DRAINAGE REPORT

for

Sunrise Assisted Living
Paradise Hills
Golf Course Road
Albuquerque, New Mexico

Prepared by:

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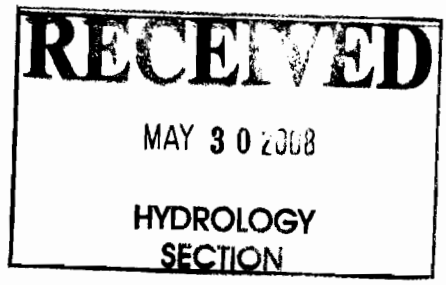
May, 2008

I certify that this report was prepared under my supervision, and I am a registered professional engineer in the State of New Mexico in good standing.

Ronald R. Bohannan
PE NO. 7868

Job No 27109



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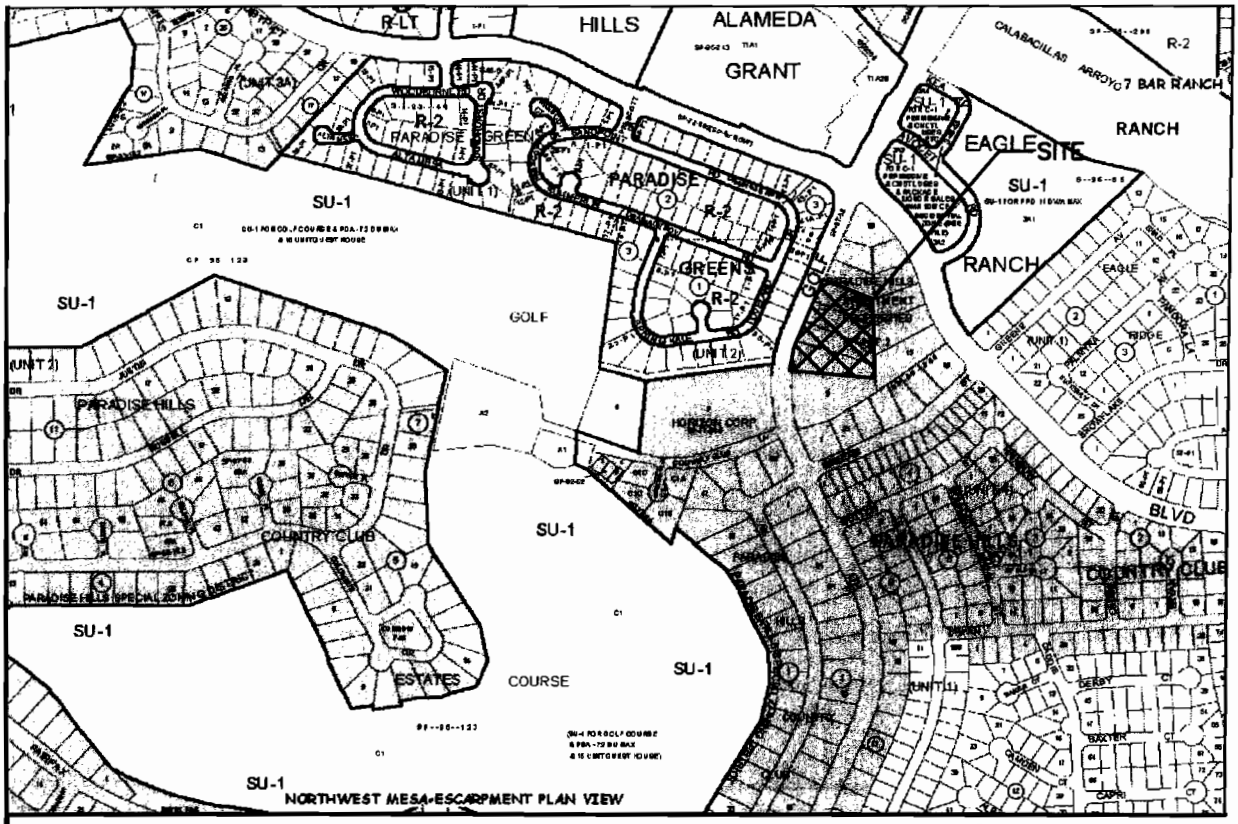
PURPOSE

The purpose of this report is to provide the drainage management plan for the development of the Sunrise Development. This plan will be utilized for the development of an assisted living facility on Tract B (former lots 4-7), however, this analysis includes the adjacent Tract A (former lot 3) which is to be graded but not developed at this time. Tract A will encompass approximately 1.48 acres, and Tract B approximately 2.73 acres. The specific future use of the Tract A is currently undetermined. This plan is in accordance with the DPM, Chapter 22, Hydrology Section. The purpose of this report is to provide the drainage analysis and management plan for the new site.

