

RETURN TO:
Land Development
101 West Castilla, Suite 122
Colorado Springs, CO 80904

MASTER DEVELOPMENT DRAINAGE PLAN

CHAPEL HILLS CROSSING

JANUARY 1989

JOB NO. 8335

Prepared For:

Rosenbaum/Dean
101 North Cascade, Suite 400
Colorado Springs, CO 80903
(719) 630-0066

Prepared By:

JR Engineering, Ltd.
6455 North Union Boulevard, Suite 202
Colorado Springs, CO 80918
(719) 593-2593

CITY OF ~~COLORADO~~ SPRINGS
COLORADO

INTEROFFICE MEMORANDUM

DATE: January 26, 1989

TO: Debra Little, Planner

FROM: Chris Smith, Subdivision Administrator

SUBJECT: CHAPEL HILLS CROSSING; CPC MP 88-276,
CPC A 88-274, 275

This is an update of our previous comments dated November 16, 1988 as they apply to drainage.

A Master Development Drainage Plan (MDDP) has been prepared by J. R. Engineering in accordance with our drainage criteria manual. As of this date, this report is being finalized to address our review comments and it is anticipated to be accepted by us when finalized.

The development as depicted on the Master Plan will require a very large storm sewer system in order to route the computed 100 year flows around the buildings that are proposed over the natural drainage path. The MDDP demonstrates the feasibility of such a system to be constructed by the developer.

The following additional construction will be required by the City Engineer and is included in the MDDP:

- 1) The existing upstream system will be upgraded from Grashio Drive to the easterly boundary of the site such that the computed Q100 is contained in an adequate facility within an adequate easement.
- 2) The existing outfall system will be upgraded from the east side of Academy Boulevard at the northwest corner of the site to the existing "Burns Road Channel" such that the computed Q100 is contained in an adequate facility within an adequate easement.

Since both the existing upstream system and the existing outfall system will lie outside of the proposed annexation limits, the developer will also be required to satisfy any construction requirements imposed by the County Engineer

We request that these drainage construction requirements become conditions of the Master Plan.

CS/DRL/mls DRL

cc: Gary R. Haynes, City Engineer

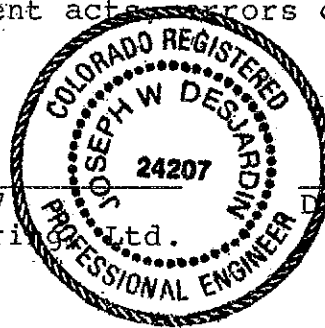
MASTER DEVELOPMENT DRAINAGE PLAN
CHAPEL HILLS CROSSING

DRAINAGE REPORT STATEMENT

Engineer's Statement:

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

Joseph W. DesJardin
Joseph W. DesJardin, P.E. #24207
For and on Behalf of JR Engineering Ltd. Date 1.25.89



Developer's Statement:

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

Rosenbaum/Dean Address: 101 North Cascade Avenue
Business Name Suite 400
By: Steven M. Bonetto Colorado Springs, CO 80903
Title: DEV. MGR

City of Colorado Springs:

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

[Signature] Date 1/30/89
City Engineer

Conditions: [Signature]
HYDROLOGY IS SUBJECT
TO FURTHER ANALYSIS
AS NEEDED UPON PLATTING

TABLE OF CONTENTS

	<u>Page</u>
Purpose	1
General Description	1
Offsite Basins	3
Onsite Basins	6
Onsite Facilities	7
Downstream Facilities	8
Summary	9
Drainage Fees	10

APPENDIX

U.S.G.S. MAP	Exhibit A
SCS SOILS MAP	Exhibit B
ZONING MAP	Exhibit C
TRIBUTARY PLATTED SUBDIVISIONS	Exhibit D
HYDROLOGIC RESULTS - Rational Method	Exhibit E
HYDROLOGIC RESULTS - TR-20 Model	Exhibit F
DRAINAGE PLAN	Back Pocket
TR-20 FLOW CHART	" "

MASTER DEVELOPMENT DRAINAGE PLAN
CHAPEL HILLS CROSSING
JANUARY, 1989

PURPOSE:

The purpose of the Master Development Drainage Plan is to identify major drainageways, ponding/detention areas and locations of drainage facilities and areas which are tributary to the proposed development. This report presents alternative solutions to the drainage problems. The selected alternative will be refined in subsequent preliminary and final drainage reports. The ability of downstream drainage facilities to pass developed runoff from the proposed development has been thoroughly analyzed.

GENERAL DESCRIPTION:

Chapel Hills Crossing is located south of Briargate Boulevard, east of Academy Boulevard, and west of Anderosa Estates (Exhibit "A"). It is a proposed annexation of a portion of Falcon Estates Filing No. 2. The master plan consists of commercial (PBC-1 & PBC-2) and low density residential development on approximately 36.8738 acres. This area is tributary to Pine Creek but the City considers it to be within Cottonwood Creek for basin and bridge fees in accordance with the current Cottonwood Creek Basin Study. The area tributary to this development consists of several subdivisions to the east along Briargate Boulevard. The offsite basin extends to east of Union Boulevard and contains two detention ponds.

Soil type and Hydrologic Group information was obtained from the SCS "Soil Survey of El Paso County Area, Colorado", (Exhibit "B") and summarized in the following table:

<u>Identity Number</u>	<u>Soil Type</u>	<u>Hydrologic Group</u>
8	Blakeland	A
78	Sampson	B
83	Stapleton	B

Due to the complexity of the tributary basin, two methods were used to calculate the anticipated amounts of runoff. First, each sub-basin was modeled using the Rational Method as outlined in the City of Colorado Springs/El Paso County "Drainage Criteria Manual", 1987. Then the TR-20 model (which is allowed per the Manual) was used to combine the results from the first step and route the flows through the detention ponds, storm sewers, and surface reaches. Both methods used design storms of 24-hour duration with 10-year and 100-year recurrence intervals. A 10-year precipitation of 3.2" and a 100-year precipitation of 4.5" was used in the TR-20 model.

The Technical Release 20, Computer Program for Project Formulation-Hydrology (TR-20) was prepared by the Soil Conservation Service (SCS). The program utilizes curve numbers and hydrologic soil groups to define basin parameters as is done in the SCS (by hand) method presented in the Manual. For this application the curve numbers were increased until the computer model produced similar results to the Rational Method for each sub-basin. The computer program also allows routing of hydrographs through detention ponds and drainageway reaches which models the attenuation and corresponding reduction in peak runoff. This report also utilized the diversion capability of the program to model hydrograph separation where the base flows are intercepted by storm sewers and the remaining top or peak flows were discharged on the surface. The Rational Method of computation for sub-basins and the TR-20 results are presented as Exhibits "E" and "F" in the Appendix.

OFFSITE BASINS:

The area tributary to this proposed development consists of approximately 250 acres. A list of upstream platted subdivisions is shown as Exhibit "D" in the Appendix. The offsite basin has been divided into twenty (20) sub-basins for drainage analysis, see Offsite Basin Maps 1, 2, and 3.

