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MASTER DEVELOPMENT DRAINAGE PLAN
FOR
MIDDLE CREEK MANOR
AT NORTHGATE

May 1998
Revised June 1998
Revised July 1998
Revised August 1998

Prepared For:

RMC CORPORATION
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Prepared By:

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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 any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Mike A. Bramlett, Colorado P.E. #32314
For and On Behalf of JR Engineering, Ltd.

10/14/98
Date

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: RMC Corporation

By: Robert P. Osborne

Title: President

Address: P.O. Box 908
Colorado Springs, CO 80906

CITY OF COLORADO SPRINGS ONLY:
Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

City Engineer

October 19, 1998
Date

Conditions:

MASTER DEVELOPMENT DRAINAGE PLAN FOR MIDDLE CREEK MANOR AT NORTHGATE

TABLE OF CONTENTS

MASTER DEVELOPMENT DRAINAGE PLAN FOR MIDDLE CREEK MANOR AT NORTHGATE

PURPOSE

This document is the Master Development Drainage Plan for Middle Creek Manor at Northgate. The purpose of this report is to analyze the phased development and create the foundation for each final drainage report, which will be filed with the subdivision plats. This report will estimate peak rates of storm water runoff, recommend solutions for drainage problems resulting from development, and identify necessary improvements to safely route storm water runoff to adequate outfall facilities. This report will detail the proposed system in Middle Creek Parkway east of Voyager, to enable the developer to construct Middle Creek Parkway prior to platting the roadway.

GENERAL DESCRIPTION

Middle Creek Manor at Northgate is located in the northeast quarter of Section 17, Township 12 South, Range 66 West of the Sixth Principal Meridian in the City of Colorado Springs, County of El Paso. The site is bounded to the north by unplatted land, to the west by future Voyager Parkway, to the south by Middle Creek Parkway and unplatted future park site and elementary school, and to the east by unplatted land. Zoning of this 54.19 acre site will be R1-6000-DFOZ. Proposed use is single family residential development, containing 160 lots.

Middle Creek Manor at Northgate is located on an existing ridge, which slopes from northeast to southwest at a 7.0% grade. Vegetation is native grass with some pods of grambling oak. The grading for this site has preserved specific areas of vegetation therefore some portions of this site will not be overlot graded. The soil condition reflects Hydrologic Group "B" (Crowfoot, Tomah, and Payton) soils as determined by the "Soil Survey of El Paso County Area," prepared by S.C.S. (See Appendix).

EXISTING DRAINAGE CONDITIONS

Middle Creek Manor at Northgate is located within the Middle Tributary Drainage Basin and a small portion of Monument Branch Drainage Basin. In the analysis of this site, JR Engineering, Ltd. used the "Middle Tributary Drainage Basin Planning Study," by URS Consultants, 1987 in combination with the "Northgate Filing No. 6, Phase 1, Final Drainage Report (Voyager Parkway)," by JR Engineering, Ltd., and "The MDDP for the Northgate Software Campus," by JR Engineering, Ltd. Currently the site drains into both the Monument Branch and Middle Tributary basins.

PROPOSED DRAINAGE CHARACTERISTICS

After construction of Middle Creek Manor at Northgate, on-site and off-site runoff will be split into several outfall locations (see drainage map). Per the drainage basin planning study prepared by URS, this development requires the construction of two public regional detention facilities to release flows at near historic levels. These facilities will outfall into a proposed storm sewer system in Voyager Parkway and outfall into future Regional Detention Pond 9. These facilities have been detailed in the Preliminary/Final Drainage Report for Voyager Parkway Filing No. 6 – Phase I, and the Master Drainage Development Plan for the Northgate Software Campus by JR Engineering, Ltd.

Basin OS-1 consists of 2.76 acres of unplatted county land, for calculation purposes this basin has been assumed to have a developed runoff coefficient of $C_5 = 0.45$ and $C_{100} = 0.55$. This flow will sheet flow into Basin A and will then be routed through side lot line swales and discharge into Rockbridge Circle. Basin A combines with runoff from Basin B at the intersection of Bridle Oaks Circle (See drainage plan). This runoff then flows west in Bridle Oaks Drive. The combined flows in Rockbridge Circle is $Q_5 = 9.4$ cfs and $Q_{100} = 19.7$ cfs, therefore Rockbridge Circle has capacity to carry this discharge with ramp curb.

Basins C and D discharge into Highland Oaks Place and are routed south into Bridle Oaks Drive. The combined flows in Highland Oaks Place are $Q_5 = 11.5$ cfs and $Q_{100} = 23.6$ cfs, therefore Highland Oaks Place has capacity to carry these flows with ramp curb and gutter.

Basin E discharge into the north half of Hillsbro Drive with a combined flow of Q_5 = 5.8 cfs and Q_{100} = 11.8 cfs, therefore Hillsbro Drive has capacity to carry this flow with ramp curb and gutter.

Design Point 1 consists of a combined runoff from the previously referenced basins (OS-1, A, B, C, D, E, F), with a runoff of Q_5 = 32.4 cfs and Q_{100} = 67.4 cfs. The street capacity of Bridle Oaks Drive with vertical curb and gutter at 2.0% is 24 cfs each side in the 5-year event, therefore Bridle Oaks Drive has capacity to convey these flows. At Design Point 1, there is a proposed sump 14' D-10-R inlet which will intercept a portion of these flows, additional flows will cross the crown and collect at Design Point 2.

Design Point 2 consists of runoff from Basin G with a combined discharge of Q_5 = 2.7 cfs and Q_{100} = 5.3 cfs. This discharge will be intercepted by a sump 14' D-10-R inlet, and combine with overflows from Design Point 1, and be routed west via a 36" RCP to Design Point 3 as subsurface flow.

Design Point 3 consists of surface flows from Basins I, J, and K. The surface runoff at Design Point 3 is Q_5 = 12.9 cfs and Q_{100} = 26.8 cfs and will be intercepted by a 8' D-10-R sump inlet.

Design Point 4 consists of surface runoff from Basin L and overflow from Design Point 3 (sump inlet). The surface flow of Q_5 = 5.8 cfs and Q_{100} = 11.6 cfs will be intercepted by a 6' D-10-R sump inlet. The pipe flow from these inlets and the inlets at Design Points 1 and 2 discharge into the detention pond at Design Point 11 with a discharge into the pond of Q_5 = 54.5 cfs and Q_{100} = 110.4 cfs. The allowable release rate is Q_{100} = 39 cfs (historic flow into Design Point 11). With this release rate the required storage in the detention facility is 4.5 ac-ft (see appendix for pond calculations).

The detention facility at Design Point 11 is the Regional Detention Pond No. 8 detailed in the Drainage Basin Planning Study. The basin study called for a 2.3 ac-ft. storage facility, the reason that the facility's size has increase to 4.5 ac-ft. is that the tributary area has increased, which in turn has reduced the size of Regional Detention Pond No. 9. This facility as Design Point 11 will be a public facility with ownership by the City of Colorado Springs and surface maintenance by the

Northgate Homeowners Association. The Final Engineering drawings with the first phase of development will include detailed construction plans, which will meet all requirement detailed in the drainage criteria manual.

Basin OS-2 consists of 0.47 acres of unplatted county land. As stated previously for calculation purposes, this basin has been assumed to have a developed runoff coefficient of $C_5 = 0.45$ and $C_{100} = 0.55$. This flow will sheet flow into Basin P and then be routed through side lot line swales and discharge into Rockbridge Circle. Basin OS-2 and P combine at a 12' D-10-R sump inlet at Design Point 5 with $Q_5 = 7.1$ cfs and $Q_{100} = 15.1$ cfs. Rockbridge Circle with ramp curb and gutter will have adequate capacity.

Design Point 6 consists of runoff from Basins Q and R with a discharge of $Q_5 = 16.5$ cfs and $Q_{100} = 29.4$ cfs. This flow will collect at a 20' D-10-R sump inlet, then be piped sub-surface south in Rockbridge Circle to the sump at Design Points 7 and 8 via an 30" RCP pipe. Rockbridge Circle has adequate capacity to convey this flow via ramp curb and gutter.

Design Point 7 consists of surface runoff from Basins S and T with a discharge of $Q_5 = 5.7$ cfs and $Q_{100} = 11.2$ cfs. This flow collects at a sump location on Rockbridge Circle.

Design Point 8 consists of Basin U with a discharge of $Q_5 = 2.3$ cfs and $Q_{100} = 4.6$ cfs, which collects at a sump location in Rockbridge Circle located next to the second detention facility at Design Point 10. The pipe flow from Design Points 5, 6, 7, and 8 discharge into the detention pond at Design Point 10 with an inflow of $Q_5 = 31.1$ cfs and $Q_{100} = 61.6$ cfs. The allowable release rate is $Q_{100} = 30$ cfs (historic flow). With this release rate, a 2.9 ac-ft detention pond will be required (see appendix for pond calculation).

