTATIONS

Sheet No. A-6

Offsite Westside #5

PROJECT

Drainage Area No. B

Area = 69.0 Acres

C = 0.50 (Table VI)

Maximum Overland Flow: L = 100 feet S = 0.02

H = 2 feet

Maximum Channel Flow: L = 4400 feet S = 0.0255

H = _____ feet

Accumulation Time

Overland Flow: (Figure 2) = 12 min

Channel Flow:

Velocity = 9.3 ft/sec Time = $\frac{4400 \text{ feet}}{9.3 \text{ feet/sec} \times 60}$ = 8 min

Total Accumulated Time = 20 min

I = $\frac{50}{20+20}$ = $\frac{50}{45}$ = 4.2 "/hr.

Q = CIA = (0.50)(1.20)(69.0) = 145 cfs

Date_____

Com. by [illegible] Ck. by _____

RUNOFF COMPUTATIONS

Sheet No. A-7

Offsite Watershed #5

PROJECT

Drainage Area No. C

Area = 19.9 Acres

C = 0.50 (Table VI)

Maximum Overland Flow: L = 100 feet S = 0.02

H = 2 feet

Maximum Channel Flow: L = 2400 feet S = 0.025±

H = _____ feet

Accumulation Time

Overland Flow: (Figure 2) = 12 min

Channel Flow:

Velocity = 9.3 ft/sec Time = $\frac{2400 \text{ feet}}{9.3 \text{ feet/sec} \times 60}$ = 4 min

Total Accumulated Time = 16 min

I = $\frac{185}{t+25}$ = $\frac{185}{16+25}$ = 4.61 "/hr.

Q = CIA = (0.50)(4.6)(19.9) = 46 cfs

Date_____

Com. by DLW Ck. by _____

RUNOFF COMPUTATIONS

Sheet No. A-8

[illegible]

PROJECT

Drainage Area No. D

Area = 11.6 Acres

C = 0.50 (Table VI)

Maximum Overland Flow: L = 100 feet S = 0.02

H = 2 feet

Maximum Channel Flow: L = 1120 feet S = 0.02

H = _____ feet

Accumulation Time

Overland Flow: (Figure 2) = 12 min

Channel Flow:

Velocity = 3.3 ft/sec Time = $\frac{1120 \text{ feet}}{3.3 \text{ feet/sec} \times 60}$ = 2 min

Total Accumulated Time = 14 min

I = $\frac{190}{14.25}$ = $\frac{189}{14.25}$ = 4.95 "/hr.

Q = CIA = (0.50)(4.95)(11.6) = 28 cfs

Date_____

Com. by [illegible] Ck. by _____

RUNOFF COMPUTATIONS

Sheet No. A-9

Westminster Heights #5
PROJECT

Drainage Area No. 5-1

Area = 10.8 Acres

C = 0.48 (Table V)

Maximum Overland Flow: L = 120 feet S = 3%

H = 3 feet

Maximum Channel Flow: L = 1450 feet S = 1%

H = 13 feet

Accumulation Time

Overland Flow: (Figure 2) = 10 min

Channel Flow:

Velocity = 5.9 ft/sec Time = $\frac{1450 \text{ feet}}{5.9 \text{ feet/sec} \times 60}$ = 4 min

Total Accumulated Time = 14 min

I = 139 / 5.25 = 139 / 29 = 4.95 "/hr.

Q = CIA = (0.48)(4.95)(10.8) = 25 cfs

Date 1-1-13

Com. by FCA Ck. by

RUNOFF COMPUTATIONS

Westgate Heights

PROJECT

Sheet No. A-10

Drainage Area No. 5-2

Area = 10.2 Acres

C = 0.50 (Table V)

Maximum Overland Flow: L = 120 feet S = 3%

H = 3 feet

Maximum Channel Flow: L = 1250 feet S = 2%

H = 22 feet

Accumulation Time

Overland Flow: = 11 min

Channel Flow:

Velocity = 9.9 ft/sec Time = $\frac{1400 \text{ feet}}{9.9 \text{ feet/sec} \times 60}$ = 3 min

Total Accumulated Time = 14 min

$I = \frac{189}{t+25} = \frac{189}{14+25} = 4.85$ "/hr.

