FINAL DRAINAGE REPORT

For

Stone Mountain Estates Subdivision

Developer:

Stone Mountain Holdings, LLC.
9647 E. Sutton Drive
Scottsdale, AZ 85260

Prepared By:
LANDesign LLC
259 Grand Avenue
Grand Junction, Colorado 81501
(970) 245-4099

August 11, 2000

I hereby certify that this report was prepared by myself.

Brian C. Hart
Colorado P.E. #34735

Table of Contents

I. General Location and Description

A. Site and Major Basin Location

Stone Mountain Estates Subdivision (SME) is located in the south Fruita area south of Interstate 70. The project is accessed via 17½ Road (Maple Street) and the Frontage Road of I-70. More specifically, the project parcel numbers are, 2697-201-00-012, 017 and 093. The project can also be described as being in the West ½ of the NW¼ of the NE¼ of Section 20, Township 1 North and Range 2 West of the Ute Meridian. Exhibit 1 shows the general location of the proposed project.

Streets in the vicinity include 17½ Road to the west and the I-70 Frontage Road to the north.

There are two major basins near the property. Little Salt Wash is located to the northwest of the subject property and Adobe Creek is located to the southeast of the subject property.

B. Site and Major Basin Description

The site is approximately 31.24 acres and is currently vacant with varying types of vegetation ranging from bare ground and short grass and weeds to few trees. Exhibit 2 shows the general topography of the site and surrounding area. The property can be described as flat in nature with an average slope of less than 1.0 percent to the southwest. The property does not have a recent agricultural past.

The surrounding land use in the vicinity of the project is considered to be low intensity. Subdivisions in the area include Greenbriar Estates directly north, Peter Drive Condominiums to the west and Red Cliffs Mobile Home Village one-half mile to the west. Commercial property is located to the northwest at I-70 and State Highway 340. Adobe Creek Golf Course is located southeast of the project.

The soils located on the site are described as Ravola clay loam, 0-2% slopes (Ra), Ravola fine sandy loam, 0-2% slopes (Rc) and Billings silty clay loam 0-2% slopes (Bc). The Ravola soils is defined as a hydro-group 'B' soil and the Billings soils is defined as a hydro-group 'C' soil. For the purposes of this report, a hydro-group 'C' soil will be assumed for the entire property. Exhibit 3 (Reference 3) shows the soil map subject property.

The property does not drain to either of the major basins mentioned in section I-A. Instead, this property is located in a small basin that is between Little Salt Wash and Adobe Creek. This basin seems to include area between Murray Drain (located east of the property) and the Arcuby Drain, which is the jurisdiction of the Grand Junction Drainage District. The southern extents of the downtown area of Fruita and a small area of I-70 drain towards the Arcuby Drain. The Arcuby Drain flows directly to the Colorado River approximately one-quarter mile to the south of the project. It is estimated that the basin size is approximately 400 acres. For the purposes of this report, the major basin will be named the Arcuby Drain Basin.

The SME property is located within Zone X as indicated on the FEMA Flood Insurance Rate Map 3 of 4 for the Town of Fruita and is shown on Exhibit 4.

II. Existing Drainage Conditions

A. Major Basin

The Arcuby Drain is the main conveyance feature in the Arcuby Drain basin and is controlled by the Grand Junction Drainage District. The drain's primary purpose is to collect and convey groundwater and irrigation tailwater. The drain runs from I-70 south along 17½ Road to the Colorado River.

Large acreage parcels and homesteads are the most common land use in the basin, but land uses also include a small portion of south downtown Fruita, traditional single family subdivisions and a short length of I-70.

An informal analysis of this area was performed by Williams Engineering in conjunction with an area wide study with the Fruita area. The report is entitled "Stormwater Management Master Plan for the City of Fruita, June 1998". This study refers to this area as the southwest Fruita area and Exhibit 5 shows the studies map of the area. No drainage problems for the basin were mentioned in this report and only two short sections of pipe exist downstream of the subject property. These sections can be described as crossings, one for a private driveway and the second for crossing the drain to the east side of 17½ Road at I½ Road. The first crossing is a 24-inch pipe and the second is a 30-inch concrete pipe. From I½ Road, the drain flows free to the river. The 100-year

event along the Colorado River is encountered 1/8-mile south of I½ Road.

B. Site

The SME property has two historic drainage basins, H1 and H2. The northwest basin, H1, flows southwest towards the Arcuby Drain and the southeast basin, H2, flows southwest then west towards the Arcuby Drain. All irrigation ditches were ignored in the analysis of each basin as required by the SWMM in section I.A.4.a, page I-3. It should be noted that stormwater generated on-site is blocked from free conveyance to the Arcuby Drain by an irrigation ditch and 17½ Road. However, for the purpose of this report, the irrigation ditch was ignored as a conveyance element as required. In addition, 17½ Road does not have a significant crown as is typical with many rural-type roads in the Mesa County area. Therefore, it has been assumed that once stormwater reaches the southwest corner of the site, it travels west across 17½ Road to the Arcuby Drain. A Pre-Development Drainage Map is included with this report. This map shows the basins, flow paths and historic drainage flow rates. Exhibits 7-10 show the time of concentration and flow calculations for basins H1 and H2.

The groundcover is the same for both basins and can be described as pasture area ranging from bare ground to short grasses and weeds with a few trees. Exhibit 6 shows the 'C' values taken from Table B-1 of the SWMM.

There is no area that contributes a significant amount of offsite stormwater to the subject property. The area north of the SME property includes Greenbriar Estates that drains directly west and a neighboring 2-acre parcel that mainly drains southwest. Some of the property does drain southwest into the subject property and has been accounted for in the historic calculations. An elevated irrigation ditch prevents runoff from entering the property from the east. The area south of the property drains to the south away from the property. The land west drains south away from the property and is separated from the subject property by the Arcuby Drain.

III. Proposed Drainage Conditions

A. Changes in Drainage Patterns

The historic drainage patterns will not be changed from those described in Section II-B of this report.

B. Maintenance Issues

The maintenance of the surface drainage elements located within the street right-of-way will be the responsibility of the City of Fruita Public Works Department.

IV. Design Criteria & Approach

A. General Considerations

This drainage report has been prepared for the Stone Mountain Estates Final Plan and Plat application to the City of Fruita. The only drainage report that has been performed for the area has been the previously mentioned Williams Study of the Fruita area. This study does not affect the SME property other than it gives general drainage patterns for the area south of I-70.

This project and the planned drainage design conforms to the Mesa County Stormwater Management Manual (SWMM). Therefore, the master planning issues for drainage in the area is considered addressed, as the project will not impact the area more than historic conditions.

Constraints around the property include the varying topography, existing irrigation ditches and the Arcuby Drain.

B. Hydrology

The Mesa County Stormwater Management Manual (SWMM) was used for the preparation of this Final Drainage Report. The design storms are defined in the SWMM as the 2-year and 100-year events. As the site is within the Grand Valley area, the Grand Valley area precipitation information was used and is outlined within the SWMM. The rational method was used to analyze the hydrology for onsite and offsite basins.

As stated earlier, there are two onsite basins, H1 and H2. Exhibits 7 and 8 shown the calculations for the time of concentration and peak flow for basin H1 and Exhibits 9 and 10 show the same calculations for basin H2. Basin H1 has a peak 2-year flow of 2.29 cfs and a 100-year peak flow of 11.41 cfs. Basin H2 has a peak 2-year flow of 1.0 cfs and a 100-year peak flow of 4.98 cfs.

There are 8 developed basins for the ultimate development of the entire project. A Post-Development Drainage Map is included in the appendix that shows the information for each basin. Exhibit 11 shows the developed 'C' values taken from Table B-1 of the SWMM for the developed calculations.

The basin sizes and corresponding 2-year and 100-year flows for each developed basin are as follows. Basin D1 is 1.58 acres and has a 2-year flow of 0.46 cfs and a 100-year flow of 2.36 cfs. Basin D2 is 6.07 acres and has a 2-year flow of 1.7 cfs and a 100-year flow of 8.71 cfs. Basin D3 is 1.06 acres and has a 2-year flow of 0.36 cfs and a 100-year flow of 1.86 cfs. Basin D4 is 7.71 acres and has a 2-year flow of 1.89 cfs and a 100-year flow of 9.62 cfs. Basin D5 is 0.78 acres and has a 2-year flow of 0.25 cfs and a 100-year flow of 1.26 cfs. Basin D6 is 0.81 acres and has a 2-year flow of 0.25 cfs and a 100-year flow of 1.31 cfs. Basin D7 is 4.29 acres and has a 2-year flow of 0.99 cfs and a 100-year flow of 5.05 cfs. Basin D8 is 8.39 acres and has a 2-year flow of 2.05 cfs and a 100-year flow of 10.45 cfs.

Normally, development projects that are designed in accordance with the Mesa County SWMM are required to utilize a detention pond to control increases in stormwater runoff. In the case of SME, the distance to the 100-year floodplain of the Colorado River is approximately one-half mile. The Preliminary Plan application for this project received direction by the former Fruita Engineer to *not* detain any stormwater. The reason for this is to route the stormwater from the site, to the Arcuby Drain and to the river as quickly as possible. The only question then becomes can the Arcuby Drain convey the increase in stormwater. The answer is yes, but two culverts, one at a driveway and one at I½ Road, must be replaced with larger culverts. The Grand Junction Drainage District and the new Fruita Engineer have agreed with this concept. For the reasons mentioned above, there is no detention pond provided for this project.

C. Hydraulics

There are three groups of conveyance elements: street curb and gutter, offsite culvert improvements and the onsite storm sewer. Each element has been hydraulically analyzed and the results are outlined below.

There are two street curb and gutter sections that are used for this project. The local residential street section at one-half percent will allow 9 cfs for half-street flow for the 2-year event according to

Figures G-3 and G-5 of the SWMM. This project has no street section that will be subject to that amount of 2-year flow. However, the residential collector street section only allows a 2-year flow of approximately 2.7 cfs. This is shown on Exhibits 28-30. The street profiles and stormwater inlets for the project have been designed to limit the 2-year flow to the allowable inundation limits as shown on figure G-3 of the SWMM.

The Arcuby Drain has two culvert crossings that must be replaced with larger pipe to accept the increase in stormwater from the project as described in section IV, paragraph five of this report. The first culvert is located approximately 125 feet south of the southwest corner of the site. The current culvert is a 24-inch in size and the capacity calculations are shown on Exhibits 31-32. Exhibit 31 calculates the existing depth of flow to establish the tailwater depth needed for the nomograph calculation for capacity shown on Exhibit 32. This process is repeated for the proposed culvert replacement at the driveway shown on Exhibits 33 and 34 and the existing culvert and its replacement under I½ Road, shown on Exhibits 35-38.

The storm sewer for Filing One is located in Kaley Drive and will serve the southern half of the overall development. The storm sewer was designed based on the basin size it serves as well as the time of concentration, Rational 'C' value and precipitation data provided by the SWMM. The storm sewer is sized for the developed 100-year runoff. Exhibits 39-44 show a schematic of the storm sewer, the tabulated results of the calculations and profiles of certain sections of the storm sewer.

Storm sewer will be required in future filings of this project. Calculations for the future storm sewer have not been included with this report, as no design has been finalized.