Design Point 9 consist of flow from Basin N, a down draining cul-de-sac named Hillside Oaks Place. This discharge of $Q_5 = 4.2$ cfs and $Q_{100} = 8.5$ cfs will be intercepted by a sump 4' D-10-R inlet and discharge into the system in Voyager Parkway undetained. This undetained flow has been accounted for in the Northgate Software Campus Master Drainage Development Plan, and is significantly less than the flows detailed in the basin study.

The detention facility at Design Point 10 is the Regional Detention Pond No. 7 detailed in the Drainage Basin Planning Study. The basin study called for a 3.0 AC-ft. storage facility. This facility will be public with ownership by the City of Colorado Springs and surface maintenance by the Northgate Homeowners Association. The Final Engineering drawings will also include detailed construction plans, which will meet current criteria.

Basin O consists of 0.68 acres of rear yards along Lots 1-6 south of Hillside Oaks Place. This basin will sheet flow off-site into Basin OS-4. Basin OS-4 is a future commercial site, which will convey this discharge through the future development. Also, since this basin consists of rear yards the runoff will be similar to historic levels.

Basin M and V consist of 1.61 acres and 0.82 acres of landscape areas and detention ponds, which will be landscaped with sod or reseeded.

Basin W and X also consist of rear yards, which will sheet flow onto future residential lots. The Final Drainage Report for this future development to the north of Middle Creek Manor will need to be graded to ensure proper drainage through the lots and outfall into a public street/storm system. These rear yards also have a similar runoff to historic levels.

Basin Y consists of landscaping along Voyager Parkway and detention facilities grading. The runoff from this basin will be at historic levels.

Basin OS-3 consists of 23.89 acres of undeveloped pasture, which is master planned as a future commercial site, future park site, and a future elementary school site. The composite runoff coefficient for this basin is $C_5 = 0.60$ and $C_{100} = 0.70$, which yields a developed discharge of $Q_5 =$ 54.5 cfs and $Q_{100} = 110.4$ cfs. The 42" R.C.P. storm sewer system will be extended east under Middle Creek Parkway and intercept these off-site flows (see drainage plan). There is no additional detention required at the existing Detention Pond No. 9 (northwest corner of Middle Creek Parkway and Voyager Parkway).

Basin OS-4 consists of a future commercial site with a discharge of Q_5 = 13.4 cfs and Q_{100} = 24.2 cfs. This runoff will be collected in a future on-site system and be routed into the Voyager Parkway storm sewer system. The site currently sheet flow to the southwest corner of Basin OS-4 and the Voyager Parkway system will intercept these flows.

As previously stated this drainage report will detail the facilities required to construct Middle Creek Parkway. Therefore at Design Point 12 (See drainage plan) the 100-year discharge is 11.8 cfs, which will require a 15' at grade D-10-R to intercept these flow and discharge into the Voyager Parkway system. At Design Point 13 a 10' at grade D-10-R will need to be constructed to intercept the 100-year discharge of 7.7 cfs. This intercepted flow will be also routed into the Voyager system, and discharge into the existing stock pond (future Regional Detention Pond No. 9). The existing stock pond has capacity to detain 2.41 ac-ft of storm runoff. A 30" CMP will need to be installed through the existing embankment to ensure that the pond drains. The detention pond calculations have been included in the Appendix.

HYDROLOGIC/HYDRAULIC CRITERIA

This report has been prepared in accordance with the 1991 City/County Drainage Criteria Manual. The Rational Method was used to estimate storm water runoff anticipated from design storms with a 5-year and 100-year recurrence interval. (Current Criteria dated October 12, 1994). The inlets for this site were sized based on a 5-year ponding depth not exceeding the crown of the street (6" max depth at flowline) and a 100-year ponding depth not to exceed the right-of-way assuming a 2% grade from top back of curb to the right-of-way (12" max depth at flowline). Street capacity is based on 5-year flows not exceeding the crown (6" max depth at flowline), 20 cfs max flow (34 cfs max flow collector streets) and the 100-year flows not exceeding a 12" depth at flowline with no adjacent flooding. (Current criteria dated October 12, 1994).

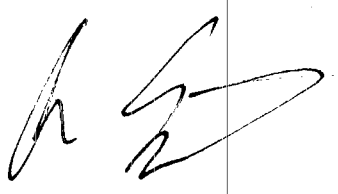
FLOODPLAIN STATEMENT

No portion of this site is located within the floodplain as determined by the Flood Insurance Rate Map (F. I .R .M.) Community Panel Number 0841C0295F, dated March 17, 1997.

SUMMARY

Construction of this subdivision will not adversely affect the surrounding developments. All drainage facilities were sized using the 1991 City of Colorado Springs Drainage Criteria and will safely discharge storm water runoff to adequate outfalls.

PREPARED BY:



Aaron B. Egbert, E.I.
Project Engineer
Land Development
For and On Behalf of JR Engineering, Ltd.

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REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual, dated October, 1991.

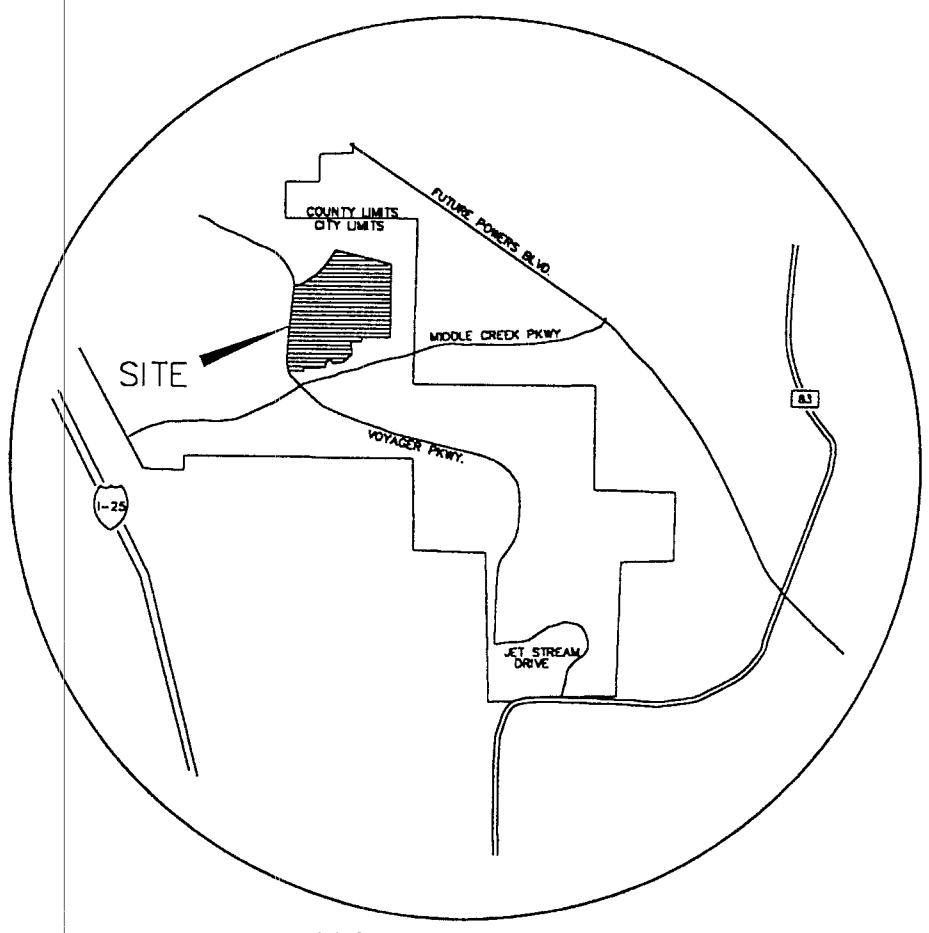
2. Northgate Filing No. 6 (Voyager Parkway - Phase I) Preliminary and Final Drainage Report, JR Engineering, Ltd.