Q = CIA = (0.50)(4.85)(10.2) = 25 cfs

Date 2-9-78

Com. by _____ Ck. by _____

HYDROLOGY M9/D10 2 of 2 4 PLANS

RUNOFF COMPUTATIONS

Sheet No. A-11

Westgate Heights #5

PROJECT

Drainage Area No. 5-3

Area = 7.5 Acres

C = 0.50 (Table V)

Maximum Overland Flow: L = 120 feet S = 3%

H = 3 feet

Maximum Channel Flow: L = 1550 feet S = 2%

H = 26 feet

Accumulation Time

Overland Flow: (Figure 2) = 10 min

Channel Flow:

Velocity = 9.9 ft/sec Time = $\frac{1550 \text{ feet}}{9.9 \text{ feet/sec} \times 60}$ = 3 min

Total Accumulated Time = 13 min

$I = \frac{189}{t+25} = \frac{189}{13+25} = 4.97$ "/hr.

Q = CIA = (0.50)(4.97)(7.5) = 19 cfs

Date 2-9-78

Com. by FCA Ck. by _____

RUNOFF COMPUTATIONS

Sheet No. A-12

Westgate Heights

PROJECT

Drainage Area No. 5-4

Area = 1.3 Acres

C = 0.54 (Table V)

Maximum Overland Flow: L = 150 feet S = 2%

H = 3 feet

Maximum Channel Flow: L = 800 feet S = 1%

H = 10 feet

Accumulation Time

Overland Flow: (Figure 2) = >10 min

Channel Flow:

Velocity = 5.9 ft/sec Time = $\frac{800 \text{ feet}}{5.9 \text{ feet/sec} \times 60}$ = >1 min

Total Accumulated Time = 10 min

$I = \frac{189}{t+25} = \frac{189}{10+25} = 5.4$ "/hr.

Q = CIA = (0.54)(5.4)(1.3) = 4 cfs

Date 2-7-78

Com. by FCA Ck. by _____

RUNOFF COMPUTATIONS

Sheet No. A-13

Westgate Heights
PROJECT

Drainage Area No. 5-5

Area = 2.1 Acres

C = .58

Maximum Overland Flow: L = 170 feet S = 3%

H = 4 feet

Maximum Channel Flow: L = 450 feet S = 2%

H = 10 feet

Accumulation Time = 10 min

Overland Flow: (Figure 2)

Channel Flow:

Velocity = 2.9 ft/sec Time = $\frac{450 \text{ feet}}{2.9 \text{ feet/sec} \times 60}$ = 1 min