V. Results and Conclusions

A. Runoff rates for 2 and 100 Year Storms

Existing Total Onsite Runoff Rates:

Basin H1
2-Year = 2.29 cfs
100-Year = 11.41 cfs

Basin H2
2-Year = 1.0 cfs
100-Year = 4.98 cfs

Sum of 100-year Historic Flows = 16.39 cfs

Proposed Total Site Runoff Rates:

Basin D1
2-Year = 0.46 cfs
100-Year = 2.36 cfs

Basin D2
2-Year = 1.7 cfs
100-Year = 8.71 cfs

Basin D3
2-Year = 0.36 cfs
100-Year = 1.86 cfs

Basin D4
2-Year = 1.89 cfs
100-Year = 9.62 cfs

Basin D5
2-Year = 0.25 cfs
100-Year = 1.26 cfs

Basin D6
2-Year = 0.25 cfs
100-Year = 1.31 cfs

Basin D7
2-Year = 0.99 cfs
100-Year = 5.05 cfs

Basin D8
2-Year = 2.05 cfs
100-Year = 10.45 cfs

Sum of 100-year Developed Flows = 40.62 cfs

Difference in Historic and Developed Flows = 24.23 cfs
(Size offsite culverts to convey this additional flow)

B. Overall Compliance

This report followed the Mesa County Stormwater Management Manual for drainage design, policy and criteria.

C. Report Limits

This report was completed for the submittal of the Final Plan and Plat for Stone Mountain Estates Subdivision, Filing One. The report encompasses the entire subject property. This report has not considered any offsite areas other than a field determination that adjacent areas do not affect the subject property.

An overall grading plan and conceptual storm sewer design for future filings have been considered in the preparation of this report. If there is any deviation from these plans, a revised drainage report must be performed.

VI. References

1. Storm Water Management Manual, (SWMM), City of Grand Junction, May 1996.

2. Flood Insurance Rate Map, City of Grand Junction, Colorado, Prepared for the City of Grand Junction, Colorado and Mesa County by the Federal Emergency Management Agency, revised 1992.

3. Soil Survey, Grand Junction Area, Colorado, Series 1940, No. 19, U.S. Department of Agriculture, issues November 1955.

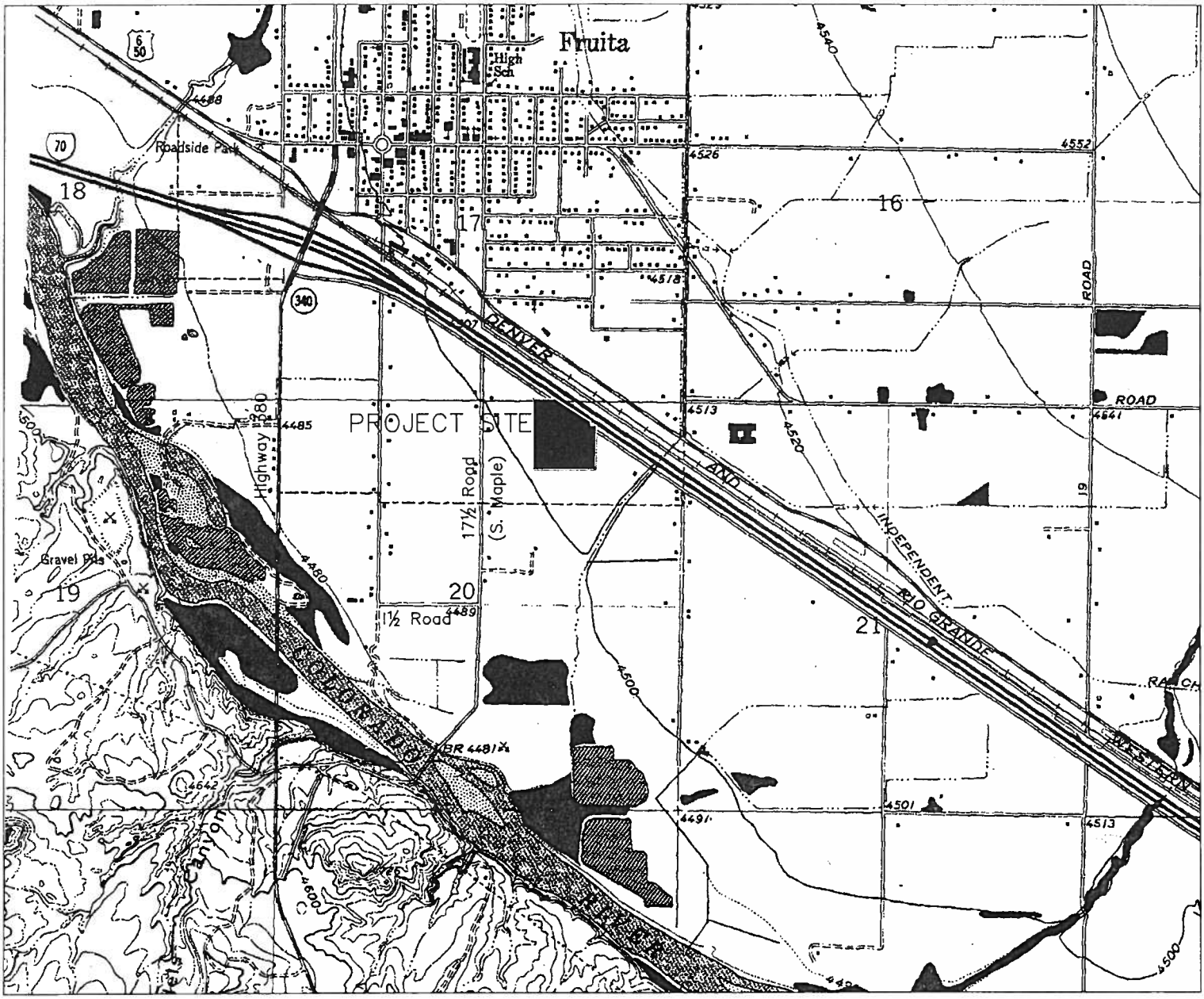
4. Flowmaster PE Version 6.0, Haestad Methods, 1998.

5. StormCAD Version 1.0, Haestad Methods, 1995.

Appendix

General Information
Historic Conditions
Developed Conditions
Conveyance Elements
Drainage Maps

General Information

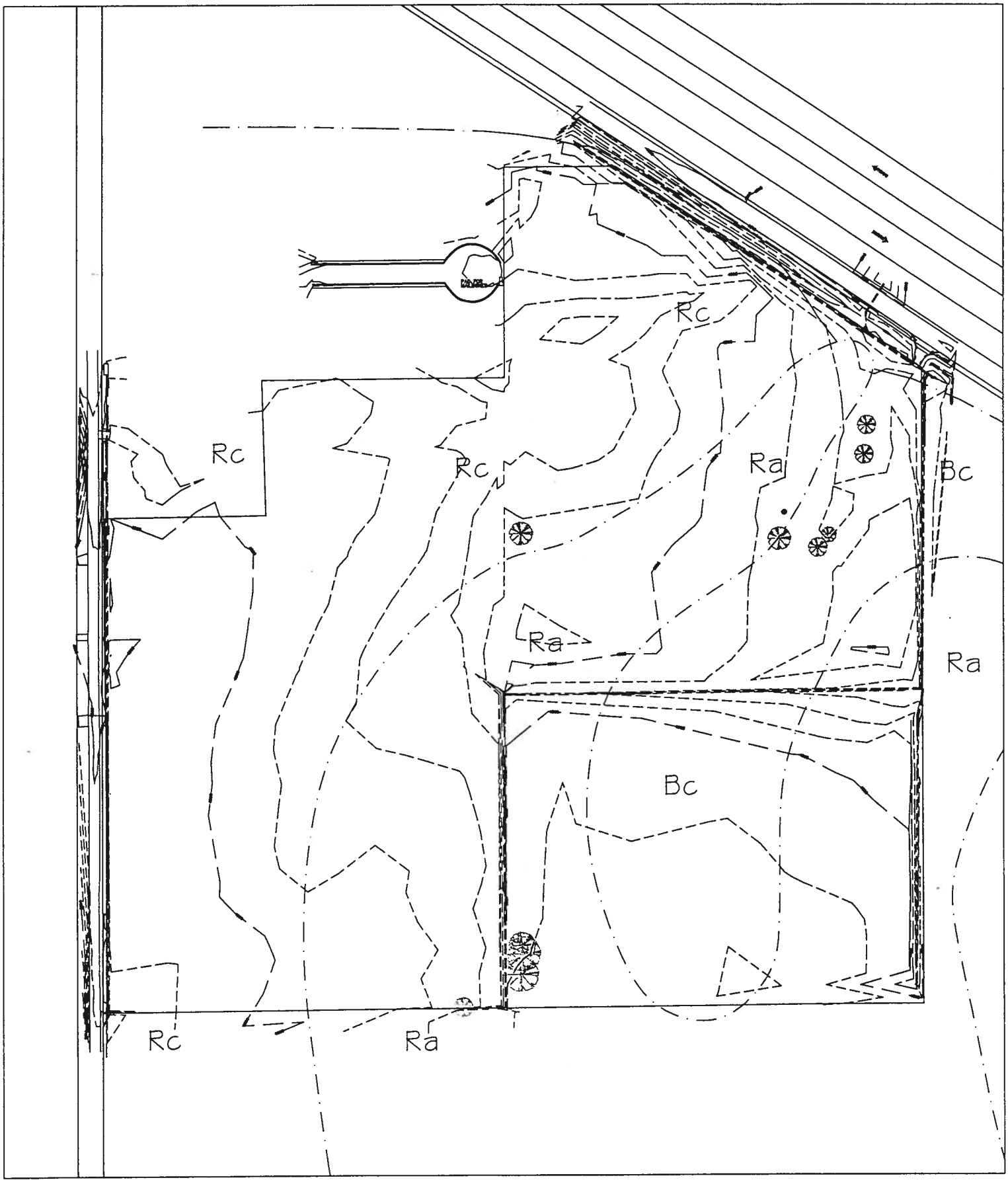


VICINITY MAP

EXHIBIT 1


50
94.7
C-13-17
4500
4500
4500
4500
07.2
4510
4510
4510
4510
4510
12.8
03.0
4510
4510
4510
4510
4510
4510
4510
4510
11.0
08.6
6
50
RIVER
07.2
ROAD
DENVER AND
07.0
09.2
14.2
70
92.2
91.2
4490
4500
96.3
4500