4. Middle Tributary Drainage Basin Planning Study, URS Consultants, 1987.

5. MDDP for the Northgate Software Campus, JR Engineering, Ltd., 1998.

APPENDIX

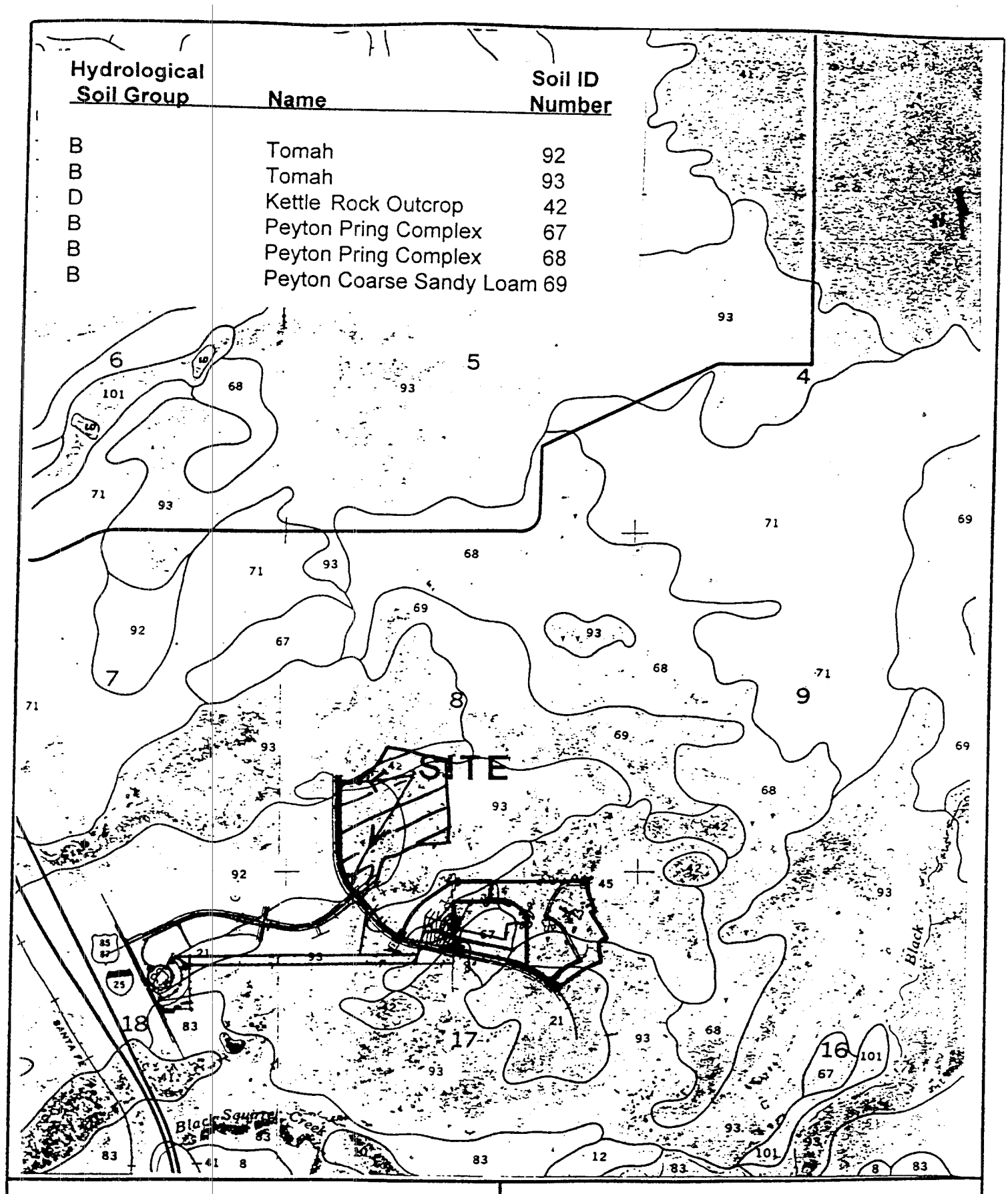
VICINITY MAP



VICINITY MAP
N.T.S.

S. C. S. SOIL MAP

Hydrological Soil Group	Name	Soil ID Number
B	Tomah	92
B	Tomah	93
D	Kettle Rock Outcrop	42
B	Peyton Pring Complex	67
B	Peyton Pring Complex	68
B	Peyton Coarse Sandy Loam	69



SCS SOIL SURVEY

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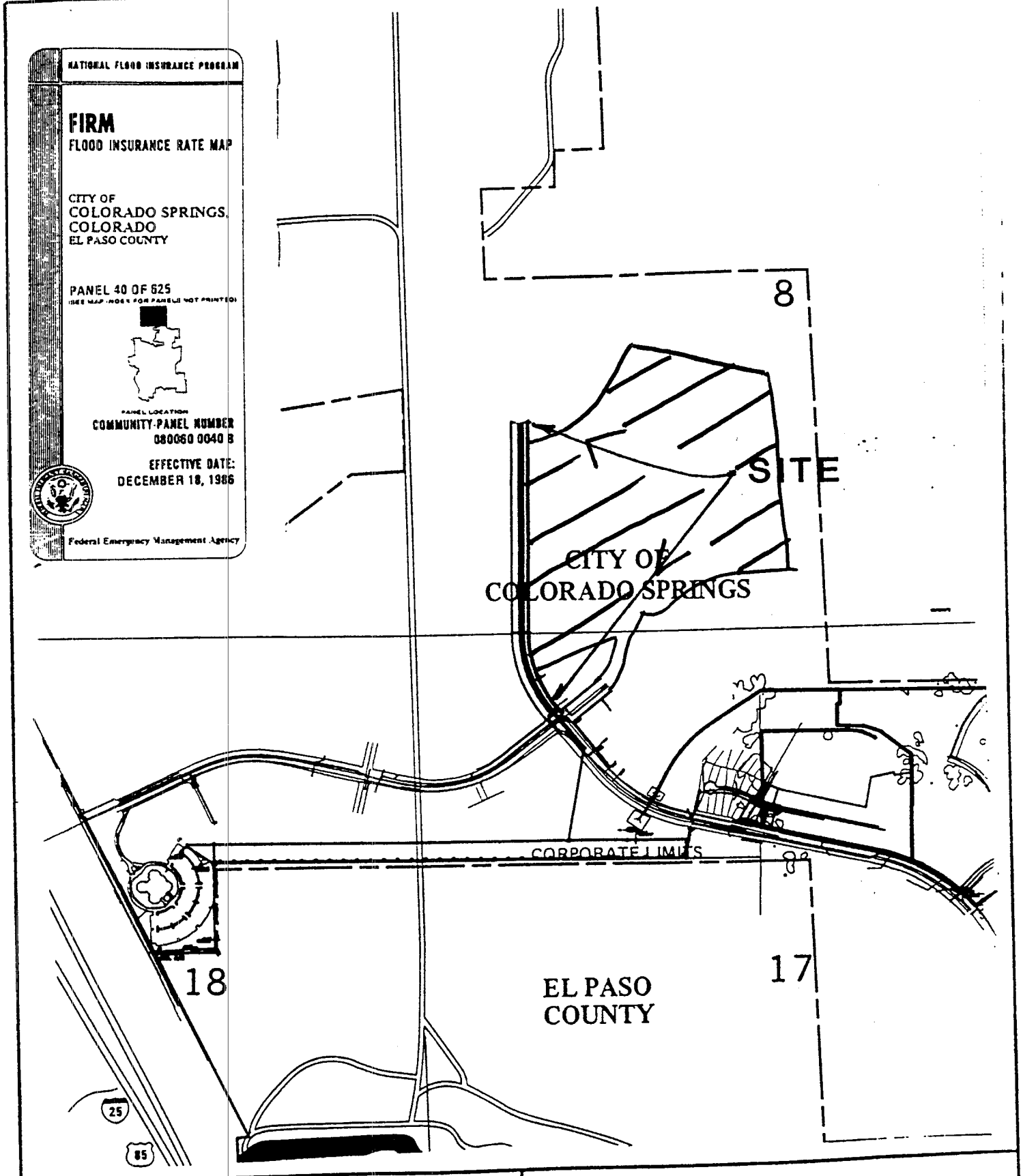
F. E. M. A. FLOODPLAIN MAP



FEMA FIRM

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HYDROLOGIC CALCULATIONS

Rational Method: Q=C*I*A [cfs]

Sub-Basin / Design Pt.	Area [ac.]	Composite Runoff Coef, C Based on Average Lot Size	Time of Concentration, Tc [min.] Flowline	L [ft.]	S [%]	v [ft/s]	**Tc [min.]**	Intensity, I [in/hr] 5-yr	100-yr	**Peak Flows, Q [cfs] 5-yr**	**100-yr**
A	4.38	~~Frequency 'C'= 0.25~~ *C_{100} = **0.55** C_5 = **0.45**	~~overland~~	~~150~~	~~2.0~~		~~15.5~~	3.2	5.6	**6.3**	**13.5**
			street	900	8.0	9.90	1.5				
						Total Tc =	**17.0**				
B	1.29	Frequency 'C'= 0.25 *C_{100} = **0.85** C_5 = **0.75**	overland	40	2.0		8.0	4.3	7.4	**4.2**	**8.1**
			street	660	10.0	11.07	1.0				
						Total Tc =	**9.0**				
C	4.55	Frequency 'C'= 0.25 *C_{100} = **0.65** C_5 = **0.55**	overland	120	2.0		13.8	3.4	5.9	**8.5**	**17.4**
			street	600	7.0	9.26	1.1				
						Total Tc =	**14.9**				
D	1.6	Frequency 'C'= 0.25 *C_{100} = **0.65** **0.55**	overland	100	2.0		12.6	3.8	6.6	**3.3**	**6.9**
						Total Tc =	**12.6**				
E	2.76	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	120	2.0		13.8	3.5	6.1	**5.8**	**11.8**
						Total Tc =	**13.8**				
F	3.23	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	120	2.0		13.8	3.5	6.1	**6.8**	**13.8**
						Total Tc =	**13.8**				

