Master Development Drainage Plan
And Preliminary Drainage Report
Lots 16 and 17, Block 20 Park
Vista Estates Addition
Colorado Springs, Colorado
SULLIVAN ANNEXATION

Prepared for:

Marie Sullivan
4640 Topaz Drive
Colorado Springs, Colorado 80918

Prepared by:

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904

Kiowa Project No. 08072

September 3, 2008

Kiowa Engineering Corporation

September 3, 2008

Mr. Tim Mitros
City of Colorado Springs
Engineering Division – Stormwater and Subdivision
30 S. Nevada Avenue, Suite 701
Colorado Springs, Colorado 80909

RE: Master Development Drainage Plan and Preliminary Final Drainage Report for Lots 16 and 17, Block 20 Park Vista Estates Addition (4640 and 4660 Topaz Drive) (Kiowa Project No. 08072)

Dear Mr. Mitros:

Following is the Master Development Drainage Plan and Preliminary Drainage Report for Lots 16 and 17, Block 20 Park Vista Estates Addition. This report addresses the annexation of these two lots into the City of Colorado Springs and development of Lot 16. The report was prepared according to City/County drainage criteria and is being submitted for approval.

If there are any questions or if we may be of further assistance, please feel free to call at any time.

Sincerely,
Kiowa Engineering Corporation

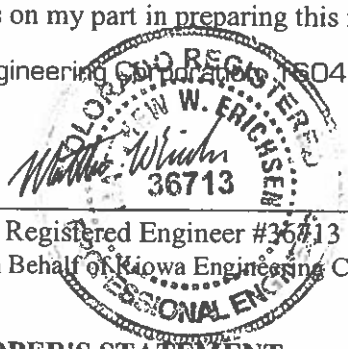
Matthew Erichsen, P.E.
Project Manager

7175 W. Jefferson Avenue Suite 3400 Lakewood, CO 80235
(303) 692-0369 (303) 692-0383 FAX

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City/County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1604 South 21st Street, Colorado Springs, Colorado 80904



Registered Engineer #36713
For and on Behalf of Kiowa Engineering Corporation

9/24/08
Date

DEVELOPER'S STATEMENT:

I, the Developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Developer / Owner

9/30/08
Date

Address: Marie Sullivan
4640 Topaz Drive
Colorado Springs, CO 80918

CITY OF COLORADO SPRINGS:

Filed in accordance with Section 7.7.906 of the code of the City of Colorado Springs, 2001, as amended.

City Engineer

Oct 9, 2008
Date

Conditions:

Table of Contents

List of Figures (Additional figures and tables are included in the Appendix)

I. General Location and Description

The purpose of this report is to address the drainage impacts related to improvements associated with the annexation of Lots 16 and 17, Block 20 of Park Vista Estates Addition. Lot 17 is currently developed with a single family home and Lot 16 is undeveloped. The annexation will include the development of Lot 16 into a duplex residential home. Lot 16 to be rezoned R2. The properties are located at 4660 (Lot 16) and 4640 (Lot 17) Topaz Drive in the City of Colorado Springs, Colorado. The property is located in the southwest corner of Section 23, Township 13 South, Range 66 West of the Sixth Principal Meridian. The site is bounded on the east by Topaz Drive, on the west by Vista Grande Subdivision Filing No. 18, on the north by undeveloped Lot 15, Park Vista Addition and on the south by single family home developed Lot 18 Park Vista Addition. The total property area is 1.15 acres. The surrounding area is an established residential neighborhood. A vicinity map of the area is included as Figure 1.

II. Hydrology

The hydrology for the site was determined using the Rational Method as outlined in the City of Colorado Springs and El Paso County Drainage Criteria Manual (DCM). Runoff for the 5-year and 100-year recurrence intervals were determined. The hydrological calculations were performed assuming a Hydrological Soil Group B. The time of concentration and rainfall intensity values used to determine runoff were calculated per the DCM.

Figure 2 presents the existing onsite sub-basins with the corresponding sub-basin area and runoff coefficient. Figure 2 also presents the proposed onsite sub-basins with the corresponding sub-basin area and developed runoff coefficients. Data and calculations are shown in spreadsheets that are included in the Appendix of this report.

III. Hydraulic Calculations

The drainage improvements for this site have been designed in conformance with the DCM. The proposed driveway culvert has been sized by using the UDFCD UD-Culvert spreadsheet. The minimum recommended culvert size is 18-inch diameter. The supporting calculations associated with the sizing of hydraulic facilities for this development are included in Appendix B of this report.

IV. Existing Drainage Patterns

The subject lots are located along the west / downhill side of Topaz Drive. The existing street does not include curb and gutter on either side of the street. A grasslined roadside ditch is located on the east side of the street and a small roadside ditch is located along the Lot 17 frontage, but no roadside ditch is located along the Lot 16 frontage. Lot 17 is developed with a single family home and Lot 16 is currently undeveloped and covered by grasses. The NRCS Soil Survey of El Paso County Area, Colorado shows this area to include Truckton Sandy Loam that is classified in Hydrologic Soil Group B. The site lies within the Templeton Gap Drainage Basin. There are no major drainageways or irrigation facilities within the subject site. The subject site has no known history of flooding and does not include any drainage easements. The existing drainage patterns for the site sub-basins are described below and are shown on Figure 2 located in the map pocket of this report.