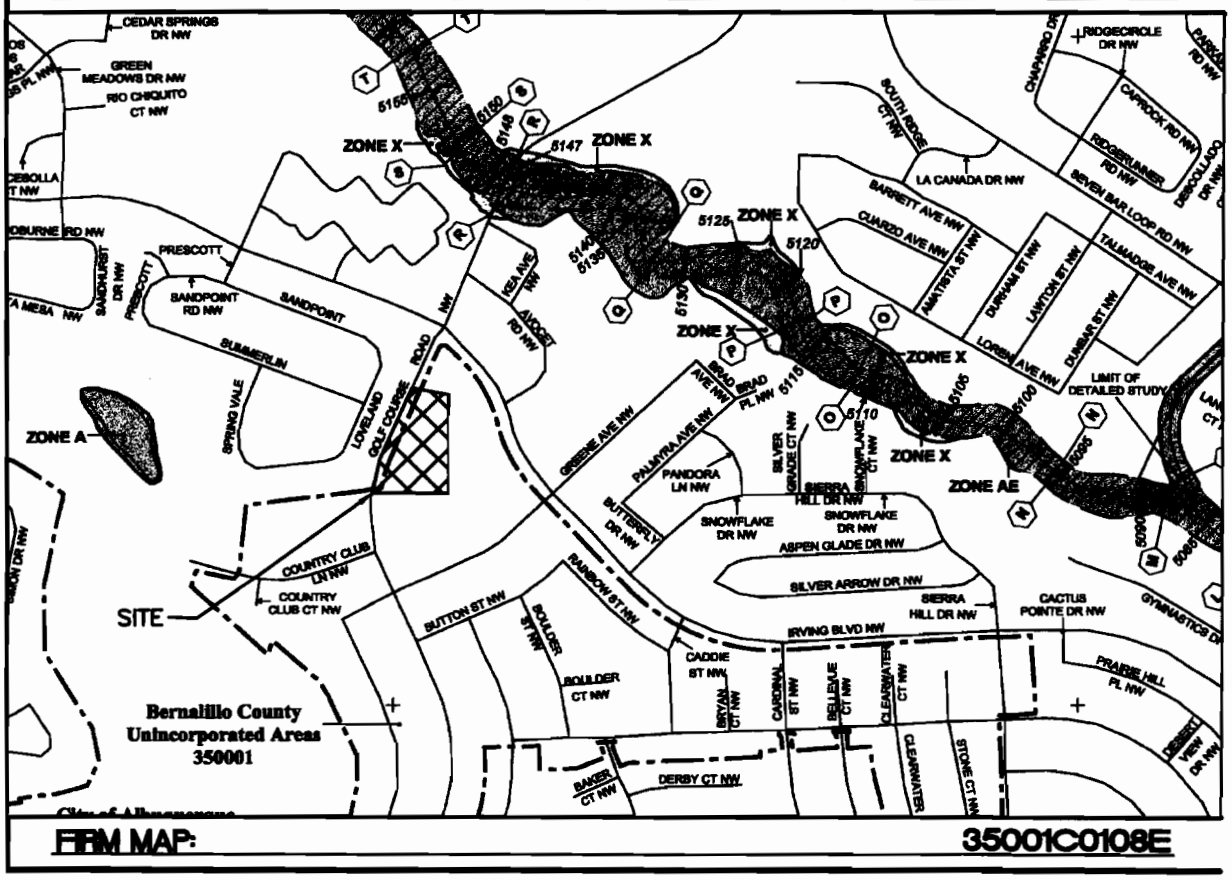
INTRODUCTION

The subject of this report, as shown on the Exhibit A vicinity map, is a 4.21-acre parcel of land located on the east side of Golf Course Road, south of Irving Boulevard. The site appears on zone atlas page B-12-Z. The site is in the Paradise Hills area of Bernalillo County, New Mexico and is currently undeveloped, although Golf Course Road has been widened to its ultimate configuration. The property has been re-platted to combine lots 4-7 into a single lot (Tract B); lot 3 is designated as Tract A. As shown on FIRM map 35001C0108E, the subject property is outside mapped flood zones. A previous drainage report for the improvements to Golf Course Road was done by Smith Engineering in January 2003. The drainage report assumes Tract B (identified in the report as Basin B-1) has free discharge to Golf Course Road for hydrologic land treatment "B" 30%, and "D" 70%. The proposed development was designed to convey flow in the manner consistent with the assumptions of the referenced report.

EXHIBIT A



VICINITY MAP: B-12-Z



FIRM MAP: 35001C0108E

EXISTING CONDITIONS

Existing drainage patterns convey flow from away from the site onto adjacent lots and Golf Course Road as the natural topography comes to a high point near the center of the site. Golf Course Road comes to a high point near the southerly portion of the site, and thusly drains mostly toward the north. In general, the majority of Tract A flows south on Golf Course Road, and Tract B flows north toward the Golf Course/Irving intersection. City of Albuquerque project #5894.91 to widened Golf Course Road and included the installation of drainage facilities near the intersection with and along Irving Boulevard.

An excerpt from the report by Smith Engineering Company, dated January, 2003 titled: Drainage Report for the Irving/Golf Course Transportation Improvements, COA Project #5894.91, is included for reference in Appendix B. The referenced report designates the site's four northerly lots as "Basin B-1" and assumed future grading of this area to convey overland flows to Golf Course Road, and ultimate development of impervious area to correspond with hydrologic land treatment "B" 30%, and "D" 70%. The runoff from this area is intercepted by catch basins constructed with the COA project.

PROPOSED CONDITIONS

A three-story senior assisted living facility is proposed for Tract B, no development is planned for Tract A, but a rough graded pad is proposed. The site has been split into 2 basins corresponding to each Tract for purposes of analyzing the pre-development and post-development flow. The storm water runoff will freely discharge into Golf Course Road.

Basin "S-post" includes the majority of Tract A. No improvements are planned for this lot as only grading is proposed. Historical flow patterns will be maintained in general, although the

existing cross-lot drainage from Tract B onto Tract A will be eliminated and directed toward the north as anticipated by the Smith Engineering report. Runoff flowing south onto Golf Course Road will marginally increase due to soil compaction (3.56 CFS developed vs. 3.99 CFS pre-development). It should be noted this marginal increase will likely be mitigated by the de-silting basin incorporated into the grading, which will remain in-place until such time the lot develops. The grading plan and Hydrology Map H-1 of this report illustrate this condition.

Tract B includes the proposed assisted living facility, associated parking lot, and generates 9.23 cfs. A land treatment of 33%B and 67%D was used to generate the runoff numbers for this basin. The runoff from the building roof drains and a portion of the parking lot will flow into a private area drain system which outlets at the proposed northerly driveway. The runoff will be conveyed by the driveway onto Golf Course Road. Although the hydraulic capacity calculation assumes all flow exits at this point, not all flow is directed to this area as curb cuts were introduced to direct flow from the parking lot toward landscape areas, where practical, in conformance with the Bernalillo County water conservation requirements. A detailed analysis for the basins tributary to the area drain system was performed and is included in the runoff calculations.

SUMMARY AND RECOMMENDATIONS

Per the pervious drainage report, this site has free discharge into Golf Course Road. The proposed improvements will accommodate the proposed development. The development of this site is consistent with the DPM, Chapter 22, Hydrology section. It is recommended this development be approved for rough grading and Site Plan for Building Permit.

MAP POCKET A

SITE GRADING AND DRAINAGE PLAN

Weighted E Method

Developed On-Site Basins: Tributary to Private Area Drain System

Basin	Area	Area	Treatment A		Treatment B		Treatment C		Treatment D		100-Year, 6-Hr			10-Year, 6-Hr			2-Year, 6-Hr			100-Year, 10-Day		
	(sf)	(acres)	%	(acres)	%	(acres)	%	(acres)	%	(acres)	Weighted E	Volume (ac-ft)	Flow cfs	Weighted E	Volume (ac-ft)	Flow cfs	Weighted E	Volume (ac-ft)	Flow cfs	Weighted E	Volume (ac-ft)	Flow cfs
A-1	10,300	0.24	0%	0	80%	0.19	0%	0	20%	0.05	0.930	0.018	0.59	0.424	0.008	0.28	0.152	0.003	0.09	0.930	0.024	0.59
A-2	22,998	0.53	0%	0	0%	0.00	0%	0	100%	0.53	1.970	0.087	2.31	1.240	0.055	1.53	0.720	0.032	0.89	1.970	0.151	2.31
A-3	19,664	0.45	0%	0	36%	0.16	0%	0	64%	0.29	1.502	0.057	1.59	0.873	0.033	0.96	0.464	0.017	0.49	1.502	0.092	1.59
A-4	14,286	0.33	0%	0	50%	0.16	0%	0	50%	0.16	1.320	0.036	1.05	0.730	0.020	0.60	0.365	0.010	0.28	1.320	0.056	1.05
B-1	1,612	0.04	0%	0	90%	0.03	0%	0	10%	0.00	0.800	0.002	0.08	0.322	0.001	0.04	0.081	0.000	0.01	0.800	0.003	0.08
B-2	14,504	0.33	0%	0	0%	0.00	0%	0	100%	0.33	1.970	0.055	1.46	1.240	0.034	0.96	0.720	0.020	0.56	1.970	0.095	1.46
Total	83,364									1.36		0.255	7.08			4.36					0.422	7.08