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Project: Middle Creek Manor at Northgate

Job No.: 8966.00 Date: 5/20/98

Engineer: ABE Page: 1 of 5

dr-calcs.xls

Rational Method: Q=C*I*A [cfs]

Sub-Basin / Design Pt.	Area [ac.]	Composite Runoff Coef, C Based on Average Lot Size	Time of Concentration, Tc [min.] Flowline	L [ft.]	S [%]	v [ft/s]	**Tc [min.]**	Intensity, I [in/hr] 5-yr	100-yr	**Peak Flows, Q [cfs] 5-yr**	**100-yr**
G	0.85	Frequency 'C'= 0.25 *C_{100} = **0.85** C_5 = **0.75**	overland	50	2.0		8.9 Total Tc = **8.9**	4.3	7.4	**2.7**	**5.3**
H	1.82	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	120	2.0		13.8 Total Tc = **13.8**	3.5	6.1	**3.8**	**7.8**
I	3.78	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland street	110 600	2.0 7.0	 9.3	13.2 1.1 Total Tc = **14.3**	3.5	6.1	**7.9**	**16.1**
J	0.96	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	50	2.0		8.9 Total Tc = **8.9**	4.3	7.4	**2.5**	**5.0**
K	2.92	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland street	120 300	2.0 2.0	 4.9	13.8 1.0 Total Tc = **14.8**	3.4	5.9	**6.0**	**12.1**
L	2.91	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland street	130 750	2.0 3.0	 6.1	14.4 2.1 Total Tc = **16.4**	3.3	5.7	**5.8**	**11.6**

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Rational Method: Q=C*I*A [cfs]

Sub-Basin / Design Pt.	Area [ac.]	Composite Runoff Coef, C Based on Average Lot Size	Time of Concentration, Tc [min.] Flowline	L [ft.]	S [%]	v [ft/s]	Tc [min.]	Intensity, I [in/hr] 5-yr	100-yr	Peak Flows, Q [cfs] 5-yr	100-yr
M	1.61	Frequency 'C'= 0.25 *C_{100} = **0.35** C_5 = **0.25**	overland	50	10.0		5.2	5.2	9.0	**2.1**	**5.1**
			street	0							
						Total Tc =	**5.2**				
N	1.98	Frequency 'C'= 0.25 *C_{100} = **0.7** C_5 = **0.60**	overland	110	2.0		13.2	3.5	6.1	**4.2**	**8.5**
			street	300	3.0	6.06	0.8				
						Total Tc =	**14.1**				
O	0.68	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	50	2.0		8.9	4.3	7.4	**1.8**	**3.5**
						Total Tc =	**8.9**				
P	4.44	Frequency 'C'= 0.25 *C_{100} = **0.55** C_5 = **0.45**	overland	150	2.0		15.5	3.2	5.6	**6.4**	**13.7**
			street	1000	7.0	9.26	1.8				
						Total Tc =	**17.3**				
Q	5.33	Frequency 'C'= 0.25 *C_{100} = **0.55** C_5 = **0.45**	overland	120	2.0		13.8	3.4	5.9	**8.2**	**17.3**
			street	450	7.0	9.3	0.8				
						Total Tc =	**14.6**				
R	3.29	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	100	2.0		12.6	3.5	6.1	**6.9**	**14.0**
			street	300	2.0	4.9	1.0				
						Total Tc =	**13.6**				

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dr-calcs.xls

Rational Method: Q=C*I*A [cfs]

Sub-Basin / Design Pt.	Area [ac.]	Composite Runoff Coef, C Based on Average Lot Size	Time of Concentration, Tc [min.] Flowline	L [ft.]	S [%]	v [ft/s]	**Tc [min.]**	Intensity, I [in/hr] 5-yr	100-yr	**Peak Flows, Q [cfs] 5-yr**	**100-yr**
S	0.57	Frequency 'C'= 0.25 *C_{100} = **0.85** C_5 = **0.75**	overland street	40 400	2.0 4.0	 7.00	8.0 1.0 Total Tc = **8.9**	4.3	7.4	**1.8**	**3.6**
T	1.98	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland street	120 250	2.0 2.0	 4.95	13.8 0.8 Total Tc = **14.7**	3.4	5.9	**4.0**	**8.2**
U	1.08	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	120	2.0		13.8 Total Tc = **13.8**	3.5	6.1	**2.3**	**4.6**
V	0.82	Frequency 'C'= 0.25 *C_{100} = **0.35** C_5 = **0.25**	overland	50	2.0		8.9 Total Tc = **8.9**	4.3	7.4	**0.9**	**2.1**
W	0.21	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	50	2.0		8.9 Total Tc = **8.9**	4.3	7.4	**0.5**	**1.1**
X	1.34	Frequency 'C'= 0.25 *C_{100} = **0.55** C_5 = **0.45**	overland	100	2.0		12.6 Total Tc = **12.6**	3.7	6.3	**2.2**	**4.6**

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Job No.: 8966.00 Date: 5/20/98

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Rational Method: Q=C*I*A [cfs]

Sub-Basin / Design Pt.	Area [ac.]	Composite Runoff Coef, C Based on Average Lot Size	Time of Concentration, Tc [min.] Flowline	L [ft.]	S [%]	v [ft/s]	Tc [min.]	Intensity, I [in/hr] 5-yr	100-yr	Peak Flows, Q [cfs] 5-yr	100-yr
Y	1.58	Frequency 'C'= 0.25 *C_{100} = **0.35** C_5 = **0.25**	overland	50	2.0		8.9 Total Tc = **8.9**	4.3	7.4	**1.7**	**4.1**
Z	1.50	Frequency 'C'= 0.25 *C_{100} = **0.95** C_5 = **0.90**	overland	NA	0.0		0.0 Total Tc = **5.0**	5.2	9.0	**7.0**	**12.8**
OS-1	2.76	Frequency 'C'= 0.25 *C_{100} = **0.55** C_5 = **0.45**	overland	150	8.0		9.7 Total Tc = **9.7**	4.1	7.0	**5.1**	**10.6**
OS-2	0.47	Frequency 'C'= 0.25 *C_{100} = **0.55** C_5 = **0.45**	overland	170	8.0		10.4 Total Tc = **10.4**	4	6.8	**0.8**	**1.8**
OS-3	23.89	Frequency 'C'= 0.25 *C_{100} = **0.70** C_5 = **0.60**	overland	100	2.0		12.6 Total Tc = **12.6**	3.8	6.6	**54.5**	**110.4**
OS-4	3.11	Frequency 'C'= 0.25 *C_{100} = **0.95** C_5 = **0.90**	overland	50	4.0		7.1 Total Tc = **7.1**	4.8	8.2	**13.4**	**24.2**

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COLORADO SPRINGS, CO 80919
(719) 593-2593 FAX (719) 528-6613

Project: Middle Creek Manor at Northgate

Job No.: 8966.00 Date: 5/20/98

Engineer: ABE Page: 5 of 5

dr-calcs.xls

Rational Method Flow Routing

Design Point	Basins	$CA_{(5)}$	$CA_{(100)}$	T_c [min]	I_5 [in/hr]	I_{100} [in/hr]	Peak Flow Q_5 [cfs]	Peak Flow Q_{100} [cfs]
DP-1	A	1.97	2.41					
	B	0.97	1.1					
	C	2.50	2.96					
	D	0.88	1.04					
	E	1.66	1.93					
	F	1.94	2.26					
	OS-1	1.24	1.52					
		11.16	13.22	***20.0***	2.9	5.1	32.4	67.4
DP-2	G	0.64	0.72	***8.9***	4.3	7.4	2.8	5.3
DP-3	DP-1	11.16	13.22					
	K	1.75	2.04					
	I	2.27	2.65					
	J	0.58	0.67					
		15.76	18.58	***21.2***	2.8	5	44.1	92.9
DP-4	L	1.75	2.04	***16.4***	3.3	5.7	5.8	11.6
DP-5	P	2.00	2.44					
	OS-2	0.21	0.26					
		2.21	2.70	***17.3***	3.2	5.6	7.1	15.1
DP-6	Q	2.40	2.93					
	R	2.30	1.97					
		4.70	4.90	***14.6***	3.5	6	16.5	29.4
DP-7	S	0.43	0.48					
	T	1.19	1.39					
		1.62	1.87	***14.7***	3.5	6	5.7	11.2