Basin EX-A1 includes the west side of Topaz Drive and the corresponding roadside ditch in front of the developed lots. There is no roadside ditch along the Lots 15 and 16 frontages, so flows in the roadside ditch sheet flow west into the vacant lots. The runoff from Basin EX-A1 sheets flow west across Lots 15 and 16 to the existing Vista Grande subdivision.

Basin EX-A2 includes the west side of Topaz Drive in front of Lot 16. The runoff from this area sheet flows east into Lot 16. The runoff flows into Drainage Basin EX-B and Lot 16.

SCALE: NTS

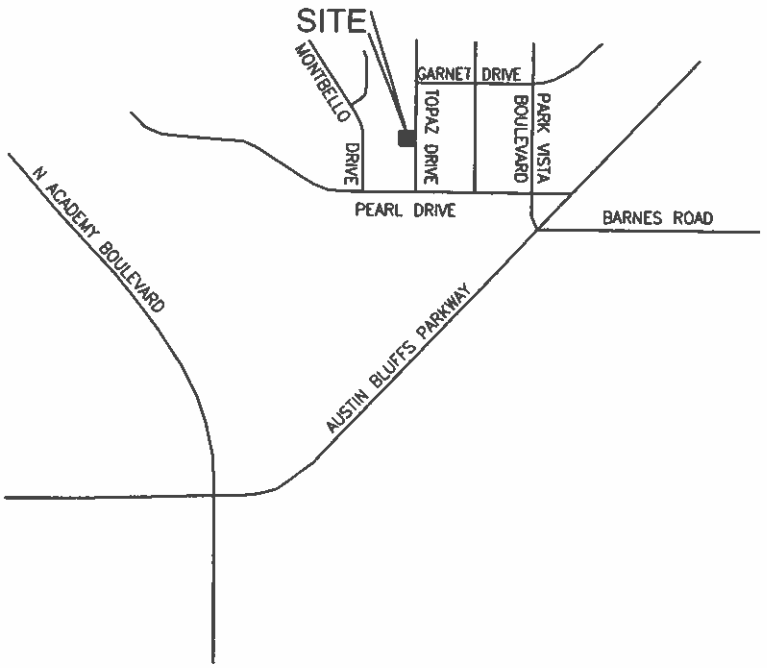


FIGURE 1
VICINITY MAP
LOTS 16 AND 17, BLOCK 20 PARK VISTA SUBDIVISION

08055 Base.dwg/Aug 11, 2008

Basin EX-B includes the area associated with Lots 16 and 17. Lot 17 is developed with a single family home and Lot 16 is currently undeveloped. The majority of the runoff from this basin sheet flows west to the Vista Grande subdivision.

V. Site Drainage Plan

The proposed development of the lots includes the construction of a duplex residential building on Lot 16. Lot 17 currently includes a single family home and will not be redeveloped as part of the annexation. The developed/proposed drainage patterns for the site drainage basins are described below and are shown on Figure 2 located in the map pocket of this report. Refer to the Appendix for hydrologic calculations.

Basin EX-A1 includes the same area and drainage characteristics in the developed as in the existing condition. The flows in the existing roadside ditch along the west side of Topaz Drive will continue to sheet flow across Lot 15, since no roadside ditch exists along the Lot 15 frontage.

Basin A includes the same area as Basin EX-A2, however the drainage characteristics will be altered in the developed condition. A roadside ditch, driveway and driveway culvert will be installed as part of the development of the lot. The size of the driveway culvert has been calculated to be 18-inch diameter. The ditch and culvert will direct the runoff south into the existing roadside ditch along the west side of Topaz Drive. The roadside ditch will convey flows to the northwest corner of the Topaz and Pearl intersection. The roadside ditch turns west at the intersection and continues west.

Basin B includes the same area as Basin EX-B, however the drainage characteristics will be altered in the developed condition. Lot 16 (0.57 acres) will be developed with a duplex residential home. The runoff from Lot 16 will sheet flow west around the proposed duplex and across the backyard, ultimately sheet flowing into the Vista Grande Subdivision as it does in the existing condition. A small increase in runoff (0.3cfs in the 5yr / 0.5cfs in the100yr) will occur in the developed condition in comparison to the existing. The Drainage Report for Vista Grande Subdivision Filing No. 16 does not account for the flows from Lot 16 sheet flowing onto Lots 7 or 8 of Vista Grande Sub. Filing 18 (No drainage reports are on file with the City for Vista Grande Subdivision Filing No. 18). The increase in runoff from Lot 16 is minor and will not adversely impact the downstream property owners or the downstream drainage facilities. The drainage characteristics of Lot 17 will not be altered as part of the development.

VI. Floodplain Statement

There is no designated Federal Emergency Management Agency (FEMA) floodplain located within the subject site. The Floodplain Insurance Rate Map (FIRM) for El Paso County panel 08041C0729 F, dated March 17, 1997, was reviewed to determine any potential floodplain delineation. A copy of the relevant portion of this FIRM panel is shown on Figure 3.

