MASTER DEVELOPMENT DRAINAGE PLAN
For
PALMER HOUSE REDEVELOPMENT

February, 2008
Revised August, 2008

Project No. 07019

Obering Wurth & Associates
Consulting Civil Engineers
Registered Land Surveyors

1042 Elkton Drive
Colorado Springs, Colorado 80907
Phone (719) 531-6200

18057-11

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MAP POCKET

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1042 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

February, 2008
Revised August, 2008

City of Colorado Springs
Engineering Unit
Subdivision Review
30 S. Nevada Ave., Suite 702
Colorado Springs, Colorado 80903

Re: Master Development Drainage Plan
for Palmer House Redevelopment

OWA Project No. 07019

To Whom It May Concern:

Transmitted herewith is the Master Development Drainage Plan (MDDP) for the Palmer House Redevelopment site located northwest of the intersection of Fillmore Street and Chestnut Street in Colorado Springs. The site consists of 13.3 acres which includes platted and unplatted areas. The site has a combination of developed and undeveloped areas within it with the majority of the developed area being a hotel and paved parking lots. The plans indicate the proposed development for this portion of the site is to be for commercial buildings with associated pavement, utilities and detention/water quality facilities. This MDDP drainage analysis was completed in accordance with the current City of Colorado Springs Drainage Criteria manual in order to satisfy submittal requirements for a Concept Plan application.

If there are any comments or questions regarding any part of this drainage analysis, please contact the undersigned.

Very truly yours,
OBERING WURTH & ASSOCIATES

Will Vilhauer

Reviewed by:
Roland G. Obering, P.E. & P.L.S.

Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
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Master Development Drainage Plan
for Palmer House Redevelopment
Project No. 07019

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.

Roland G. Obering

Roland G. Obering, P.E. & P.L.S., Colorado 13226

DEVELOPER'S STATEMENT

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

C Restaurant Development

Business Name

John G. Wolfe

By

President

Title

501 N. Nevada Ave 80901

Address

ROLAND G. OBERING REGISTERED 13226 8/28/08 P.E. & L.S. STATE OF COLORADO

CITY OF COLORADO SPRINGS

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

City Engineer

8/29/08

Date

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1042 Elkton Drive • Colorado Springs, Colorado 80907 • Phone (719) 531-6200 • Fax (719) 531-6266

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FLOODPLAIN STATEMENT

To the best of my knowledge and belief, the Palmer House Redevelopment Concept Plan area is not located within a designated floodplain as indicated by the Flood Insurance Rate Map Panel No. 08041C0514 F, dated March 17, 1997. A copy of a portion of the FIRM Panel is included in the Appendix of this study.

Roland G. Obering, P.E. & P.L.S., Colorado No. 13226

I. GENERAL

The proposed Palmer House Redevelopment Concept Plan area is a parcel of land consisting of approximately 13.3 acres located in Colorado Springs (see Vicinity Map). Existing parcels within the site are zoned C6 and PIP2. This Concept Plan consists of unplatted land and previously platted parcels known as American Oil Subdivision No. 1, Fillmore Subdivision and Fillmore Heights Subdivision Filing No. 3. The unplatted areas consist of both developed and undeveloped land. The developed land consists of hotel buildings and paved parking lots. The platted areas also consist of both developed and undeveloped land. The developed areas consist of a residential house, commercial buildings and parking. The site is impacted by numerous utilities and drainage infrastructure. The site is located within the Mesa Drainage Basin. The site is also located in "Zone X" according to FEMA and is therefore outside of a designated floodplain. A copy of a portion of the appropriate FIRM panel is included in the Appendix.

Both the developed and undeveloped portions of the site generally drain east toward Chestnut Street then south to a 4' D-10-R curb inlet at the northwest corner of the Fillmore/Chestnut Street intersection. The undeveloped areas within the site are covered with native vegetation including grasses and trees. The soils in this area are Razor-Midway complex that are classified as Hydrologic Soils Group C/D according to the Soil Survey of El Paso County by the Soil Conservation Service. The conservative Group "D" soil will be utilized in this drainage analysis. A copy of a portion of the Soil Survey Map is included in the Appendix.

II. DRAINAGE DESIGN CRITERIA

This MDDP has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2. The MDDP is to accompany a Concept Plan submittal for the Palmer House Redevelopment area and will provide an overall guide for phased development of the site. Recommendations included in this MDDP will be refined in final drainage reports that will be prepared for the individual phases. Drainage studies referenced in the preparation of this report include:

1. Master Plan for Mesa Drainage Basin, by Gilbert, Meyer & Sams, Inc., Revised January 1986.

2. Final Hydrology and Hydraulics Report for Interstate Highway 25 Improvements – Bijou Street to Fillmore Street, Southbound, by Wilson & Company, dated March 1998.

3. Preliminary/Final Drainage Report for Fillmore Heights Filing No. 1, by Associated Design Professionals, Inc., dated June 29, 1998.

4. Preliminary/Final Drainage Report for Fillmore Heights Filing No. 3, by Associated Design Professionals, Inc., dated November 18, 1998.

5. Drainage Letter for Fillmore Heights Filing No. 3, Lot 2, by Associated Design Professionals, Inc., dated December 14, 2000.

6. Drainage Letter for Fillmore Heights Filing No. 3, Lot 1, by Associated Design Professionals, Inc., dated November 14, 2001.

7. Drainage Plan for American Oil Subdivision No. 1, by Karcich & Weber, Inc., dated September 4, 1969.

The drainage conditions at the site have been estimated using the Rational Method for runoff computations as required by the City of Colorado Springs Drainage Criteria Manual for sites with less than 100 acres. A summary of all hydrologic calculations has been included in the Appendix of this report. Detention and water quality facilities have been identified however specific design calculations will be prepared at the time of final drainage report preparation. Storm sewer recommendations have been provided on the MDDP Drainage Plan included in the Appendix but are subject to refinement by final drainage report and final design.