Pre/Post Development Comparison

Basin	Area	Area	Treatment A		Treatment B		Treatment C		Treatment D		100-Year, 6-Hr			10-Year, 6-Hr			2-Year, 6-Hr			100-Year, 10-Day		
	(sf)	(acres)	%	(acres)	%	(acres)	%	(acres)	%	(acres)	Weighted E	Volume (ac-ft)	Flow cfs	Weighted E	Volume (ac-ft)	Flow cfs	Weighted E	Volume (ac-ft)	Flow cfs	Weighted E	Volume (ac-ft)	Flow cfs
South																						
S-pre	85,725	1.97	0%	0	100%	1.97	0%	0	0%	0.00	0.670	0.110	3.99	0.220	0.036	1.50	0.010	0.002	0.06	0.670	0.110	3.99
S-post (ΣDx)	66,710	1.53	0%	0	0%	0.00	93%	1.424	7%	0.11	1.059	0.135	4.56	0.496	0.063	2.43	0.162	0.021	0.85	1.059	0.148	4.56
North																						
Tract B (Σax+Bx+Cx)	111,757	2.57	0%	0	33%	0.85	0%	0	67%	1.72	1.541	0.329	9.23	0.903	0.193	5.61	0.486	0.104	2.93	1.541	0.540	9.23

Equations for Weighted E Method:

Weighted E = Ea*Aa + Eb*Ab + Ec*Ac + Ed*Ad / (Total Area)

Volume = Weighted D * Total Area

Flow = Qa * Aa + Qb * Ab + Qc * Ac + Qd * Ad

Volume (10-day) = V_{360} + Ad * (P_{10days} - P_{360})/ 12 in/ft

Excess Precipitation, E (inches)			
Zone 1	100-Year	10 - Yea	2 - Year
E_a	0.44	0.08	0.00
E_b	0.67	0.22	0.01
E_c	0.99	0.44	0.12
E_d	1.97	1.24	0.72

Peak Discharge (cfs/acre)			
Zone 1	100-Year	10 - Yea	2 - Year
Q_a	1.29	0.24	0
Q_b	2.03	0.76	0.03
Q_c	2.87	1.49	0.47
Q_d	4.37	2.89	1.69

Weighted E Method

Developed On-Site Basins: Overland Flow Tributary to Golf Course Road North

Basin	Area (sf)	Area (acres)	Treatment A %	Treatment A (acres)	Treatment B %	Treatment B (acres)	Treatment C %	Treatment C (acres)	Treatment D %	Treatment D (acres)	100-Year, 6-Hr Weighted E	100-Year, 6-Hr Volume (ac-ft)	100-Year, 6-Hr Flow cfs	10-Year, 6-Hr Weighted E	10-Year, 6-Hr Volume (ac-ft)	10-Year, 6-Hr Flow cfs	2-Year, 6-Hr Weighted E	2-Year, 6-Hr Volume (ac-ft)	2-Year, 6-Hr Flow cfs	100-Year, 10-Day Weighted E	100-Year, 10-Day Volume (ac-ft)	100-Year, 10-Day Flow cfs
C-1	12,918	0.30	0%	0	42%	0.12	0%	0	58%	0.17	1.424	0.035	1.00	0.812	0.020	0.59	0.422	0.010	0.29	1.424	0.056	1.00
C-2	8,065	0.19	0%	0	0%	0.00	0%	0	100%	0.19	1.970	0.030	0.81	1.240	0.019	0.54	0.720	0.011	0.31	1.970	0.053	0.81
C-3	2,290	0.05	0%	0	100%	0.05	0%	0	0%	0.00	0.670	0.003	0.11	0.220	0.001	0.04	0.010	0.000	0.00	0.670	0.003	0.11
C-4	5,120	0.12	0%	0	100%	0.12	0%	0	0%	0.00	0.670	0.007	0.24	0.220	0.002	0.09	0.010	0.000	0.00	0.670	0.007	0.24
Total	28,393									0.36		0.075	2.16			1.26					0.119	2.16

Developed On-Site Basins: Overland Flow Tributary to Golf Course Road South

Basin	Area (sf)	Area (acres)	Treatment A %	Treatment A (acres)	Treatment B %	Treatment B (acres)	Treatment C %	Treatment C (acres)	Treatment D %	Treatment D (acres)	100-Year, 6-Hr Weighted E	100-Year, 6-Hr Volume (ac-ft)	100-Year, 6-Hr Flow cfs	10-Year, 6-Hr Weighted E	10-Year, 6-Hr Volume (ac-ft)	10-Year, 6-Hr Flow cfs	2-Year, 6-Hr Weighted E	2-Year, 6-Hr Volume (ac-ft)	2-Year, 6-Hr Flow cfs	100-Year, 10-Day Weighted E	100-Year, 10-Day Volume (ac-ft)	100-Year, 10-Day Flow cfs
D1	6,956	0.16	0%	0	0%	0.00	32%	0.0511001	68%	0.11	1.656	0.022	0.62	0.984	0.013	0.39	0.528	0.007	0.21	1.656	0.035	0.62
D2	46,969	1.08	0%	0	0%	0.00	100%	1.078	0%	0.00	0.990	0.089	3.09	0.440	0.040	1.61	0.120	0.011	0.51	0.990	0.089	3.09
D3	12,785	0.29	0%	0	0%	0.00	100%	0.2935032	0%	0.00	0.990	0.024	0.84	0.440	0.011	0.44	0.120	0.003	0.14	0.990	0.024	0.84
Total	66,710												4.56									4.56

Equations for Weighted E Method:

Weighted E = Ea*Aa + Eb*Ab + Ec*Ac + Ed*Ad / (Total Area)

Volume = Weighted D * Total Area

Flow = Qa * Aa + Qb * Ab + Qc * Ac + Qd * Ad

Volume (10-day) = V_{360} + Ad * (P_{10days} - P_{360})/ 12 in/ft

Excess Precipitation, E (inches)			
Zone 1	100-Year	10 - Yea	2 - Year
E_a	0.44	0.08	0.00
E_b	0.67	0.22	0.01
E_c	0.99	0.44	0.12
E_d	1.97	1.24	0.72

Peak Discharge (cfs/acre)			
Zone 1	100-Year	10 - Yea	2 - Year
Q_a	1.29	0.24	0
Q_b	2.03	0.76	0.03
Q_c	2.87	1.49	0.47
Q_d	4.37	2.89	1.69