VII. Drainage and Bridge Fees

The site lies within the Templeton Gap Drainage Basin. The City's Drainage Fee for the Basin is $5,222 per acre. The total property area for Lots 16 and 17 is 1.15 acres. The Drainage Fee for the site is $6,005.30. The City's Bridge Fee for the Basin is $57 per acre. The Bridge Fee for the site is $65.55. The total of the Drainage and Bridge Fees is $6,070.85.

VIII. References

1) Preliminary / Final Drainage Report for Park Vista Townhomes, prepared by JR Engineering, LTD dated December 1998, Revised March 1999.

2) Vista Grande Subdivision, Filing No. 16 Drainage Plan, prepared by Planners-Consultants-Engineers dated April 16, 1971.

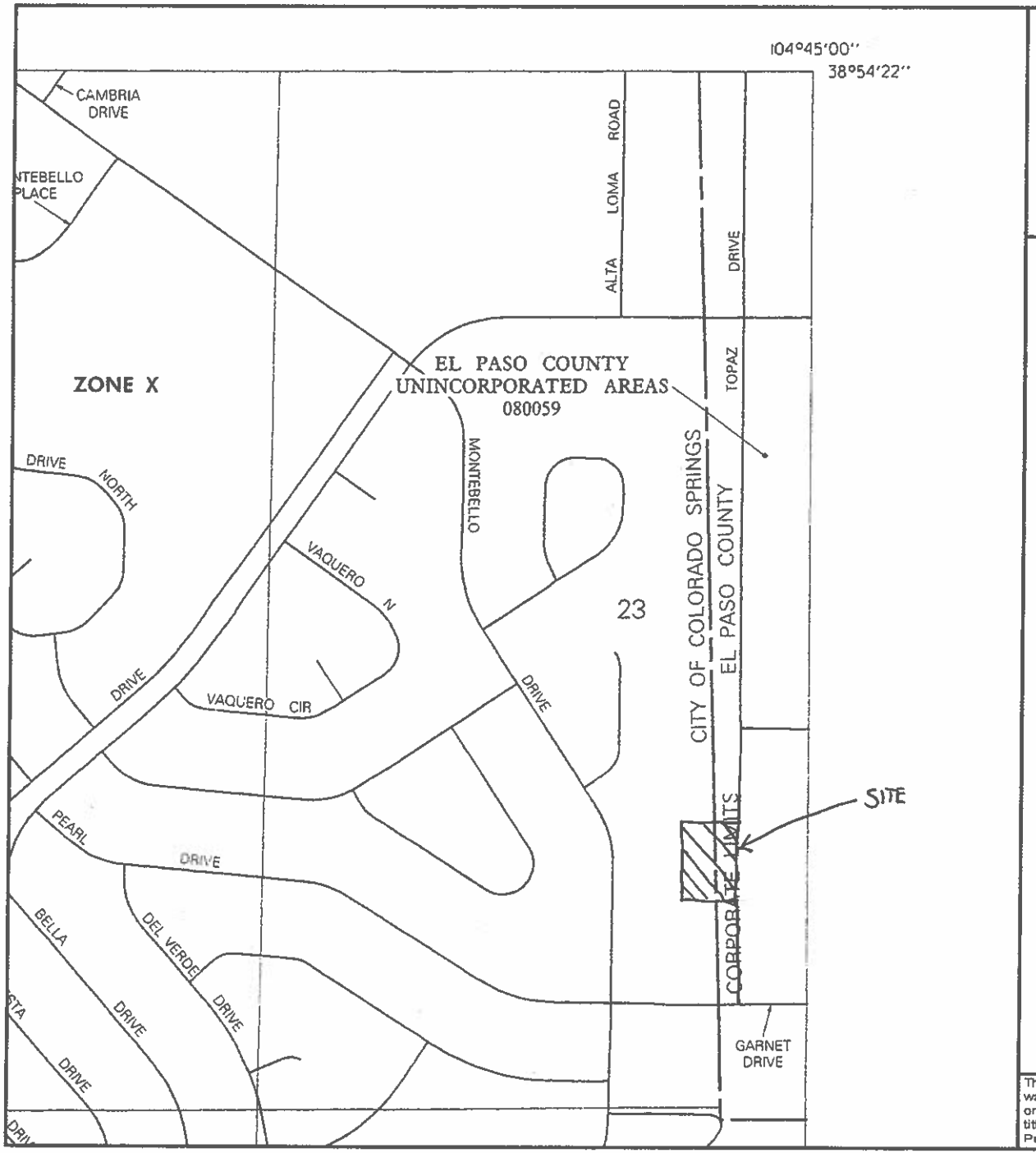
3) City of Colorado Springs and El Paso County Drainage Criteria Manual, City of Colorado Springs and El Paso County, Colorado, September 30, 1990 (with current revisions).

4) Urban Storm Drainage Criteria Manual - Volumes 1-3, Urban Drainage and Flood Control District, Denver, Colorado, June 2001 (with current revisions).