EXHIBIT 2



STONE MOUNTAIN SOILS MAP

EXHIBIT 3

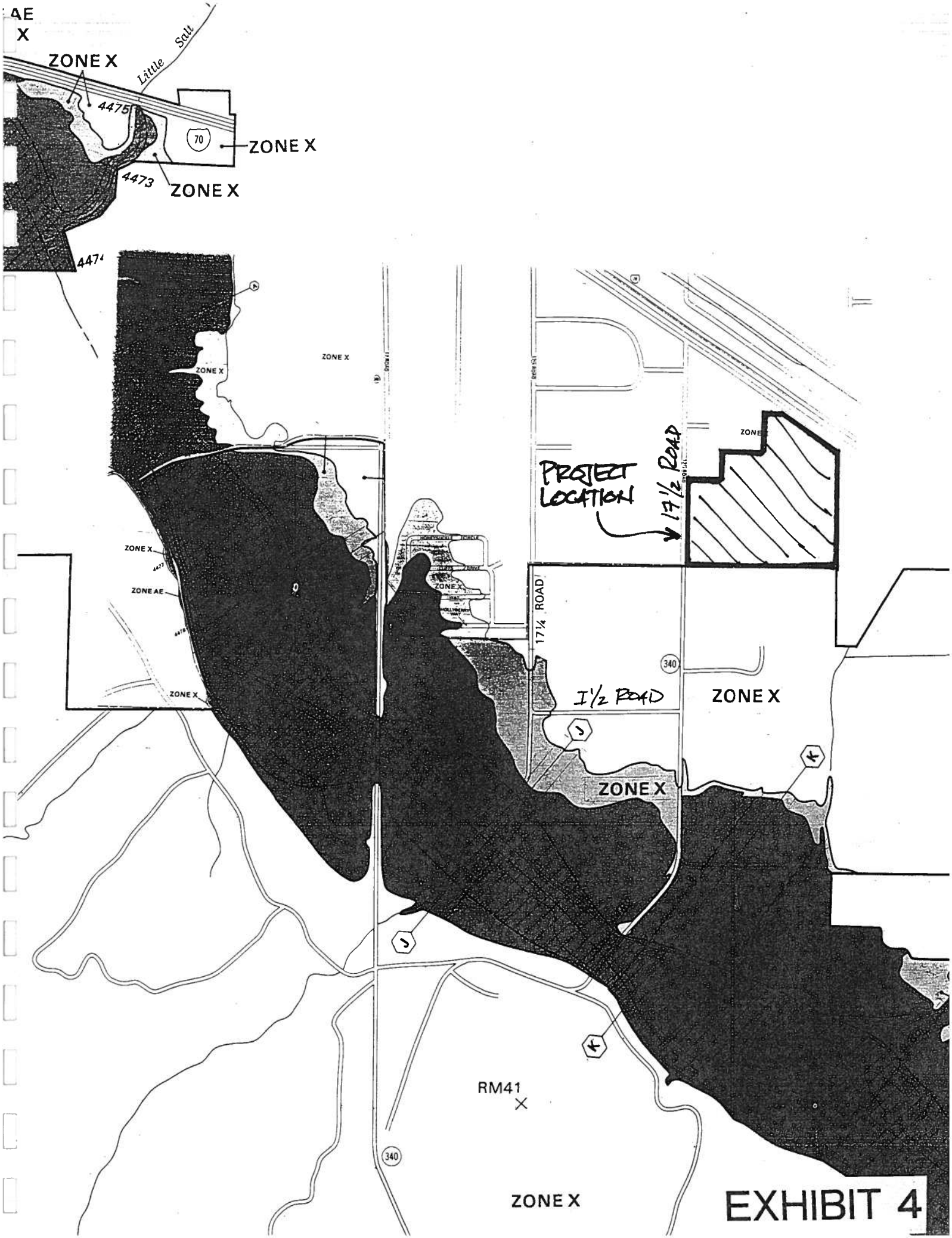
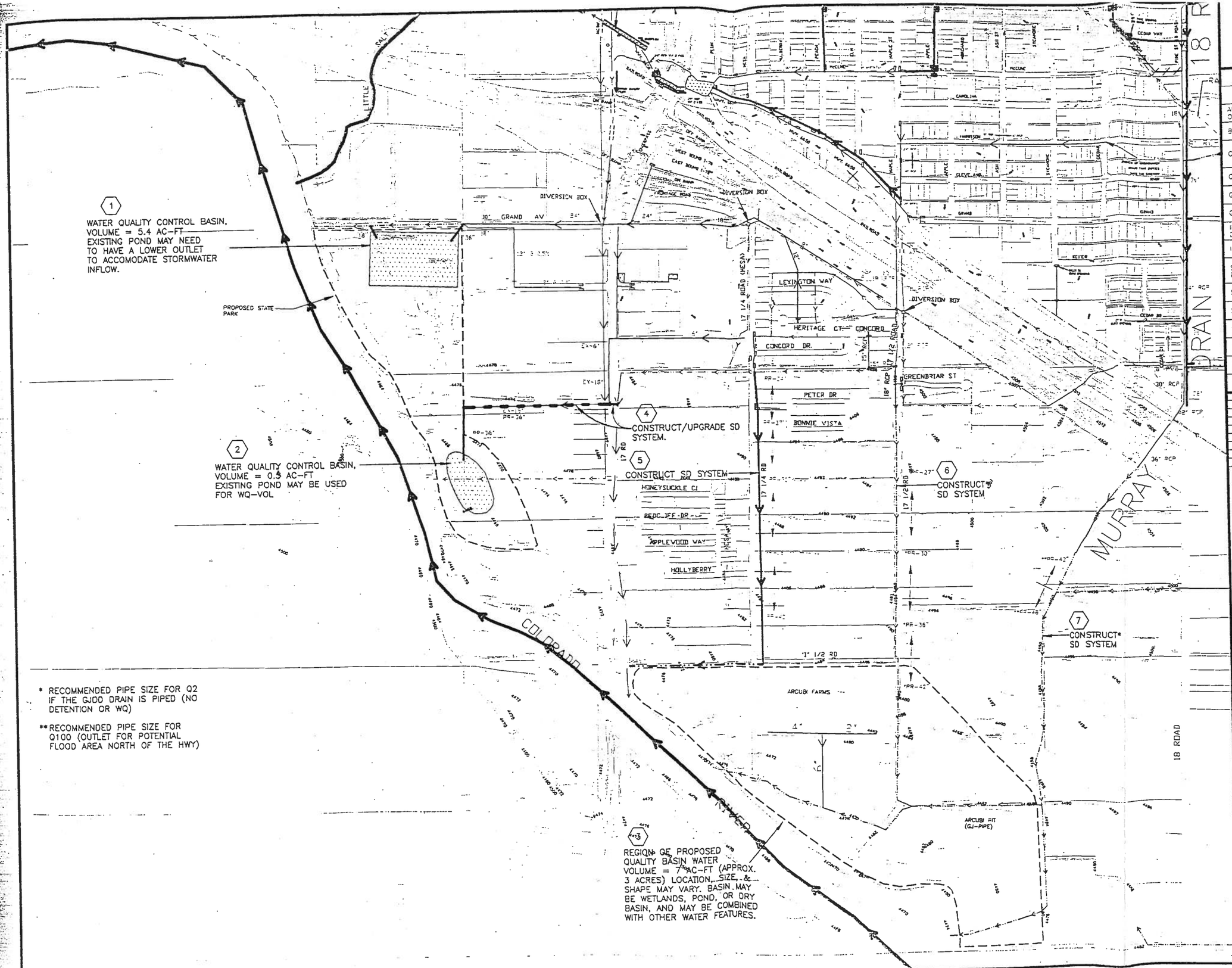

AE
X
ZONE X
Little Salt
4475
70
ZONE X
4473
ZONE X
4471
ZONE X
ZONE X
ZONE X
ZONE AE
ZONE X
ZONE X
PROJECT LOCATION
17½ ROAD
17¼ ROAD
I½ ROAD
ZONE X
340
J
K
ZONE X
RM41
340
ZONE X

EXHIBIT 4

EXHIBIT "9A"
SOUTHWEST FRUITA
2 Yr. & 100 Yr. Condition



* RECOMMENDED PIPE SIZE FOR Q2 IF THE GJDD DRAIN IS PIPED (NO DETENTION OR WQ)

** RECOMMENDED PIPE SIZE FOR Q100 (OUTLET FOR POTENTIAL FLOOD AREA NORTH OF THE HWY)

LEGEND

FACILITY	EXISTING	PROPOSED	REMOVE & REPLACE
ABANDON & PLUG OR REMOVE LINE			
BORE & CASING			
CONTOURS	(BOR 1975)		
CULVERT			
GJDD DRAIN CHANNEL			
GJDD DRAIN PIPE			
IRRIGATION CANAL/ DITCH			
IRRIGATION PIPE			
STORM DETENTION FACILITY			
STORM DRAIN CHANNEL			
STORM DRAIN PIPE			
STORM DRAIN INLET			
STORM GUTTER FLOW			
STORM OVERLAND FLOW			
STREAM, CREEK, RIVER, OR WASH			

SCHEDULE OF IMPROVEMENTS

I.D.	DESCRIPTION	PRIORITY	COST
1	CONSTRUCT WATER QUALITY SYSTEM.	4	$33,217.96
2	CONSTRUCT WATER QUALITY SYSTEM.	4	$76,734.2
3	CONSTRUCT WATER QUALITY SYSTEM.	4	$72,791.2
4	CONSTRUCT/UPGRADE SD SYSTEM.	3	$209,669.66
5	CONSTRUCT SD SYSTEM.	3	$399,380.1
6	CONSTRUCT SD SYSTEM.	5	$546,834.2
7	CONSTRUCT SD SYSTEM.	5	$507,251.8

* RECOMMENDED PIPE SIZE FOR Q2 IF THE GJDD DRAIN IS PIPED (NO DETENTION OR WQ)

** RECOMMENDED PIPE SIZE FOR Q100 (OUTLET FOR POTENTIAL FLOOD AREA NORTH OF THE HWY)

GENERAL RECOMMENDATIONS

1. IF THE GJDD 17-1/4, 17-1/2, AND 17-3/4 ROAD DRAINS ARE PIPED, THE CITY AND GJDD SHOULD COOPERATE TO CONSTRUCT A PIPELINE LARGE ENOUGH TO HANDLE BOTH GROUNDWATER AND IRRIGATION TAILWATER AND STORMWATER RUNOFF AS SHOWN.
2. DRAINAGE IMPACT FEES SHOULD BE ASSESSED TO DEVELOPMENT TO DEFRAY OUTFALL PIPELINE COSTS IF NOT DEVELOPER INSTALLED.
3. MORE SPECIFIC RECOMMENDATIONS CANNOT BE GIVEN WITHOUT A MORE DETAILED ANALYSIS FOR THIS AREA.