Private Grate Capacity Calculations

Basin	Flow cfs	Flow gpm	Grate capacity* (gpm)	Grates required	Grates provided
A-1	0.59	265.09	51.75	5.12	7
A-2	2.31	1035.47	Roof	N/A	N/A
A-3	1.59	714.69	**Type D Inlet	1	1
A-4	1.05	471.01	51.75	9.10	13
B-1	0.08	37.60	51.75	0.73	3
B-2	1.46	653.03	51.75	12.62	14

*Capacity for NDS #980 per manufacturer specification
**See Capacity Calculation below:

Capacity of a Single 'D' Storm Drop Inlet

Capacity of the grate:

L = 40" - 2(2"$_{ends}$) - 7(½"$_{middle\ bars}$)
= 32 1/2"
= 2.7083'

W = 25" - 13(½"$_{middle\ bars}$)
= 18.5"
= 1.54'

Area = 2.7083' x 1.54'
= 4.18 ft^2

Effective Ar = 4.18- 4.18 (0.5 $_{clogging\ factor}$)
= 2.09 ft^2 at the grate

Orifice Equation

Q = CA sqrt(2gH)
For H =0.33' (assumes no ponding in pavement area)
Q = 0.6*2.09*sqrt(2*32.2*0.33)
Q = 5.78 cfs (capacity) >1.59 cfs (required), therefore OK

Worksheet for Driveway Capacity at Min Slope

Project Description

Solve For	Spread

Input Data

Channel Slope	0.01000	ft/ft	
Discharge	9.23	ft³/s	$= Q_{100}$ TRACT B DEVELOPED
Gutter Width	1.50	ft	
Gutter Cross Slope	0.02	ft/ft	
Road Cross Slope	0.02	ft/ft	
Roughness Coefficient	0.016		

Results

Spread	16.59	ft	$< 24'$ ∴ OK
Flow Area	2.75	ft²	
Depth	0.33	ft	$< 0.5'$ ∴ OK
Gutter Depression	0.00	ft	
Velocity	3.35	ft/s	

Worksheet for Headwall-Rundown Outfall

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02000	ft/ft
Bottom Width	2.00	ft
Discharge	7.08	ft³/s

Results

Normal Depth	0.47	ft
Flow Area	0.94	ft²
Wetted Perimeter	2.94	ft
Top Width	2.00	ft
Critical Depth	0.73	ft
Critical Slope	0.00568	ft/ft
Velocity	7.55	ft/s
Velocity Head	0.89	ft
Specific Energy	1.36	ft
Froude Number	1.95	
Flow Type	Supercritical	

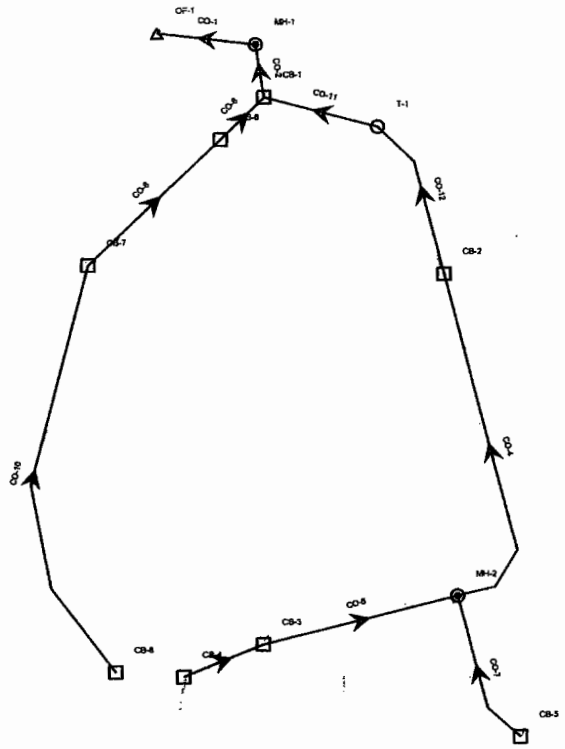
GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.47	ft
Critical Depth	0.73	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.00568	ft/ft

Print Preview



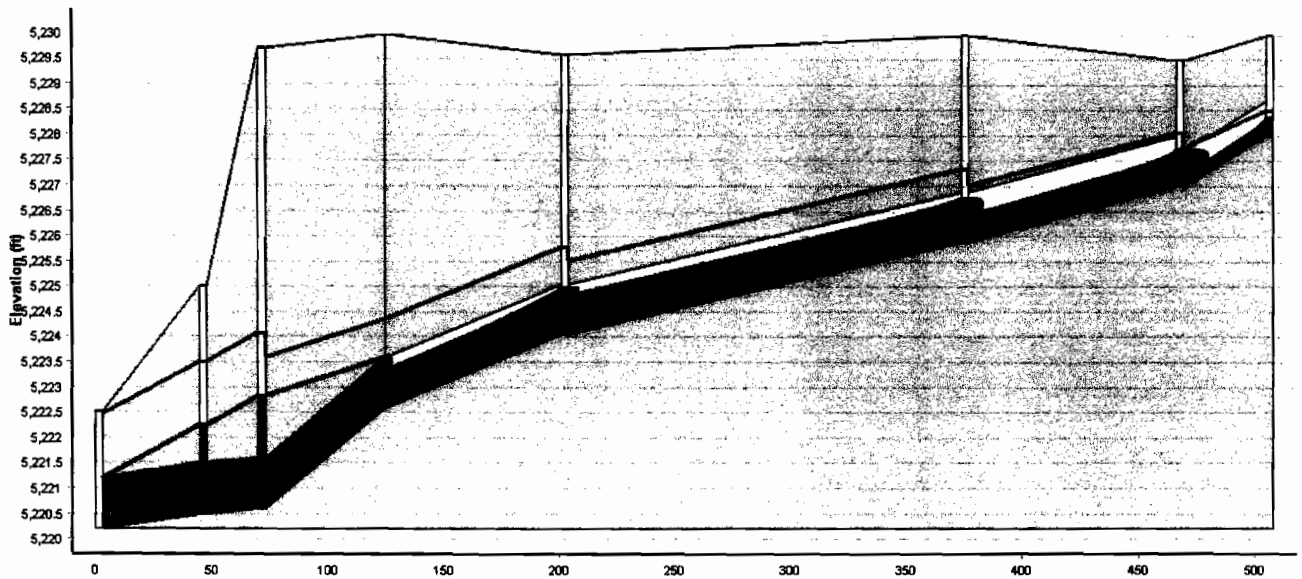
FlexTable: Conduit Table (27109 AREA DRAIN.stc)