5) Flood Insurance Rate Map, Map Number 08041C0519 F, Federal Emergency Management Administration, dated March 17, 1997.

IX. Appendix Table of Contents

Flood Insurance Rate Map



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 519 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0519	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0519	F

MAP NUMBER
08041C0519 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

APPENDIX A
Hydrologic Calculations

Lots 16 and 17, Block 20 Park Vista Estates Addition
Runoff Coefficient Calculation

Basin	Land Use	Area	% Area	C_{10}	C_{100}	C_{10}	C_{100}
EX-A	Paved	0.26 ac	55.1%	0.90	0.95	0.50	0.52
	Lawn	0.21 ac	44.9%	0.25	0.35	0.11	0.16
		0.48 ac	100.0%			**0.61**	**0.68**

Basin	Land Use	Area	% Area	C_{10}	C_{100}	C_{10}	C_{100}
EX-B	1/2 ac Lot	0.58 ac	45.1%	0.35	0.45	0.16	0.20
	Lawn	0.70 ac	54.9%	0.25	0.35	0.14	0.19
		1.28 ac	100.0%			**0.30**	**0.40**

Design Pt	Basin	Area	% Area	C_{10}	C_{100}	C_{10}	C_{100}
DP EX1	EX-A	0.48 ac	27.1%	0.61	0.68	0.16	0.18
	EX-B	1.28 ac	72.9%	0.30	0.40	0.22	0.29
		1.76 ac	100.0%			**0.38**	**0.47**

Existing Drainage Patterns - Time of Concentration Calculations

Basin / DP	Contributing Basins	Slope		Length		C_{10}	Land		Velocity		t_c		Comp. t_c
		O'land	Travel	O'land	Travel	O'land	Type	Cv	O'land	Travel Time	O'land (t_i)	Travel (t_t)	
EX-A1		6.5%	2.0%	150 lf	550 lf	0.61	GW	15	0.4 ft/sec	2.1 ft/sec	5.8 min.	4.3 min.	**10.1 min**
EX-A2		2.0%		35 lf		0.61	GW	15	0.1 ft/sec	0.0 ft/sec	4.2 min.	0.0 min.	**5.0 min**
EX-B		3.0%	3.0%	150 lf	100 lf	0.30	SP	7	0.2 ft/sec	1.2 ft/sec	12.3 min.	1.4 min.	**13.7 min**
DP EX1	EXA1, EXA2, EXB	6.5%	2.5%	150 lf	750 lf	0.38	GW	15	0.3 ft/sec	2.4 ft/sec	8.5 min.	5.3 min.	**13.8 min**

Equations:

t_i (Overland) = $1.8(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

Table RO-2

Land Surface Type	Land Type	Cv
Grassed Waterway	GW	15
Nearly Bare Ground	NBG	10
Paved Area	PA	20
Short Pasture/Lawns	SP	7

Existing Drainage Patterns - Runoff Calculations

Basin / DP	Contributing Basins	Drainage Area		C_{10}	C_{100}	Time of Concentration	Rainfall Intensity		Runoff		Basin / DP
							i_5	i_{100}	Q_5	Q_{100}	
EX-A1		20,700sf	0.48 ac	0.61	0.68	10.1 min.	4.1 in/hr	7.3 in/hr	**1.2 cfs**	**2.4 cfs**	EX-A1
EX-A2		2,500sf	0.06 ac	0.61	0.68	5.0 min.	5.1 in/hr	9.1 in/hr	**0.2 cfs**	**0.4 cfs**	EX-A2
EX-B		55,800sf	1.28 ac	0.30	0.40	13.7 min.	3.6 in/hr	6.4 in/hr	**1.4 cfs**	**3.3 cfs**	EX-B
DP EX1	EXA1, EXA2, EXB	79,000sf	1.81 ac	0.38	0.47	13.8 min.	3.6 in/hr	6.4 in/hr	**2.5 cfs**	**5.5 cfs**	DP EX1

Equations:

$i_5=40/((10+T_c)^{0.76})$

$i_{100}=71.2/((10+T_c)^{0.76})$

P=One-hour point rainfall depth (in.)

i_5, i_{100}=Average 5 and 100-year Rainfall Intensity in inches per hour

Q = CiA

Q = Peak Runoff Rate, in cubic feet per second (cfs) {Initial Storm=Q_5 Major Storm=Q_{100}}

C = Runoff coefficient representing a ration of peak runoff rate to aver
intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

Developed Drainage Patterns - Time of Concentration Calculations

Basin / DP	Contributing Basins	Slope		Length		C_{10}	Land		Velocity		t_c		Comp. t_c
		O'land	Travel	O'land	Travel	O'land	Type	Cv	O'land	Travel Time	O'land (t_i)	Travel (t_t)	
A		2.0%		35 lf		0.61	GW	15	0.1 ft/sec	0.0 ft/sec	4.2 min.	0.0 min.	**5.0 min**
B		3.0%	3.0%	150 lf	100 lf	0.35	SP	7	0.2 ft/sec	1.2 ft/sec	11.5 min.	1.4 min.	**12.8 min**