EXHIBIT 5

WILLIAMS ENGINEERING
1231 19 ROAD, FRUITA, COLORADO 81521-968
(970) 858-1014 PHONE (970) 858-1007 FA

GRAPHIC SCALE: (METRIC)	JOB: FR-SWMMP	DATE:
0 100 200	FILE: SW_2_100	05/27

Historic Conditions

LAND USE OR SURFACE CHARACTERISTICS	SCS HYDROLOGIC SOIL GROUP (SEE APPENDIX "C" FOR DESCRIPTIONS)											
	A			B			C			D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
UNDEVELOPED AREAS												
Bare ground	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .40 - .48	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Cultivated/Agricultural	.08 - .18 .14 - .24	.13 - .23 .18 - .28	.16 - .26 .22 - .32	.11 - .19 .16 - .24	.15 - .23 .21 - .29	.21 - .29 .28 - .36	.14 - .22 .20 - .28	.19 - .27 .25 - .33	.26 - .34 .34 - .42	.18 - .26 .24 - .32	.23 - .31 .29 - .37	.31 - .39 .41 - .49
Pasture	.12 - .22 .15 - .25	.20 - .30 .25 - .35	.30 - .40 .37 - .47	.18 - .26 .23 - .31	.28 - .36 .34 - .42	.37 - .45 .45 - .53	.24 - .32 .30 - .38	.34 - .42 .42 - .50	.44 - .52 .52 - .60	.30 - .38 .37 - .45	.40 - .48 .50 - .58	.50 - .58 .62 - .70
Meadow	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .44 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Forest	.05 - .15 .08 - .18	.08 - .18 .11 - .21	.11 - .23 .14 - .24	.08 - .16 .10 - .18	.11 - .20 .14 - .22	.14 - .24 .18 - .28	.10 - .18 .12 - .20	.13 - .21 .16 - .24	.16 - .24 .20 - .28	.12 - .20 .15 - .23	.16 - .24 .20 - .28	.20 - .28 .25 - .33
RESIDENTIAL AREAS												
1/8 acre per unit	.40 - .50 .48 - .58	.43 - .53 .52 - .62	.45 - .55 .54 - .64	.37 - .45 .45 - .53	.40 - .48 .48 - .58	.42 - .50 .50 - .60	.45 - .53 .53 - .61	.48 - .56 .57 - .65	.53 - .61 .64 - .72	.48 - .56 .56 - .64	.51 - .59 .60 - .68	.57 - .65 .69 - .77
1/4 acre per unit	.27 - .37 .35 - .45	.31 - .41 .39 - .49	.34 - .44 .42 - .52	.29 - .37 .36 - .45	.34 - .42 .42 - .50	.38 - .46 .46 - .54	.32 - .40 .41 - .49	.36 - .44 .45 - .53	.41 - .49 .52 - .60	.35 - .43 .43 - .51	.39 - .47 .47 - .55	.45 - .53 .57 - .65
1/3 acre per unit	.22 - .32 .31 - .41	.26 - .36 .35 - .45	.30 - .40 .38 - .48	.25 - .35 .33 - .41	.29 - .37 .38 - .46	.33 - .41 .42 - .50	.28 - .36 .36 - .44	.32 - .40 .41 - .49	.37 - .45 .48 - .56	.31 - .39 .39 - .47	.35 - .43 .43 - .51	.42 - .50 .53 - .61
1/2 acre per unit	.16 - .26 .25 - .35	.20 - .30 .29 - .39	.24 - .34 .32 - .42	.19 - .27 .28 - .36	.23 - .31 .32 - .40	.28 - .36 .36 - .44	.22 - .30 .31 - .39	.27 - .35 .35 - .43	.32 - .40 .42 - .50	.26 - .34 .34 - .42	.30 - .38 .38 - .46	.37 - .45 .48 - .56
1 acre per unit	.14 - .24 .22 - .32	.19 - .29 .26 - .36	.22 - .32 .29 - .39	.17 - .25 .24 - .32	.21 - .29 .28 - .36	.26 - .34 .34 - .42	.20 - .28 .28 - .36	.25 - .33 .32 - .40	.31 - .39 .40 - .48	.24 - .32 .31 - .39	.29 - .37 .35 - .43	.35 - .43 .46 - .54
MISC. SURFACES												
Pavement and roofs	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97
Traffic areas (soil and gravel)	.55 - .65 .65 - .70	.60 - .70 .70 - .75	.64 - .74 .74 - .79	.60 - .68 .68 - .76	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.69 - .77 .77 - .85	.72 - .80 .79 - .87	.75 - .83 .82 - .90	.77 - .85 .84 - .92
Green landscaping (lawns, parks)	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .42 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Non-green and gravel landscaping	.30 - .40 .34 - .44	.36 - .46 .42 - .52	.45 - .55 .50 - .60	.45 - .55 .50 - .60	.42 - .50 .48 - .56	.50 - .58 .57 - .65	.40 - .48 .46 - .54	.48 - .56 .55 - .63	.56 - .64 .64 - .72	.44 - .52 .50 - .58	.50 - .58 .60 - .68	.60 - .68 .70 - .78
Cemeteries, playgrounds	.20 - .30 .24 - .34	.26 - .36 .32 - .42	.35 - .45 .40 - .50	.35 - .45 .40 - .50	.32 - .40 .38 - .46	.40 - .48 .47 - .55	.30 - .38 .36 - .44	.38 - .44 .45 - .53	.46 - .54 .54 - .62	.34 - .42 .40 - .48	.40 - .48 .50 - .58	.50 - .58 .60 - .68

HISTORIC "C" VALUES:
2 YEAR - 0.26
100 YEAR - 0.32

NOTES:
1. Values above and below pertain to the 2-year and 100-year storms, respectively.
2. The range of values provided allows for engineering judgement of site conditions such as basic shape, homogeneity of surface type, surface depression storage, and storm duration. In general, during shorter duration storms (Tc ≤ 10 minutes), infiltration capacity is higher, allowing use of a "C" value in the low range. Conversely, for longer duration storms (Tc) 30 minutes), use a ""C value in the higher range.
3. For residential development at less than 1/8 acre per unit or greater than 1 acre per unit, and also for commercial and industrial areas, use values under MISC SURFACES to estimate "C" value ranges for use.

RATIONAL METHOD RUNOFF COEFFICIENTS
(Modified from Table 4, UC-Davis, which appears to be a modification of work done by Rawls)

TABLE "B-1"

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: H1 - Historic on-site
Historic Conditions
Flowing to: Southwest Corner

OVERLAND FLOW:		2-Year	100-Year
Surface Description:		Pasture in poor shape and bare ground	
Rational Coefficient:	c<2>:	0.26	0.32
Flow Length, L (total < 300 ft.)		300 ft.	300 ft.
Land Slope, S		0.007 ft/ft	0.007 ft/ft
To<2> (Figure E-2):		**29.49** min.	
To<100> (Figure E-2):			**27.39** min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Pasture in poor shape and bare ground	
Flow Length, L	700 ft.	700 ft.
Flow Slope, S	0.005 ft/ft	0.005 ft/ft
Flow Velocity: (Figure E-3)	0.5 ft/sec	0.5 ft/sec
Travel Time = L/(60V)	**23.33** min.	**23.33** min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	6.00 ft^2
Wetted Perimeter, Pw	6.00 ft.
Hydraulic Radius, r = a/Pw	1.00 ft.
Channel Slope, S	0.006 ft./ft.
Manning's Coefficient, n	0.050
Velocity, V=1.49r^.67s^.5/n	2.31 ft./sec.
Flow Length, L	770.00 ft.
Travel Time = L/(60V)	**5.56** min.

TIME OF CONCENTRATION

Tc<2>	**58.39** min.
Tc<100>	**56.28** min.

EXHIBIT 7

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: H1 - Historic On-Site
FLOWING TO: South Boundary

1. Basin Area — 25.500 acres

2. Time of Concentration
   - 2-Year — 58.39 min.
   - 100-Year — 56.28 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.35 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 1.40 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.26
   - 100-Year — 0.32

5. Q = CIA

Q(2)=	0.26 x	0.35	x	25.500	=	**2.29 cfs**
Q(100)=	0.32 x	1.40	x	25.500	=	**11.41 cfs**

EXHIBIT 8

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: H2 - Historic on-site
Historic Conditions
Flowing to: Southwest Corner

OVERLAND FLOW:		2-Year	100-Year
Surface Description:		Pasture in poor shape and bare ground	
Rational Coefficient:	c<2>:	0.26	0.32
Flow Length, L (total < 300 ft.)		150 ft.	150 ft.
Land Slope, S		0.017 ft/ft	0.017 ft/ft
To<2> (Figure E-2):		**15.52** min.	
To<100> (Figure E-2):			**14.41** min.

SHALLOW CONCENTRATED FLOW		
Surface Description:	Pasture in poor shape and bare ground	
Flow Length, L	450 ft.	450 ft.
Flow Slope, S	0.003 ft/ft	0.003 ft/ft
Flow Velocity: (Figure E-3)	0.5 ft/sec	0.5 ft/sec
Travel Time = L/(60V)	**15.00** min.	**15.00** min.

CHANNEL FLOW	
Cross-Sectional Flow Area, a	3.00 ft^2
Wetted Perimeter, Pw	4.50 ft.
Hydraulic Radius, r = a/Pw	0.67 ft.
Channel Slope, S	0.006 ft./ft.
Manning's Coefficient, n	0.050
Velocity, V=1.49r^.67s^.5/n	1.76 ft./sec.
Flow Length, L	250.00 ft.
Travel Time = L/(60V)	**2.37** min.

TIME OF CONCENTRATION

Tc<2>	**32.88** min.
Tc<100>	**31.77** min.

EXHIBIT 9

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: H2 - Historic On-Site
FLOWING TO: South Boundary

1. Basin Area — 7.500 acres

2. Time of Concentration
   - 2-Year — 32.88 min.
   - 100-Year — 31.77 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.51 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 2.07 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.26
   - 100-Year — 0.32

5. Q = CIA

Q(2)=	0.26	x	0.51	x	7.500	=	**1.00 cfs**
Q(100)=	0.32	x	2.07	x	7.500	=	**4.98 cfs**

EXHIBIT 10

Developed Conditions

DEC 1994

LAND USE OR SURFACE CHARACTERISTICS	SCS HYDROLOGIC SOIL GROUP (SEE APPENDIX "C" FOR DESCRIPTIONS)											
	A			B			C			D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
UNDEVELOPED AREAS												
Bare ground	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .40 - .48	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Cultivated/Agricultural	.08 - .18 .14 - .24	.13 - .23 .18 - .[illegible]	[illegible]	[illegible] - .23 [illegible] - .29	[illegible] - .29 .28 - .36	[illegible]	[illegible]	[illegible] - .26 - .34 .34 - .42	[illegible]	.18 - .26 .24 - .32	.23 - .31 .29 - .37	.31 - .39 .41 - .49
Pasture	.12 - .22 .15 - .25	.20 - .30 .25 - .35	.30 - .40 .37 - .47	.18 - .26 .23 - .31	.28 - .36 .34 - .42	.37 - .45 .45 - .53	.24 - .32 .30 - .38	.34 - .42 .42 - .50	.44 - .52 .52 - .60	.30 - .38 .37 - .45	.40 - .48 .50 - .58	.50 - .58 .62 - .70
Meadow	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .[illegible] .30 - [illegible]	[illegible] [illegible]	.22 - .30 [illegible] - .36	.30 - .38 .37 - .46	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .44 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Forest	.05 - .15 .08 - .18	.08 - .18 .11 - .[illegible]	.11 - .[illegible] .14 - [illegible]	.08 - .16 [illegible]	.11 - .19 .14 - .22	.14 - .22 .18 - .26	.10 - .18 .12 - .20	.13 - .21 .16 - .24	.16 - .24 .20 - .28	.12 - .20 .15 - .23	.16 - .24 .20 - .28	.20 - .28 .25 - .33
RESIDENTIAL AREAS												
1/8 acre per unit	.40 - .50 .48 - .58	.45 - .53 .52 - .62	.46 - .56 .55 - .65	.42 - .50 .50 - .58	.45 - .53 .54 - .62	.50 - .58 .59 - .67	.45 - .53 .53 - .61	.48 - .56 .57 - .65	.53 - .61 .64 - .72	.48 - .56 .56 - .64	.51 - .59 .60 - .68	.57 - .65 .69 - .77
1/4 acre per unit	.27 - .37 .35 - .45	.31 - .41 .39 - .49	.34 - .44 .42 - .52	.29 - .37 .38 - .46	.34 - .42 .42 - .50	.38 - .46 .47 - .55	.32 - .40 .41 - .49	.36 - .44 .45 - .53	.41 - .49 .52 - .60	.35 - .43 .43 - .51	.39 - .47 .47 - .55	.45 - .53 .57 - .65
1/3 acre per unit	.22 - .32 .31 - .41	.26 - .36 .35 - .45	.29 - .39 .38 - .48	.25 - .33 .33 - .41	.29 - .37 .38 - .46	.33 - .41 .42 - .50	.28 - .36 .36 - .44	.32 - .40 .41 - .49	.37 - .45 .48 - .56	.31 - .39 .39 - .47	.35 - .43 .43 - .51	.42 - .50 .53 - .61
1/2 acre per unit	.16 - .26 .25 - .35	.20 - .30 .29 - .39	.24 - .34 .32 - .42	.19 - .27 .28 - .36	.23 - .31 .32 - .40	.28 - .36 .36 - .44	.22 - .30 .31 - .39	.27 - .35 .35 - .43	.32 - .40 .42 - .50	.26 - .34 .34 - .42	.30 - .38 .38 - .46	.37 - .45 .48 - .56
1 acre per unit	.14 - .24 .22 - .32	.19 - .29 .26 - .36	.22 - .32 .29 - .39	.17 - .25 .24 - .32	.21 - .29 .28 - .36	.26 - .34 .34 - .42	.20 - .28 .28 - .36	.25 - .33 .32 - .40	.31 - .39 .40 - .48	.24 - .32 .31 - .39	.29 - .37 .35 - .43	.35 - .43 .46 - .54
MISC. SURFACES												
Pavement and roofs	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97
Traffic areas (soil and gravel)	.55 - .65 .65 - .70	.60 - .70 .70 - .75	.64 - .74 .74 - .79	.60 - .68 .68 - .76	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.69 - .77 .77 - .85	.72 - .80 .79 - .87	.75 - .83 .82 - .90	.77 - .85 .84 - .92
Green landscaping (lawns, parks)	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .42 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Non-green and gravel landscaping	.30 - .40 .34 - .44	.36 - .46 .42 - .52	.45 - .55 .50 - .60	.45 - .55 .50 - .60	.42 - .50 .48 - .56	.50 - .58 .57 - .65	.40 - .48 .46 - .54	.48 - .56 .55 - .63	.56 - .64 .64 - .72	.44 - .52 .50 - .58	.50 - .58 .60 - .68	.60 - .68 .70 - .78
Cemeteries, playgrounds	.20 - .30 .24 - .34	.26 - .36 .32 - .42	.35 - .45 .40 - .50	.35 - .45 .40 - .50	.32 - .40 .38 - .46	.40 - .48 .47 - .55	.30 - .38 .36 - .44	.38 - .44 .45 - .53	.46 - .54 .54 - .62	.34 - .42 .40 - .48	.40 - .48 .50 - .58	.50 - .58 .60 - .68