Rational Method Flow Routing

DP-8	U	0.65	0.76	***13.8***	3.5	6.1	2.3	4.6
DP-9	N	1.19	1.39	***14.1***	3.5	6.1	4.2	8.5
DP-10	DP-5	2.21	2.70					
	DP-6	4.70	4.90					
	DP-7	1.62	1.87					
	DP-8	0.65	0.76					
	DP-9	1.19	1.39					
		10.37	11.62	***18.6***	3.0	5.3	31.1	61.6
DP-11	DP-2	0.64	0.72					
	DP-3	15.76	18.58					
	DP-4	1.75	2.04					
	DP-9	1.19	1.39					
		19.34	22.73	***21.2***	2.8	5	54.2	113.7
DP-12	OS-3	14.33	16.72	12.6	3.8	6.6	54.5	110.4

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Project: **Middle Creek Manor At Northgate**

Job No.: 8966.00 Date: 5/20/98
Engineer: ABE Page: 1 of 1

HYDRAULIC CALCULATIONS

Calculations for Sizing of City Standard D-10-R Sump Inlets

Design Point	Q_5 [cfs]	Q_{100} [cfs]	$d_{5\text{-yr.}}$ [ft]	$d_{100\text{-yr.}}$ [ft]	Length of Inlet, L_i [ft]	
					$L_{i\text{-}5yr}$ [ft]	$L_{i\text{-}100yr}$ [ft]
1 & 2	34	71	0.50	1.00	**28.7**	**22.2**
3 & 4	18	37	0.50	1.00	**12.6**	**9.0**
5	7	15	0.50	0.50	**4.0**	**9.6**
6	17	29	0.50	0.50	**11.6**	**23.6**
7	6	11	0.50	1.00	**4.0**	**4.0**
8	2	5	0.50	1.00	**4.0**	**4.0**
9	4	9	0.50	1.00	**4.0**	**4.0**

$$*Q_i = 1.7(L_i+1.8W)(d_{max}+w/12)^{1.85}$$

*Equation taken from Figure 7-11 of the City of Colorado Springs Drainage Criteria Manual

where:	where:	
Qi =	Qi =	flow to inlet [cfs]
L_i =	L_i =	length of inlet [ft]
W =	W =	width of gutter pan [=3 ft]
d_{max} =	d_{max} =	ponding depth [0.94 ft max.]
w =	w =	depth of depressed area at inlet [3 in]

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Project: **Middle Creek Manor**

Job No.: 8966.00 Date: 5/20/98
Engineer: ABE Page: 1 of 1

Quick TR-55 Ver.5.46 S/N:
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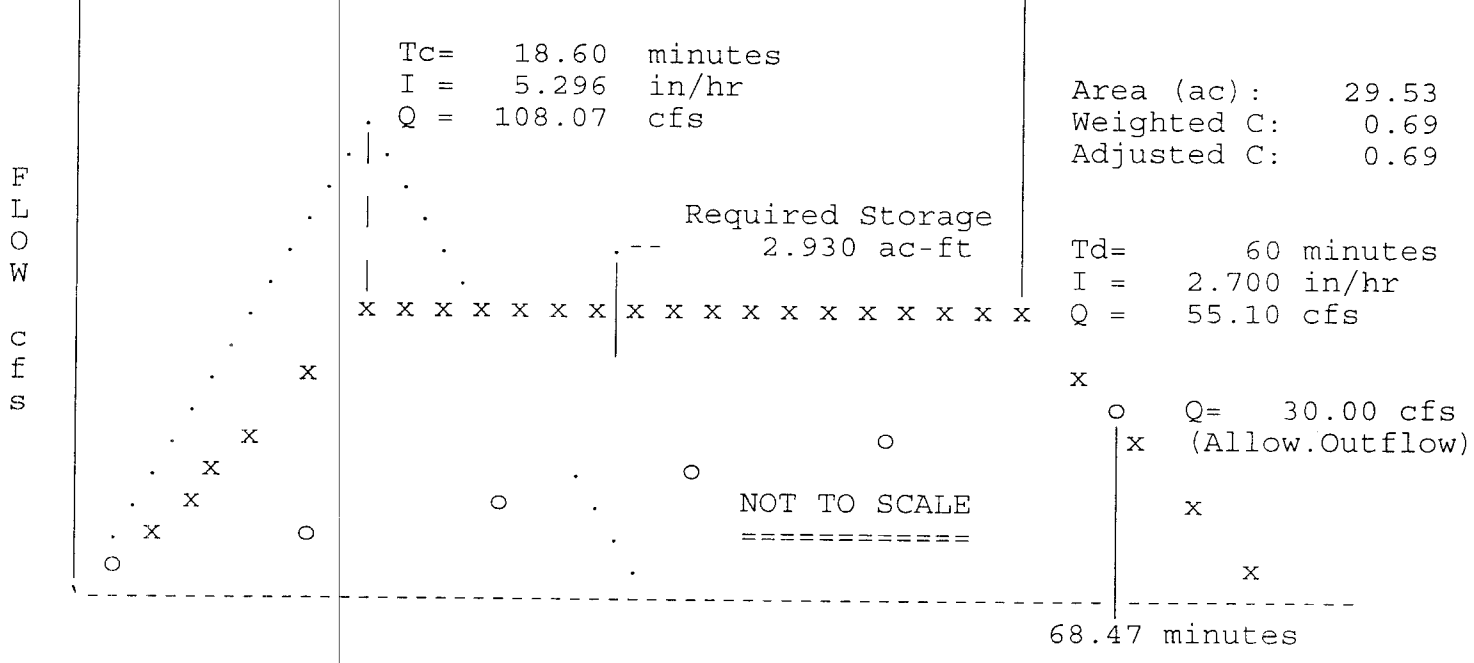
MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at inflow recession leg.

Design Point 10 - Required Detention

RETURN FREQUENCY: 100 yr	Allowable Outflow: 30.00 cfs
'C' Adjustment: 1.000	Required Storage: 2.930 ac-ft
Peak Inflow: 55.10 cfs	Inflow .HYD stored: 100YR-PO.HYD



Quick TR-55 Ver.5.46 S/N:
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Design Point 10 - Required Detention

**** Modified Rational Hydrograph *****

Weighted C = 0.691 Area= 29.530 acres Tc = 18.60 minutes

Adjusted C = 0.691 Td= 60.00 min. I= 2.70 in/hr Qp= 55.10 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.00
Output file: 100YR-PO.HYD

HYDROGRAPH FOR MAXIMUM STORAGE
For the 100 Year Storm

Time increment = 0.017 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.010	1.78	4.74	7.70	10.66	13.63	16.59	19.55
0.127	22.51	25.47	28.44	31.40	34.36	37.32	40.29
0.243	43.25	46.21	49.17	52.13	55.10	55.10	55.10
0.360	55.10	55.10	55.10	55.10	55.10	55.10	55.10
0.477	55.10	55.10	55.10	55.10	55.10	55.10	55.10
0.593	55.10	55.10	55.10	55.10	55.10	55.10	55.10
0.710	55.10	55.10	55.10	55.10	55.10	55.10	55.10
0.827	55.10	55.10	55.10	55.10	55.10	55.10	55.10
0.943	55.10	55.10	55.10	55.10	53.32	50.36	47.40
1.060	44.43	41.47	38.51	35.55	32.58	29.62	26.66
1.177	23.70	20.74	17.77	14.81	11.85	8.89	5.92
1.293	2.96	0.00					

Quick TR-55 Ver.5.46 S/N:
Executed: 09:17:09 08-07-1998

Design Point 10 - Required Detention

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
Hist.	0.680	18.02						
J	0.900	2.74						
K	0.950	3.26						
Ditch	0.470	5.51						
			18.60	0.691	0.691	5.296	29.53	108.07

Quick TR-55 Ver.5.46 S/N:
Executed: 09:17:09 08-07-1998

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* MODIFIED RATIONAL METHOD
* ---- Grand Summary For All Storm Frequencies ----
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First peak outflow point assumed to occur at inflow recession leg.

Design Point 10 - Required Detention

Area = 29.53 acres Tc = 18.60 minutes

Frequency (years)	Adjusted 'C'	Duration minutes	Intens. in/hr	Qpeak cfs	Allowable cfs	VOLUMES Inflow (ac-ft)	VOLUMES Storage (ac-ft)
100	0.691	60	2.700	55.10	30.00	4.553	2.930

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MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at inflow recession leg.