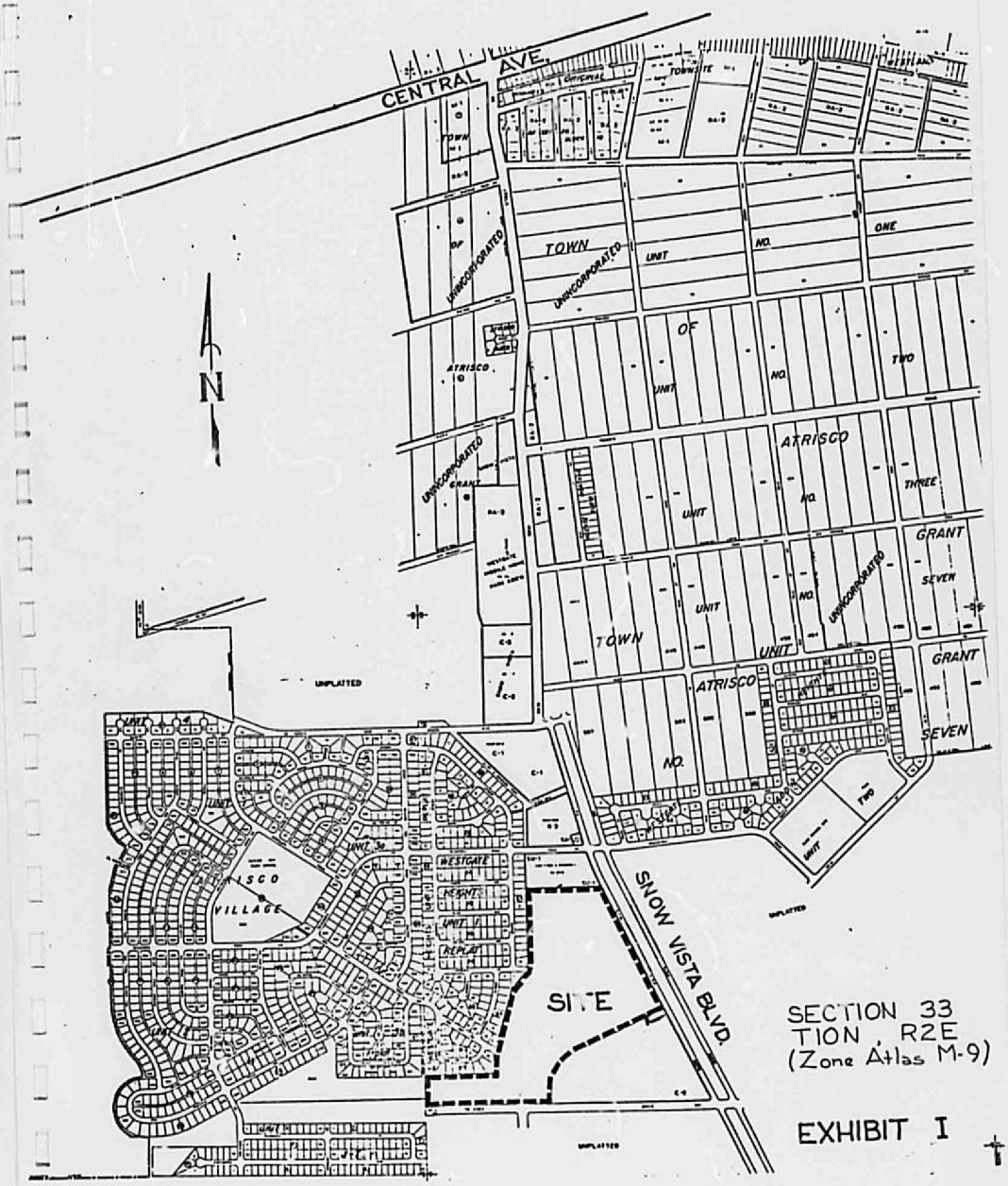
Total Accumulated Time = 11 min

I = $\frac{199}{4.175}$ = $\frac{199}{11.75}$ = 5.75 "/hr.