III. DRAINAGE ISSUES

The proposed Palmer House Redevelopment site has one outfall location that has distinct drainage issues. The site has been divided into various sub-basins based on existing and proposed grading. These sub-basins (B-1 through B-14) all correspond to one outfall location. Runoff estimates for both proposed and existing conditions have been determined based on these sub-basins and are summarized in the Appendix.

Existing runoff produced from the Palmer House Redevelopment site currently drains east as overland flow, then directed south within the curb and gutter along Chestnut Street. Flow is then intercepted by existing 4' D-10-R and 2' X 2' bubbler inlets where it is directed southeast via an existing 24" CMP. This pipe then outfalls into a rip-rap lined channel that directs flow to a 48" RCP pipe ultimately outfalling into Monument Creek. According to the Master Plan for Mesa Drainage Basin and based on the runoff estimates produced from this report, the existing 4' D-10-R inlet and 24" CMP pipe are inadequate to accommodate existing flows that are directed to these drainage structures. It was estimated in the Master Plan study that the 4' D-10-R can accept a maximum capacity of 10 cfs. Calculations from this report estimate existing flow produced from the Palmer House Redevelopment site is Q_5 = 31.1 cfs and Q_{100} = 60.1 cfs. Flow that is not intercepted by the 4' D-10-R or 2' X 2' bubbler inlets currently overtops the intersection of Fillmore Street and Chestnut Street and continues southeast to the rip-rap lined channel outfalling into the 48" RCP. This drainage pattern would be unchanged by the

development of this site since the existing Palmer House Redevelopment site drains to this outfall point. Proposed drainage facilities including a detention/water quality pond will allow the runoff to be conveyed efficiently through the improved site while also decreasing the runoff quantity from its current level.

The existing 48" RCP is currently the outfall point for 52.7 acres which includes the site and areas upstream of the site. The majority of the remaining areas upstream of the site are directed to a serious of curb inlets along Fillmore Street that direct flow to a 36" CMP that outfalls at the same location as the 24" CMP (southeast corner of the intersection of Chestnut Street and Fillmore Street).

Existing development west of the site has been developed such that no off-site flow impacts the Palmer House Redevelopment site. This off-site area consists of two drainage basins (OS-1 and OS-2).

OS-1 consists of lots 3, 4 and 5 of Fillmore Heights Subdivision Filing No.1 and lot 2 of Fillmore Heights Subdivision Filing No. 3. According to the Preliminary/Final Drainage Report for Fillmore Heights Filing No. 1, lots 3, 4 and 5 are graded to a 2' deep rip-rap lined swale that directs flow to a temporary detention basin north of the site. Additionally, the Drainage Letter for Fillmore Heights Filing No. 3, Lot 2 shows that flow produced from this lot is directed northeast to a 5' D-10-R inlet that also outfalls into the aforementioned temporary detention basin. Outfall flow rates (Q_5 = 129.9 cfs and Q_{100} = 276.0 cfs) to this temporary detention basin are shown on the Drainage Plan and were gathered from the Preliminary/Final Drainage Report for Fillmore Heights Filing No. 1. It should be noted that additional sub-basins other then OS-1 contribute to this accumulated flow.

Off-site area OS-2 consists of an unplatted parcel of land adjacent to the southwest portion of the site. A site visit was conducted as no drainage information is provided for this area. It was found that the driveway to this area that is immediately adjacent to the Palmer House Redevelopment is graded in the form of an approximate 3' swale that conveys runoff to Fillmore Street. Runoff generated from sub-basin OS-2 was calculated to be Q_5 = 4.1 cfs and Q_{100} = 7.4 cfs. It was estimated that the driveway can carry both the 5-year and 100-year storm events to Fillmore Street. Calculations show the driveway can convey approximately 8.2 cfs. Off-site calculations for sub-basin OS-2 can be found in the Appendix.

Proposed drainage structures north and northeast of the site consisting of a 5' X 9' CBC and 72" pipe as outlined in the Master Plan for Mesa Drainage Basin will not require construction due to the development of this site. The existing runoff pattern of the site will be maintained as it currently drains southeast as overland flow. Because existing and proposed runoff generated from the site is not directed north, development of this site will not require the installation of the aforementioned drainage facilities.

Offsite runoff generated from adjacent areas north of the site drain east as overland flow and do not impact the Palmer House Redevelopment site.

IV. DRAINAGE SOLUTIONS

The proposed Palmer House Redevelopment site will require a combination of storm sewer, detention and water quality facilities in order to maintain existing drainage patterns and insure that existing runoff quantities decrease at the outfall location. This drainage approach limits drainage facility recommendations to on-site improvements only and should prevent any downstream impact at this site.

The storm sewers are recommendations that are subject to refinement as final drainage reports are prepared for this site. All proposed sub-basins within the site will be directed to the detention/water quality facility prior to outfalling to the existing 4' D-10-R inlet. The detention/water quality facility and storm sewer outfall are private facilities and will be subject to further analysis at the time of final drainage report preparation. All proposed improvements are shown on the Drainage Plan in the Appendix of this report.

All water quality facilities require periodic maintenance. The water quality facility recommended for this site will need to be monitored for silt buildup and clogging. This area can be used as a temporary sediment basin during construction but must be thoroughly cleaned prior to its use as a water quality facility. The proposed water quality and storm sewer facilities are private facilities that are to be privately maintained.

Runoff generated from sub-basin B-1 will be directed to a proposed 4' D-10-R inlet (PI-1). Runoff produced from sub-basin B-2 will be directed to a proposed 10'D-10-R inlet (PI-2). Flow generated from sub-basin B-3 will be conveyed to a proposed grated dock drain inlet and two (2) 4' grated inlet yard drains. Runoff produced from sub-basin B-4 will be directed along the curb and gutter until reaching a proposed 10' D-10-R inlet (PI-3). Runoff produced from sub-basin B-5 will be conveyed to a proposed 8' D-10-R inlet (PI-4). Runoff produced from sub-basin B-6 will be conveyed to a proposed 4' D-10-R inlet (PI-5). Flow generated from sub-basin B-1 though B-6 will be directed to a proposed 18" RCP via 15" RCP pipes. The 18" RCP will connect to a proposed 24" RCP that will outfall into the proposed detention/water quality facility.