DEVELOPED "C" VALUES:
2 YEAR = 0.36
100 YEAR = 0.45

NOTES:
1. Values above and below pertain to the 2-year and 100-year storms, respectively.
2. The range of values provided allows for engineering judgement of site conditions such as basic shape, homogeneity of surface type, surface depression storage, and storm duration. In general, during shorter duration storms (Tc ≤ 10 minutes), infiltration capacity is higher, allowing use of a "C" value in the low range. Conversely, for longer duration storms (Tc) 30 minutes), use a ""C value in the higher range.
3. For residential development at less than 1/8 acre per unit or greater than 1 acre per unit, and also for commercial and industrial areas, use values under MISC SURFACES to estimate "C" value ranges for use.

RATIONAL METHOD RUNOFF COEFFICIENTS
(Modified from Table 4, UC-Davis, which appears to be a modification of work done by Rawls)

TABLE "B-1"

EXHIBIT 11

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: D1 - Developed Conditions

Flowing to: Basin Inlet

OVERLAND FLOW:		2-Year	100-Year
Surface Description:		Residential Lawn	
Rational Coefficient:	c<2>:	0.36	0.45
Flow Length, L (total < 300 ft.)		80 ft.	80 ft.
Land Slope, S		0.02 ft/ft	0.02 ft/ft
To<2> (Figure E-2):		**9.46** min.	
To<100> (Figure E-2):			**8.31** min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Shallow Street Flow	
Flow Length, L	150 ft.	150 ft.
Flow Slope, S	0.0066 ft/ft	0.0066 ft/ft
Flow Velocity: (Figure E-3)	1.6 ft/sec	1.6 ft/sec
Travel Time = L/(60V)	**1.56** min.	**1.56** min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	1.40 ft^2
Wetted Perimeter, Pw	12.00 ft.
Hydraulic Radius, r = a/Pw	0.12 ft.
Channel Slope, S	0.0066 ft./ft.
Manning's Coefficient, n	0.016
Velocity, V=1.49r^.67s^.5/n	1.81 ft./sec.
Flow Length, L	320.00 ft.
Travel Time = L/(60V)	**2.95** min.

TIME OF CONCENTRATION

Tc<2>	**13.97** min.
Tc<100>	**12.82** min.

EXHIBIT 12

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: D1 - Developed Conditions
FLOWING TO: Basin Inlet

1. Basin Area — 1.580 acres

2. Time of Concentration
   - 2-Year — 13.97 min.
   - 100-Year — 12.82 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.81 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 3.32 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.36
   - 100-Year — 0.45

5. Q = CIA

Q(2)=	0.36	x	0.81	x	1.580	=	**0.46 cfs**
Q(100)=	0.45	x	3.32	x	1.580	=	**2.36 cfs**

EXHIBIT 13

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: D2 - Developed Conditions

Flowing to: Basin Inlet

OVERLAND FLOW:		2-Year	100-Year
Surface Description:		Residential Lawn	
Rational Coefficient:	c<2>:	0.36	0.45
Flow Length, L (total < 300 ft.)		80 ft.	80 ft.
Land Slope, S		0.02 ft/ft	0.02 ft/ft
To<2> (Figure E-2):		**9.46** min.	
To<100> (Figure E-2):			**8.31** min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Shallow Street Flow	
Flow Length, L	150 ft.	150 ft.
Flow Slope, S	0.0073 ft/ft	0.0073 ft/ft
Flow Velocity: (Figure E-3)	1.75 ft/sec	1.75 ft/sec
Travel Time = L/(60V)	**1.43** min.	**1.43** min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	1.40 ft^2
Wetted Perimeter, Pw	12.00 ft.
Hydraulic Radius, r = a/Pw	0.12 ft.
Channel Slope, S	0.0073 ft./ft.
Manning's Coefficient, n	0.016
Velocity, V=1.49r^.67s^.5/n	1.90 ft./sec.
Flow Length, L	500.00 ft.
Travel Time = L/(60V)	**4.39** min.

TIME OF CONCENTRATION

Tc<2>	**15.27** min.
Tc<100>	**14.12** min.

EXHIBIT 14

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: D2 - Developed Conditions
FLOWING TO: Basin Inlet

1. Basin Area — 6.070 acres

2. Time of Concentration
   - 2-Year — 15.27 min.
   - 100-Year — 14.12 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.78 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 3.19 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.36
   - 100-Year — 0.45

5. Q = CIA

Q(2)=	0.36 x	0.78	x	6.070	=	**1.70 cfs**
Q(100)=	0.45 x	3.19	x	6.070	=	**8.71 cfs**

EXHIBIT 15

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: D3 - Developed Conditions

Flowing to: Basin Inlet

OVERLAND FLOW:		2-Year	100-Year
Surface Description:		Residential Lawn	
Rational Coefficient:	c<2>:	0.36	0.45
Flow Length, L (total < 300 ft.)		50 ft.	50 ft.
Land Slope, S		0.02 ft/ft	0.02 ft/ft
To<2> (Figure E-2):		**7.48** min.	
To<100> (Figure E-2):			**6.57** min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Shallow Street Flow	
Flow Length, L	80 ft.	80 ft.
Flow Slope, S	0.024 ft/ft	0.024 ft/ft
Flow Velocity: (Figure E-3)	3.0 ft/sec	3.0 ft/sec
Travel Time = L/(60V)	**0.44** min.	**0.44** min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	1.40 ft^2
Wetted Perimeter, Pw	12.00 ft.
Hydraulic Radius, r = a/Pw	0.12 ft.
Channel Slope, S	0.0080 ft./ft.
Manning's Coefficient, n	0.016
Velocity, V=1.49r^.67s^.5/n	1.99 ft./sec.
Flow Length, L	125.00 ft.
Travel Time = L/(60V)	**1.05** min.

TIME OF CONCENTRATION

Tc<2>	**8.97** min.
Tc<100>	**8.06** min.

EXHIBIT 16

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: D3 - Developed Conditions
FLOWING TO: Basin Inlet

1. Basin Area — 1.060 acres

2. Time of Concentration
   - 2-Year — 8.97 min.
   - 100-Year — 8.06 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.95 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 3.91 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.36
   - 100-Year — 0.45

5. Q = CIA

Q(2)=	0.36 x	0.95	x	1.060	=	**0.36 cfs**
Q(100)=	0.45 x	3.91	x	1.060	=	**1.86 cfs**

EXHIBIT 17

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: D4 - Developed Conditions

Flowing to: Basin Inlet

OVERLAND FLOW:		2-Year	100-Year
Surface Description:		Residential Lawn	
Rational Coefficient:	c<2>:	0.36	0.45
Flow Length, L (total < 300 ft.)		90 ft.	90 ft.
Land Slope, S		0.02 ft/ft	0.02 ft/ft
To<2> (Figure E-2):		**10.03** min.	
To<100> (Figure E-2):			**8.81** min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Shallow Street Flow	
Flow Length, L	150 ft.	150 ft.
Flow Slope, S	0.0071 ft/ft	0.0071 ft/ft
Flow Velocity: (Figure E-3)	1.6 ft/sec	1.6 ft/sec
Travel Time = L/(60V)	**1.56** min.	**1.56** min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	1.40 ft^2
Wetted Perimeter, Pw	12.00 ft.
Hydraulic Radius, r = a/Pw	0.12 ft.
Channel Slope, S	0.0075 ft./ft.
Manning's Coefficient, n	0.016
Velocity, V=1.49r^.67s^.5/n	1.92 ft./sec.
Flow Length, L	1000.00 ft.
Travel Time = L/(60V)	**8.66** min.

TIME OF CONCENTRATION

Tc<2>	**20.25** min.
Tc<100>	**19.03** min.

EXHIBIT 18

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: D4 - Developed Conditions
FLOWING TO: Basin Inlet

1. Basin Area — 7.710 acres

2. Time of Concentration
   - 2-Year — 20.25 min.
   - 100-Year — 19.03 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.68 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 2.77 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.36
   - 100-Year — 0.45

5. Q = CIA

Q(2)=	0.36	x	0.68	x	7.710	=	**1.89 cfs**
Q(100)=	0.45	x	2.77	x	7.710	=	**9.62 cfs**

EXHIBIT 19

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: D5 - Developed Conditions

Flowing to: Basin Inlet

OVERLAND FLOW:		2-Year	100-Year
Surface Description:		Residential Lawn	
Rational Coefficient:	c<2>:	0.36	0.45
Flow Length, L (total < 300 ft.)		90 ft.	90 ft.
Land Slope, S		0.02 ft/ft	0.02 ft/ft
To<2> (Figure E-2):		**10.03** min.	
To<100> (Figure E-2):			**8.81** min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Shallow Street Flow	
Flow Length, L	50 ft.	50 ft.
Flow Slope, S	0.008 ft/ft	0.008 ft/ft
Flow Velocity: (Figure E-3)	1.8 ft/sec	1.8 ft/sec
Travel Time = L/(60V)	**0.46** min.	**0.46** min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	1.40 ft^2
Wetted Perimeter, Pw	12.00 ft.
Hydraulic Radius, r = a/Pw	0.12 ft.
Channel Slope, S	0.0080 ft./ft.
Manning's Coefficient, n	0.016
Velocity, V=1.49r^.67s^.5/n	1.99 ft./sec.
Flow Length, L	130.00 ft.
Travel Time = L/(60V)	**1.09** min.

TIME OF CONCENTRATION

Tc<2>	**11.58** min.
Tc<100>	**10.36** min.