Current Time: 0.000 min

Label	Start Node	Invert (Upstream) (ft)	Stop Node	Invert (Downstream) (ft)	Conduit Type	Conduit Shape	Material	Manning's n
CO-1	OF-1	5,220.20	MH-1	5,220.50	User Defined Conduit	Circular Pipe	PVC	0.010
CO-2	MH-1	5,220.50	CB-1	5,220.60	User Defined Conduit	Circular Pipe	PVC	0.010
CO-4	CB-2	5,224.05	MH-2	5,225.89	User Defined Conduit	Circular Pipe	PVC	0.010
CO-5	MH-2	5,225.89	CB-3	5,227.00	User Defined Conduit	Circular Pipe	PVC	0.010
CO-6	CB-3	5,227.00	CB-4	5,228.00	User Defined Conduit	Circular Pipe	PVC	0.010
CO-7	MH-2	5,225.89	CB-5	5,226.27	User Defined Conduit	Circular Pipe	PVC	0.010
CO-8	CB-1	5,220.60	CB-6	5,225.00	User Defined Conduit	Circular Pipe	<None>	0.013
CO-9	CB-6	5,225.00	CB-7	5,225.80	User Defined Conduit	Circular Pipe	PVC	0.010
CO-10	CB-7	5,225.80	CB-8	5,228.00	User Defined Conduit	Circular Pipe	PVC	0.010
CO-11	CB-1	5,220.60	T-1	5,222.59	User Defined Conduit	Circular Pipe	PVC	0.010
CO-12	T-1	5,222.59	CB-2	5,224.05	User Defined Conduit	Circular Pipe	PVC	0.010

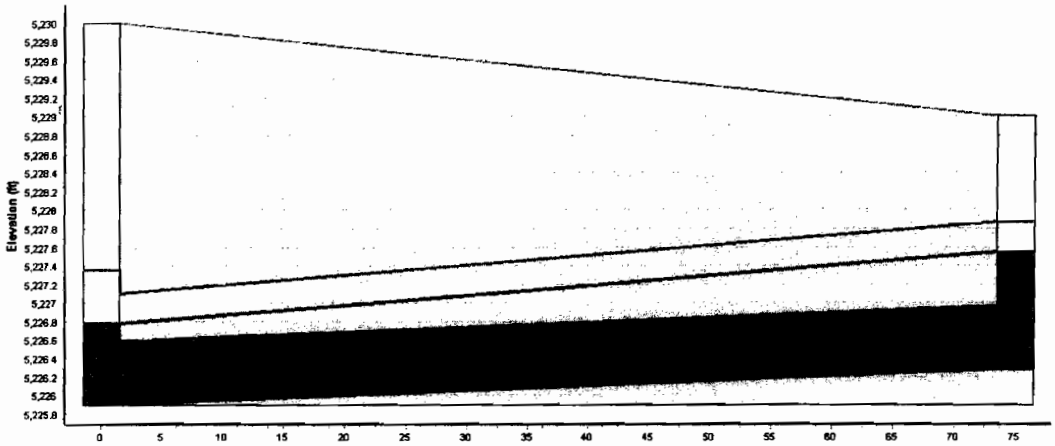
Diameter (in)	Flow (ft^3/s)	Length (ft)	Slope (Calculated) (ft/ft)	Capacity (Full Flow) (ft^3/s)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Velocity (Average) (ft/s)
12.0	7.08	45.0	-0.007	-3.78	5,222.50	5,225.00	5,222.24	5,221.18	9.01
12.0	7.08	25.0	-0.004	-2.93	5,225.00	5,229.70	5,222.83	5,222.24	9.01
12.0	4.49	173.0	-0.011	-4.78	5,229.60	5,230.00	5,226.78	5,224.99	6.91
12.0	2.90	92.0	-0.012	-5.09	5,230.00	5,229.50	5,227.73	5,226.78	6.69
8.0	0.59	39.0	-0.026	-2.52	5,229.50	5,230.00	5,228.36	5,227.73	5.89
8.0	1.59	75.0	-0.005	-1.12	5,230.00	5,229.00	5,227.54	5,226.78	4.56
12.0	1.54	28.0	-0.157	-14.12	5,229.70	5,230.00	5,225.53	5,222.83	11.79
8.0	1.54	84.0	-0.010	-1.53	5,230.00	5,228.50	5,226.38	5,225.55	5.01
8.0	0.08	206.0	-0.011	-1.62	5,228.50	5,230.00	5,228.13	5,226.38	2.41
12.0	5.54	53.0	-0.038	-8.97	5,229.70	5,230.00	5,223.58	5,222.83	12.02
12.0	5.54	78.0	-0.019	-6.34	5,230.00	5,229.60	5,224.99	5,223.58	9.09

Profile - A - Base



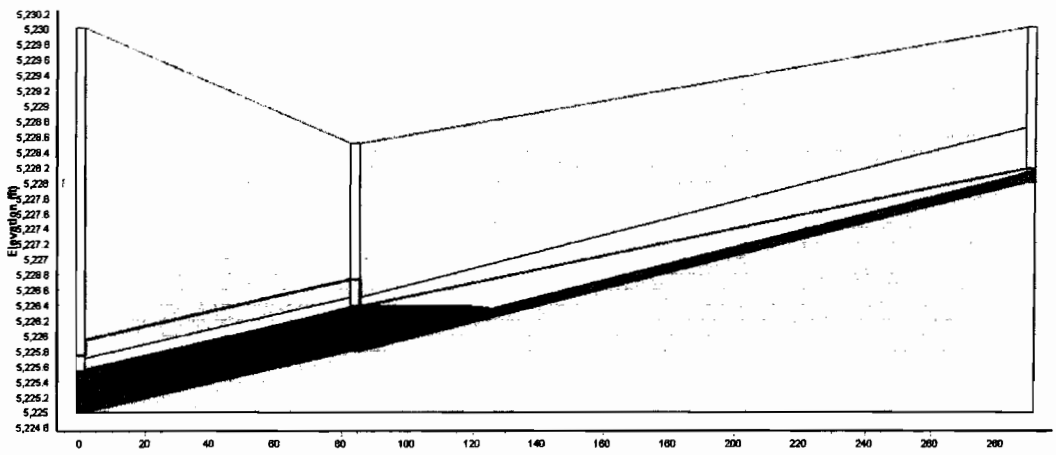
ID\Label		17 \ CO-1	19 \ CO-2	39 \ CO-11	40 \ CO-12		23 \ CO-4			25 \ CO-5	27 \ CO-6			
Link Length (ft)		42	22	51.5	76.5		170			89	36			
Rise\Material		1 \ PVC	1 \ PVC	1 \ PVC	1 \ PVC		1 \ PVC			1 \ PVC	0.7 \ PVC			
Flow (ft^3/s)		7.08	7.08	5.54	5.54		4.49			2.9	0.59			
Slope (ft/ft)		-0.007	-0.004	-0.038	-0.019		-0.011			-0.012	-0.026			
ID\Label	15 \ OF-1		16 \ MH-1	18 \ CB-1	38 \ T-1	20 \ CB-2			22 \ MH-2			24 \ CB-3	26 \ CB-4	
Ground (ft)	5222.5		5225	5229.7	5230	5229.6			5230			5229.5	5230	
Invert (ft)	5220.2		5220.5	5220.6	5222.59	5224.05			5225.89			5227	5228	
Station (ft)	1.5		46.5	71.5	124.5	202.5			375.5			467.5	508.5	