Runoff generated from sub-basin B-7 will be directed to a proposed 6' D-10-R inlet (PI-8). Flow produced from sub-basin B-8 will be directed to a proposed 10' D-10-R inlet (PI-9). Flow that is not intercepted by PI-9 will be directed to a proposed 12' D-10-R inlet (PI-10) that will also collect flow generated from sub-basin B-11. Flow generated from sub-basin B-7 and B-8 will be directed to a proposed 18" RCP via 15" RCP pipes. The 18" RCP will also connect to PI-10 and will outfall into the proposed detention pond.

Runoff generated from sub-basins B-9 and B-10 will be directed to a proposed 4' D-10-R inlet (PI-6) and 10'D-10-R inlet (PI-7) respectively. These inlets will be directed to a proposed 24" RCP via proposed 15" RCP pipes. Flow generated from sub-basins B-12

and B-13 will enter the proposed detention/water quality facility via two (2) 4' curb openings. Finally, sub-basin B-14 is where the detention/water quality facility is located.

The detention/water quality facility will treat the total runoff generated from the Palmer House Redevelopment site. This facility will also provide significant detention benefits. Summary point calculations for both the existing and proposed condition were determined to be $Q_5 = 31.1$ cfs and $Q_{100} = 60.1$ cfs and $Q_5 = 61.0$ cfs and $Q_{100} = 108.6$ cfs (Summary Pt. 1), respectively. The detention/water quality facility will detain approximately $Q_5 = 42$ cfs and $Q_{100} = 70$ cfs. Under the developed condition this results in an allowable outflow of $Q_5 = 20$ cfs and $Q_{100} = 40$ cfs (Summary Pt. 2). This provides a decrease in runoff leaving the site as is currently occurring under the existing condition. No off-site downstream improvements for the development of this site are proposed. The detention/water quality facility will be subject to further analysis at the time of final drainage report preparation. The outfall facilities for the pond will be directed to the existing 4' D-10-R on Chestnut Street which is consistent with the existing drainage pattern and DBPS. This system will be within the Chestnut Street right of way.

V. DRAINAGE BASIN FEE OBLIGATIONS

The proposed Palmer House Redevelopment site consists of 13.295 acres of which 9.398 acres are unplatted. This site is located in the Mesa Drainage Basin and is subject to Drainage and Bridge Fees. The current fees in the basin are $7985 per acre for drainage fees and no bridge fees. The fee calculation for this subdivision is as follows:

Drainage: 9.398 ac x $7,985/ac = $75,043.03

VI. SUMMARY

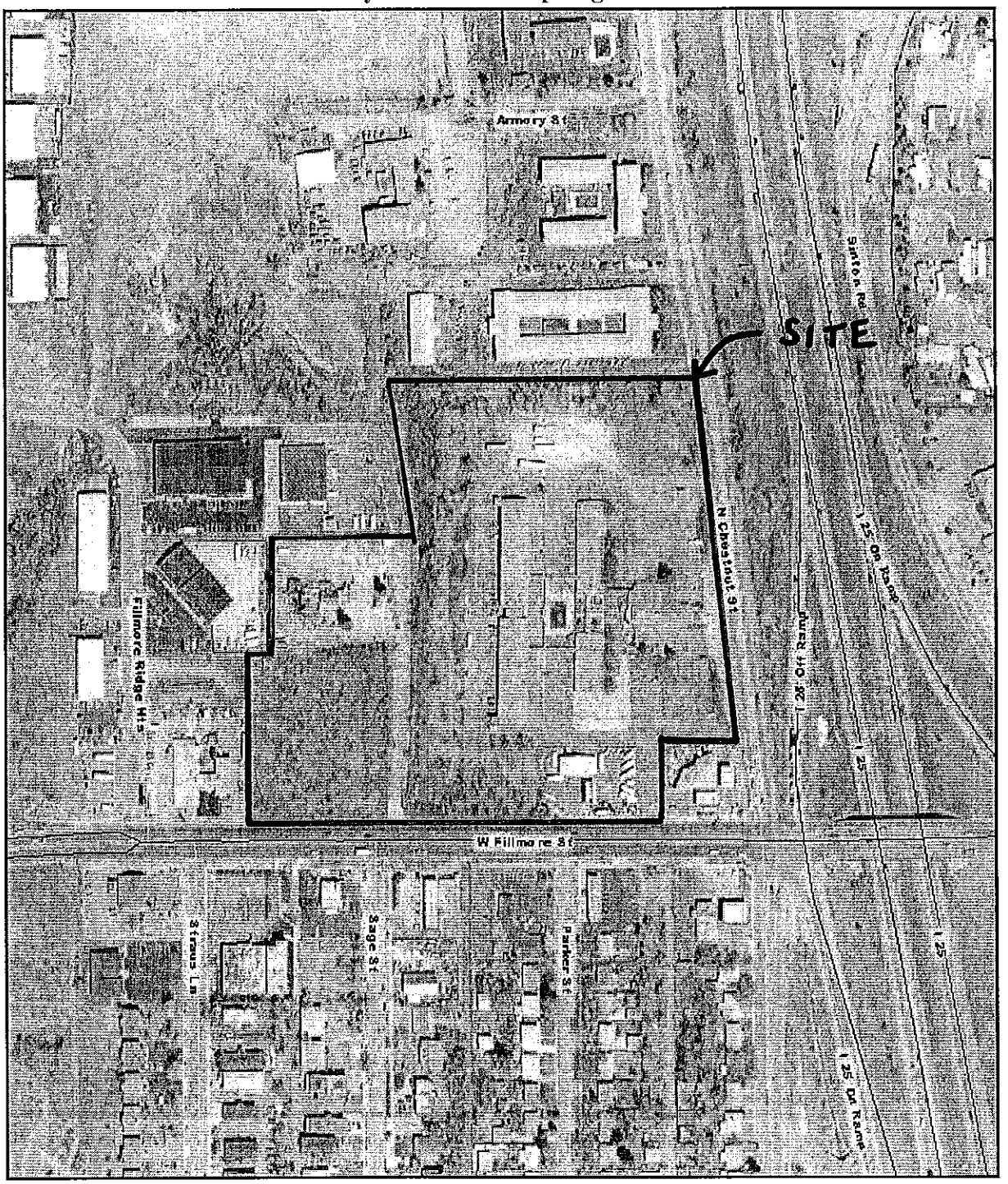
This MDDP has been prepared to accompany a Concept Plan application for Palmer House Redevelopment. Private drainage facilities and water quality facilities will be required at this site. Preliminary storm sewer facilities have been determined and are shown on the attached Drainage Plan. Detention/water quality facilities have been identified and located for this site. Phased development of this site will require final drainage reports. All facilities shown on the Drainage Plan are subject to final design.