EXHIBIT 20

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: D5 - Developed Conditions
FLOWING TO: Basin Inlet

1. Basin Area — 0.780 acres

2. Time of Concentration
   - 2-Year — 11.58 min.
   - 100-Year — 10.36 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.87 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 3.60 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.36
   - 100-Year — 0.45

5. Q = CIA

Q(2)=	0.36 x	0.87	x	0.780	=	**0.25 cfs**
Q(100)=	0.45 x	3.60	x	0.780	=	**1.26 cfs**

EXHIBIT 21

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: D6 - Developed Conditions

Flowing to: Basin Inlet

OVERLAND FLOW:		2-Year		100-Year	
Surface Description:		Residential Lawn			
Rational Coefficient:	c<2>:	0.36		0.45	
Flow Length, L (total < 300 ft.)		90	ft.	90	ft.
Land Slope, S		0.02	ft/ft	0.02	ft/ft
To<2> (Figure E-2):		**10.03**	min.		
To<100> (Figure E-2):				**8.81**	min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Shallow Street Flow			
Flow Length, L	50	ft.	50	ft.
Flow Slope, S	0.008	ft/ft	0.008	ft/ft
Flow Velocity: (Figure E-3)	1.8	ft/sec	1.8	ft/sec
Travel Time = L/(60V)	**0.46**	min.	**0.46**	min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	1.40	ft^2
Wetted Perimeter, Pw	12.00	ft.
Hydraulic Radius, r = a/Pw	0.12	ft.
Channel Slope, S	0.0080	ft./ft.
Manning's Coefficient, n	0.016	
Velocity, V=1.49r^.67s^.5/n	1.99	ft./sec.
Flow Length, L	135.00	ft.
Travel Time = L/(60V)	**1.13**	min.

TIME OF CONCENTRATION

Tc<2>	**11.62**	min.
Tc<100>	**10.41**	min.

EXHIBIT 22

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: D6 - Developed Conditions
FLOWING TO: Basin Inlet

1. Basin Area — 0.810 acres

2. Time of Concentration
   - 2-Year — 11.62 min.
   - 100-Year — 10.41 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.87 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 3.59 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.36
   - 100-Year — 0.45

5. Q = CIA

Q(2)=	0.36 x	0.87	x	0.810	=	**0.25 cfs**
Q(100)=	0.45 x	3.59	x	0.810	=	**1.31 cfs**

EXHIBIT 23

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: D7 - Developed Conditions

Flowing to: Basin Inlet

OVERLAND FLOW:		2-Year		100-Year	
Surface Description:		Residential Lawn			
Rational Coefficient:	c<2>:	0.36		0.45	
Flow Length, L (total < 300 ft.)		90	ft.	90	ft.
Land Slope, S		0.02	ft/ft	0.02	ft/ft
To<2> (Figure E-2):		**10.03**	min.		
To<100> (Figure E-2):				**8.81**	min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Shallow Street Flow			
Flow Length, L	150	ft.	150	ft.
Flow Slope, S	0.005	ft/ft	0.005	ft/ft
Flow Velocity: (Figure E-3)	1.5	ft/sec	1.5	ft/sec
Travel Time = L/(60V)	**1.67**	min.	**1.67**	min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	1.40	ft^2
Wetted Perimeter, Pw	12.00	ft.
Hydraulic Radius, r = a/Pw	0.12	ft.
Channel Slope, S	0.0063	ft./ft.
Manning's Coefficient, n	0.016	
Velocity, V=1.49r^.67s^.5/n	1.76	ft./sec.
Flow Length, L	1150.00	ft.
Travel Time = L/(60V)	**10.87**	min.

TIME OF CONCENTRATION

Tc<2>	**22.56** min.
Tc<100>	**21.34** min.

EXHIBIT 24

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: D7 - Developed Conditions
FLOWING TO: Basin Inlet

1. Basin Area — 4.290 acres

2. Time of Concentration
   - 2-Year — 22.56 min.
   - 100-Year — 21.34 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.64 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 2.61 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.36
   - 100-Year — 0.45

5. Q = CIA

Q(2)=	0.36 x	0.64	x	4.290	=	**0.99 cfs**
Q(100)=	0.45 x	2.61	x	4.290	=	**5.05 cfs**

EXHIBIT 25

TIME OF CONCENTRATION CALCULATION WORKSHEET

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.4
DATE: 8/11/00

BASIN DESIGNATION: D8 - Developed Conditions

Flowing to: Basin Inlet

OVERLAND FLOW:		2-Year	100-Year
Surface Description:		Residential Lawn	
Rational Coefficient:	c<2>:	0.36	0.45
Flow Length, L (total < 300 ft.)		90 ft.	90 ft.
Land Slope, S		0.02 ft/ft	0.02 ft/ft
To<2> (Figure E-2):		**10.03** min.	
To<100> (Figure E-2):			**8.81** min.

SHALLOW CONCENTRATED FLOW

Surface Description:	Shallow Street Flow	
Flow Length, L	135 ft.	135 ft.
Flow Slope, S	0.0062 ft/ft	0.0062 ft/ft
Flow Velocity: (Figure E-3)	1.6 ft/sec	1.6 ft/sec
Travel Time = L/(60V)	**1.41** min.	**1.41** min.

CHANNEL FLOW

Cross-Sectional Flow Area, a	1.40 ft^2
Wetted Perimeter, Pw	12.00 ft.
Hydraulic Radius, r = a/Pw	0.12 ft.
Channel Slope, S	0.0063 ft./ft.
Manning's Coefficient, n	0.016
Velocity, V=1.49r^.67s^.5/n	1.76 ft./sec.
Flow Length, L	940.00 ft.
Travel Time = L/(60V)	**8.88** min.

TIME OF CONCENTRATION

Tc<2>	**20.32** min.
Tc<100>	**19.10** min.

EXHIBIT 26

RUNOFF CALCULATION WORKSHEET
RATIONAL METHOD

JOB NAME: **Stone Mountain Estates**
JOB NUMBER: 200022.40
DATE: 8/11/00

BASIN DESIGNATION: D8 - Developed Conditions
FLOWING TO: Basin Inlet

1. Basin Area — 8.390 acres

2. Time of Concentration
   - 2-Year — 20.32 min.
   - 100-Year — 19.10 min.

3. Storm Intensity (for use in the Grand Valley) per Table "A-1a"
   - 2-year $\frac{26.71}{Tc + 19.01}$ — 0.68 in/hr
   - 100-Year $\frac{104.94}{Tc + 18.8}$ — 2.77 in/hr

4. Composite Runoff Coefficients
   - 2-Year — 0.36
   - 100-Year — 0.45

5. Q = CIA

Q(2)=	0.36 x	0.68	x	8.390	=	**2.05 cfs**
Q(100)=	0.45 x	2.77	x	8.390	=	**10.45 cfs**

EXHIBIT 27

Conveyance Elements

Stone Mountain Estates - Urban Residential Collector Gutter Flow
Worksheet for Gutter Section

Project Description	
Worksheet	Urban Residential Collector
Type	Gutter Section
Solve For	Discharge

Input Data		
Slope	0.005000	ft/ft
Gutter Width	1.42	ft
Gutter Cross Slope	0.083300	ft/ft
Road Cross Slope	0.020000	ft/ft
Spread	11.50	ft
Mannings Coefficient	0.016	

Results		
Discharge	2.72	cfs
Flow Area	1.4	ft^2
Depth	0.32	ft
Gutter Depression	1.1	in
Velocity	1.96	ft/s

EXHIBIT 28

LANDesign L.L.C.
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Cross Section
Cross Section for Gutter Section

Project Description	
Worksheet	Urban Residential Collector
Type	Gutter Section
Solve For	Discharge

Section Data		
Slope	0.005000	ft/ft
Discharge	2.72	cfs
Gutter Width	1.42	ft
Gutter Cross Slope	0.083300	ft/ft
Road Cross Slope	0.020000	ft/ft
Spread	11.50	ft
Mannings Coefficient	0.016	

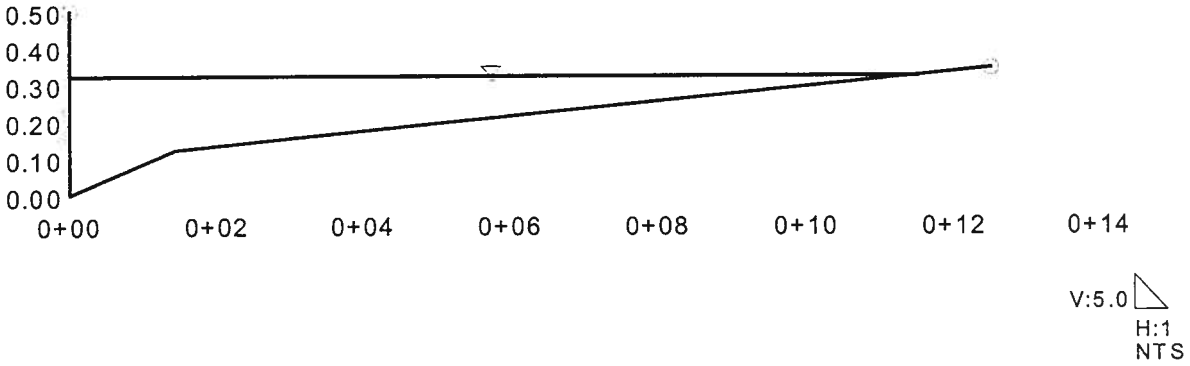


EXHIBIT 29

LANDesign L.L.C.
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Curve
Plotted Curves for Gutter Section

Project Description	
Worksheet	Urban Residential Collector
Type	Gutter Section
Solve For	Discharge

Input Data		
Gutter Width	1.42	ft
Gutter Cross Slope	0.083300	ft/ft
Road Cross Slope	0.020000	ft/ft
Spread	11.50	ft
Mannings Coefficient	0.016	