Design Point 10 - Required Detention

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.000 Allowable Q = 30.00 cfs

Hydrograph file duration= 60.00 minutes
Hydrograph file: 100YR-PO.HYD Tc = 18.60 minutes

Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	VOLUMES Inflow (ac-ft)	VOLUMES Storage (ac-ft)
0.691	0.691	19	5.296	29.53	108.07	2.769	2.000
0.691	0.691	20	5.100	29.53	104.07	2.867	2.069
0.691	0.691	30	4.200	29.53	85.71	3.542	2.537
0.691	0.691	40	3.500	29.53	71.42	3.935	2.724
0.691	0.691	50	3.000	29.53	61.22	4.216	2.799
0.691	0.691	60	2.700	29.53	55.10	4.553	2.930 Storage Maximum

Quick TR-55 Ver.5.46 S/N:
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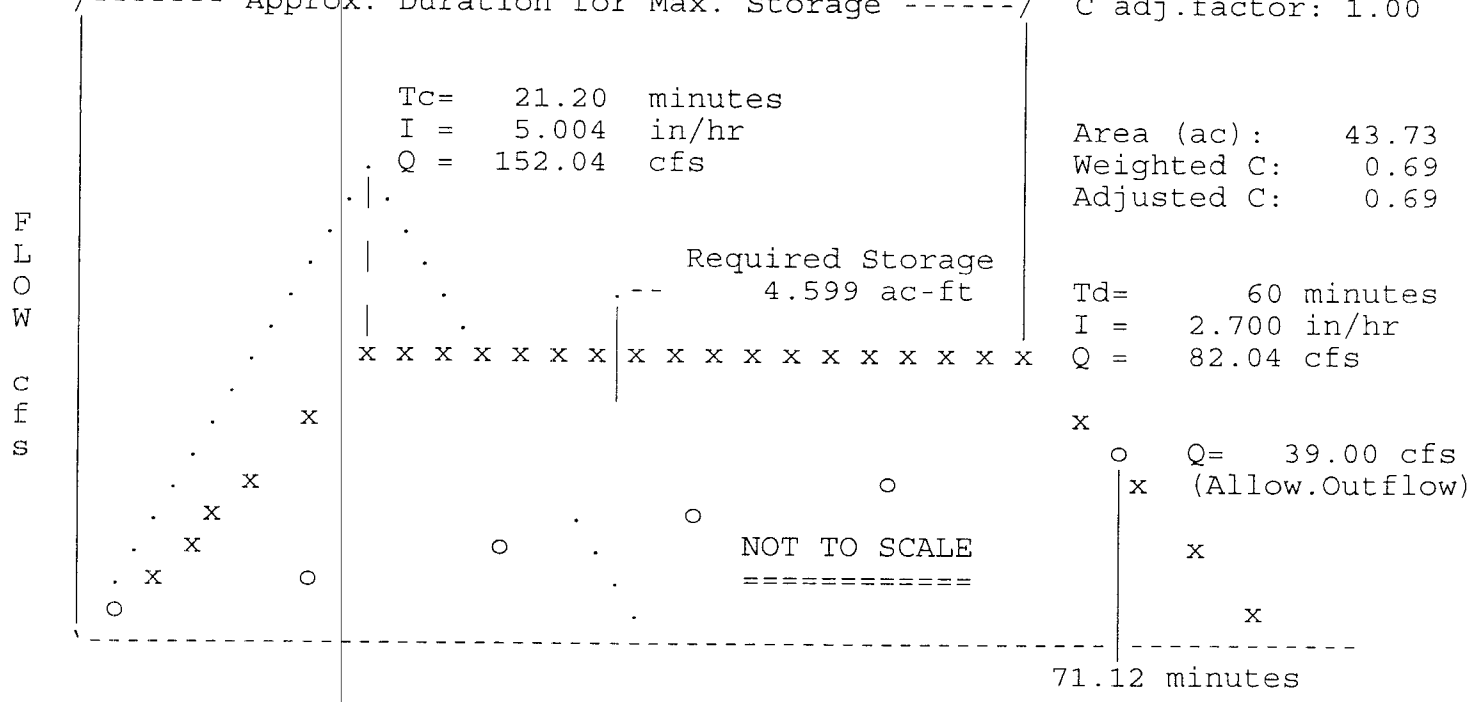
MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at inflow recession leg.

Design Point 11 - Required Detention

RETURN FREQUENCY: 100 yr	Allowable Outflow: 39.00 cfs
'C' Adjustment: 1.000	Required Storage: 4.599 ac-ft
Peak Inflow: 82.04 cfs	Inflow .HYD stored: 100YR-PO.HYD



Quick TR-55 Ver.5.46 S/N:
Executed: 09:07:45 08-07-1998

Design Point 11 - Required Detention

**** Modified Rational Hydrograph *****

Weighted C = 0.695 Area= 43.730 acres Tc = 21.20 minutes

Adjusted C = 0.695 Td= 60.00 min. I= 2.70 in/hr Qp= 82.04 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.00
Output file: 100YR-PO.HYD

HYDROGRAPH FOR MAXIMUM STORAGE
For the 100 Year Storm

Time increment = 0.017 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.003	0.77	4.64	8.51	12.38	16.25	20.12	23.99
0.120	27.86	31.73	35.60	39.47	43.34	47.21	51.08
0.237	54.95	58.82	62.69	66.56	70.43	74.30	78.17
0.353	82.04	82.04	82.04	82.04	82.04	82.04	82.04
0.470	82.04	82.04	82.04	82.04	82.04	82.04	82.04
0.587	82.04	82.04	82.04	82.04	82.04	82.04	82.04
0.703	82.04	82.04	82.04	82.04	82.04	82.04	82.04
0.820	82.04	82.04	82.04	82.04	82.04	82.04	82.04
0.937	82.04	82.04	82.04	82.04	81.26	77.39	73.52
1.053	69.66	65.79	61.92	58.05	54.18	50.31	46.44
1.170	42.57	38.70	34.83	30.96	27.09	23.22	19.35
1.287	15.48	11.61	7.74	3.87	0.00		

Quick TR-55 Ver.5.46 S/N:
Executed: 09:07:45 08-07-1998

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* MODIFIED RATIONAL METHOD *
* ---- Grand Summary For All Storm Frequencies ---- *
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First peak outflow point assumed to occur at inflow recession leg.

Design Point 11 - Required Detention

Area = 43.73 acres Tc = 21.20 minutes

Frequency (years)	Adjusted 'C'	Duration minutes	Intens. in/hr	Qpeak cfs	Allowable cfs	VOLUMES Inflow (ac-ft)	VOLUMES Storage (ac-ft)
100	0.695	60	2.700	82.04	39.00	6.780	4.599

Quick TR-55 Ver.5.46 S/N:
Executed: 09:07:45 08-07-1998

Design Point 11 - Required Detention

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
Hist.	0.690	32.22						
J	0.900	2.74						
K	0.950	3.26						
Ditch	0.470	5.51						
			21.20	0.695	0.695	5.004	43.73	152.04

Quick TR-55 Ver.5.46 S/N:
Executed: 09:07:45 08-07-1998

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at inflow recession leg.

Design Point 11 - Required Detention

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.000 Allowable Q = 39.00 cfs

Hydrograph file duration= 60.00 minutes
Hydrograph file: 100YR-PO.HYD Tc = 21.20 minutes

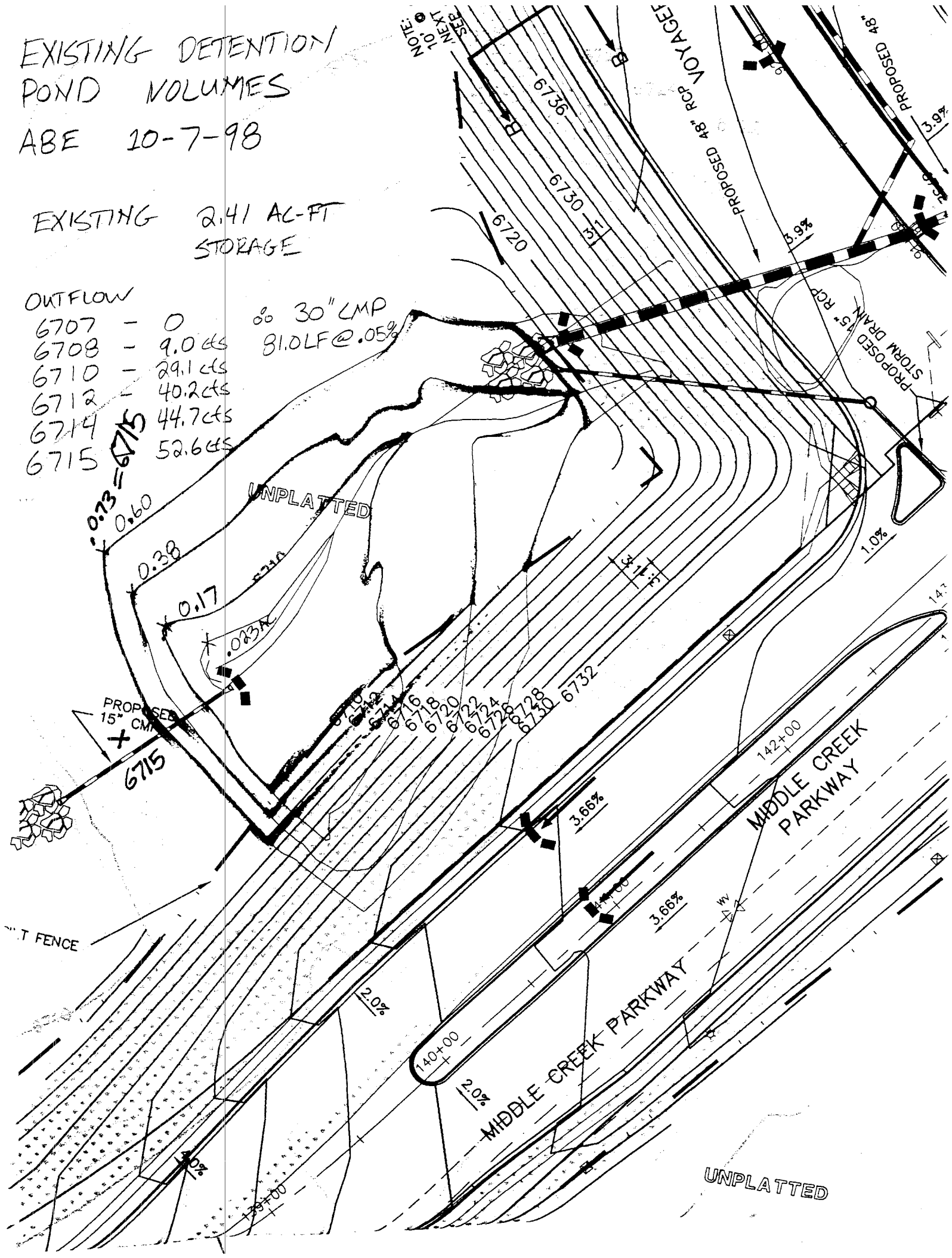
Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	VOLUMES Inflow (ac-ft)	VOLUMES Storage (ac-ft)
0.695	0.695	21	5.004	43.73	152.04	4.440	3.301
0.695	0.695	30	4.200	43.73	127.61	5.273	3.898
0.695	0.695	40	3.500	43.73	106.35	5.859	4.215
0.695	0.695	50	3.000	43.73	91.15	6.278	4.365
0.695	0.695	60	2.700	43.73	82.04	6.780	4.599