Map 1 shows Basins 1, 2, and 3 which are located northeast of Union Boulevard and Briargate Boulevard. In general, the main emphasis of the offsite analysis is to determine 100-year flows entering the site. This study used 100-year flow depths at inlets to determine interception and storm sewer slopes (Manning Equation) to determine capacity of existing facilities. With this criteria, it appears that all 10-year flows will be intercepted by the Union Boulevard storm sewer thereby diverting the 10-year runoff (46 CFS) away from the study area. The 100-year runoff in excess of the 10-year runoff, will flow by the inlets and continue west in Briargate Boulevard.

Basins 4, 5, 6, 7, 8, 9, and 10 (Map 2) will enter a storm sewer system at the north intersection of Vintage Drive with Briargate Boulevard. This system discharges directly into Pond "A" via a 48" CMP which has a total capacity (inlets and storm sewer) of 168 CFS. This capacity will accommodate all the 10-year but results in a 100-year flow by condition in Briargate Boulevard.

Basins 11, 12, and 13 combine at the south intersection of Vintage Drive and Briargate Boulevard. A portion of the runoff (22 CFS) from Basin 11 is diverted away from the study area due to inlets and storm sewer at Horizon Drive and Zephyr Drive. The minor flowby is combined with runoff from Basins 12 and 13 and intercepted by another storm sewer system near Briargate Boulevard which discharges into Pond "A" via a 42" CMP. This system (inlets and storm sewer) has capacity for 86 CFS which will accommodate all the 10-year but results in a 100-year flowby condition in Briargate Boulevard.

Due to the curb opening inlet adjacent to Pond "A" (41" long, 12" opening), all runoff on the south side of Briargate Boulevard will be intercepted and discharged into the pond. The 100-year flowby mentioned above will be along the north flowline of Briargate Boulevard.

Pond "A" appears to not have a low flow discharge structure or in other words is a Retention Pond. The lowest point of discharge is a vertical 42" CMP standpipe with an elaborate trash rack atop. The invert out is 9.29' above the bottom of the pond. This standpipe is the beginning of a storm sewer system that is located north of Anderosa Estates and eventually discharges onto the Chapel Hills site. The 100-year rip-rap spillway for Pond "A" is 10.00' above the pond bottom and discharges onto the street surface in Anderosa Estates via a concrete side lot swale.

Offsite Basin (Map 3) reflects the remainder of the tributary basin. Basin 16 discharges into a pair of grate inlets connected to the 42" CMP trunk storm sewer system with a 36" CMP. Due to the limited capacity of the 42" CMP (110 CFS), all 10-year flows will be intercepted but some 100-year flow will backup and flowby onto Briargate Boulevard.

Basin 17 also discharges into a pair of grate inlets with a 36" CMP outlet. The 36" CMP discharges into Pond "B". The 10-year flow peak is reduced by Pond "B" and the 42" CMP trunk storm sewer has capacity to accept the flow. However, due to the limited capacity of the 42" CMP (110 CFS) and limited storage capacity of Pond "B", some 100-year runoff will flowby onto Briargate Boulevard.

At the intersection of Chapel Hills Drive and Briargate Boulevard, all the 100-year flowby mentioned above will combine with runoff from Basins 14, 15, 18 and 19 (Map 3). Again, the focus of this analysis is the 100-year storm. A diversion was used to leave 100 CFS on the north side which is 50% of the 100-year total flow at that point. With the remaining peak of 99 CFS on the south side, a diversion was used to leave 60 CFS going west (straight) and the remaining peak of 39 CFS discharging south along Chapel Hills Drive into Anderosa Estates. Field observation and field data indicate a 60/40 split is appropriate for this intersection.

Within Anderosa Estates, there exist several inlets, storm sewers, and other drainage facilities. The number of inlets and the available 18" of head at the last two sumped inlets on Chapel Hills Drive indicates the storm sewer system at this point will be limited by the downstream 48" RCP (at estimated 4% slope) which has a capacity of 287 CFS. The 10-year discharge of 177 CFS will be contained in the storm sewer system. The 100-year discharge of 361 CFS will result in a full storm sewer system and 74 CFS overflow on the surface. The 48" RCP will be asbuilt during subsequent phases to verify its capacity and corresponding surface flows.

A minor offsite tributary basin is north of the proposed site and south of Briargate Boulevard. The drainage study for H & W Subdivision by Berge-Brewer & Associates, Inc. filed October 19, 1983 calls for a grass-lined swale to extend from Chapel Hills Drive west to Academy Boulevard. A continuous swale, 15' wide and 2.5' deep does not exist. There are some areas with a well defined swale but it intermittently becomes undefined and allows runoff to discharge onsite.

ONSITE BASINS:

The Chapel Hills Crossing site and surrounding areas have been divided into two major basins. Basin "A" will be routed via a proposed storm sewer along the north boundary discharging at the existing storm sewer beneath Academy Boulevard. Basin "B" will intercept some offsite flows, the central and southern onsite flows, and utilize the existing north/south storm sewer parallel to Academy Boulevard. The drainage plan in the back pocket shows five sub-basins for each major basin. The sub-basins define the areas that will be used to size proposed inlets. The runoff calculations are summarized in Table 1, Exhibit "E".

ONSITE FACILITIES:

There exists a large diameter (48" RCP) storm sewer which lies along the back property lines of existing Falcon Estates discharging west from Anderosa Estates to Academy Boulevard. The existing storm sewer then discharges to the north, intercepting flows from inlets in Academy Boulevard. At the site's northwest corner the pipe flows to the west in an easement just south of the USAA building. At its outfall to the existing open channel, the pipe diameter is 54" and appears to be at a relatively flat slope.

The City Engineering Division will require a drainage system (surface and pipe) adequate to contain the 100-year storm runoff beginning at Grashio Drive.

At the east property line, the proposed storm sewer will intercept runoff from the existing pipe. The proposed system will be routed north of the buildings with inlets installed at key locations to intercept onsite and offsite runoff. The proposed system will discharge into the existing storm sewer near the northwest corner.

At this time, it appears that a 60" RCP at 1.33% (capacity = 300 CFS) will be adequate to handle the 10-year runoff. The corresponding 100-year surface flow behind the anchor building would be 61 CFS. A triangular section consisting of 40' at 2% away from the building with a vertical curb height of 0.8' at a slope of 1% will have adequate capacity to channel the 100-year surface flows. The minimum finished floor elevation must be 12" above the water surface elevation. If the storm sewer becomes plugged, the 12" freeboard will provide adequate capacity for the 100-year flow.

The existing storm sewer parallel to Academy Boulevard (with the addition of inlets) will be used to intercept onsite and state highway runoff. This modified system will also discharge to the existing storm sewer at the northwest corner.

DOWNSTREAM FACILITIES:

The City Engineering Division has determined the "Point of Outfall" for this development is the existing concrete-lined channel where it intersects with the discharge from the existing 54" RCP. Since the City is currently designing improvements for this channel, it is assumed the re-constructed channel will have adequate capacity for 100-year flow from this basin.

JR Engineering, Ltd. has asbuilt the existing 54" RCP from the concrete-lined channel to Academy Boulevard. Although the last portion of the storm sewer is very flat (as evidenced by standing water), the average hydraulic grade line from the manhole rim just west of Academy Boulevard to the top of pipe at the outfall is 2.37% which yields a 54" RCP capacity of 302 CFS.

On the east side of Academy Boulevard, the developer must provide an open transition structure to the outfall facility beneath Academy Boulevard. Fencing around the top of the transition structure will be required for pedestrian safety. This transition structure must have adequate capacity to accept all 100-year flowby.