This Master Development Drainage Plan has been prepared in accordance with the current City of Colorado Springs Drainage Criteria Manuals. Supporting information is included in the Appendix. It is believed that all pertinent information has been considered in the preparation of this MDDP. The recommendations contained herein are subject to the conditions set forth.

APPENDIX

VICINITY MAP

City of Colorado Springs



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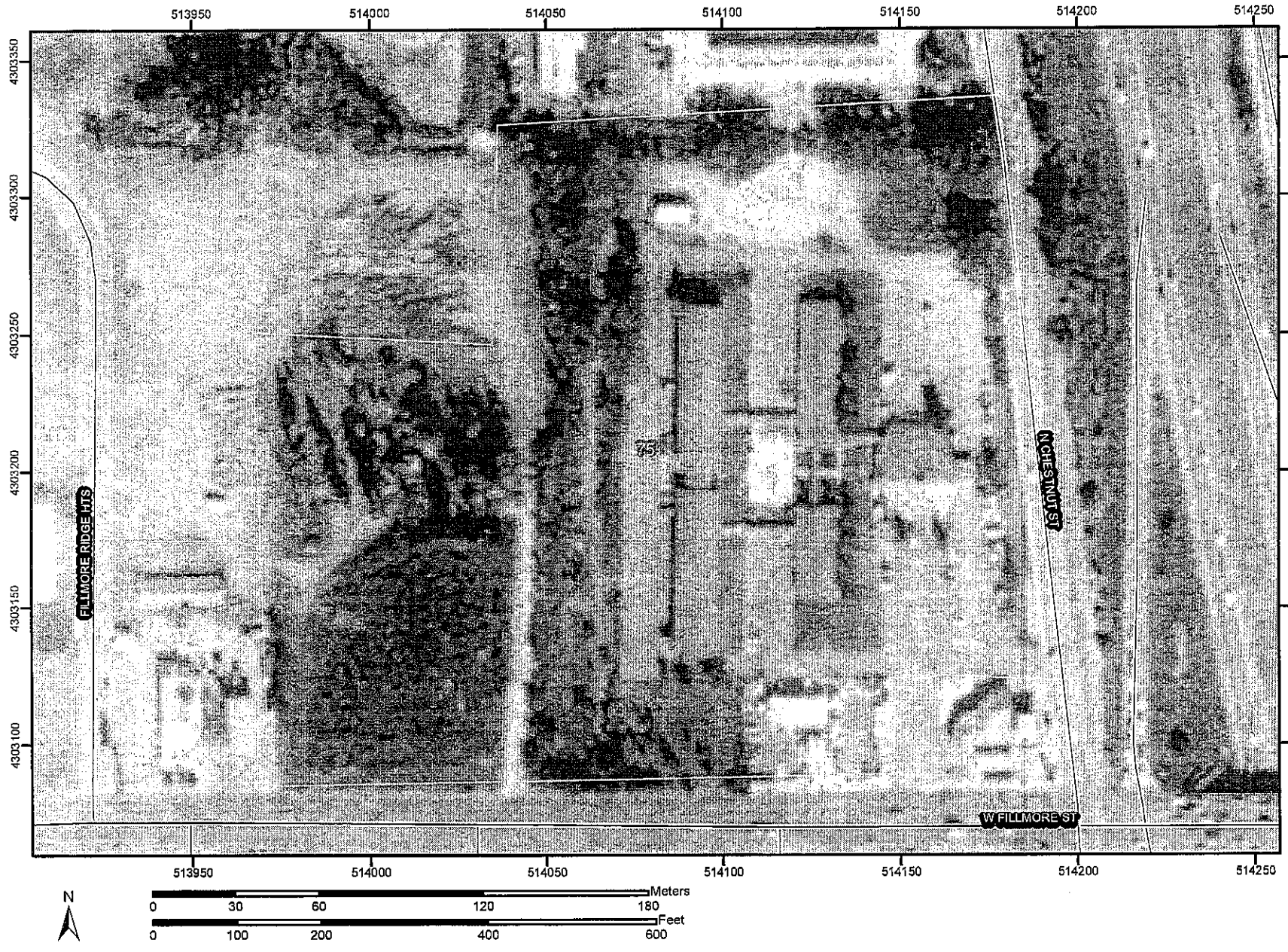
Map Scale
1 inch = 267 feet

SOILS MAP


513950
514000
514050
514100
514150
514200
514250
4303350
4303300
4303250
4303200
4303150
4303100
FILLMORE RIDGE HTS
N CHESTNUT ST
W FILLMORE ST
N
Meters
0
30
60
120
180
Feet
0
100
200
400
600