Q = CIA = (0.58)(5.75)(2.1) = 10 cfs

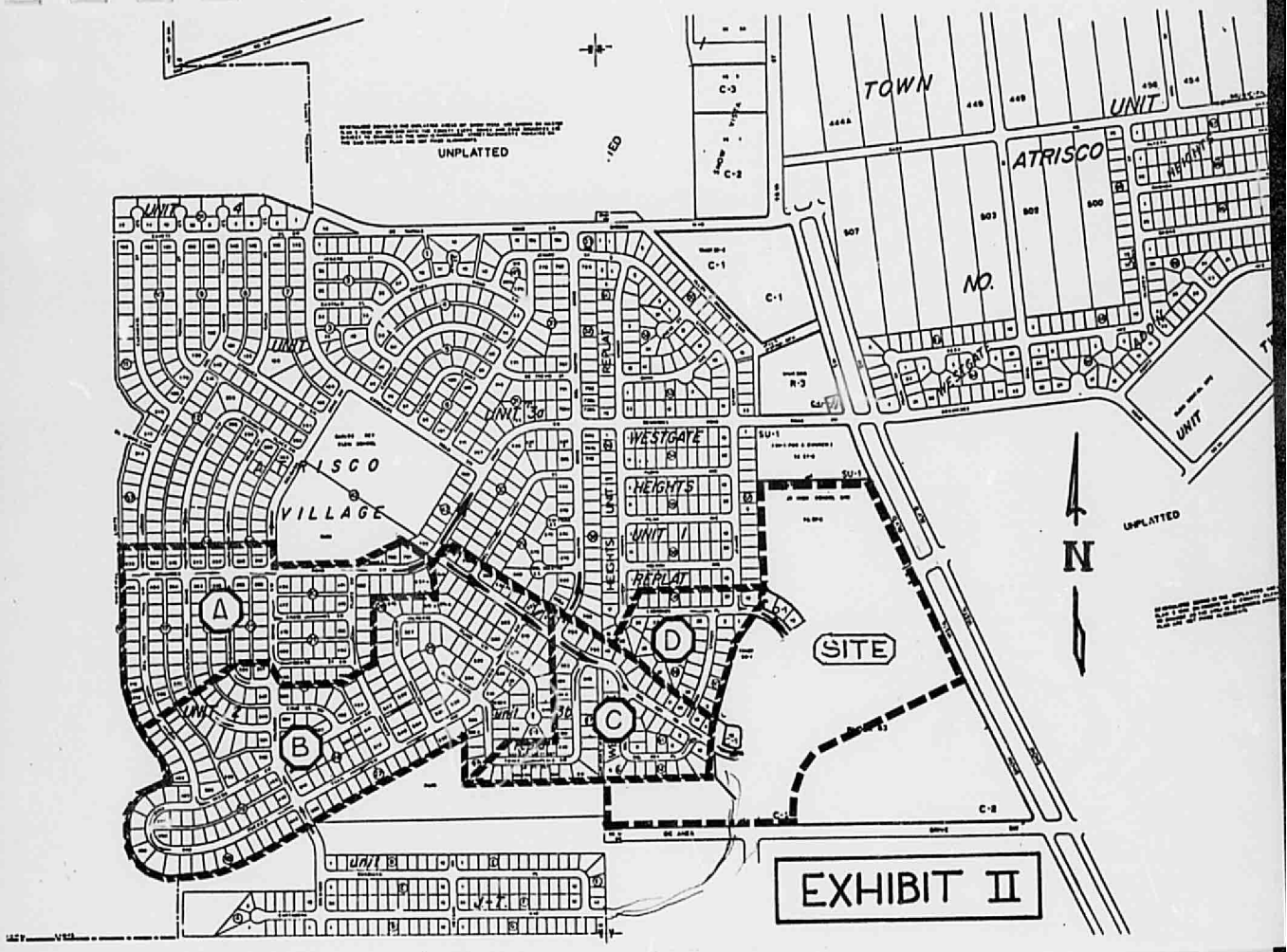
Date 1-11-78

Com. by FEL Ck. by _____



SECTION 33
TION , R2E
(Zone Atlas M-9)