Profile - A1 - Base



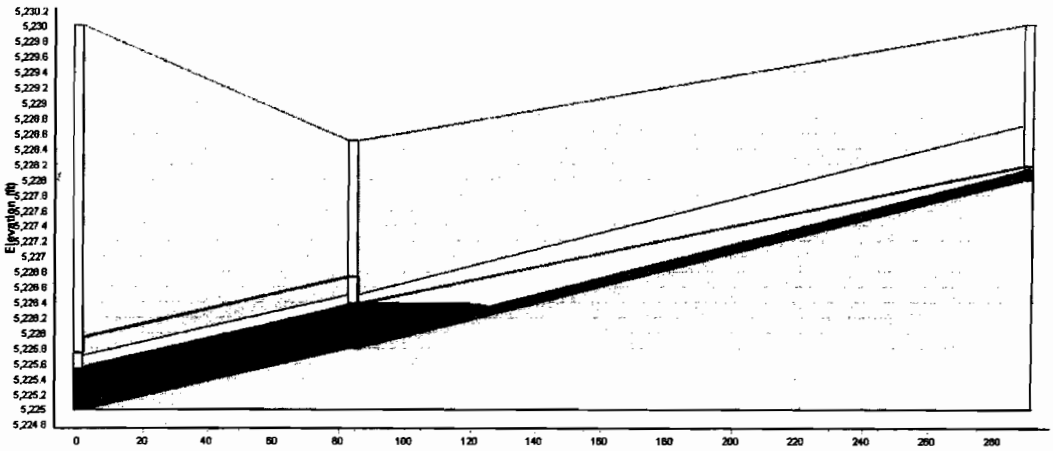
ID\Label		31 \CO-7	
Link Length (ft)		72	
Rise/Material		0.7 \PVC	
Flow (ft^3/s)		1.59	
Slope (ft/ft)		-0.005	
ID\Label	22 \MH-2		30 \CB-5
Ground (ft)	5230		5229
Invert (ft)	5225.89		5226.27
Station (ft)	0		75

Profile - B - Base



ID\Label		35 \ CO-9			37 \ CO-10		
Link Length (ft)		61			203		
Pipe/Material		0.7 \ PVC			0.7 \ PVC		
Flow (ft^3/s)		1.54			0.06		
Slope (ft/ft)		-0.01			-0.011		
ID\Label	32 \ CB-8		34 \ CB-7			36 \ CB-6	
Ground (ft)	5230		5228.5			5230	
Invert (ft)	5225		5225.8			5228	
Station (ft)	0		84			290	

Profile - B - Base



ID\Label		35 \ CO-9			37 \ CO-10			
Link Length (ft)		81			203			
Size/Material		0.7 \ PVC			0.7 \ PVC			
Flow (ft^3/s)		1.54			0.06			
Slope (ft/ft)		-0.01			-0.011			
ID\Label	32 \ CB-6		34 \ CB-7				36 \ CB-8	
Ground (ft)	5230		5228.5				5230	
Invert (ft)	5225		5225.8				5226	
Station (ft)	0		84				290	

APPENDIX B

Smith Engineering Report

DRAINAGE REPORT

for the

IRVING/GOLF COURSE TRANSPORTATION

IMPROVEMENTS, COA PROJECT #5894.91

Prepared for:

CITY OF ALBUQUERQUE

TRANSPORTATION DEPARTMENT

January, 2003

Prepared by:

Smith Engineering Company
6400 Uptown Blvd. NE, Suite 500E
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I. INTRODUCTION

The City of Albuquerque Transportation Department is planning to construct a four lane facility on Irving Boulevard from Chantilly to just west of the intersection of Golf Course Road and a four lane facility on Golf Course Road from the Bernalillo county line on the south to the south side of the Calabacillas Arroyo. A vicinity map showing the location of the project area is shown in Figure 1, page 2.

Smith Engineering Company (SEC) has been retained by the COA PWD to provide civil engineering services for the proposed Irving Boulevard/Golf Course Improvements. Included in the civil engineering scope of work is to provide a drainage analysis for the project and design an storm drain system to convey the flows to the Calabacillas Arroyo.

This drainage report will analyze the hydrology assuming fully developed conditions and provide a hydraulic analysis of a storm drain system to be constructed as part of the project.

II. DRAINAGE AREA BOUNDARIES

The drainage basin boundary for the project is bounded by Chantilly on the east, the right-of-way on the north and south sides of Irving Boulevard, several tracts of vacant land at the southeast quadrant of the intersection of Golf Course and Irving Boulevard, and the east and west sides of Golf Course Road. The drainage areas are shown on Plates 1 and 2 contained in Appendix A of this report.

III. DRAINAGE BASIN CHARACTERISTICS

This report concerns itself only with developed conditions and the planned storm drain system as the existing drainage conditions do not have an impact on the design of the final facilities.

A. Drainage Basins

Irving Boulevard:

There is a grade break on Irving Boulevard near Green Street that creates two major drainage basins for Irving Boulevard. These are the area west of Green Street and the area east of Green Street. There are existing neighborhoods on each side of Irving Boulevard along the length of the improvement with walls on the right-of-way line. This report assumes that, due to the walls, the drainage in the backyards of the lots will not get to the Irving Boulevard right-of-way but will remain on the lots.

East of Green Street:

The major drainage basin east of Green Street is from the break-line at Green Street east to Chantilly Road. This basin drains to a proposed storm drain system in Irving Boulevard and Chantilly Road that connects to an existing storm drain system in Bryan