Equations:

t_i (Overland) = $1.8(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

Table RO-2

Land Surface Type	Land Type	Cv
Grassed Waterway	GW	15
Nearly Bare Ground	NBG	10
Paved Area	PA	20
Short Pasture/Lawns	SP	7

Developed Drainage Patterns - Runoff Calculations

Basin / DP	Contributing Basins	Drainage Area		C_{10}	C_{100}	Time of Concentration	Rainfall Intensity		Runoff		Basin / DP
							i_5	i_{100}	Q_5	Q_{100}	
A		2,500sf	0.06 ac	0.61	0.68	5.0 min.	5.1 in/hr	9.1 in/hr	**0.2 cfs**	**0.4 cfs**	A
B		55,800sf	1.28 ac	0.35	0.45	12.8 min.	3.7 in/hr	6.6 in/hr	**1.7 cfs**	**3.8 cfs**	B

Equations:

$i_5=40/((10+T_c)^{0.76})$

$i_{100}=71.2/((10+T_c)^{0.76})$

P=One-hour point rainfall depth (in.)

i_5, i_{100}=Average 5 and 100-year Rainfall Intensity in inches per hour

Q = CiA

Q = Peak Runoff Rate, in cubic feet per second (cfs) {Initial Storm=Q_5 Major Storm=Q_{100}}

C = Runoff coefficient representing a ration of peak runoff rate to aver
intensity for a duration equal to the runoff time of concentration.

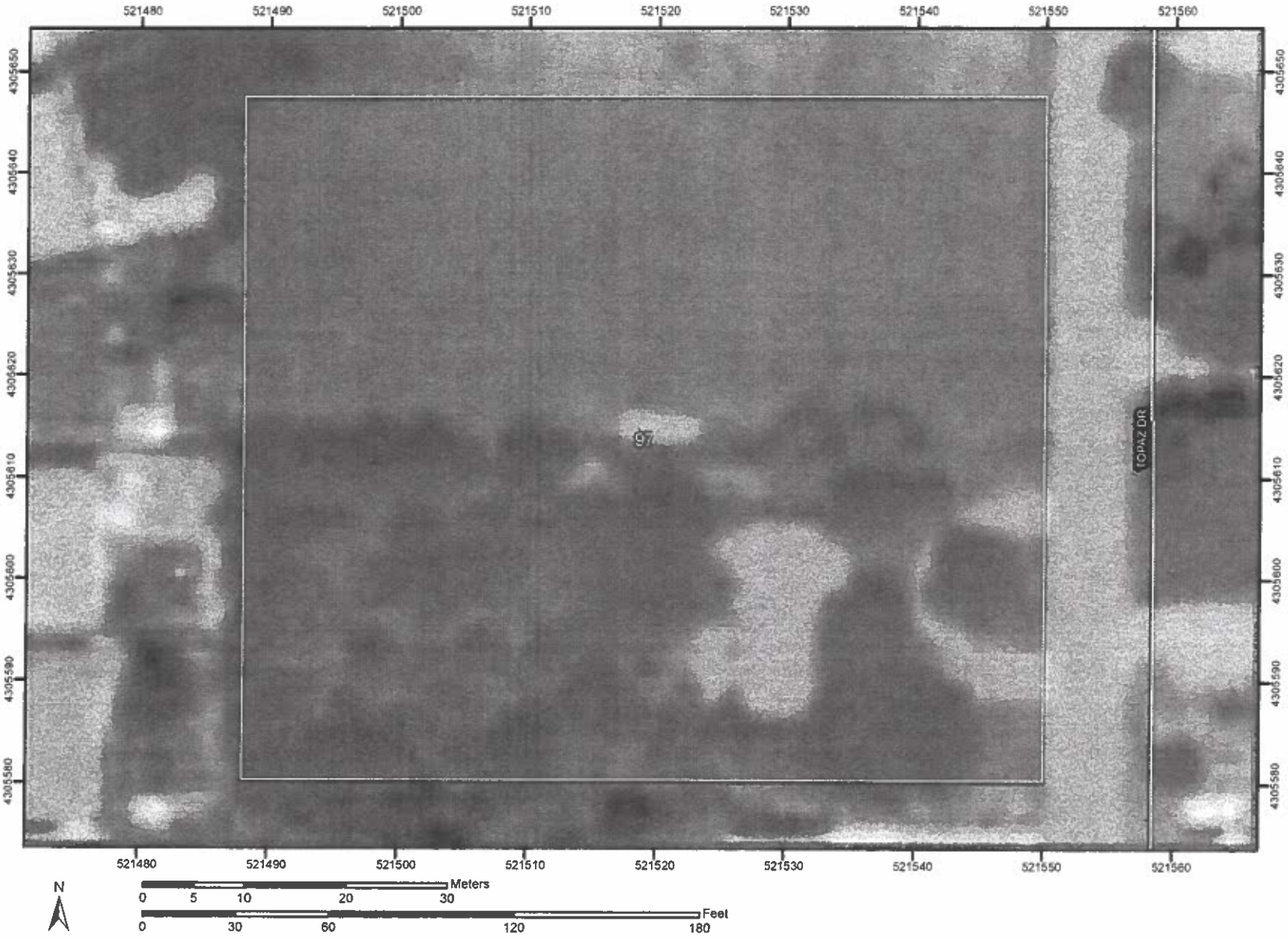
i = average rainfall intensity in inches per hour