Beneath Academy Boulevard, the outfall facility will be a reinforced concrete box culvert or an RCP equivalent. This facility must have capacity for the 100-year storm runoff.

The City Engineering Division has determined the drainage facility from Academy Boulevard to the existing channel must have adequate capacity for the 100-year storm runoff. This may be satisfied by installing a large diameter storm sewer (72" RCP at 2.0%) in place of the existing 54" RCP or installing a parallel storm sewer (54" RCP) or by installing an open channel.

The most appropriate alternative will be selected and analyzed in subsequent preliminary and final drainage studies.

Approval from the Colorado Department of Highways (CDOH) must be obtained prior to any construction within the Academy Boulevard right-of-way.

SUMMARY:

Proposed onsite improvements consisting of RCP storm sewer and curb opening inlets will be required to intercept existing off-site runoff. Onsite facilities must be designed to safely convey 10-year and 100-year runoff to the northwest corner of the site using storm sewer and surface (parking lot) flows. Onsite surface runoff must be intercepted prior to entering Academy Boulevard per CDOH requirements. Adequate drainage facilities with 100-year capacity must be installed from just east of Academy Boulevard to the existing concrete-lined channel.

At the time of the final drainage report, improvement costs eligible for credit will be determined. Improvements from the east property line to Grashio Drive (if necessary) are reimbursable. Improvements beneath and west of Academy Boulevard are reimbursable. Improvements to reduce the current runoff onto Academy Boulevard may be reimbursable. If the cost of public drainage facilities is greater than the drainage fee, the

developer may apply for reimbursement from the Basin Fund. The City will not allow reimbursement or credit for any extra costs associated with storm sewer relocation to facilitate building locations.

This drainage study does not take responsibility for any existing drainage studies and/or existing drainage structure deficiencies. In the event that either or both upstream pond outfalls become blocked, the analysis for the offsite basin will remain unchanged.

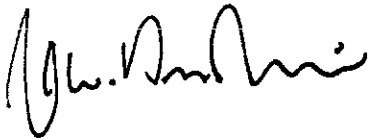
This site does not lie within a F.E.M.A. floodplain as verified by the current F.I.R.M. for Colorado Springs, Panel 154/625, effective date December 18, 1986.

DRAINAGE FEES:

1989 Drainage Fee @ \$3,633/Acre		
x <u>36.8738</u> Acres	=	\$ 133,962.52

1989 Bridge Fee @ \$220/Acre		
x <u>36.8738</u> Acres	=	\$ 8,112.24

Respectfully submitted,



Joseph W. DesJardin, P.E.
Director of Engineering
For and on Behalf of JR Engineering, Ltd.

A P P E N D I X

U.S.G.S. MAP - Exhibit A



SITE

OFFSITE

BOULEVARD

Chapel Hill Mall

High Plains School

AQUEDUCT

Substa

WOODMEN ROAD

ROAD

Cottonwood

DUBLIN BLVD

Creek

Pulpit Rock Park

Pulpit Rock

Park

VICKERS DRIVE

Park

16

SPRINGS

Park

Athletic Fields

Austin

Bluffs

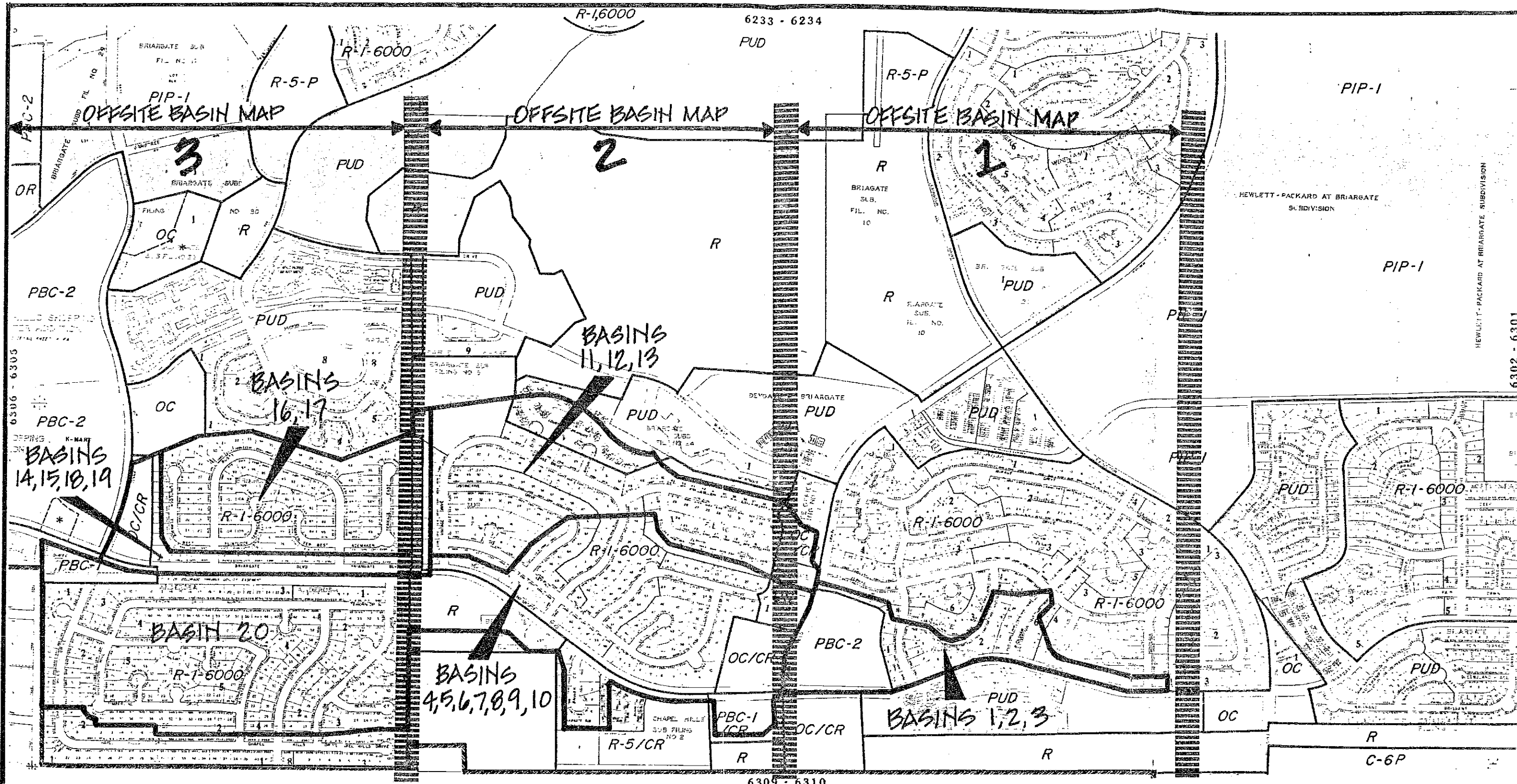
EXHIBIT A
U.S.G.S. MAP

SCS SOILS MAP - Exhibit B



EXHIBIT B
SCS SOILS MAP

ZONING MAP - Exhibit C



ZONING LEGEND	
PUD	PLANNED UNIT DEVELOPMENT
A	AGRICULTURAL
R	ESTATE - SINGLE FAMILY RESIDENTIAL
R-1	9,000 SQ. FT. SINGLE FAMILY RESIDENTIAL
R-1	6,000 SQ. FT. SINGLE FAMILY RESIDENTIAL
R-2	TWO-FAMILY RESIDENTIAL
R-4	EIGHT-FAMILY RESIDENTIAL
R-5	MULTI-FAMILY RESIDENTIAL