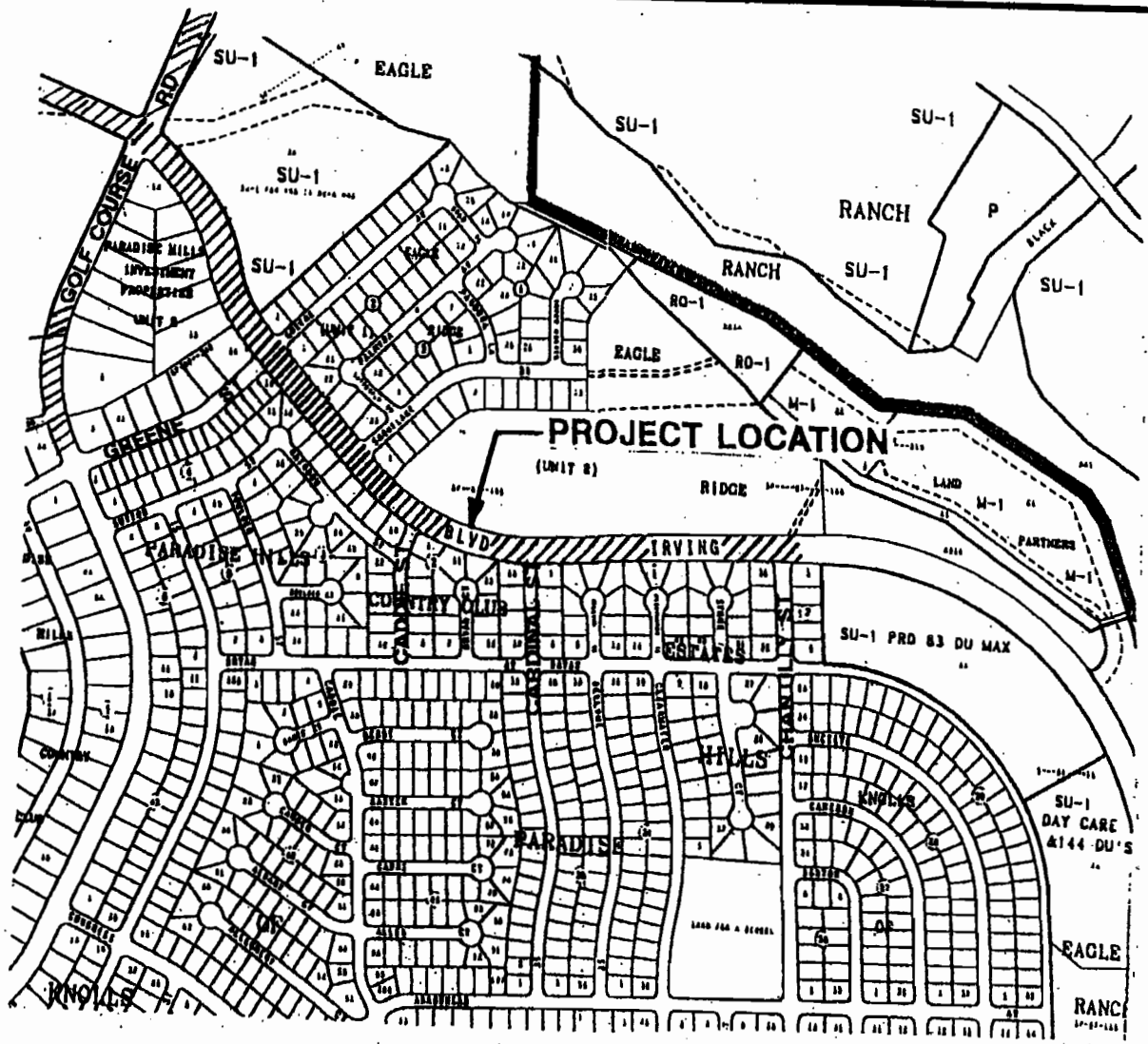

Figure No. 1 – Project Location Map

N

GRAPHIC SCALE

MAP NO.

B-12-Z
B-13-Z

Road. The existing system is referred to as the Cactus Pointe system in this report. The Cactus Pointe system discharges to the Calabacillas Arroyo.

Off-site drainage basins flow to the existing Cactus Pointe storm drain system to which the proposed Irving Boulevard storm drain system connects. This system has to accommodate the existing flows as well as the proposed flows from the Irving system.

West of Green Street:

The major drainage basin west of Green Street to Irving Boulevard is collected in the proposed storm drain system via inlets. This new storm drain system connects to an existing storm drain system at the intersection of Irving Boulevard and Golf Course Road. The proposed system conveys flows to the Calabacillas Arroyo. There are four undeveloped lots that drain to Irving Boulevard. These are designated as Basins E.2 and E.3 on the basin map. There are currently no development plans for the lots designated as E.2. The basin E.3 is currently under design by Mark Goodwin and Associates and is planned as a gas station and convenience store. Runoff from this tract will drain directly into the planned storm drain system using a connector pipe that will be constructed as part of this project. Basin E.2 will drain directly onto Irving Boulevard and, for this analysis, it has been assumed that the lots are fully developed.

There are two major off-site basins that drain to the existing storm drain system in Irving and Golf Course. These are the Paradise Greens, Unit II Subdivision at the southwest quadrant of the intersection of Golf Course and Irving, the Arroyo Villas Apartments, and the Eagle Ranch development at the northeast quadrant of the intersection. These basins currently drain into the existing storm drain system that outfall to the Calabacillas Arroyo and do not impact the drainage basin for the project. However, they do drain to the existing storm drain system and this system has to accommodate the existing developed conditions flows as well as the flows from the construction of the project and flows from the developed lots within the project area.

Golf Course Road:

The portion of Golf Course Road in this project drains overland from approximately the Bernalillo County line (just south of the Paradise Hills Golf Course) north to the intersection of Irving Boulevard and Golf Course Road. The runoff is collected in the proposed storm drain system via inlets just south of the intersection. The proposed storm drain system connects to the existing storm drain system at the intersection of Golf Course Road and Irving Boulevard. This existing system then conveys flows to the Calabacillas Arroyo. There are no off-site drainage basins impacting the Golf Course system.

The existing storm drain systems that the proposed storm drain systems connect to are described in Section IV, Existing Drainage Facilities.

B. Existing Vegetation

Existing vegetation is relatively sparse throughout the area and consists of open-type desert grassland (Drainage Basins E.1, E.2 and E.3). Under developed conditions, it is

anticipated that the area will be covered with hard impervious surfaces and various types of landscaping.

C. Land Use

Developed condition land uses were determined from the proposed roadway improvements and the potential development of the vacant lots. This report assumed the roadway as 100% "D" and the vacant lots as 30% "B: and 70% "D".

IV. EXISTING DRAINAGE FACILITIES

There are two existing storm drain systems to which the proposed storm drain will connect. The proposed storm drain for Irving Boulevard west of Green Street will connect to the Arroyo Villas Apartments system (contained in Appendix B). This system was constructed to provide drainage for the Paradise Greens, Phase II, Subdivision (southwest quadrant), the Arroyo Villas Apartments (northwest quadrants), and the Eagle Ranch Development (northeast quadrant). The existing system consists of pipes ranging from 18-inch diameter to 42-inches in diameter at the outfall. The proposed storm drain system in Irving Boulevard will connect to the existing system at MH #4. The as-built drawings for this system are located in the pocket at the back of the report.

The proposed storm drain system for Irving Boulevard east of Green Street will connect to the Cactus Pointe Subdivision storm drain (contained in Appendix C). This system begins at the intersection of Chantilly Street and Bryan Road and consists of 18-inch pipe up to 60-inch pipe at the outfall. The system winds through existing neighborhoods and outfalls to the Calabacillas Arroyo. The proposed storm drain for Irving Boulevard will connect to the existing storm drain at the beginning of the system at Bryan Street just east of Chantilly.