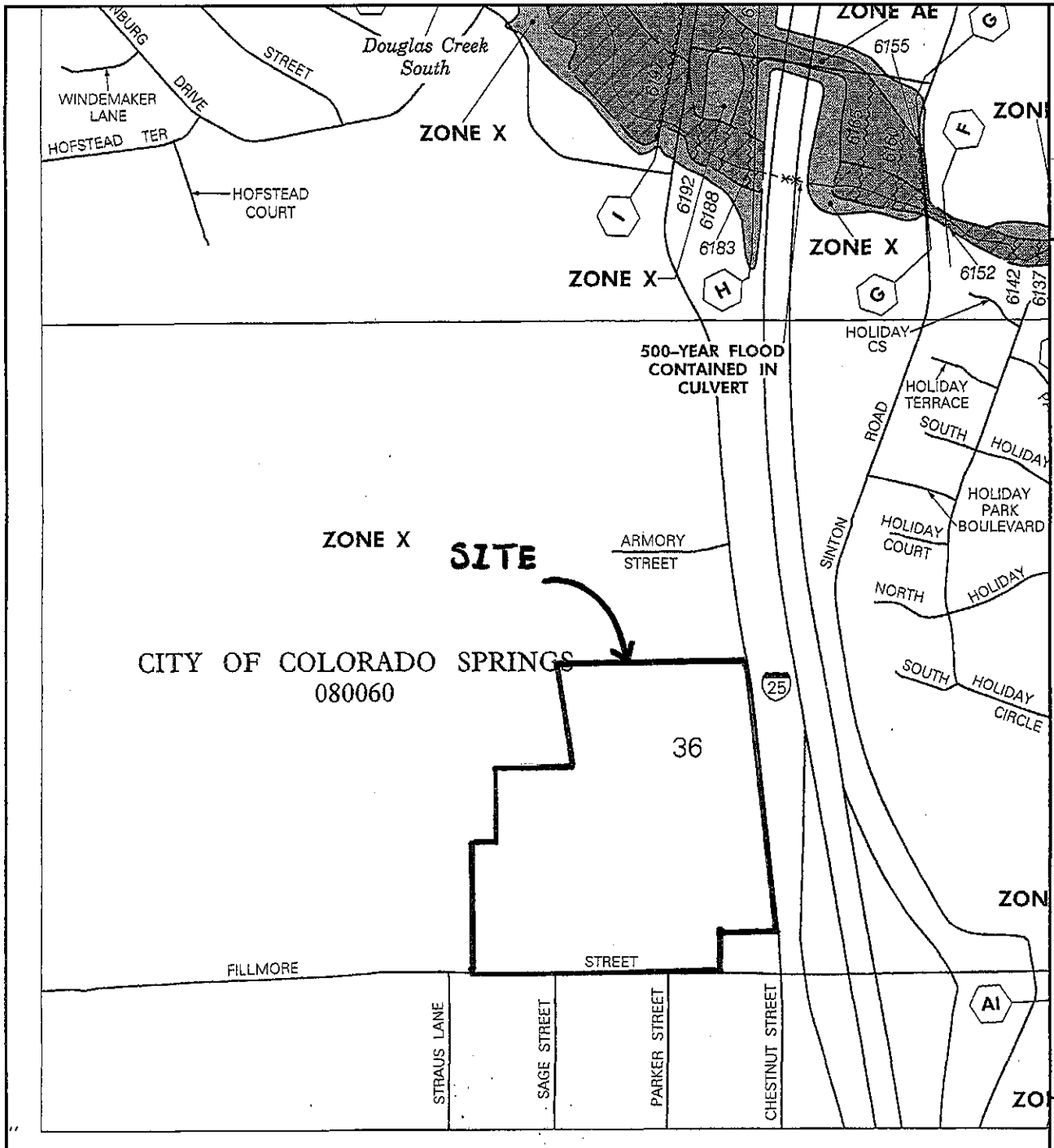
Report—Water Features

Water Features– El Paso County Area, Colorado										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
75—Razor-Midway complex										
Razor	C	Medium	Jan-Dec	—	—	—	—	None	—	—
Midway	D	Medium	Jan-Dec	—	—	—	—	None	—	—

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 5, Jan 15, 2008

FLOODPLAIN MAP



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 514 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0514	F

MAP NUMBER
08041C0514 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

HYDROLOGIC CALCULATIONS

RATIONAL METHOD FOR RUNOFF COMPUTATIONS

Proposed Condition

BASIN	AREA	GEOMETRY		C		Tc	INTENSITY,in/hr		PEAK FLOW cfs	
	(acres)	Length	Height	5 yr	100 yr	min.	5 yr	100yr	5 yr	100yr
B-1	0.66			0.81	0.86	5	5.1	9.07	2.7	5.1
B-2	1.36			0.9	0.9	5	5.1	9.07	6.2	11.1
B-3	0.3			0.9	0.9	5	5.1	9.07	1.4	2.4
B-4	1.1			0.9	0.95	5	5.1	9.07	5	9.5
B-5	1.23			0.9	0.9	5	5.1	9.07	5.6	10
B-6	0.53			0.9	0.9	5	5.1	9.07	2.4	4.3
B-7	0.68			0.9	0.9	5	5.1	9.07	3.1	5.6
B-8	1.54			0.9	0.9	5	5.1	9.07	7.1	12.6
B-9	0.4			0.9	0.9	5	5.1	9.07	1.8	3.3
B-10	1.39			0.9	0.9	5	5.1	9.07	6.4	11.3
B-11	0.76			0.9	0.9	5	5.1	9.07	3.5	6.2
B-12	0.77			0.9	0.9	5	5.1	9.07	3.5	6.3
B-13	1.72			0.9	0.9	5	5.1	9.07	7.9	14
B-14	0.48			0.3	0.45	5	5.1	9.07	0.7	2
Summary Pt. 1	13.3			0.9	0.9	5	5.1	9.07	61	108.6
Summary Pt. 2	13.3	See Detention Calculations							20	40

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Colorado Springs, Colorado 80907
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JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Sub-basin Calculations

