CONCEPTUAL DESIGN ANALYSIS FOR LYON (UNSER) BOULEVARD/ PARADISE BOULEVARD STORM DRAIN

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PREPARED FOR:

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w/ question

40 YEARS

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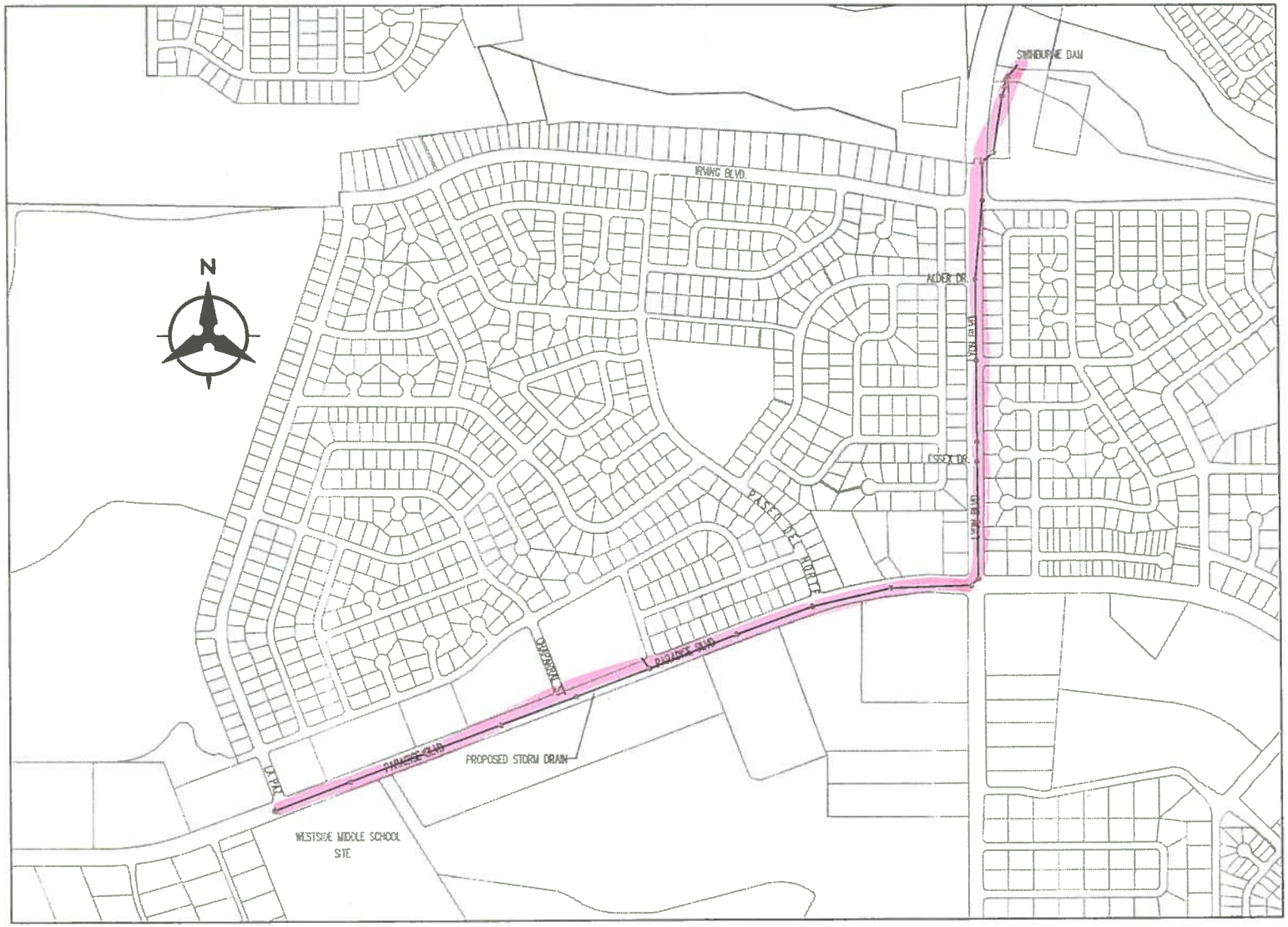
I. PURPOSE