MHP	MOBILE HOME PARK
MHS	MOBILE HOME SUBDIVISION
OR	OFFICE RESIDENTIAL
OC	OFFICE COMPLEX
PBC	PLANNED BUSINESS CENTER NO. 1 and 2
C-5	INTERMEDIATE BUSINESS
C-6	GENERAL BUSINESS
PIP	PLANNED INDUSTRIAL PARK NO. 1 and 2
M-1	LIGHT INDUSTRIAL

M-2	HEAVY INDUSTRIAL
APD	AIRPORT PLANNED DEVELOPMENT
SU	SPECIAL USE
RVP	RECREATIONAL VEHICLE PARK
SP	SPECIAL PERMIT
*	USE VARIANCE
*	CONDITIONAL USE
HR	HIGH RISE
P	PLANNED PROVISIONAL

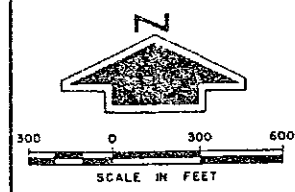
/CR	ZONE SUBJECT TO CONDITIONS OF RECORD
---	CITY LIMITS
///	HILLSIDE OVERLAY



CITY PLANNING DEPARTMENT
 POST OFFICE BOX 1575 COLORADO SPRINGS, COLORADO 80901

ZONING MAP

NOTICE: THE OFFICIAL ZONING MAP OF THE CITY IS MAINTAINED IN THE PLANNING DEPARTMENT AND IS AVAILABLE FOR INSPECTION DURING REGULAR BUSINESS HOURS. PLEASE BE ADVISED THAT ALL COPIES OF THE OFFICIAL ZONING MAP ARE HEREBY DEEMED UNOFFICIAL SHOULD NOT BE RELIED UPON, AND MAY NOT ACCURATELY REFLECT CURRENT ZONING DISTRICTS DUE TO ZONE CHANGES AFTER THE EFFECTIVE DATE OF THE OFFICIAL ZONING MAP.



BASE MAP REVISION DATE:
 ZONE MAP REVISION DATE:

6304 - 6303

EXHIBIT "C" ZONING MAP

TRIBUTARY PLATTED SUBDIVISIONS - Exhibit D

Master Development Drainage Plan
Chapel Hills Crossing

EXHIBIT "D"
Tributary Platted Subdivisions

Anderosa Estates

Banner Court Condo's No. 7 & 8

Briargate Satellite Filing No. 2

Briargate Subdivision Filing No. 1

Briargate Subdivision Filing No. 2

Briargate Subdivision Filing No. 3

Briargate Subdivision Filing No. 4

Briargate Subdivision Filing No. 5

Briargate Subdivision Filing No. 6

Briargate Subdivision Filing No. 7

Briargate Subdivision Filing No. 9

Briargate Subdivision Filing No. 9-A

Briargate Subdivision Filing No. 10

Briargate Subdivision Filing No. 11

Briargate Subdivision Filing No. 32

Briargate Subdivision Filing No. 36

Briarhill Place Condo's

Chapel Hills Filing No. 2

Chapel Hills Filing No. 3

Chapel Hills Shopping Center Subdivision No. 3

Courtside Townhomes Filing No. 1

Courtside Townhomes Filing No. 2

N.B.W. Filing No. 1

Rampart Medical Centre Subdivision Filing No. 1

Union Boulevard Subdivision No. 1

HYDROLOGIC RESULTS (Rational Method) - Exhibit E

BASIN	AREA in ACRES	BASIN		Tc (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW		
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀	
OFF SITE BASIN	~250	SEE TR-20 MODEL					A&B	~50%	0.52	0.62	177	361	
A2	13.8			15	3.9	5.8	A&B	45%	0.55	0.65	30	52	
A3	5.5			15	3.9	5.8	A&B	45%	0.55	0.65	12	21	
A4	15.1			15	3.9	5.8	A&B	45%	0.55	0.65	32	57	
A5	11.1			15	3.9	5.3	A&B	45%	0.55	0.65	24	42	
	45.5			15	3.6	5.8			0.55	0.65	90	160	
B1	6.6			10	4.6	7.0	A&B	95%	0.90	0.90	27	42	
B2	1.0			10	4.6	7.0	A&B	95%	0.90	0.90	4	6	
B3	11.9			10	4.6	7.0	A&B	95%	0.90	0.90	49	75	
B4	1.0			10	4.6	7.0	A&B	95%	0.90	0.90	4	6	
B5	3.6			10	4.6	7.0	A&B	95%	0.90	0.90	15	23	
	24.1			10	4.6	7.0			0.90	0.90	100	152	
TOTAL	~320 AC.	SEE TR-20 MODEL - AT NORTHWEST CORNER OF SITE:										356	573



JR ENGINEERING, LTD.
6455 North Union Boulevard, Suite 202
Colorado Springs, Colorado 80918
593-2593

PRELIMINARY

TABLE 1
MASTER DEVELOPMENT DRAINAGE PLAN
CHAPEL HILLS CROSSING
JWD 1/13/89 Job No. 8335

EXHIBIT "E"

BASIN	AREA in ACRES	BASIN		Tc (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW	
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀
1	14.06	115 2650'	22% 2.8 FPS	19	3.5	5.2	A	1/5 AC=50%	0.52	0.62	26	45
2	4.73	50' 600'	22% 2.5 FPS	11	4.4	6.7	A	NEIGHBOR COMM=70%	0.75	0.80	16	25
3	5.49	50' 800'	22% 2.8 FPS	11	4.4	6.7	A	NEIGHBOR COMM=70%	0.75	0.80	18	29
TOTAL	24.28			19	3.5	5.2		58%	0.54	0.64	46	81
4 & 5	11.5			15	3.9	5.8	A	1/5 AC=50%	0.52	0.62	23	41
6 & 7	22.1			15	3.9	5.8	A	1/5 AC=50%	0.52	0.62	45	79
8 & 9	19.4			15	3.9	5.8	A	1/5 AC+NEIGH 70%	0.75	0.80	57	90
10	7.7			15	3.9	5.8	A	COMBINE 30%	0.40	0.55	12	25
TOTAL	60.7			15	3.9	5.8		54%	0.53	0.63	125	222



JR ENGINEERING, LTD.
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Colorado Springs, Colorado 80918
593-2593