- Proposed Conditions -

Sub-basin B-1

14% LS 86% HS

$C_{w_5} = 0.14(0.25) + 0.86(0.9) = 0.81$

$C_{w_{100}} = 0.14(0.3) + 0.86(0.95) = 0.86$

$T_c = 5$ min $\therefore i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-2

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-3

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

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CHECKED BY _____ DATE _____

SCALE _____

Sub-basin B-4

$C_5 = 0.9$ $C_{100} = 0.95$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-5

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-6

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-7

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

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Sub-basin B-8

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-9

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-10

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min $i_5 = 5.1$ $i_{100} = 9.07$ in/hr

Sub-basin B-11

$C_5 = 0.9$ $C_{100} = 0.9$ $T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-bas. B-12

See Sub-basin B-12 - Existing

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Sub-basin B-13

See existing B-13

Sub-basin B-14

$C_5 = 0.3$ $C_{100} = 0.45$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Summary Point 1

$C_5 = 0.9$ $C_{100} = 0.9$

Storm flow travel time from inlet @ sub-basin B-3

$$V = \frac{1.49}{n}\left(\frac{d}{4}\right)^{2/3} S^{1/2}$$

$S = \frac{40}{740} = 5.4\%$ Use 5%

$d = 2'$

$$V = \frac{1.49}{0.013}\left(\frac{2}{4}\right)^{2/3}(0.05)^{1/2} = 16.15 \text{ ft/sec}$$

$$T = \frac{740}{16.15} = 45.8 \text{ sec}$$

$i_5 = 5.1$ $i_{100} = 9.07$ in/hr

RATIONAL METHOD FOR RUNOFF COMPUTATIONS

Existing Condition

BASIN	AREA	GEOMETRY		C		Tc	INTENSITY,in/hr		PEAK FLOW cfs	
	(acres)	Length	Height	5 yr	100 yr	min.	5 yr	100yr	5 yr	100yr
B-1	0.66			0.25	0.3	13	3.68	6.55	0.6	1.3
B-2	1.36			0.29	0.35	10	4.1	7.29	1.6	3.5
B-3	0.3			0.25	0.3	5	5.1	9.07	0.4	0.8
B-4	1.1			0.41	0.46	5	5.1	9.07	2.3	4.6
B-5	1.23			0.25	0.3	9	4.3	7.65	1.3	2.8
B-6	0.53			0.36	0.41	7	4.75	8.33	0.9	1.8
B-7	0.68			0.38	0.43	12	3.82	6.8	1	2
B-8	1.54			0.39	0.44	17	3.29	5.81	2	3.9
B-9	0.4			0.25	0.3	10	4.1	7.29	0.4	0.9
B-10	1.39			0.9	0.9	5	5.1	9.07	6.4	11.3
B-11	0.76			0.9	0.9	5	5.1	9.07	3.5	6.2
B-12	0.77			0.9	0.9	5	5.1	9.07	3.5	6.3
B-13	1.72			0.9	0.9	5	5.1	9.07	7.9	14
B-14	0.48			0.9	0.9	5	5.1	9.07	2.2	3.9
Summary Pt. 1	13.3			0.57	0.62	10	4.1	7.29	31.1	60.1

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JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Sub-basin Calculations

- Existing Condition -

Sub-basin B-1

$C_5 = 0.25$ $C_{100} = 0.30$

$L = 230'$ $H = 14'$ $S = \frac{14}{230} = 6.1\%$

$T_c = 1.87(1.1 - 0.25)(230)^{0.5}(6.1)^{-0.33} = 13.27 \approx 13$ min

$\therefore i_5 = 3.68$ in/hr $i_{100} = 6.55$ in/hr

Sub-basin B-2

6.8% Hardscape 93.2% Landscape

$C_{w_5} = 0.9(0.068) + 0.932(0.25) = 0.29$

$C_{w_{100}} = 0.95(0.068) + 0.932(0.3) = 0.35$

$L = 180'$ $H = 16'$ $S = \frac{16}{180} = 8.9\%$

$T_c = 1.87(1.1 - 0.29)(180)^{0.5}(8.9)^{-0.33} = 9.8 \approx 10$ min

$\therefore i_5 = 4.1$ in/hr $i_{100} = 7.29$ in/hr

PRODUCT 204-1 (Single Sheets) 205-1 (Padded)

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Sub-basin B-3

$C_5 = 0.25 \quad C_{100} = 0.3$

$L = 60' \quad H = 12' \quad S = \frac{12}{60} = 20\%$

$$T_c = 1.87(1.1 - 0.25)\frac{(60)^{0.5}}{(20)^{0.33}} = 4.5 \approx 5 \text{ min}$$

$i_5 = 5.1$ in/hr $\quad i_{100} = 9.07$ in/hr

Sub-basin B-4

25% HS 75% LS

$C_{w_5} = 0.25(0.9) + 0.75(0.25) = 0.41$

$C_{w_{100}} = 0.25(0.95) + 0.75(0.3) = 0.46$

$L = 80' \quad H = 18' \quad T_c = 5$ min

$i_5 = 5.1$ in/hr $\quad i_{100} = 9.07$ in/hr

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SCALE _____

Sub-basin B-5

$C_5 = 0.25$ $C_{100} = 0.30$

$L = 170'$ $H = 20'$ $S = \frac{20}{170} = 11.7\%$

$T_c = 1.87(1.1 - 0.25)(170)^{0.5}(11.7)^{-0.33} = 9.2 \text{ min} \simeq 9 \text{ min}$