This Conceptual Design Drainage Analysis presents the hydrologic and hydraulic analysis for the proposed storm drain in Paradise Boulevard and Lyon (Unser) Boulevard. A portion of the storm drain will be installed with the infrastructure needed for the proposed Westside Middle School. See Figure 1, Vicinity Map. This storm drain analysis, from the school site to the ultimate outfall at the Calabacillas Arroyo, is necessary to ensure that the portion to be constructed with the school site is properly sized and located when installed adjacent to the school site. Chapter 22.2 of the July, 1997 revision, City of Albuquerque (COA) Development Process Manual (DPM) guidelines, was utilized in this analysis.

II. BACKGROUND INFORMATION

The following reports include drainage analyses that have been done in this geographical vicinity. These reports were used as a reference for this analysis; however the flow data from the reports could not be used. Site visits verified that some of the basin boundaries in these reports needed adjusting. The previous studies were completed using earlier hydrological methods and must be revised to meet current standards. For this reason, a full hydrologic analysis was done in order to determine flows for the design of the storm drain. The reports listed below were utilized in this analysis to help establish basin boundaries and provide a comparison.

1. Community Sciences Corporation, Revised and Amended Drainage Report for Paradise Meadows, Unit 1, dated May, 1994.
2. Community Science Corporation, Addendum to Master Drainage Report for Paradise Greens Tract and Paradise Meadows Tract Along Irving Boulevard, dated January, 1994, revised May, 1994.
3. Molzen Corbin, AMAFCA Piedras Marcadas Drainage Management Plan Revision, dated May, 1993.
4. Leedshill – Herkenhoff, Unser Boulevard North Drainage Report, dated January 1990.



VICINITY MAP
A-10, A-11, B-10, B-11
1"=1000'

Bohannan ▲ Huston

Courtyard One 7500 JEFFERSON NE Albuquerque NEW MEXICO 87109

ENGINEERS PLANNERS PHOTOGRAMMETRISTS SURVEYORS SOFTWARE DEVELOPERS

III. SCOPE OF ANALYSIS

This report discusses the hydrologic and hydraulic analysis used to determine the design of the storm drain required in Paradise Boulevard and Lyon Boulevard. This report includes a hydrologic analysis for the 100-year storm runoff that flows to one of four locations: a pond park, Irving Boulevard, Paradise Boulevard, or Lyon Boulevard. The Arid-lands Hydrologic Model (AHYMO) computer program was used to do the hydrologic analysis. See Time to Peak, AHYMO Input and AHYMO Summary Output in Appendix A. Also refer to the AHYMO Basin Summary Table 1 below.

TABLE 1
BASIN SUMMARY

Watershed	Basin	Area (ACRES)	% LAND TREATMENT* A	B	C	D	Q(100-YR) (CFS)
Piedras Marcadas	316	19.20	24.00	13.00	18.00	45.00	58
	313N	49.90	5.00	10.00	20.00	65.00	131
	314	57.00	7.00	30.00	20.00	43.00	179
	314.1	23.04	0.00	42.00	18.00	40.00	72
	312	129.28	7.20	14.10	19.60	59.10	336
	312.1	8.96	7.00	14.00	20.00	59.00	31
Calabacillas	101	32.60	7.00	14.00	20.00	59.00	100
	105	13.44	7.00	14.00	20.00	59.00	47
	105.1	5.76	7.00	14.00	20.00	59.00	20
	107	42.88	7.00	14.00	20.00	59.00	116
	108	6.40	7.00	14.00	20.00	59.00	22
	108.1	7.04	7.00	14.00	20.00	59.00	25

NOTES:
Obtained from Section 22.2, Hydrology of the Development Process Manual, Volume 2. Design Criteria for the City of Albuquerque, July, 1997 Table A-4 Table A-9