PRELIMINARY

TABLE 2
MASTER DEVELOPMENT DRAINAGE PLAN
CHAPEL HILLS CROSSING
JWD 1/13/89 Job No. 8335

BASIN	AREA in ACRES	BASIN		Tc (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW	
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀
11	13.1			15	3.9	5.8	A & B	50%	0.52	0.62	27	47
12	16.1			15	3.9	5.8	A & B	50%	0.52	0.62	33	58
13	17.0			15	3.9	5.8	A & B	50%	0.52	0.62	34	61
TOTAL	33.1			15	3.9	5.8		50%	0.52	0.62	67	119
11+12+13	46.2			20	3.4	5.2		50%	0.52	0.62	82	149
TOTAL											-22	-22
											60	127
16	13.5			15	3.9	5.8	A & B	1/4 AC 40%	0.50	0.60	26	47
17	18.6			15	3.9	5.8	A & B	1/4 AC 40%	0.50	0.60	36	65
14, 15, 18, 19	19.6			15	3.9	5.8	A & B	COMBINED 50%	0.52	0.62	40	70
20	70.4			20	3.4	5.2		50%	0.52	0.62	124	227



JR ENGINEERING, LTD.
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593-2593

PRELIMINARY

TABLE 3
MASTER DEVELOPMENT DRAINAGE PLAN
CHAPEL HILLS CROSSING
JWD 1/13/89 Job No. 8335

HYDROLOGIC RESULTS (TR-20 Model) - Exhibit F

TR20 XEQ 01-13-89 10:52
REV PC 09/83(.2)

CHAPEL HILLS CROSSING PRELIMINARY DRAINAGE STUDY
24 HR, IIA, 10&100 YEAR, INCREMENT=0.10

20
21

JOB 1 PASS 1
PAGE 1

FILE NO. 1

COMPUTER PROGRAM FOR PROJECT FORMULATION - HYDROLOGY USER NOTES

THE USERS MANUAL FOR THIS PROGRAM IS THE MAY 1983 DRAFT OF TR-20. CHANGES FROM THE 2/14/74 VERSION INCLUDE:

REACH ROUTING - THE MODIFIED ATT-KIN ROUTING PROCEDURE REPLACES THE CONVEX METHOD. INPUT DATA PREPARED FOR PREVIOUS PROGRAM VERSIONS USING CONVEX ROUTING COEFFICIENTS WILL NOT RUN ON THIS VERSION.

THE PREFERRED TYPE OF DATA ENTRY IS CROSS SECTION DATA REPRESENTATIVE OF A REACH. IT IS RECOMMENDED THAT THE OPTIONAL CROSS SECTION DISCHARGE-AREA PLOTS BE OBTAINED WHENEVER NEW CROSS SECTION DATA IS ENTERED. THE PLOTS SHOULD BE CHECKED FOR REASONABLENESS AND ADEQUACY OF INPUT DATA FOR THE COMPUTATION OF "M" VALUES USED IN THE ROUTING PROCEDURE.

GUIDELINES FOR DETERMINING OR ANALYZING REACH LENGTHS AND COEFFICIENTS (X,M) ARE AVAILABLE IN THE USERS MANUAL. SUMMARY TABLE 2 DISPLAYS REACH ROUTING RESULTS AND ROUTING PARAMETERS FOR COMPARISON AND CHECKING.

HYDROGRAPH GENERATION - THE PROCEDURE TO CALCULATE THE INTERNAL TIME INCREMENT AND PEAK TIME OF THE UNIT HYDROGRAPH HAVE BEEN IMPROVED. PEAK DISCHARGES AND TIMES MAY DIFFER FROM THE PREVIOUS VERSION. OUTPUT HYDROGRAPHS ARE STILL INTERPOLATED, PRINTED, AND ROUTED AT THE USER SELECTED MAIN TIME INCREMENT.

INTERMEDIATE PEAKS - METHOD ADDED TO PROVIDE DISCHARGES AT INTERMEDIATE POINTS WITHIN REACHES WITHOUT ROUTING.

OTHER - THIS VERSION CONTAINS SOME ADDITIONS TO THE INPUT AND NUMEROUS MODIFICATIONS TO THE OUTPUT. USER OPTIONS HAVE BEEN MODIFIED AND AUGMENTED ON THE JOB RECORD, RAINTABLES ADDED, ERROR AND WARNING MESSAGES EXPANDED, AND THE SUMMARY TABLES COMPLETELY REVISED. THE HOLDOUT OPTION IS NOT OPERATIONAL AT THIS TIME.

PROGRAM QUESTIONS OR PROBLEMS SHOULD BE DIRECTED TO HYDRAULIC ENGINEERS AT THE SCS NATIONAL TECHNICAL CENTERS:
CHESTER, PA (NORTHEAST) -- 215-499-3933, FORT WORTH, TX (SOUTH) -- 334-5242 (FTS)
LINCOLN, NB (MIDWEST) -- 541-5318 (FTS), PORTLAND, OR (WEST) -- 423-4099 (FTS)

PROGRAM CHANGES SINCE MAY 1982:

12/17/82 - CORRECT PEAK RATE FACTOR FOR USER ENTERED DIMHYD
CORRECT REACH ROUTING PEAK TRAVEL TIME PRINTED WITH FULLPRINT OPTION

5/02/83 - CORRECT COMPUTATIONS FOR ---

1. DIVISION OF BASEFLOW IN DIVERT OPERATION
2. HYDROGRAPH VOLUME SPLIT BETWEEN BASEFLOW AND ABOVE BASEFLOW
3. CROSS SECTION DATA PLOTTING POSITION
4. INTERMEDIATE PEAK WHEN "FROM" AREA IS LARGER THAN "THRU" AREA
5. STORAGE ROUTED REACH TRAVEL TIME FOR MULTYPEAK HYDROGRAPH
6. ORDERING "FLOW-FREQ" FILE FROM SUMMARY TABLE #3 DATA
7. BASEFLOW ENTERED WITH READHYD
8. LOW FLOW SPLIT DURING DIVERT PROCEDURE #2 WHEN SECTION RATINGS START AT DIFFERENT ELEVATIONS

ENHANCEMENTS ---

1. REPLACE USER MANUAL ERROR CODES (PAGE 4-9 TO 4-11) WITH MESSAGES
2. LABEL OUTPUT HYDROGRAPH FILES WITH CROSS SECTION/STRUCTURE, ALTERNATE AND STORM NO'S