$i_5 = 4.3$ in/hr $i_{100} = 7.65$ in/hr

Sub-basin B-6

17.3% HS 82.7% LS

$C_5 = 0.173(0.9) + 0.827(0.25) = 0.36$

$C_{100} = 0.173(0.95) + 0.827(0.3) = 0.41$

$L = 140'$ $H = 16'$ $S = \frac{16}{140} = 11.4\%$

$T_c = 1.87(1.1 - 0.36)(140)^{0.5}(11.4)^{-0.33} = 7.3 \simeq 7 \text{ min}$

$i_5 = 4.75$ in/hr $i_{100} = 8.33$ in/hr

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Sub-basin B-7

20.4% HS 79.6% LS

$C_{w_5} = 0.204(0.9) + 0.796(0.25) = 0.38$

$C_{w_{100}} = 0.204(0.95) + 0.796(0.3) = 0.43$

$L = 320'$ $H = 24'$ $S = \frac{24}{320} = 7.5\%$

$T_c = 1.87(1.1 - 0.38)(320)^{0.5}(7.5)^{-0.33} = 12.39 \approx 12$ min

$i_5 = 3.82$ in/hr $i_{100} = 6.8$ in/hr

Sub-basin B-8

21.5% HS 78.5% LS

$C_{w_5} = 0.215(0.9) + 0.785(0.25) = 0.39$

$C_{w_{100}} = 0.215(0.95) + 0.785(0.3) = 0.44$

$L = 540'$ $H = 32'$ $S = \frac{32}{540} = 5.9\%$

$T_c = 1.87(1.1 - 0.39)(540)^{0.5}(5.9)^{-0.33} = 17.17 \approx 17$ min

$i_5 = 3.29$ in/hr $i_{100} = 5.81$ in/hr

PRODUCT 201-1 (Single Sheets) 205-1 (Pedded)

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SCALE _____

Sub-basin B-9

$C_5 = 0.25$ $C_{100} = 0.3$ $L = 160'$ $H = 14'$ $S = \frac{14'}{160'} = 8.8\%$

$$T_c = 1.87(1.1 - 0.25)(160)^{0.5}(8.8)^{-0.33} = 9.8 \pm 10 \text{ min}$$

$i_5 = 4.1$ in/hr $i_{100} = 7.29$ in/hr

Sub-basin B-10

95% HS 5% LS

$C_5 = 0.9$ $C_{100} = 0.9$

$L = 160'$ $H = 10'$ $S = \frac{10}{160} = 6.3\%$

$$T_c = 1.87(1.1 - 0.9)(160)^{0.5}(6.3)^{-0.33} = 2.6 \text{ min}$$

$i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-11

$C_5 = 0.9$ $C_{100} = 0.9$

$L = 320'$ $H = 20'$ $S = 6.3\%$

$$T_c = 1.87(1.1 - 0.9)(320)^{0.5}(6.3)^{-0.33} = 3.6$$

$i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

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JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Sub-basin B-12

$C_5 = 0.9$ $C_{100} = 0.9$

$L = 160'$ $H = 8'$ $S = \frac{8}{160} = 5\%$

$$T_c = 1.87(1.1 - 0.9)(160)^{0.5}(5.0)^{-0.33} = 2.7$$

$i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Sub-basin B-13

$C_5 = 0.9$ $C_{100} = 0.9$

$L = 280'$ $H = 12'$ $S = \frac{12}{280} = 4.3\%$

$$T_c = 1.87(1.1 - 0.9)(280)^{0.5}(4.3)^{-0.33} = 3.4 \text{ min}$$

$i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

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JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Subbasin B-14

$C_5 = 0.9$ $C_{100} = 0.9$

$T_c = 5$ min

$i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

Summary Point 1

49 % HS 51 % LS

$C_{w5} = 0.49(0.9) + 0.51(0.25) = 0.57$

$C_{w100} = 0.49(0.95) + 0.51(0.3) = 0.62$

$L = 680'$ $H = 70'$ $S = \frac{70}{680} = 10.3\%$

$T_c = 1.87(1.1 - 0.57)(680)^{0.5}(10.3)^{-0.33} = 9.7 \leq 10$ min

$i_5 = 4.1$ in/hr $i_{100} = 7.29$ in/hr

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JOB 07019
SHEET NO. 1 OF 1
CALCULATED BY WEV DATE
CHECKED BY DATE
SCALE

OFF-SITE CALCS

Sub-basin OS-2

$C_5 = 0.9$ $A = 0.90$ acres

$L = 150'$ $H = 8'$ $S = \frac{8}{150} = 5.3\%$

$T_c = 1.87(1.1 - 0.9)(150)^{0.5}(5.3)^{-0.33} = 2.64$

$T_c = 5$ min $i_5 = 5.1$ in/hr $i_{100} = 9.07$ in/hr

$Q_5 = 0.9(0.9)(5.1) = 4.13$ cfs

$Q_{100} = 0.9(0.9)(9.07) = 7.35$ cfs

Driveway entrance conveys 8.21 cfs (See offsite Driveway calc)

$8.21 > 7.35$ cfs O.K.

HYDRAULIC CALCULATIONS

SAG INLET CALCULATIONS

WEIR-TYPE OPERATION

INLET	LENGTH (L_i) (feet)	WATER DEPTH (d_i) (feet)	CLOGGING FACTOR (F)	CAPACITY (Q_i) (cfs)
PI-1	4	0.67	1.25	5.26
PI-2	10	0.67	1.25	13.16
PI-4	8	0.67	1.25	10.53
PI-5	4	0.67	1.25	5.26
PI-6	4	0.67	1.25	5.26
PI-7	10	0.67	1.25	13.16
PI-8	8	0.67	1.25	10.53

Inlet Calculator for Curb-Opening Inlets on Grade

5-year Storm Inlet Capacity

Inputs					Outputs													
Inlet Description	S_x	S_o	Q	L_i	$(Q_i/Q)100$	$Q/S_o^{1/2}$	T	$F_w/S^{1/2}$	F_w	F_wT	L_1	L_2	L_3	Q_2	$L_i<=L_2$	$L_i>L_2$	Q_i	Q_c
	(%)	(%)	(cfs)	(ft.)	(%)	(cfs)	(ft.)			(ft.)	(ft.)	(ft.)	(ft.)	(cfs)			(cfs)	(cfs)
PI-3	2.00	2.00	5.00	10.00	61.56	35.36	11.57	12.45	1.76	20.38	15.69	9.42	33.63	3.00		X	3.08	1.92
PI-9	2.00	2.00	7.10	10.00	54.43	50.20	13.20	12.78	1.81	23.86	18.37	11.03	39.37	4.26	X		3.86	3.24
PI-10	2.00	2.00	6.74	12.00	62.76	47.63	12.94	12.73	1.80	23.30	17.94	10.78	38.45	4.05		X	4.23	2.51