A = Drainage area in acres

APPENDIX A.1

Hydrologic Calculations– Supporting Figures and Tables

Hydrologic Soil Group–El Paso County Area, Colorado
(Topaz Drive Drainage)



USDA Natural Resources Conservation Service

Web Soil Survey 2.0
National Cooperative Soil Survey

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 5, Jan 15, 2008

Date(s) aerial images were photographed: 1999

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
97	Truckton sandy loam, 3 to 9 percent slopes	B	1.3	100.0%
Totals for Area of Interest (AOI)			1.3	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

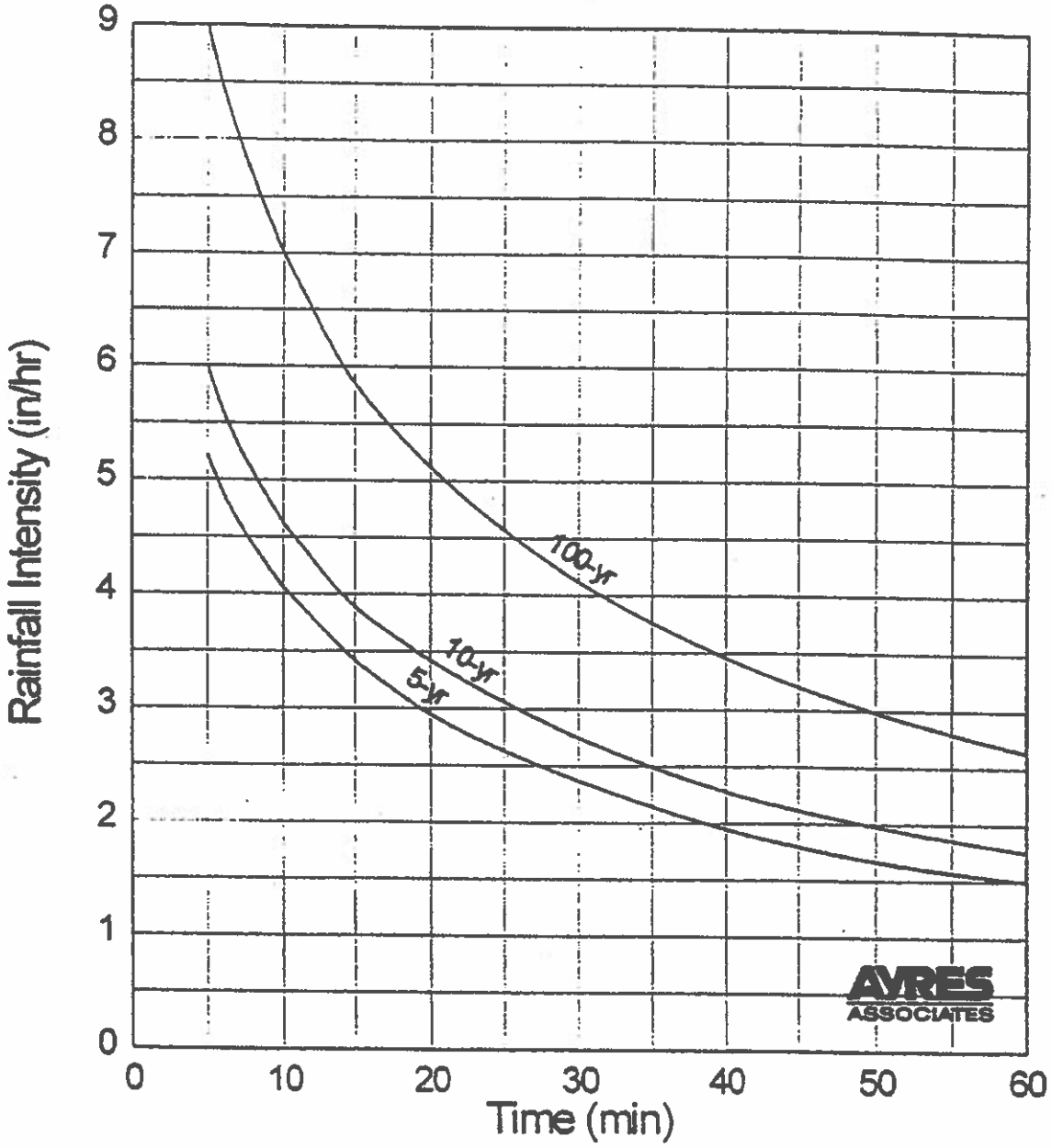
TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY 10 A&B*	10 C&D*	100 A&B*	100 C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45

* Hydrologic Soil Group

9/30/90



Interim Release October 12, 1994 , Rainfall Intensity Curves
City Of Colorado Springs Drainage Criteria Manual

L = length of overland flow (500 ft maximum for non-urban land uses, 300 ft maximum for urban land uses)

S = average basin slope (ft/ft)

Equation RO-3 is adequate for distances up to 500 feet. Note that, in some urban watersheds, the overland flow time may be very small because flows quickly channelize.