********** Storage Maximum **********

EXISTING DETENTION
POND VOLUMES
ABE 10-7-98

EXISTING 2.41 AC-FT
STORAGE

OUTFLOW
6707 - 0
6708 - 9.0 cfs
6710 - 29.1 cfs
6712 - 40.2 cfs
6714 - 44.7 cfs
6715 - 52.6 cfs



JR Engineering, Ltd.

CLIENT _____ JOB NO. _____

PROJECT _____ BY _____ CHK. BY _____ DATE _____

SUBJECT _____ SHEET NO. _____ OF _____

Temporary Basin No. 9

Calculation to determine if the temp basin No. 9 designed under the Voyager PKWY Filing 6 Phase I FDR is adequate to detain the 100yr developed flows from the Middle Creek Manor (areas H + N) and Middle Creek PKWY east of Voyager PKWY

Q_{100} HISTORIC

	Area
1	4.0
2	4.3
10	5.5
H	1.82
N	1.96 AC
MC PKWY	1.50
	19.08 AC

$C_{100} = 0.35$

$T_c = 14$ min $I_{100} = 6.10$

$Q_{100} = 40.7$ cfs

Q_{100} Developed

	Area
1	4
2	4.3
10	5.5
H	1.82
N	1.96
McPkwy	1.50
	19.08

$C_{100} = 0.90$

$T_c = 14$ min

1.80 AC-FT REQUIRED

Quick TR-55 Ver.5.46 S/N:
Executed: 11:15:09 10-07-1998

MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at inflow recession leg.

MODIFIED RATIONAL METHOD FOR TEMP BASIN NO. 9 AT NORTHGATE. THIS OPTION COMPUTES THE PEAK INFLOW INTO THE DETENTION POND AND THE DETENTION VOL. REQ'D USING THE RELEASE RATE FORM THE URS STUDY

RETURN FREQUENCY: 100 yr	Allowable Outflow: 40.70 cfs
'C' Adjustment: 1.000	Required Storage: 1.798 ac-ft
Peak Inflow: 61.13 cfs	Inflow .HYD stored: BASIN9TA.HYD

Quick TR-55 Ver.5.46 S/N:
Executed: 11:15:09 10-07-1998

MODIFIED RATIONAL METHOD FOR TEMP BASIN NO. 9 AT NORTHGATE. THIS OPTION COMPUTES THE PEAK INFLOW INTO THE DETENTION POND AND THE DETENTION VOL. REQ'D USING THE RELEASE RATE FORM THE URS STUDY

**** Modified Rational Hydrograph *****

Weighted C = 0.900 Area= 19.080 acres Tc = 14.00 minutes

Adjusted C = 0.900 Td= 39.00 min. I= 3.56 in/hr Qp= 61.13 cfs

RETURN FREQUENCY: 100 year storm Adj.factor = 1.00
Output file: BASIN9TA.HYD

HYDROGRAPH FOR MAXIMUM STORAGE
For the 100 Year Storm

Time increment = 0.017 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.000	0.00	4.37	8.73	13.10	17.47	21.83	26.20
0.117	30.57	34.93	39.30	43.67	48.03	52.40	56.77
0.233	61.13	61.13	61.13	61.13	61.13	61.13	61.13
0.350	61.13	61.13	61.13	61.13	61.13	61.13	61.13
0.467	61.13	61.13	61.13	61.13	61.13	61.13	61.13
0.583	61.13	61.13	61.13	61.13	61.13	56.77	52.40
0.700	48.03	43.67	39.30	34.93	30.57	26.20	21.83
0.817	17.47	13.10	8.73	4.37	0.00		

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MODIFIED RATIONAL METHOD FOR TEMP BASIN NO. 9 AT NORTHGATE. THIS OPTION COMPUTES THE PEAK INFLOW INTO THE DETENTION POND AND THE DETENTION VOL. REQ'D USING THE RELEASE RATE FORM THE URS STUDY

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 100 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
A	0.900	19.08						
			14.00	0.900	0.900	6.040	19.08	103.72

Quick TR-55 Ver.5.46 S/N:
Executed: 11:15:09 10-07-1998

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* MODIFIED RATIONAL METHOD *
* ---- Grand Summary For All Storm Frequencies ---- *
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First peak outflow point assumed to occur at inflow recession leg.

MODIFIED RATIONAL METHOD FOR TEMP BASIN NO. 9 AT NORTHGATE. THIS OPTION COMPUTES THE PEAK INFLOW INTO THE DETENTION POND AND THE DETENTION VOL. REQ'D USING THE RELEASE RATE FORM THE URS STUDY

Area = 19.08 acres Tc = 14.00 minutes

Frequency (years)	Adjusted 'C'	Duration minutes	Intens. in/hr	Qpeak cfs	Allowable cfs	VOLUMES Inflow (ac-ft)	Storage (ac-ft)
100	0.900	39	3.560	61.13	40.70	3.284	1.798

Quick TR-55 Ver.5.46 S/N:
Executed: 11:15:09 10-07-1998

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

First peak outflow point assumed to occur at inflow recession leg.

MODIFIED RATIONAL METHOD FOR TEMP BASIN NO. 9 AT NORTHGATE. THIS OPTION COMPUTES THE PEAK INFLOW INTO THE DETENTION POND AND THE DETENTION VOL. REQ'D USING THE RELEASE RATE FORM THE URS STUDY

RETURN FREQUENCY: 100 yr 'C' Adjustment = 1.000 Allowable Q = 40.70 cfs

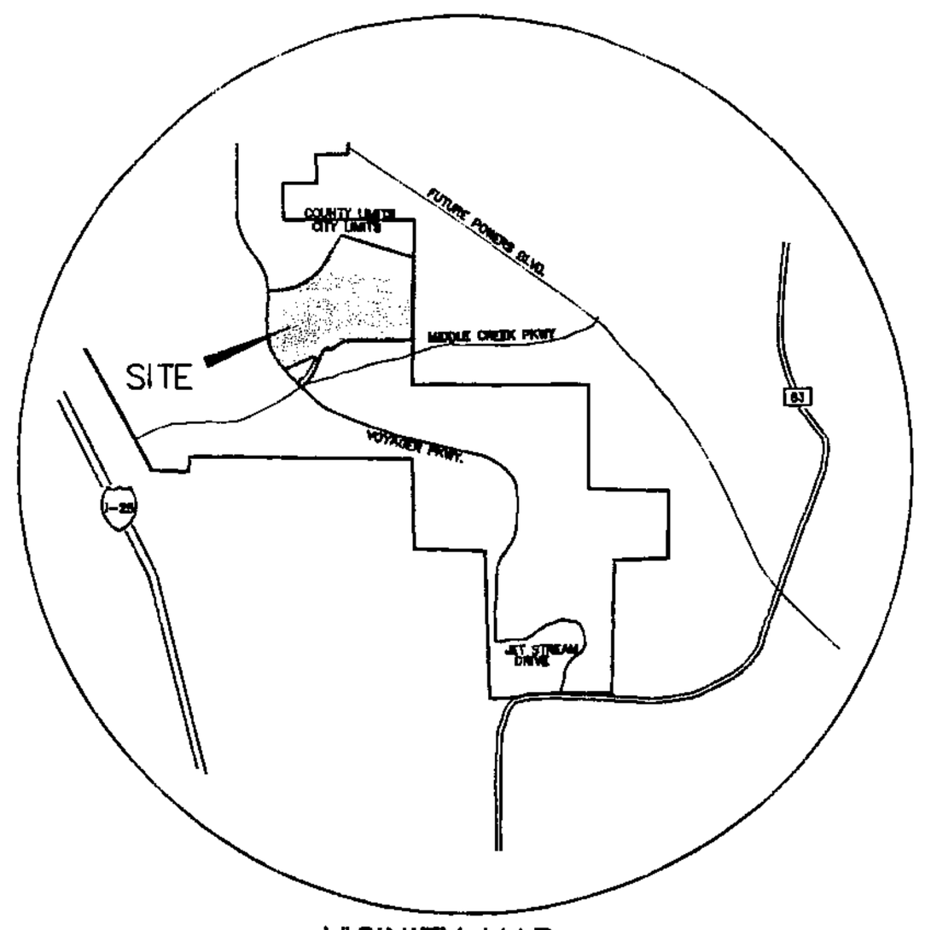
Hydrograph file duration= 39.00 minutes
Hydrograph file: BASIN9TA.HYD Tc = 14.00 minutes