The hydraulic analysis is dependent upon the hydrologic analysis. In the 100-year storm event, flow exceeds the street capacities in the above mentioned streets and overflows in the direction of either the Calabacillas Arroyo or the Piedras Marcadas Arroyo. The basin flows calculated by AHYMO, minus the flow that Paradise Boulevard and Lyon Boulevard can carry were utilized in this analysis of the storm drain. Manning's equation was used determine the amount of flow (55.1 cfs) that the streets could carry at minimum slope of 0.5%. See Appendix B, Street Capacity Output and 100-Year Flow Rates. This equation calculates flow capacities in open channel systems. The dimensions of the street cross section (or open channel flow) were defined into this equation. A thorough investigation of the Hydraulic Grade Line (HGL) for the storm drain

was done. See Exhibits 2 and 3 for the plan and profile (p&p) layout of the storm drain. The size, number, and location of inlets is beyond the scope of this report.

IV. METHODOLOGY

In order to run AHYMO, the following information was required:

1. Rainfall distribution data according to geographic location. These numbers can be found in chapter 22 of the DPM.
2. Street cross-section for routing a basin peak flow through another basin
3. The Time to Peak (TP) values which can be found in Appendix A. The distance of overland, gully, and arroyo reaches were used in this spreadsheet. The slopes of these reaches were also used.
4. The lengths and slopes of the flow paths.
5. The land treatment percentages.

Upon inputting this information, AHYMO flows were determined for each basin (summarized in Table 1) and analysis points in Lyon Boulevard (identified on Exhibit 1, Drainage Basin Map). The flows obtained from AHYMO were then used for the hydraulic analysis of the streets and storm drains. See Paradise Boulevard and Lyon Boulevard Street Capacity Output and 100 Year Flow Rates in Appendix B.

V. RESULTS

The HGL has been shown on the storm drain system p&p, Exhibits 2 and 3. The HGL location is dependent upon flow rates, storm drain pipe sizes, slopes, and pressure or non-pressure conditions. Maintaining the HGL below the existing ground at all the manholes required the flow through the pipes to be non-pressurized in most instances. Large pipe sizes and deep manholes had to be utilized to maintain this non-pressure condition.

In order to maintain the HGL below existing ground throughout the system, four pipes needed to be 84" in diameter (pipes 11-14). The pipe diameter of this system could not gradually

increase in size from upstream to downstream like an ideal system. The proposed storm drain system begins at the intersection of Paradise and La Paz adjacent to Westside Middle School with a 36" pipe. The pipe sizes increase to 72" before the pond. The pipe out of the pond is 48" since the peak discharge has been reduced due to routing through the pond. The pipe sizes continue to increase to 84" then decrease to a 72" to tie to the existing 72" storm drain at the intersection of Irving Boulevard and Lyon Boulevard that outflows to Swinburne Dam. See p&p, Exhibits 2 and 3.

Also, in order to maintain the HGL below existing ground throughout the system, three manholes needed to be 14-18 feet deep (MH #9, #10, and #11). The deep manholes were necessary to obtain desirable slopes that ensured non-pressurized conditions within the pipe to keep the HGL below ground. See the p&p Exhibits 2 and 3 for additional storm drain information.

Since the storm drain was determined to require non-pressurized conditions throughout the system to keep the HGL below ground, Manning's equation could be applied to obtain the HGL of this system. Manning's equation provides normal depths for non-pressurized systems. These normal depths have been plotted as the HGL of the system. See HGL Based on Mannings Equation, Appendix C.

Pressurized system HGL's were calculated in a spreadsheet that follows the City of Albuquerque method given in the DPM. These calculations are not included in this report since a non-pressure system is needed.

VI. COST ESTIMATE

A conceptual cost estimate for the storm drain was prepared and is included in Table 2. The estimate is based on quantities from the conceptual storm drain design and the COA's "Unit Prices for Contract Items", dated Summer, 1998. The items included this estimate include pavement removal and replacement, pipeline, manholes, trenching, and basalt rock removal. Because inlets are beyond the scope of this analysis, they have not been included in the estimate. A 30% contingency has been applied in the estimate. The conceptual design construction cost total was $2,692,166.00.