EXHIBIT I


UNPLATTED
TOWN
UNIT
ATRISCO
NO.
VILLAGE
WESTGATE
HEIGHTS
UNIT I
REPLAT
SITE
N
A
B
C
D
EXHIBIT II

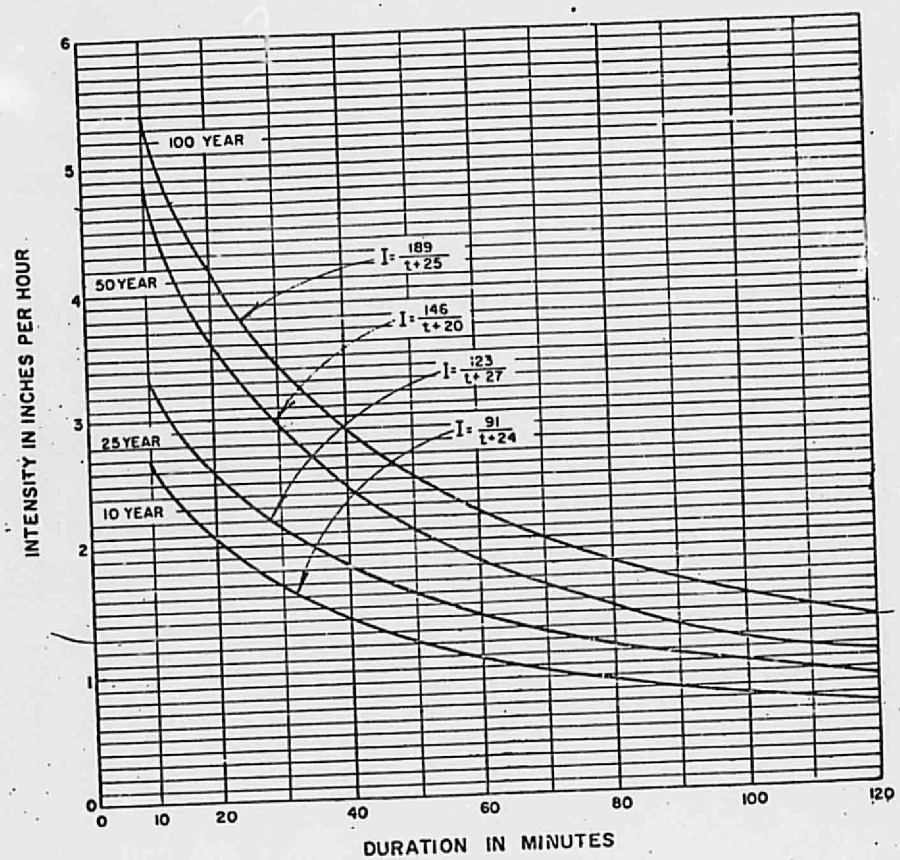


FIGURE I

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

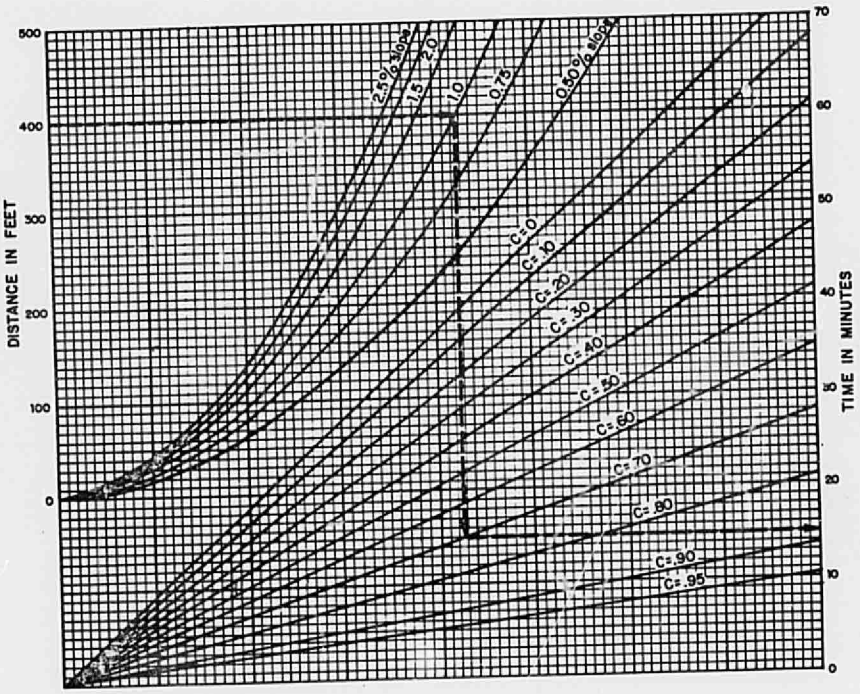
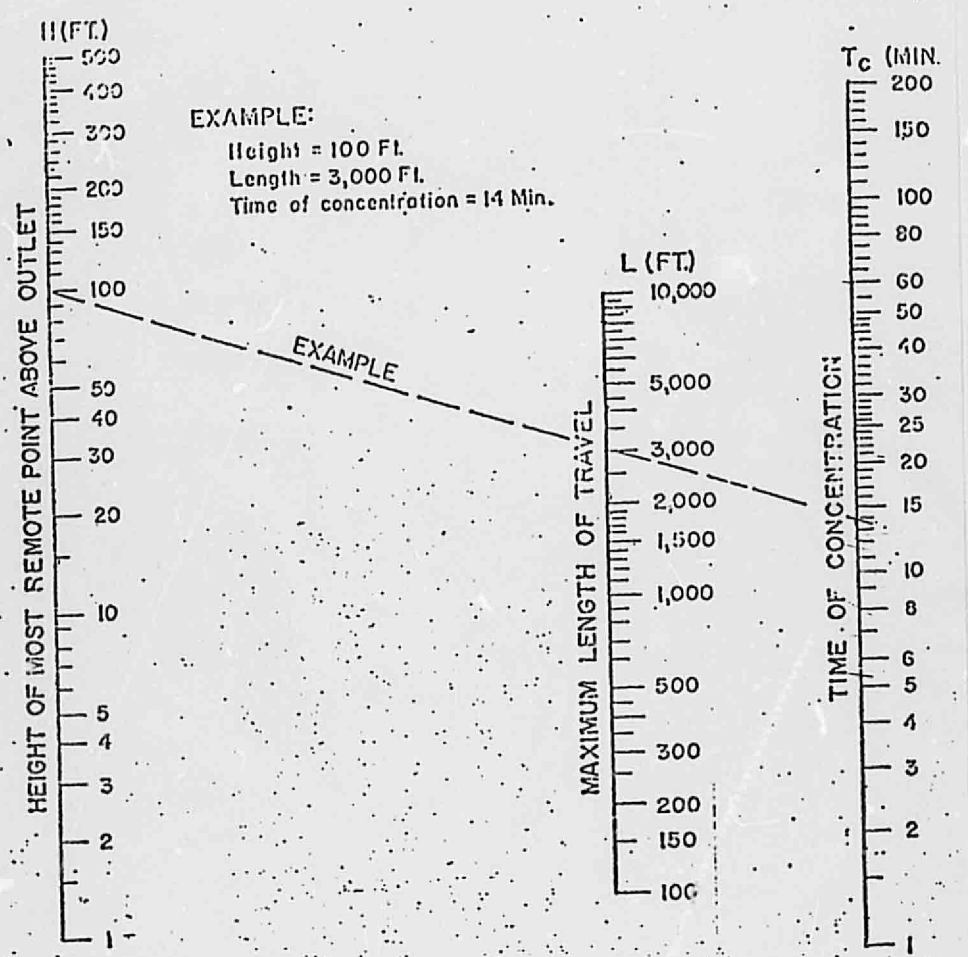


FIGURE II OVERLAND TIME OF FLOW CURVES (7)

1-15-69
Denver Regional Council of Governments



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

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

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

FIGURE III