Weighted 'C'	Adjusted 'C'	Duration minutes	Intens. in/hr	Areas acres	Qpeak cfs	VOLUMES Inflow (ac-ft)	VOLUMES Storage (ac-ft)
0.900	0.900	14	6.040	19.08	103.72	2.000	1.215
0.900	0.900	15	5.800	19.08	99.60	2.058	1.245
0.900	0.900	20	5.100	19.08	87.58	2.413	1.460
0.900	0.900	30	4.200	19.08	72.12	2.980	1.747
**********	**********	**********	**********	**********	**********	********** Storage Maximum	
0.900	0.900	39	3.560	19.08	61.13	3.284	1.798
**********	**********	**********	**********	**********	**********	**********	**********
0.900	0.900	40	3.500	19.08	60.10	3.311	1.798
0.900	0.900	50	3.000	19.08	51.52	3.548	1.754
0.900	0.900	60	2.700	19.08	46.36	3.832	1.758

DRAINAGE MAPS

MIDDLE CREEK MANOR @ NORTHGATE

CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO



VICINITY MAP
N.T.S.

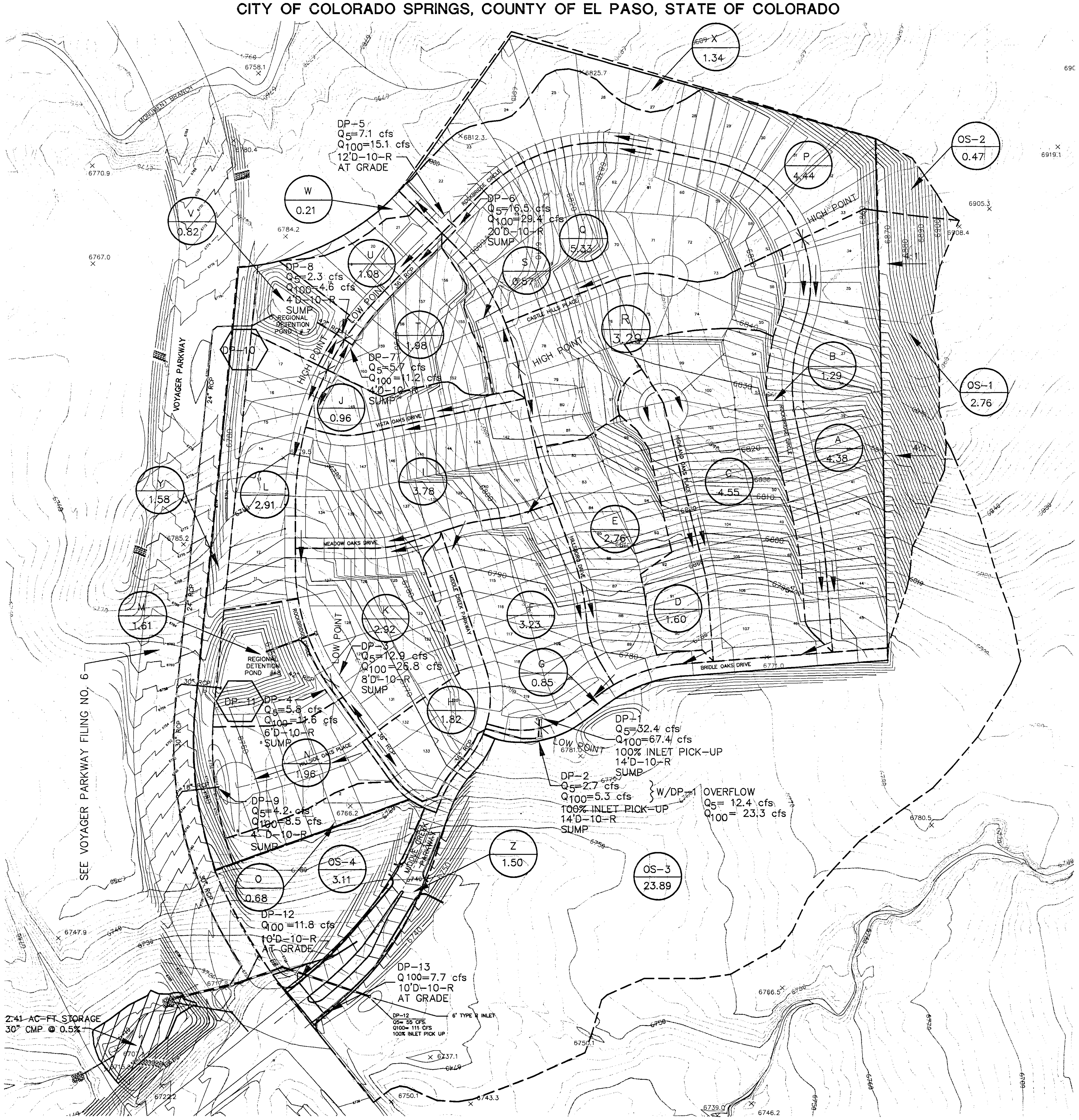
BASIN	AREA (ACRES)	Q_5 (CFS)	Q_{100} (CFS)
A	4.38	6.3	13.5
B	1.29	4.2	8.1
C	4.55	8.5	17.4
D	1.60	3.3	6.9
E	2.76	5.8	11.8
F	3.23	6.8	13.8
G	0.85	2.7	5.3
H	1.82	3.8	7.8
I	3.78	7.9	16.1
J	0.96	2.5	5.0
K	2.92	6.0	12.1
L	2.91	5.8	11.6
M	1.61	2.1	5.1
N	4.96	4.2	8.5
O	0.68	1.8	3.5
P	4.44	6.4	13.7
Q	5.33	8.2	17.3
R	3.29	6.9	14.0
S	0.57	1.8	3.6
T	1.98	4.0	8.2
U	1.08	2.3	4.6
V	0.82	0.9	2.1
W	0.21	0.5	1.1
X	1.33	2.2	4.6
Y	1.58	1.7	4.1
Z	1.50	7.0	12.8
OS-1	2.76	5.1	10.6
OS-2	0.47	0.8	1.8
OS-3	23.89	54.5	110.4
OS-4	3.11	13.4	24.2

DEVELOPED FLOWS

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
DP-1	32.4	67.4
DP-2	2.8	5.3
DP-3	44.1	92.9
DP-4	5.8	11.6
DP-5	7.1	15.1
DP-6	16.5	29.4
DP-7	5.7	11.2
DP-8	2.3	4.6
DP-9	4.2	8.5
DP-10	31.1	64.6
DP-11	54.2	113.7
DP-12	54.5	110.4

HISTORIC FLOWS

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
DP-10	10	30
DP-11	17	39



SCALE: 1" = 100'

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	
PROPOSED FINISHED CONTOUR	
SUBDIVISION BOUNDARY	
LOT LINE	
BASIN BOUNDARY	
DIRECTION OF DRAINAGE	
BASIN IDENTIFIER AREA IN ACRES	
DETENTION DESIGN POINT	
PROPOSED STORM SEWER	

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NO.	REVISION	BY	DATE
1	REVISED LOT LAYOUT	ABE	8-27-98
2	REVISED GRADING ON ADJACENT PROPERTY	ABE	8-27-98

SCALE	1"=100'
DATE	8-4-98
DES. BY	ABE
CHK. BY	
DWN. BY	MLP

MIDDLE CREEK MANOR@ NORTHGATE
BASIN MAP

SHEET 1 OF 1
JOB NO. 896600