TABLE 2 - STORM DRAIN IN PARADISE AND LYON - CONCEPTUAL DESIGN COST ESTIMATE

ITEM #	SHORT DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST
910.018	REM&REPL AC PVMT.	18900	SY	$23.00	$434,700.00
910.018	33" RCP, IV	500	LF	$42.50	$21,250.00
910.022	48" RCP, IV	1000	LF	$70.00	$70,000.00
910.028	60" RCP, IV	500	LF	$107.00	$53,500.00
910.028	66" RCP, IV	500	LF	$135.00	$67,500.00
910.030	72" RCP, IV	3350	LF	$130.00	$435,500.00
910.033	84" RCP, IV	1350	LF	$185.00	$249,750.00
701.110	TRCH, BF,18-36" SWR,8-12'	500	LF	$15.00	$7,500.00
701.150	TRCH, BF, 42"-60" SWR, <8'	500	LF	$22.00	$11,000.00
701.160	TRCH, BF, 42"-60" SWR, 8'-12'	1000	LF	$25.00	$25,000.00
701.200	TRCH, BF, > 60" SWR, 8'-12'	3550	LF	$35.00	$124,250.00
701.210	TRCH, BF, > 60" SWR, 12'-16'	1350	LF	$39.00	$52,650.00
701.220	TRCH, BF, > 60" SWR, 16'-20'	200	LF	$62.00	$12,400.00
1020.00X	BASALT ROCK REMOVAL	6400	CY	$65.00	$416,000.00
920.210X	MH, TEE TYPE	14	EA	$5,500.00	$77,000.00
920.210	MH, 8'DIA, C or E, 6'-10' D	3	EA	4,300.00	$12,900.00
					==========
				SUB TOTAL	$2,070,900.00
				APPROX 30% CONTINGENCIES	$621,300.00
				CONCEPTUAL DESIGN CONSTRUCTION COST	$2,692,200.00

VII. SUMMARY

This conceptual design analysis report presented the hydrologic and hydraulic analysis for the proposed storm drain in Paradise Boulevard and Lyon (Unser) Boulevard. This analysis ensures proper sizing and location of the portion of storm drain system to be constructed with the proposed Westside Middle School. Furthermore, it will serve as a guide for the design of the remainder of the downstream system. This storm drain system is designed to transport the 100-year peak flow that cannot be maintained within the streets to the Calabacillas Arroyo just downstream of the of the Swinburne Dam.