JOB TR-20	FULLPRINT	SUMMARY		10		
TITLE 001 CHAPEL HILLS CROSSING	PRELIMINARY DRAINAGE STUDY			20		
TITLE 24 HR, IIA, 10&100 YEAR, INCREMENT=0.10				21		
3 STRUCT 01				30		
9 ENDTBL				40		
3 STRUCT 02				50		
9 ENDTBL				60		
3 STRUCT 03				70		
9 ENDTBL				80		
3 STRUCT 04	POND "A"			90		
3	94.	0.0	0.1	100		
3	95.	1.0	0.2	110		
3	96.	2.0	0.3	120		
3	97.	3.0	0.4	130		
3	98.	4.0	0.5	140		
3	99.	5.0	1.1	150		
3	100.	6.0	1.8	160		
3	101.	7.0	2.5	170		
3	102.	8.0	3.4	180		
3	103.	9.0	4.4	190		
3	104.	23.0	5.4	200		
3	105.	161.0	6.6	210		
3	106.	415.0	7.9	220		
9 ENDTBL				230		
3 STRUCT 05	POND "B"			240		
3	94.	0.0	0.00	250		
3	95.	3.0	0.01	260		
3	96.	9.0	0.03	270		
3	97.	12.0	0.09	280		
3	98.	15.0	0.17	290		
3	99.	17.0	0.28	300		
3	100.	20.0	0.40	310		
3	101.	75.0	0.53	320		
9 ENDTBL				330		
5 PAINF 2	0.25	TYPE II A		340		
3	0.0	0.0015	0.0030	0.0045	0.0060	350
3	0.0080	0.0100	0.0120	0.0143	0.0165	360
3	0.0188	0.0210	0.0233	0.0255	0.0278	370
3	0.0320	0.0390	0.0460	0.0530	0.0600	380
3	0.0750	0.1000	0.4000	0.7000	0.7250	390
3	0.7500	0.7650	0.7800	0.7900	0.8000	400
3	0.8100	0.8200	0.8250	0.8300	0.8350	410
3	0.8400	0.8450	0.8500	0.8550	0.8600	420
3	0.8638	0.8675	0.8713	0.8750	0.8788	430
3	0.8825	0.8863	0.8900	0.8938	0.8975	440
3	0.9013	0.9050	0.9083	0.9115	0.9148	450
3	0.9180	0.9210	0.9240	0.9270	0.9300	460
3	0.9325	0.9350	0.9375	0.9400	0.9425	470
3	0.9450	0.9475	0.9500	0.9525	0.9550	480
3	0.9575	0.9600	0.9625	0.9650	0.9675	490
3	0.9700	0.9725	0.9750	0.9775	0.9800	500
3	0.9813	0.9825	0.9838	0.9850	0.9863	510
3	0.9875	0.9888	0.9900	0.9913	0.9925	520
3	0.9938	0.9950	0.9963	0.9975	0.9988	530
3	1.0000	1.0000	1.0000	1.0000	1.0000	540

9	ENDTBL						550	
6	RUNOFF	1	01	6	0.04	81.	0.32	560 BASIN 1,2,3
6	RESVOR	2	01	6	7			570
6	REACH	3	001	7	5	1.0	2.7	1.33
6	DIVERT	6	001	5	7	1	44.0	2.
6	REACH	3	002	1	4	1900.0	3.9	1.33
6	RUNOFF	1	02	6	0.09	83.	0.25	610 BASIN 4,5,6,7,8,9,10
6	RESVOR	2	02	6	7			620
6	REACH	3	002	7	5	250.0	3.9	1.33
6	ADDHYD	4	002	4	5	6		640
6	DIVERT	6	002	6	2	3	168.0	6.
6	RUNOFF	1	03	6	0.02	81.	0.25	650 BASIN 11
6	RESVOR	2	03	6	7			670
6	REACH	3	003	7	5	1.0	2.7	1.33
6	DIVERT	6	003	5	6	7	22.0	4.
6	REACH	3	004	7	5	3300.	3.9	1.33
6	RUNOFF	1	004	6	0.05	81.	0.25	700 BASIN 12,13
6	ADDHYD	4	004	5	6	7		720
6	REACH	3	005	7	5	250.	3.9	1.33
6	DIVERT	6	005	5	6	4	86.	6.
6	ADDHYD	4	004	2	6	5		750
6	RESVOR	2	04	5	7			760
6	DIVERT	6	04	7	2	1	96.0	10.
6	ADDHYD	4	006	3	4	6		780
6	REACH	3	006	6	7	3200.	2.7	1.33
6	RUNOFF	1	006	6	0.03	81.	0.25	790 BASIN 14,15,18,19
6	ADDHYD	4	006	6	7	5		810
6	REACH	3	007	2	3	600.0	7.8	1.33
6	RUNOFF	1	007	4	0.02	80.	0.25	820 BASIN 16
6	ADDHYD	4	007	3	4	2		840
6	DIVERT	6	007	2	3	4	110.0	6.
6	RUNOFF	1	05	6	0.03	80.	0.25	850 BASIN 17
6	RESVOR	2	05	6	7			870
6	REACH	3	008	7	6	1.0	7.8	1.33
6	ADDHYD	4	008	6	3	7		890
6	DIVERT	6	008	7	2	3	110.0	6.
6	ADDHYD	4	006	5	3	7		910
6	ADDHYD	4	006	7	4	6		920
6	DIVERT	6	006	6	7	5	100.	20.
6	DIVERT	6	006	5	6	4	60.	30.
6	REACH	3	009	4	3	1100.	2.7	1.33
6	ADDHYD	4	009	2	3	5		960
6	REACH	3	010	1	2	3250.	2.7	1.33
6	RUNOFF	1	010	3	0.11	81.0	0.33	970 BASIN 20
6	ADDHYD	4	010	2	3	4		990
6	ADDHYD	4	010	4	5	3		1000
6	DIVERT	6	010	3	6	5	287.	15.
6	REACH	3	011	6	7	2300.	7.8	1.33
6	REACH	3	011	5	4	2300.	2.7	1.33
6	ADDHYD	4	011	4	7	5		1040
6	RUNOFF	1	011	1	0.07	83.	0.30	1050 BASIN A
6	ADDHYD	4	011	1	5	2		1060
6	RUNOFF	1	011	6	0.04	98.	0.17	1070 BASIN B
6	ADDHYD	4	011	2	6	7		1080
	ENDATA							1090

7 INCREM 6		.10				1100
7 COMPUT 7	01 011		3.2 = P_{10}	1.0	2 2 01 01	1110
ENDCMP 1						1120
7 COMPUT 7	01 011		4.5 = P_{100}	1.0	2 2 01 02	1130
ENDCMP 1						1140
ENDJOB 2						1150

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION			RUNOFF AMOUNT (IN)	PEAK DISCHARGE			
						BEGIN (HR)	AMOUNT (IN)	DURATION (HR)		ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSM)
ALTERNATE 1 STORM 1													
STRUCTURE 1	RUNOFF	.04	2	2	.10	.0	3.20	23.75	1.47	---	5.82	46.16	1154.1
STRUCTURE 1	RESVOR	.04	2	2	.10	.0	3.20	23.75	1.47	---	5.82	46.16	1154.1
XSECTION 1	REACH	.04	2	2	.10	.0	3.20	23.75	1.47	---	5.82	46.16	1154.1
XSECTION 1	DIVERT	.00	2	2	.10	.0	3.20	23.75	1.47	---	5.82	46.16	*****
XSECTION 2	DIVERT	.04	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 2	REACH	.04	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
STRUCTURE 2	RUNOFF	.09	2	2	.10	.0	3.20	23.75	1.61	---	5.79	127.38	1415.4
STRUCTURE 2	RESVOR	.09	2	2	.10	.0	3.20	23.75	1.61	---	5.79	127.38	1415.4
XSECTION 2	REACH	.09	2	2	.10	.0	3.20	23.75	1.61	---	5.79	127.38	1415.4
XSECTION 2	ADDHYD	.13	2	2	.10	.0	3.20	23.75	1.11	---	5.79	127.38	979.9
XSECTION 2	DIVERT	.00	2	2	.10	.0	3.20	23.75	1.11	---	5.79	127.38	*****
XSECTION 6	DIVERT	.13	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
STRUCTURE 3	RUNOFF	.02	2	2	.10	.0	3.20	23.75	1.47	---	5.79	25.73	1286.3
STRUCTURE 3	RESVOR	.02	2	2	.10	.0	3.20	23.75	1.47	---	5.79	25.73	1286.3
XSECTION 3	REACH	.02	2	2	.10	.0	3.20	23.75	1.47	---	5.79	25.73	1286.3
XSECTION 3	DIVERT	.00	2	2	.10	.0	3.20	23.75	1.47	---	5.77	22.16	*****
XSECTION 4	DIVERT	.02	2	2	.10	.0	3.20	23.75	.02	---	5.80	3.67	183.7
XSECTION 4	REACH	.02	2	2	.10	.0	3.20	23.75	.03	---	6.00?	.98?	49.0
XSECTION 4	RUNOFF	.05	2	2	.10	.0	3.20	23.75	1.47	---	5.79	64.32	1286.3
XSECTION 4	ADDHYD	.07	2	2	.10	.0	3.20	23.75	1.05	---	5.79	64.32	918.8
XSECTION 5	REACH	.07	2	2	.10	.0	3.20	23.75	1.05	---	5.79	64.32	918.8
XSECTION 5	DIVERT	.00	2	2	.10	.0	3.20	23.75	1.05	---	5.79	64.32	*****
XSECTION 6	DIVERT	.07	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
STRUCTURE 4	ADDHYD	.00	2	2	.10	.0	3.20	23.75	.00	105.12	5.79	191.68	*****
STRUCTURE 4	RESVOR	.00	2	2	.10	.0	3.20	23.75	.00	104.18	6.11	47.25	*****
STRUCTURE 4	DIVERT	.00	2	2	.10	.0	3.20	23.75	.00	104.18	6.11	47.25	*****
XSECTION 10	DIVERT	.00	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	*****
XSECTION 6	ADDHYD	.20	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 6	REACH	.20	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 6	RUNOFF	.03	2	2	.10	.0	3.20	23.75	1.47	---	5.79	38.59	1286.3
XSECTION 6	ADDHYD	.23	2	2	.10	.0	3.20	23.75	.19	---	5.79	38.59	167.8
XSECTION 7	REACH	.00	2	2	.10	.0	3.20	23.75	.19	---	6.11	47.25	*****