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.050000	0.001000

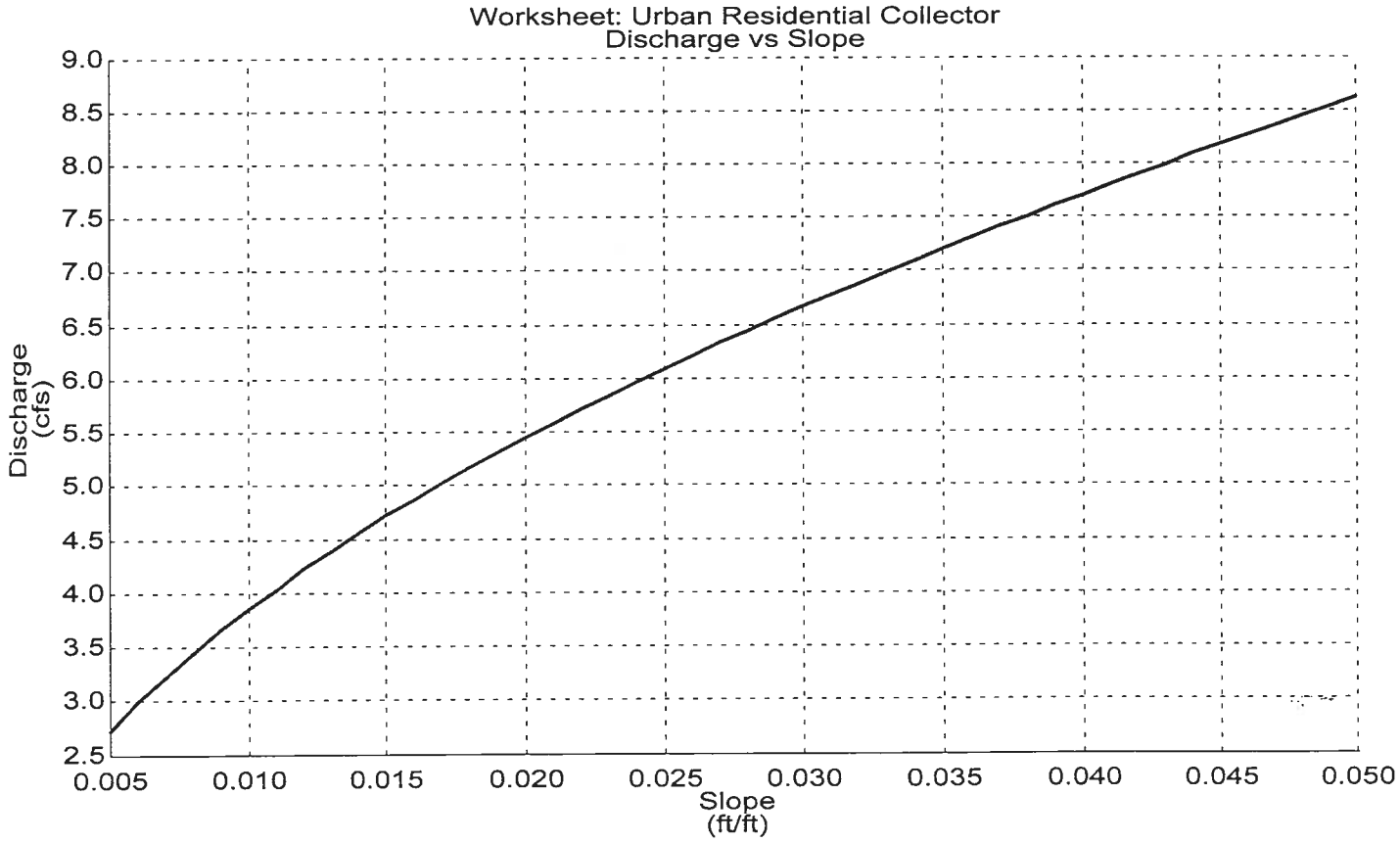


EXHIBIT 30

LANDesign L.L.C.
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Existing Depth of Channel at Driveway Crossing
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Existing Depth of Channel at Driveway Crossing
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.003500	ft/ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	2.00	ft
Discharge	35.00	cfs

Results		
Depth	2.12	ft
Flow Area	11.0	ft²
Wetted Perimeter	9.63	ft
Top Width	8.35	ft
Critical Depth	1.48	ft
Critical Slope	0.015757	ft/ft
Velocity	3.19	ft/s
Velocity Head	0.16	ft
Specific Energy	2.28	ft
Froude Number	0.49	
Flow Type	Subcritical	

← DEPTH OF CHANNEL

EXHIBIT 31

LANDesign L.L.C.
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

New Depth of Channel Flow at Driveway Crossing
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	New Depth of Arcuby Drain at Drivewa
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.003500	ft/ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	2.00	ft
Discharge	59.00	cfs

Results		
Depth	2.69	ft
Flow Area	16.2	ft²
Wetted Perimeter	11.69	ft
Top Width	10.06	ft
Critical Depth	1.93	ft
Critical Slope	0.014818	ft/ft
Velocity	3.64	ft/s
Velocity Head	0.21	ft
Specific Energy	2.89	ft
Froude Number	0.51	
Flow Type	Subcritical	

← DEPTH OF CHANNEL

EXHIBIT 33

Existing Depth of Channel at I-1/2 Road
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Existing Depth of Channel at I-1/2 Road
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.003500	ft/ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	2.00	ft
Discharge	52.00	cfs

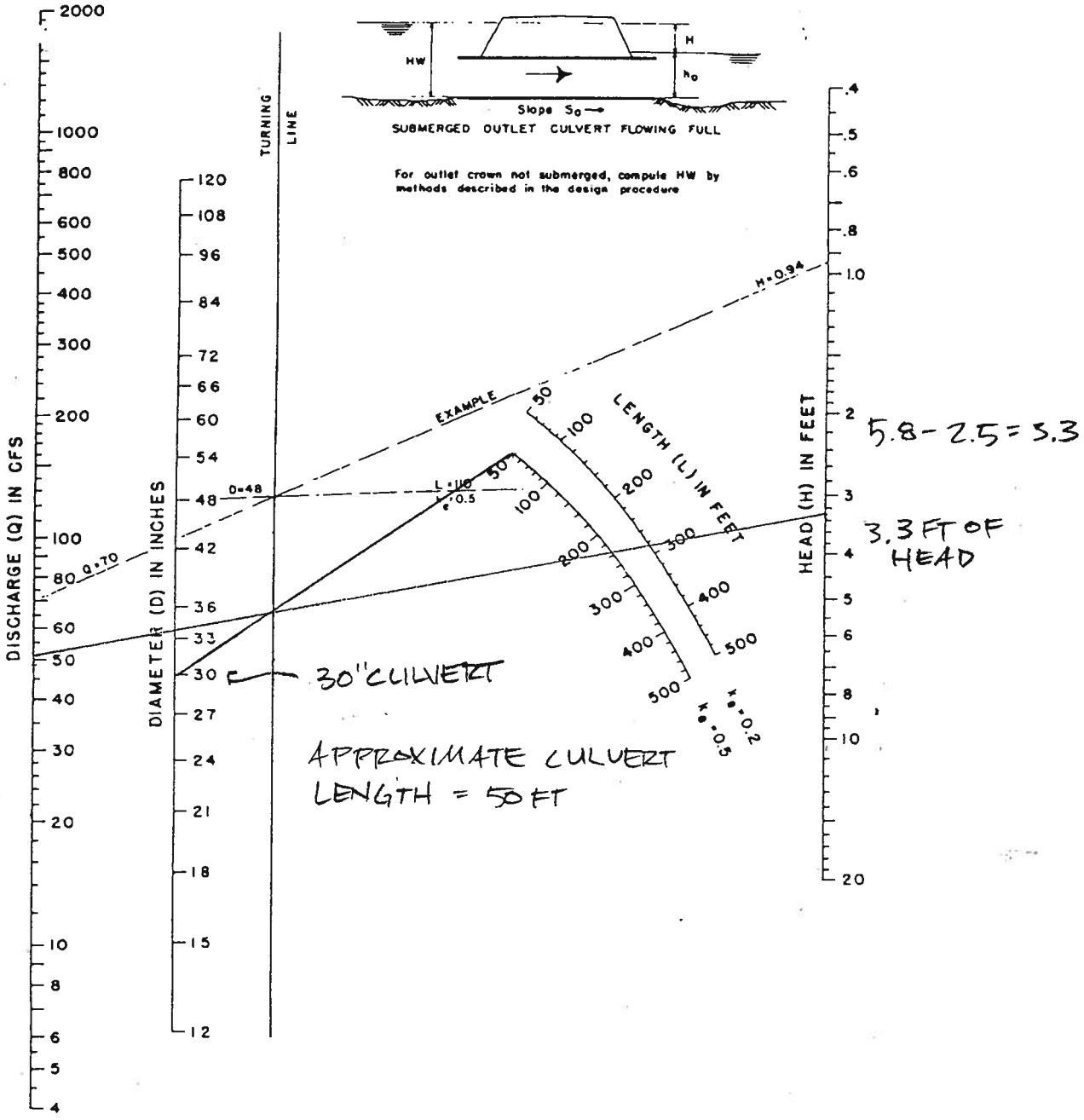
Results		
Depth	2.54	ft ← DEPTH OF CHANNEL
Flow Area	14.7	ft²
Wetted Perimeter	11.15	ft
Top Width	9.61	ft
Critical Depth	1.81	ft
Critical Slope	0.015040	ft/ft
Velocity	3.53	ft/s
Velocity Head	0.19	ft
Specific Energy	2.73	ft
Froude Number	0.50	
Flow Type	Subcritical	