TIME TO PEAK

Storm Drain in Paradise Blvd and Lyon Blvd

Calculation of Time to Peak

Revised DPM procedure

Description	Var.	Unit	313N	316	314	314.1	312	312.1	101	105	105.1	108.1	108	107
Basin														
Basin Area		Acres												
Total Reach	L	Feet	3500.0	1350.0	400.0	450.0	6100.0	950.0	3700.0	1400.0	1000.0	1300.0	1400.0	3500.0
Overland Reach	L1	Feet	300.0	400.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	200.0	400.0
Overland K	K1		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overland Slope	S1	Percent	2.35	2.10	3.60	22.00	2.50	2.11	20.00	11.90	26.30	21.00	1.67	1.87
Adj. Overland Slope	S1'	Percent	2.350	2.100	3.600	6.646	2.500	2.110	6.519	5.993	6.920	6.583	1.670	1.870
Gully Reach	L2	Feet	400.0	950.0	400.0	0.0	0.0	0.0	400.0	0.0	800.0	0.0	0.0	0.0
Gully K	K2		3	2	2	2	2	2	2	2	2	2	2	2
Gully Slope	S2	Percent	1.000	4.690	3.910	4.690	4.690	6.090	1.940	3.590	9.690	11.100	8.810	5.250
Adj. Gully Slope	S2'	Percent	1.000	4.569	3.910	4.569	4.569	5.227	1.940	3.590	5.820	5.935	5.733	4.892
Arroyo Reach	L3	Feet	2800.0	0.0	0.0	450.0	6000.0	950.0	3300.0	1400.0	200.0	1300.0	1200.0	3100.0
Arroyo K	K3		3	3	3	3	3	3	3	3	3	3	3	3
Arroyo Slope	S3	Percent	1.000	4.250	0.600	2.000	2.500	2.110	1.940	2.640	3.600	3.600	1.670	1.870
Adj. Arroyo Slope	S3'	Percent	1.140	4.233	0.600	2.000	2.500	2.110	1.940	2.640	3.600	3.600	1.670	1.870
Lca	Lca	Feet					2200.0							
Base Discharge	Qb	cfs		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ground Slope S	S	Percent	1.116	3.923	3.910	2.000	2.500	2.110	1.940	2.640	8.472	3.600	1.670	1.870
Adjusted Slope S'	S'	Percent	1.116	3.923	3.910	2.000	2.500	2.110	1.940	2.640	5.693	3.600	1.670	1.870
K	K		2.461	1.111	2.000	3.000	2.847	3.000	2.846	3.000	2.100	3.000	2.042	2.181
K'	K'		2.575	1.106	2.000	3.000	2.847	3.000	2.846	3.000	2.086	3.000	2.042	2.181
K''	K''		0.000	3.493	3.499	4.892	4.376	4.763	4.967	4.258	2.899	3.646	5.354	5.059
K'''	K'''		0.000	2.394	2.398	3.353	2.999	3.265	3.405	2.919	1.987	2.499	3.670	3.468
Kn	Kn		0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Orig. TC	TC	Hrs.	0.374	0.170	0.028	0.029	0.347	0.061	0.259	0.080	0.045	0.063	0.147	0.326
Adjusted TC	TC'	Hrs.	0.374	0.170	0.028	0.029	0.347	0.061	0.259	0.080	0.055	0.063	0.147	0.326
Time Lag	Lg	Hrs.	-	-	-	-	-	-	-	-	-	-	-	-
Time to Peak	TP	Hrs.	0.249	0.133	0.133	0.133	0.231	0.133	0.173	0.133	0.133	0.133	0.133	0.217

Notes:

1. Basins without an entry for base discharge have a wieghted slope of less than 4% therefore do not require this value.
2. For basins with a total reach length less than 1600 ft, an arroyo slope is required, but not used, in this spread sheet.
3. For basins with a total reach length less that 400 ft, a gully slope is also required but not used.
4. For basins with a total reach length of 4000ft or more an Lca is needed.

STREET CAPACITY OUTPUT - PARADISE AND LYON (UNSER) BOULEVARD

***** PC PROGRAM STREAM SEPTEMBER 1994 *****

.5%slope Paradise

MANNING'S N= .013 SLOPE= .005

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1	0.00	0.67	4	25.00	1.00	7	88.00	0.00
2	0.00	0.00	5	63.00	1.00	8	88.00	0.67
3	25.00	0.50	6	63.00	0.50	9	0.00	0.00

WSEL	DEPTH INC	FLOW AREA	FLOW RATE	WETTED PER	FLOW VEL	TOPWID	VEL HEAD	ENERGY HEAD
(FT)	(FT)	SQ.FT.	(CFS)	(FT)	(FPS)	(FT)	(FT)	(FT)
0.10	0.10	0.50	0.5	10.20	1.08	10.00	0.02	0.12
0.20	0.20	2.00	3.4	20.40	1.72	20.00	0.05	0.25
0.30	0.30	4.50	10.1	30.61	2.25	30.00	0.08	0.38
0.40	0.40	8.00	21.8	40.81	2.73	40.00	0.12	0.52
0.50	0.50	12.50	39.6	51.01	3.17	50.00	0.16	0.66
0.60	0.60	17.50	69.0	51.41	3.94	50.00	0.24	0.84
0.67	0.67	21.00	93.1	51.69	4.43	50.00	0.31	0.98

SEE FLOWS ALONG PARADISE BOULEVARD NEXT PAGE.