V. HYDROLOGY

The hydrology for the project was developed using Section 22.2 Hydrology of the Development Process Manual, Design Criteria for the City of Albuquerque, New Mexico. The design storm is the 100-Year, 6-Hour storm. The procedure used for the analysis was the Part A Procedure for 40-acre area and smaller drainage basins. The following information was taken fro the DPM for the analysis:

Precipitation zone:	1
Peak discharge/acre:	2.03 cfs (land use B)
	4.37 cfs (land use D)

Mapping for this study (shown on Plates 1 and 2) utilized the ortho-photography and vector contour composite images (part of the Bernalillo County Digital Mapping). The mapping was obtained from the Albuquerque Metropolitan Arroyo and Flood Control Authority (AMAFCA).

The drainage basins were determined based on two criteria: existing right-of-way and anticipated or proposed patting actions. The basins for the roadway improvements are

taken to be the right-of-way of the road as the lots adjacent to the right-of-way will not drain to the road and the land use was assumed to be 100% "D". These basins are designated as A, C, D, E and F.

The lots that are at the southeast quadrant of Irving Boulevard and Golf Course Road were assumed to develop as 30% "B" and 70% "D". The basin designated as B.3 is the proposed gas station and convenience store that is currently being designed by Mark Goodwin and Associates. This development will drain to an on-site system that will connect to the proposed storm drain in Irving Boulevard. The other lots, designated as B.1 and B.2 were assumed to overland flow to either Irving Boulevard or Golf Course Road based on frontage, and the runoff is intercepted by the proposed system catch basins.

The basin designations and hydrology calculations are as follows:

BASIN #	TOTAL AREA	LANDUSE 'D' AREA	LANDUSE 'B' AREA	Q_{100} FLOW
	(acres)	(acres)	(acres)	(cfs)
A1	0.77	0.616	0.154	3.00
A2	0.67	0.536	0.134	2.61
B1	2.72	2.176	0.544	10.61
B2	2.22	1.776	0.444	8.66
B3	2.36	1.888	0.472	9.21
C1	1.98	1.584	0.396	7.73
C2	0.23	0.184	0.046	0.90
C3	0.78	0.624	0.156	3.04
C4	0.63	0.504	0.126	2.46
C5	0.42	0.336	0.084	1.64
C6	0.47	0.376	0.094	1.83
D	1.96	1.568	0.392	7.65
E1	0.52	0.416	0.104	2.03
E2	0.53	0.424	0.106	2.07
F1	0.11	0.088	0.022	0.43
F2	0.92	0.736	0.184	3.59
F3	0.84	0.672	0.168	3.28
F4	0.39	0.312	0.078	1.52
F5	0.41	0.328	0.082	1.60
Total	**18.93**	**15.14**	**3.79**	**73.86**

VI. HYDRAULICS

The hydraulics of the proposed storm drain system are based on utilizing the following system parts:

- Streets which act as open channels to convey storm water runoff the drop inlets.
- Underground piping which convey storm water runoff from the drop inlets to the final outfall at the Calabacillas Arroyo.

Street capacities were determined using "Flow Master", a computer program that utilizes Manning's Equation to determine hydraulic capacities of the roadways and the interception capacity of the inlets. Hydraulic grade lines for storm drain pipes were calculated using "Storm Cad", a computer program used to perform hydraulic analyses on storm drain pipe systems. "Storm Cad" utilizes Manning's Equation for open channel flow as well as pressurized flow incorporating friction head loss and other minor head losses within the storm drain system.

The results of the HGL calculations are shown in Appendix E and F and the hydraulic capacity of the roads in Appendix G.

PROPOSED STORM DRAIN

Two storm drain systems are proposed for the project, the Irving/Golf Course system and the Irving/Chantilly system. The plan-and-profile sheets for the proposed system is contained in Appendix D.

Irving/Golf Course System:

This system consists of RCP storm drain ranging in size from 18-inch to 36-inch and has two "legs"; one that proceeds up Irving Boulevard to the east from the existing MH 4 and one that proceeds south up Golf Course Road from the Irving Boulevard system at Station 9+93.

The system for Irving Boulevard collects flows generated west of Green Street as well as the on-site system from the future gas station/convenience store site. Catch basins will be constructed along the length of the system to collect street flows. The HGL analysis of the system shows that the system will function well and the HGL stays below the road surface and in some instances, the HGL stays within the pipe.

The Golf Course "leg" begins at the manhole at Station 9+93 in the Irving system and proceeds south up Golf Course for two pipe segments, each being 24-inch pipes. This system collects street flows in catch basins prior to the intersection. The HGL analysis of the system shows that the system will function well and the HGL stays below the road surface.

Irving/Chantilly System:

This system consists of RCP storm drain ranging in size from 18-inch to 24-inch. The system begins in Irving Boulevard at Station 29+04 and proceeds east to Chantilly. At Chantilly, the system turns south to Bryan Street and then east again to connect to the existing Cactus Pointe storm drain system. Catch basins will be constructed along the length of the system in Irving Boulevard to collect street flows. No catch basins will be constructed in Chantilly Street as they are not required. The flow that will be added to the existing system due to the proposed improvements in Irving Boulevard is 22 cfs. The proposed system and the existing system were analyzed to determine the effect of the additional flows on the combined system. The HGL analysis shows that the existing system cannot carry the additional flows from the proposed system due to an under-

sized storm drain for the first 95 feet of the existing system. This part of the existing system would have to be up-sized to a 30-inch pipe to keep the HGL in the ground. The HGL was re-calculated assuming that 22 cfs would get to the Cactus Pointe system from the Irving system while 11 cfs of the historic flow to the Cactus Pointe system from Bryan Avenue west of Chantilly would by-pass the system for the first two sets of catch basins. If 11 cfs of street flow is intercepted by the Cactus Pointe system at Station 5+20, the combined system would operate with the HGL below the street surface in Bryan Avenue and just above the street surface in Chantilly. Street flow calculations show that the 11 cfs of by-pass will be 0.31 feet deep at the curb and will be confined within the street section due to the street slopes (1.31 %) in that area (the street flow calculation is contained in Appendix G). Therefore, it is economically not feasible to up-size the existing system for only 95 feet when the by-pass flow can easily be accommodated within the street and intercepted not far from the original interception point.

VII. REFERENCES

City of Albuquerque, July 1997, "Development Process Manual, Section 22.2, Hydrology".

Haestad Methods Inc., August 2000, "FlowMaster PE Version 6.0 Computer Software".

Haestad Methods Inc., November 2000, "CulvertMaster Computer Software".

Haestad Methods Inc., December 1999, "StormCad Computer Software".