EXHIBIT 35

LANDesign L.L.C.
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

EXISTING CULVERT AT I 1/2 ROAD

CHART 5



HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

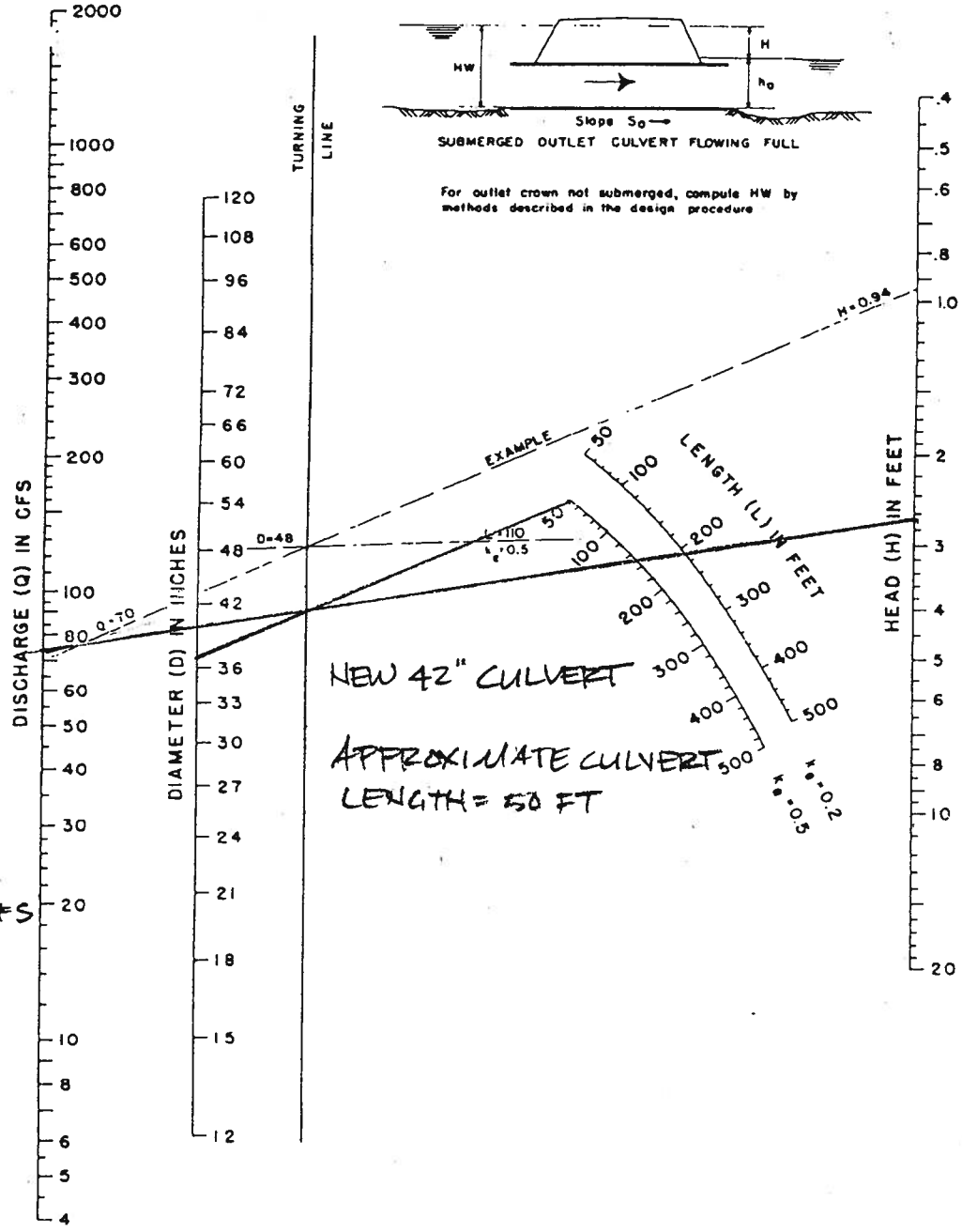
BUREAU OF PUBLIC ROADS JAN. 1963

DEC 1994

EXHIBIT 36

NEW CULVERT CROSSING AT I 1/2 ROAD

CHART 5



52 CFS +
24.23 CFS
= 76.23 CFS

5.75 - 3 = 2.75

2.75 FT OF HEAD

HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

BUREAU OF PUBLIC ROADS JAN. 1963

DEC 1994

EXHIBIT 38

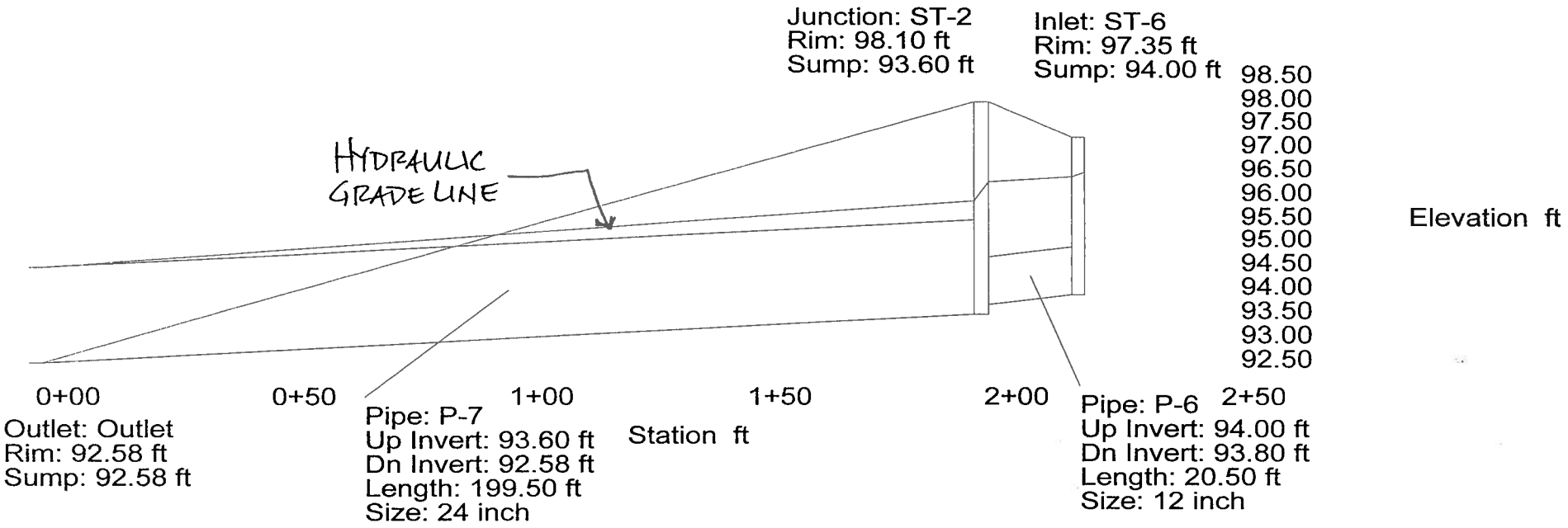

Junction: ST-2
Rim: 98.10 ft
Sump: 93.60 ft
Inlet: ST-6
Rim: 97.35 ft
Sump: 94.00 ft
HYDRAULIC GRADE LINE
98.50
98.00
97.50
97.00
96.50
96.00
95.50
95.00
94.50
94.00
93.50
93.00
92.50
Elevation ft
0+00
0+50
1+00
1+50
2+00
2+50
Station ft
Outlet: Outlet
Rim: 92.58 ft
Sump: 92.58 ft
Pipe: P-7
Up Invert: 93.60 ft
Dn Invert: 92.58 ft
Length: 199.50 ft
Size: 24 inch
Pipe: P-6
Up Invert: 94.00 ft
Dn Invert: 93.80 ft
Length: 20.50 ft
Size: 12 inch

EXHIBIT 42

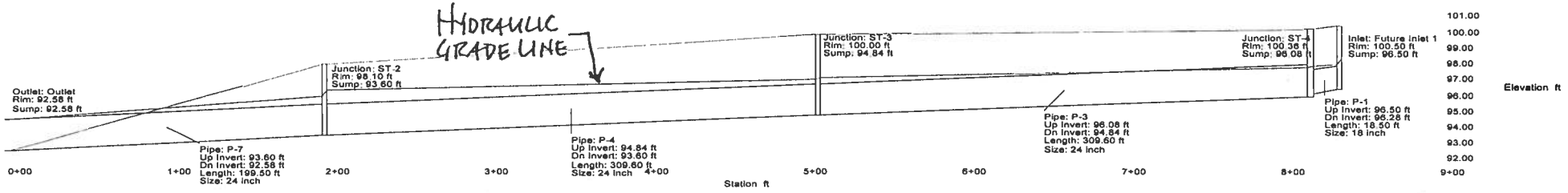


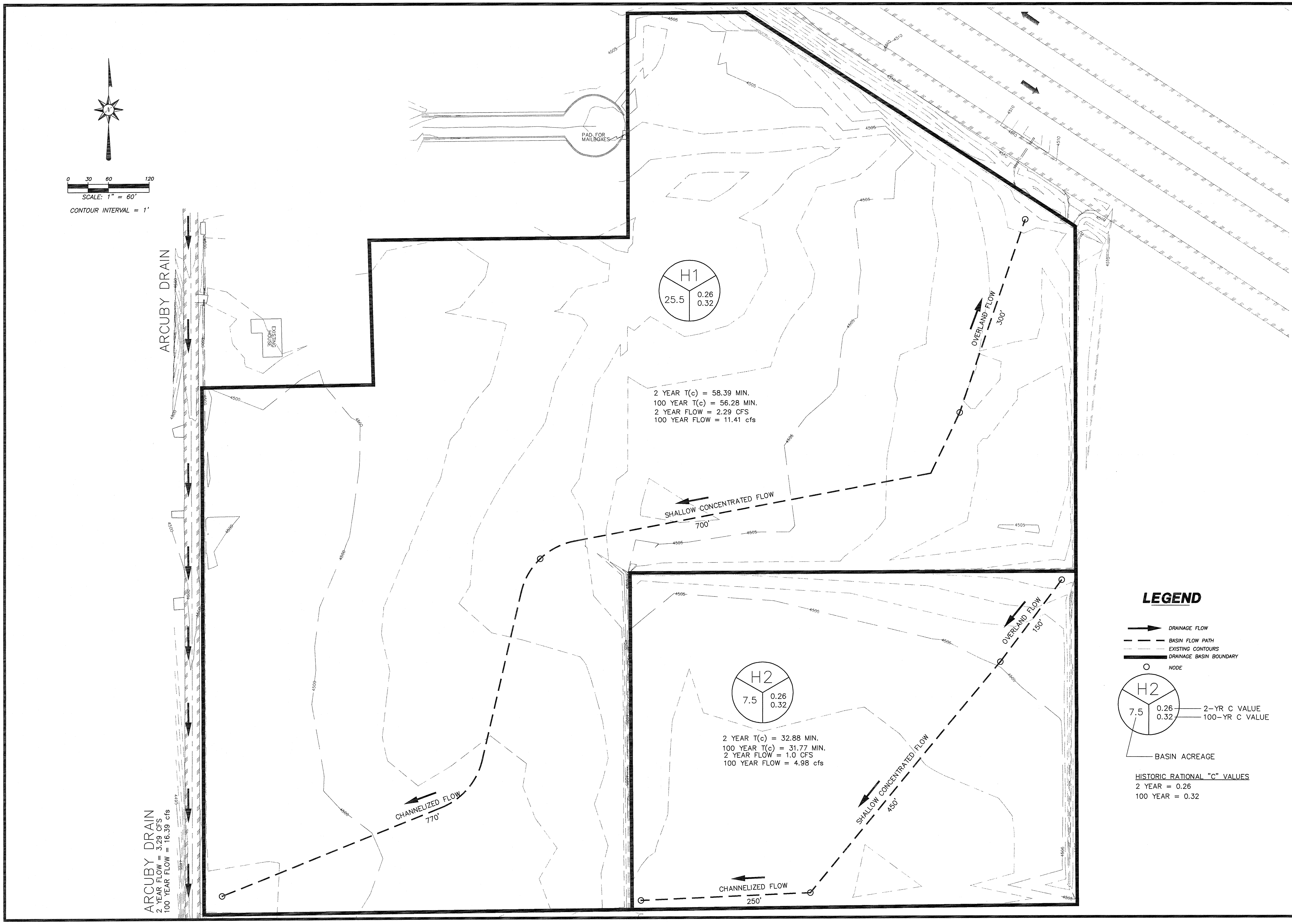
EXHIBIT 43

Project Title: Stone Mountain Estates
c:\sc14\work\200022\docs\200022-1.stm
08/07/00 02:46:02 PM

LANDESIGN
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Project Engineer: Brian Hart
StormCAD v1.0

Drainage Maps



DATE:	NO:	REVISION:	BY:

PRE-DEVELOPMENT STORMWATER MANAGEMENT MAP

DATE: 8-11-2000 | DRAWN: RLC | CHK'D: BCH

STONE MOUNTAIN ESTATES SUBDIVISION

PROJECT NO.: 200022 | FILE NAME: 200022-dev-drainage

LANDesign
ENGINEERS • SURVEYORS • PLANNERS
259 GRAND AVENUE
GRAND JUNCTION, COLORADO 81501 (970) 245-4099

SHEET 1 OF 1

C:\WORK\200022\200022-dev-drainage.dwg Fri Aug 11 09:59:17 2000 PC Price

LEGEND

- DRAINAGE FLOW
- BASIN FLOW PATH
- DRAINAGE BASIN BOUNDARY
- NODE
- 1 = OVERLAND FLOW
- 2 = SHALLOW CONCENTRATED FLOW
- 3 = CHANNELIZED FLOW

DEVELOPED RATIONAL "C" VALUES
2 YEAR = 0.36
100 YEAR = 0.45

TABULATED RESULTS

BASIN	SIZE	2 YR. T(c) (MIN.)	100 YR. T(c) (MIN.)	2 YR. FLOW (CFS)	100 YR. FLOW (CFS)
D1	1.58	13.97	12.87	0.46	2.36
D2	6.07	15.27	14.12	1.7	8.71
D3	1.06	8.97	8.06	0.36	1.86
D4	7.71	20.25	19.03	1.89	9.62
D5	0.78	11.58	10.36	0.25	1.26
D6	0.81	11.62	10.41	0.25	1.31
D7	4.29	22.56	21.34	0.99	5.05
D8	8.39	20.32	19.10	2.05	10.45

BASIN D8
8.39 AC.

BASIN D7
4.29 AC.

BASIN D6
0.81 AC.

BASIN D5
0.78 AC.

BASIN D2
6.07 AC.

BASIN D4
7.71 AC.

BASIN D1
1.58 AC.

BASIN D3
1.06 AC.

PAD FOR MAILBOXES

370.40'

2 YR. FLOW = 3.54 CFS
100 YR. FLOW = 18.07 CFS

2 YR. FLOW = 4.41 CFS
100 YR. FLOW = 40.62 CFS
22.55

TOTAL FLOW
2 YR. FLOW = 7.95 CFS
100 YR. FLOW = 40.62 CFS

0 30 60 120
SCALE: 1" = 60'
CONTOUR INTERVAL = 1'

BY:	REVISION:	NO:	DATE:

POST-DEVELOPMENT
STORMWATER
MANAGEMENT MAP

CHK'D: BCH
DRAWN: RLC
DATE: 8-11-2000
FILE NAME: 200022-dev-drainage
PROJECT NO.: 200022

STONE MOUNTAIN
ESTATES
SUBDIVISION

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SHEET 1 OF 1