Flows along Paradise (to pond)

MH 22

Q_{100} from contributing basins $= Q_{316} + Q_{313N}(1/2)$

$= 57.82 + 1/2\,(130.63)$

$= 123.14$

As shown in the Street Capacity output,

$Q_{STREET} = 51.69$ cfs

$Q_{pipe} = 123.14 - 51.69 = \underline{55.34 \text{ cfs}}$

MH 21

Q_{100} from basins $= 1/8\,313N + 1/3\,(314) = 1/3\,(130.63) + 178.64\,(1/3)$

$= 16.3 + 58.95$

$= 75.28$ cfs

$Q_{pipe} = 75.3 + 55.34 = \underline{130.64 \text{ cfs}}$

MH 20

Q_{100} from basins $= 1/8\,313N + 1/3\,(314)$

$= 1/8\,(130.63) + 178.64\,(1/3)$

$= 75.28$ cfs

$Q_{pipe} = 75.3 + 130.64 = \underline{205.94 \text{ cfs}}$

MH 19

Q_{100} from basins $= 1/8\,313N + 1/3\,(314) = 75.3$ cfs

$Q_{pipe} = 75.3 + 205.94 = 281.24$ cfs

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PROJECT NAME Lyon (Unser) / Paradise SHEET 1 OF 2

PROJECT NO. 99491 SD BY CG DATE 8/99

SUBJECT Flow along Paradise to Pond CHD DATE

Flows along Paradise (to pond) continuation

MH 18

Q from basins = 1/8 313N

= 16.3 cfs

Q_{pipe} = 281.24 + 16.3 = 297.54 cfs

Q directly to pond = 314.1 - routing = 56.81 cfs

$Q_{TOTAL\ in\ pond}$ = 354.35 cfs

Bohannan ▲ Huston

PROJECT NAME Lyon (Unser)/Paradise SD SHEET 2 OF 2
PROJECT NO. 99491 BY CG DATE 10/9
SUBJECT Flow along Paradise to Pond CH'D DATE

HGL BASED ON MANNINGS EQUATION
HGL - Normal Depths (Unpressurized System)
n = 0.013

Pipe ID#	Actual Slp	Diameter (in)	Flow (cfs)	Normal Depth (ft)
1	0.0147	33.00	55	2.0
2	0.0026	60.00	131	4.0
3	0.0041	72.00	206	3.9
4	0.0045	72.00	281	4.9
5	0.0051	72.00	298	4.8
6	0.0096	48.00	107	2.6
7	0.0303	48.00	107	1.8
8	0.0095	66.00	275	3.9
9	0.0043	72.00	275	4.9
10	0.0181	72.00	396	3.7
11	0.0039	84.00	396	5.7
12	0.0039	84.00	396	5.7
13	0.0046	84.00	427	5.7
14	0.0046	84.00	427	5.7
15	0.0276	72.00	434	3.4
16	0.0202	72.00	534	4.4
17	0.0301	72.00	546	3.9
18	0.0278	72.00	546	4.0
19	0.0622	72.00	546	3.1
20	0.0543	72.00	546	3.2
21	0.0840	72.00	546	2.8
22	0.0967	72.00	546	2.7
23	0.0808	72.00	546	2.8

WESTSIDE MID. SCHOOL B-10/D-4

Wsms.out

***** PC PROGRAM STREAM SEPTEMBER 1994 *****

DOWNSTREAM OF CULVERT

INPUT DATA:

MANNING'S N= .03 SLOPE= .0125

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1	0.00	1.00	3	58.00	1.00			
2	55.00	0.00	4	0.00	0.00			

OUTPUT DATA:

WSEL (FT)	DEPTH INC (FT)	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID (FT)	VEL HEAD (FT)	ENERGY HEAD (FT)
0.25	0.25	1.81	2.5	14.54	1.38	14.50	0.03	0.28
0.50	0.50	7.25	15.9	29.09	2.19	29.00	0.07	0.57
0.75	0.75	16.31	46.9	43.63	2.87	43.50	0.13	0.88
1.00	1.00	29.00	101.0	58.17	3.48	58.00	0.19	1.19

THE 100 YR FLOW THRU THE CULVERTS AT THE NE CORNER OF THE SITE IS ESTIMATED AT 30cfs (less than ½ of the Drng basin identified in the Paradise Blvd Storm Drain Design Analysis Report).

The velocity is much less than 3.0 cfs - the generally accepted erosive velocity for sandy soils.

Bruce S.
12/10/99