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION			RUNOFF AMOUNT (IN)	PEAK DISCHARGE			
						BEGIN (HR)	AMOUNT (IN)	DURATION (HR)		ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSM)
ALTERNATE 1 STORM 1													
XSECTION 7	RUNOFF	.02	2	2	.10	.0	3.20	23.75	1.40	---	5.79	24.48	1223.8
XSECTION 7	ADDHYD	.02	2	2	.10	.0	3.20	23.75	12.34	---	6.10	52.15	2607.5
XSECTION 7	DIVERT	.00	2	2	.10	.0	3.20	23.75	12.34	---	6.10	52.15	*****
XSECTION 6	DIVERT	.02	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
STRUCTURE 5	RUNOFF	.03	2	2	.10	.0	3.20	23.75	1.40	---	5.79	36.71	1223.8
STRUCTURE 5	RESVOR	.03	2	2	.10	.0	3.20	23.75	1.41	100.04	5.92	22.41	747.1
XSECTION 8	REACH	.03	2	2	.10	.0	3.20	23.75	1.41	---	5.92	22.41	747.1
XSECTION 8	ADDHYD	.03	2	2	.10	.0	3.20	23.75	9.64	---	6.09	70.43	2347.7
XSECTION 8	DIVERT	.00	2	2	.10	.0	3.20	23.75	9.64	---	6.09	70.43	*****
XSECTION 6	DIVERT	.03	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 6	ADDHYD	.26	2	2	.10	.0	3.20	23.75	.17	---	5.79	38.59	148.4
XSECTION 6	ADDHYD	.28	2	2	.10	.0	3.20	23.75	.16	---	5.79	38.59	137.8
XSECTION 6	DIVERT	.00	2	2	.10	.0	3.20	23.75	.16	---	5.79	38.59	*****
XSECTION 20	DIVERT	.28	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 6	DIVERT	.00	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	*****
XSECTION 30	DIVERT	.28	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 9	REACH	.28	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 9	ADDHYD	.28	2	2	.10	.0	3.20	23.75	1.03	---	6.09	70.43	251.5
XSECTION 10	REACH	.00	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	*****
XSECTION 10	RUNOFF	.11	2	2	.10	.0	3.20	23.75	1.47	---	5.83	124.76	1134.1
XSECTION 10	ADDHYD	.11	2	2	.10	.0	3.20	23.75	1.47	---	5.83	124.76	1134.1
XSECTION 10	ADDHYD	.39	2	2	.10	.0	3.20	23.75	1.16	---	5.85	177.32	454.7
XSECTION 10	DIVERT	.00	2	2	.10	.0	3.20	23.75	1.16	---	5.85	177.32	*****
XSECTION 15	DIVERT	.39	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 11	REACH	.00	2	2	.10	.0	3.20	23.75	.00	---	5.85	177.32	*****
XSECTION 11	REACH	.39	2	2	.10	.0	3.20	23.75	.00	---	.00	.00	.0
XSECTION 11	ADDHYD	.39	2	2	.10	.0	3.20	23.75	1.16	---	5.85	177.32	454.7
XSECTION 11	RUNOFF	.07	2	2	.10	.0	3.20	23.75	1.61	---	5.81	92.14	1316.2
XSECTION 11	ADDHYD	.46	2	2	.10	.0	3.20	23.75	1.22	---	5.83	268.26	583.2
XSECTION 11	RUNOFF	.04	2	2	.10	.0	3.20	23.75	2.94	---	5.68	97.37	2434.1
XSECTION 11	ADDHYD	.50	2	2	.10	.0	3.20	23.75	1.36	---	5.79	355.81	711.6
											TOTAL		
ALTERNATE 1 STORM 2													
STRUCTURE 1	RUNOFF	.04	2	2	.10	.0	4.50	23.75	2.55	---	5.81	81.79	2044.7
STRUCTURE 1	RESVOR	.04	2	2	.10	.0	4.50	23.75	2.55	---	5.81	81.79	2044.7
XSECTION 1	REACH	.04	2	2	.10	.0	4.50	23.75	2.55	---	5.91	81.79	2044.7
XSECTION 1	DIVERT	.00	2	2	.10	.0	4.50	23.75	2.55	---	5.70*	46.00	*****