2.4.2 Overland Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the overland travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure RO-1 or the following equation (Guo 1999):

$$V = C_v S_w^{0.5} \qquad \text{(RO-4)}$$

in which:

V = velocity (ft/sec)

C_v = conveyance coefficient (from Table RO-2)

S_w = watercourse slope (ft/ft)

Table RO-2—Conveyance Coefficient, C_v

Type of Land Surface	Conveyance Coefficient, C_v
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

The time of concentration, t_c, is then the sum of the initial flow time, t_i, and the travel time, t_t, as per Equation RO-2.

2.4.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (i.e., initial flow time, t_i) in an urbanized catchment should not exceed the time of concentration calculated using Equation RO-5.

$$t_c = \frac{L}{180} + 10 \qquad \text{(RO-5)}$$

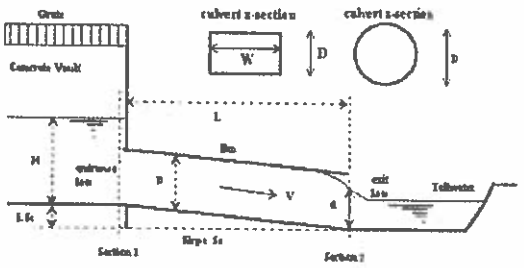
in which:

t_c = maximum time of concentration at the first design point in an urban watershed (minutes)

APPENDIX B
Hydraulic Calculations

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: **Lots 16 and 17 Park Vista Estates**
Basin ID: **Driveway Culvert Calculation**



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D = 18.00	inches
	Inlet Edge Type (choose from pull-down list)	Grooved End Projection	
OR:		OR:	
Box Culvert:	Barrel Height (Rise) in Feet	Height (Rise) =	ft.
	Barrel Width (Span) in Feet	Width (Span) =	ft.
	Inlet Edge Type (choose from pull-down list)	1 : 1 Bevel w/ Headwall	
	Number of Barrels	No = 1	
	Inlet Elevation at Culvert Invert	Inlet Elev = 100	ft. elev.
	Outlet Elevation at Culvert Invert OR Slope of Culvert (ft v./ft h.)	Outlet Elev = 99.8	ft. elev.
	Culvert Length in Feet	L = 20.00	ft.
	Manning's Roughness	n = 0.0240	*
	Bend Loss Coefficient	K_b = 0.00	
	Exit Loss Coefficient	K_x = 1.00	

* Unexpected value for Manning's n

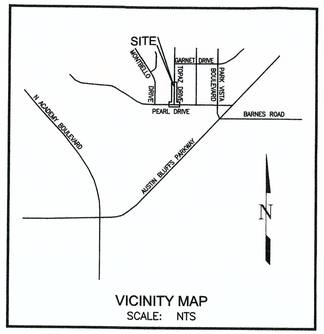
Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	1.24
Sum of All Loss Coefficients	K_s =	2.44
Orifice Inlet Condition Coefficient	C_d =	0.95
Minimum Energy Condition Coefficient	KE_{crit} =	-0.6318

Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft (input if known)	Culvert Inlet-Control Flowrate cfs (output)	Culvert Outlet-Control Flowrate cfs (output)	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used: (output)
100.00		0.00	0.00	0.00	No flow (WS < inlet)
100.10		0.04	0.02	0.02	min. energy equation
100.20		0.14	0.01	0.01	min. energy equation
100.30		0.41	0.01	0.01	min. energy equation
100.40		0.87	0.01	0.01	min. energy equation
100.50		1.22	0.01	0.01	min. energy equation
100.60		1.76	0.08	0.08	min. energy equation
100.70		2.57	0.60	0.60	min. energy equation
100.80		2.38	1.22	1.22	regression equation
100.90		2.89	2.11	2.11	regression equation
101.00		3.46	2.71	2.71	regression equation
101.10		4.08	3.36	3.36	regression equation
101.20		4.75	3.95	3.95	regression equation
101.30		5.45	4.39	4.39	regression equation
101.40		6.15	4.87	4.87	regression equation
101.50		6.84	5.37	5.37	regression equation
101.60		7.50	5.71	5.71	regression equation
101.70		8.13	6.20	6.20	regression equation
101.80		8.73	6.60	6.60	regression equation
101.90		9.29	6.94	6.94	regression equation
102.00		9.81	7.35	7.35	regression equation
102.10		10.31	7.61	7.61	regression equation
102.20		10.78	7.99	7.99	regression equation
102.30		11.24	8.35	8.35	regression equation
102.40		11.67	8.58	8.58	regression equation
102.50		12.08	8.92	8.92	regression equation
102.60		12.48	9.24	9.24	regression equation
102.70		12.87	9.53	9.53	regression equation
102.80		13.24	9.77	9.77	regression equation
102.90		13.60	10.06	10.06	regression equation

Processing Time: 0.58 seconds



VICINITY MAP
SCALE: NTS

EXISTING CONDITION
SUMMARY RUNOFF TABLE

BASIN / DP	CONTRIBUTING BASIN(S)	5-YR RUNOFF	100-YR RUNOFF
EX–A1		1.2 cfs	2.4 cfs
EX–A2		0.2 cfs	0.4 cfs
EX–B		1.4 cfs	3.3 cfs

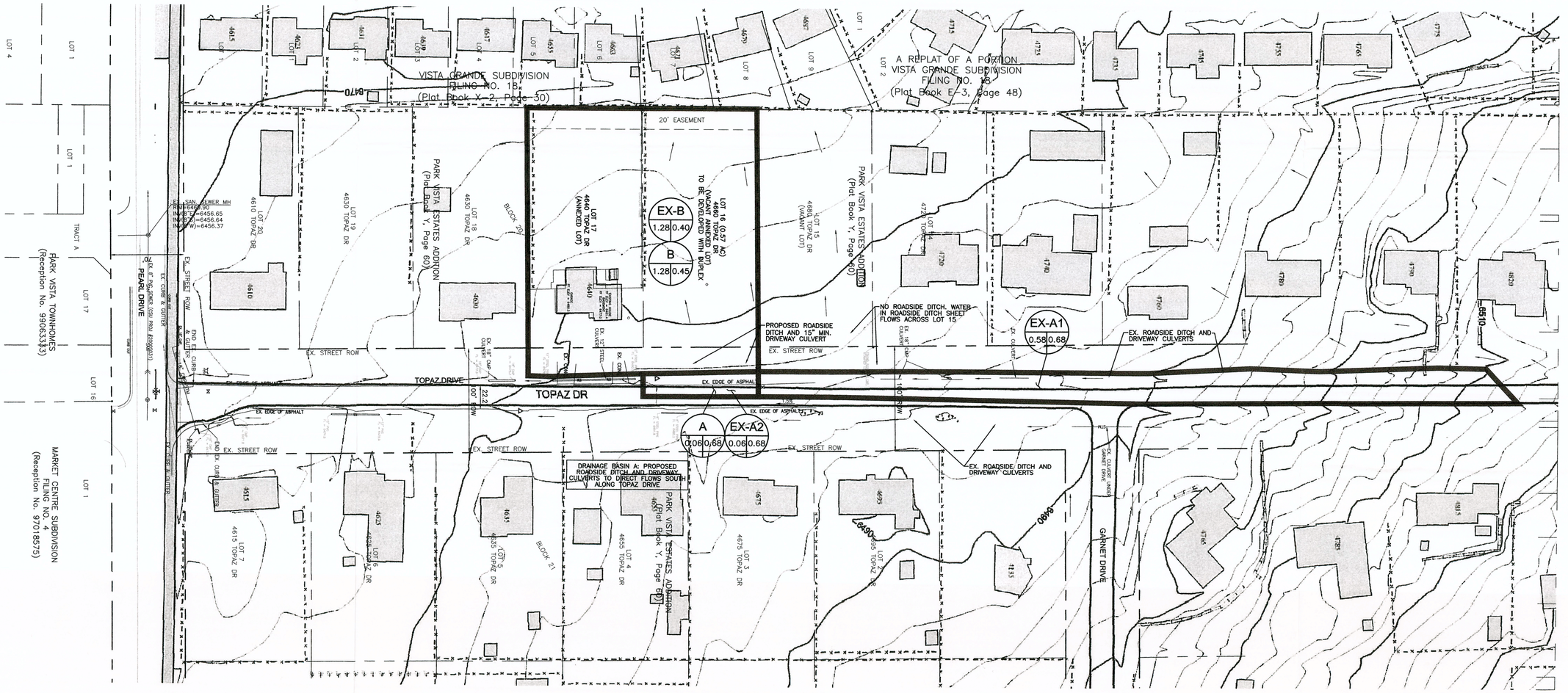
DEVELOPED CONDITION
SUMMARY RUNOFF TABLE

BASIN / DP	CONTRIBUTING BASIN(S)	5-YR RUNOFF	100-YR RUNOFF
EX–A1		1.2 cfs	2.4 cfs
A		0.2 cfs	0.4 cfs
B		1.7 cfs	3.8 cfs

LEGEND

- M — BASIN DESIGNATION
- BASIN AREA (AC) 2.03 | 0.65 — 100YR RUNOFF COEF
- DIRECTIONAL FLOW ARROW
- 1 — DESIGN POINT
- 5790 — EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- DRAINAGE BASIN BOUNDARY
- R.O.W. / PROPERTY LINE
- EASEMENT

0 50' 100'
SCALE: 1"=50'



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LOTS 16 AND 17, BLOCK 20 PARK VISTA SUBDIVISION
EXISTING AND DEVELOPED DRAINAGE PATTERNS
MDDP AND PRELIMINARY DRAINAGE REPORT
COLORADO SPRINGS, COLORADO

Project No.:	08055
Date:	September 3, 2008
Design:	MWE
Drawn:	MWE
Check:	RNW
Revisions:	

FIGURE
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