C EAST R

355.81
TOTAL

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION			RUNOFF AMOUNT (IN)	PEAK DISCHARGE				
						BEGIN (HR)	AMOUNT (IN)	DURATION (HR)		ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSH)	
ALTERNATE	1	STORM	2											
XSECTION	2	DIVERT	.04	2	2	.10	.0	4.50	23.75	.34	---	5.81	35.79	894.7
XSECTION	2	REACH	.04	2	2	.10	.0	4.50	23.75	.31	---	5.92	34.67	866.8
STRUCTURE	2	RUNOFF	.09	2	2	.10	.0	4.50	23.75	2.72	---	5.78	216.25	2402.8
STRUCTURE	2	RESVDR	.09	2	2	.10	.0	4.50	23.75	2.72	---	5.78	216.25	2402.8
XSECTION	2	REACH	.09	2	2	.10	.0	4.50	23.75	2.72	---	5.78	216.25	2402.8
XSECTION	2	ADDDHYD	.13	2	2	.10	.0	4.50	23.75	1.98	---	5.80	233.61	1797.0
XSECTION	2	DIVERT	.00	2	2	.10	.0	4.50	23.75	1.98	---	5.70*	168.00*****	
XSECTION	6	DIVERT	.13	2	2	.10	.0	4.50	23.75	.12	---	5.80	65.61	504.7
STRUCTURE	3	RUNOFF	.02	2	2	.10	.0	4.50	23.75	2.54	---	5.78	44.94	2247.2
STRUCTURE	3	RESVDR	.02	2	2	.10	.0	4.50	23.75	2.54	---	5.78	44.94	2247.2
XSECTION	3	REACH	.02	2	2	.10	.0	4.50	23.75	2.54	---	5.78	44.94	2247.2
XSECTION	3	DIVERT	.00	2	2	.10	.0	4.50	23.75	2.54	---	5.60*	22.00*****	
XSECTION	4	DIVERT	.02	2	2	.10	.0	4.50	23.75	.44	---	5.78	22.94	1147.2
XSECTION	4	REACH	.02	2	2	.10	.0	4.50	23.75	.45	---	5.91	18.57	928.6
XSECTION	4	RUNOFF	.05	2	2	.10	.0	4.50	23.75	2.54	---	5.78	112.36	2247.2
XSECTION	4	ADDDHYD	.07	2	2	.10	.0	4.50	23.75	1.94	---	5.80	123.79	1768.4
XSECTION	5	REACH	.07	2	2	.10	.0	4.50	23.75	1.94	---	5.80	123.79	1768.4
XSECTION	5	DIVERT	.00	2	2	.10	.0	4.50	23.75	1.94	---	5.70*	86.00*****	
XSECTION	6	DIVERT	.07	2	2	.10	.0	4.50	23.75	.14	---	5.80	37.79	539.8
STRUCTURE	4	ADDDHYD	.00	2	2	.10	.0	4.50	23.75	.14	105.37	5.70*	254.00*****	
STRUCTURE	4	RESVDR	.00	2	2	.10	.0	4.50	23.75	.14	105.24	5.95	221.15 *****	
STRUCTURE	4	DIVERT	.00	2	2	.10	.0	4.50	23.75	.14	104.53	5.90*	96.00*****	
XSECTION	10	DIVERT	.00	2	2	.10	.0	4.50	23.75	.14	---	5.95	123.73 *****	
XSECTION	6	ADDDHYD	.20	2	2	.10	.0	4.50	23.75	.13	---	5.80	103.39	517.0
XSECTION	6	REACH	.20	2	2	.10	.0	4.50	23.75	.14	---	5.91	78.64	393.2
XSECTION	6	RUNOFF	.03	2	2	.10	.0	4.50	23.75	2.54	---	5.78	67.42	2247.2
XSECTION	6	ADDDHYD	.23	2	2	.10	.0	4.50	23.75	.46	---	5.89	127.18	552.9
XSECTION	7	REACH	.00	2	2	.10	.0	4.50	23.75	.46	---	5.90*	96.00*****	
XSECTION	7	RUNOFF	.02	2	2	.10	.0	4.50	23.75	2.46	---	5.78	43.40	2170.1
XSECTION	7	ADDDHYD	.02	2	2	.10	.0	4.50	23.75	18.69	---	5.85	137.78	6888.9
XSECTION	7	DIVERT	.00	2	2	.10	.0	4.50	23.75	18.69	---	5.80*	110.00*****	
XSECTION	6	DIVERT	.02	2	2	.10	.0	4.50	23.75	.28	---	5.85	19.84	991.8
STRUCTURE	5	RUNOFF	.03	2	2	.10	.0	4.50	23.75	2.46	---	5.78	65.10	2170.1
STRUCTURE	5	RESVDR	.03	2	2	.10	.0	4.50	23.75	2.43	100.90	5.82	69.51	2316.9
XSECTION	8	REACH	.03	2	2	.10	.0	4.50	23.75	2.43	---	5.82	69.51	2316.9
XSECTION	8	ADDDHYD	.03	2	2	.10	.0	4.50	23.75	14.71	---	5.84	186.14	6204.6

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION			RUNOFF AMOUNT (IN)	PEAK DISCHARGE			
						BEGIN (HR)	AMOUNT (IN)	DURATION (HR)		ELEVATION (FT)	TIME (HR)	RATE (CFS)	RATE (CSM)
ALTERNATE 1 STORM 2													
XSECTION 8	DIVERT	.00	2	2	.10	.0	4.50	23.75	14.71	---	5.80*	110.00*****	
XSECTION 6	DIVERT	.03	2	2	.10	.0	4.50	23.75	.80	---	5.83	72.55	2418.3
XSECTION 6	ADDHYD	.26	2	2	.10	.0	4.50	23.75	.49	---	5.87	183.82	707.0
XSECTION 6	ADDHYD	.28	2	2	.10	.0	4.50	23.75	.49	---	5.86	203.12	725.4
XSECTION 6	DIVERT	.00	2	2	.10	.0	4.50	23.75	.48	---	5.80*	100.00*****	
XSECTION 20	DIVERT	.28	2	2	.10	.0	4.50	23.75	.10	---	5.86	103.12	368.3
XSECTION 6	DIVERT	.00	2	2	.10	.0	4.50	23.75	.10	---	5.85	67.50	*****
XSECTION 30	DIVERT	.28	2	2	.10	.0	4.50	23.75	.03	---	5.88	37.45	133.8
XSECTION 9	REACH	.28	2	2	.10	.0	4.50	23.75	.03	---	5.88	37.45	133.8
XSECTION 9	ADDHYD	.28	2	2	.10	.0	4.50	23.75	1.53	---	5.88	147.45	526.6
XSECTION 10	REACH	.00	2	2	.10	.0	4.50	23.75	1.53	---	6.09	97.74	*****
XSECTION 10	RUNOFF	.11	2	2	.10	.0	4.50	23.75	2.55	---	5.82	221.33	2012.1
XSECTION 10	ADDHYD	.11	2	2	.10	.0	4.50	23.75	2.90	---	5.82	221.33	2012.1
XSECTION 10	ADDHYD	.39	2	2	.10	.0	4.50	23.75	1.91	---	5.85	361.11	925.9
XSECTION 10	DIVERT	.00	2	2	.10	.0	4.50	23.75	1.91	---	5.80*	287.00*****	
AT LEAST R													
XSECTION 15	DIVERT	.39	2	2	.10	.0	4.50	23.75	.06	---	5.84	70.58	181.0
XSECTION 11	REACH	.00	2	2	.10	.0	4.50	23.75	.06	---	5.80*	287.00*****	
XSECTION 11	REACH	.39	2	2	.10	.0	4.50	23.75	.06	---	5.98	58.32	149.5
XSECTION 11	ADDHYD	.39	2	2	.10	.0	4.50	23.75	1.92	---	5.98	345.62	886.2
XSECTION 11	RUNOFF	.07	2	2	.10	.0	4.50	23.75	2.72	---	5.80	157.96	2256.6
XSECTION 11	ADDHYD	.46	2	2	.10	.0	4.50	23.75	2.04	---	5.88	468.84	1019.2
XSECTION 11	RUNOFF	.04	2	2	.10	.0	4.50	23.75	4.22	---	5.67	138.12	3453.1
XSECTION 11	ADDHYD	.50	2	2	.10	.0	4.50	23.75	2.22	---	5.80	572.60	145.2
												TOTAL	

DRAINAGE PLAN

TR-20 FLOW CHART