Based on Table 7-2 (pg.7-19) of Colorado Springs Drainage Criteria Manual

Assuming: W(ft.)= 2 n= 0.016

Variable	Definition	Units
S_x	Cross slope of pavement	%
S_o	Longitudinal slope of pavement	%
Q	Rate of discharge in street	cfs.
Q_i	Rate of discharge intecepted by inlet	cfs.
T	Flow spread on pavement	ft.
L_i	Length of inlet opening	ft.
$(Q_i/Q)100$	Efficiency of inlet (percentage of total flow intercepted)	%
Qc	Rate of discharge not intercepted by inlet (flowby)	cfs.

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Consulting Civil Engineers

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1042 Elkton Drive

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(719) 531-6200

Inlet Calculator for Curb-Opening Inlets on Grade

100-year Storm Inlet Capacity

Inputs					Outputs													
Inlet Description	S_x	S_o	Q	L_i	$(Q_i/Q)100$	$Q/S_o^{1/2}$	T	$F_w/S^{1/2}$	F_w	F_wT	L_1	L_2	L_3	Q_2	$L_i<=L_2$	$L_i>L_2$	Q_i	Q_c
	(%)	(%)	(cfs)	(ft.)	(%)	(cfs)	(ft.)			(ft.)	(ft.)	(ft.)	(ft.)	(cfs)			(cfs)	(cfs)
PI-3	2.00	2.00	9.50	10.00	47.77	67.18	14.72	13.06	1.85	27.19	20.93	12.57	44.86	5.71	X		4.54	4.96
PI-9	2.00	2.00	12.60	10.00	42.11	89.10	16.37	13.32	1.88	30.84	23.75	14.26	50.89	7.57	X		5.31	7.29
PI-10	2.00	2.00	13.49	12.00	49.01	95.42	16.80	13.39	1.89	31.80	24.49	14.71	52.47	8.10	X		6.61	6.88

Based on Table 7-2 (pg.7-19) of Colorado Springs Drainage Criteria Manual

Assuming: W(ft.)= 2 n= 0.016

Variable	Definition	Units
S_x	Cross slope of pavement	%
S_o	Longitudinal slope of pavement	%
Q	Rate of discharge in street	cfs.
Q_i	Rate of discharge intecepted by inlet	cfs.
T	Flow spread on pavement	ft.
L_i	Length of inlet opening	ft.
$(Q_i/Q)100$	Efficiency of inlet (percentage of total flow intercepted)	%
Qc	Rate of discharge not intercepted by inlet (flowby)	cfs.

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Colorado Springs, Colorado 80907

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Worksheet
Worksheet for Triangular Channel

Project Description	
Worksheet	Offsite Driveway
Flow Element	Triangular Char
Method	Manning's Forn
Solve For	Discharge

Input Data		
Mannings Coeffic	0.020	
Slope	020000	ft/ft
Depth	0.25	ft
Left Side Slope	0.02	V : H
Right Side Slope	0.02	V : H

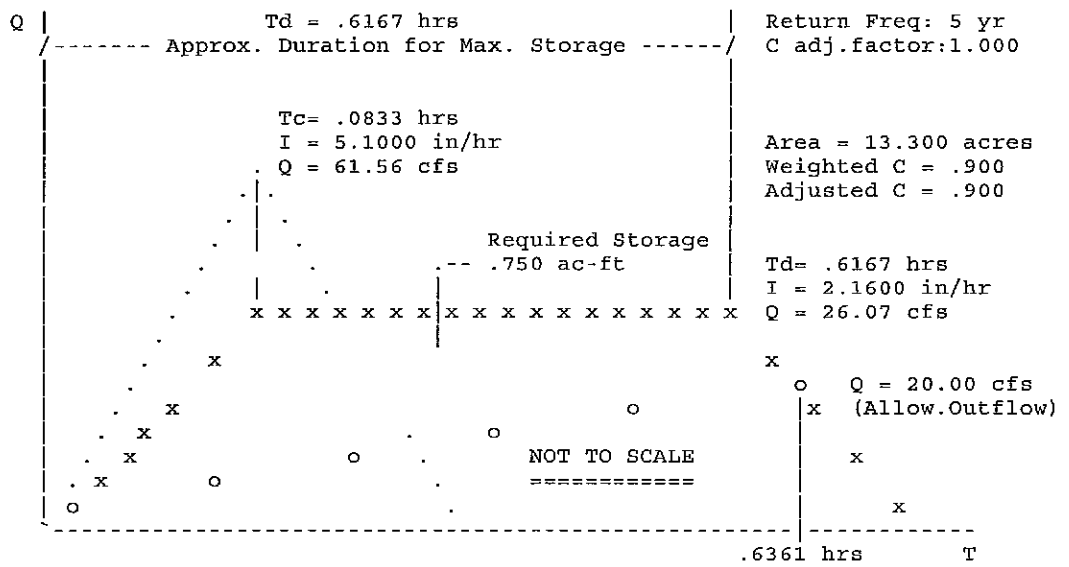
Results		
Discharge	8.21	cfs
Flow Area	3.1	ft²
Wetted Perim	25.00	ft
Top Width	25.00	ft
Critical Depth	0.28	ft
Critical Slope	0.011249	ft/ft
Velocity	2.63	ft/s
Velocity Head	0.11	ft
Specific Ener	0.36	ft
Froude Numb	1.31	
Flow Type	Supercritical	

WATER QUALITY & DETENTION CALCULATIONS

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

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

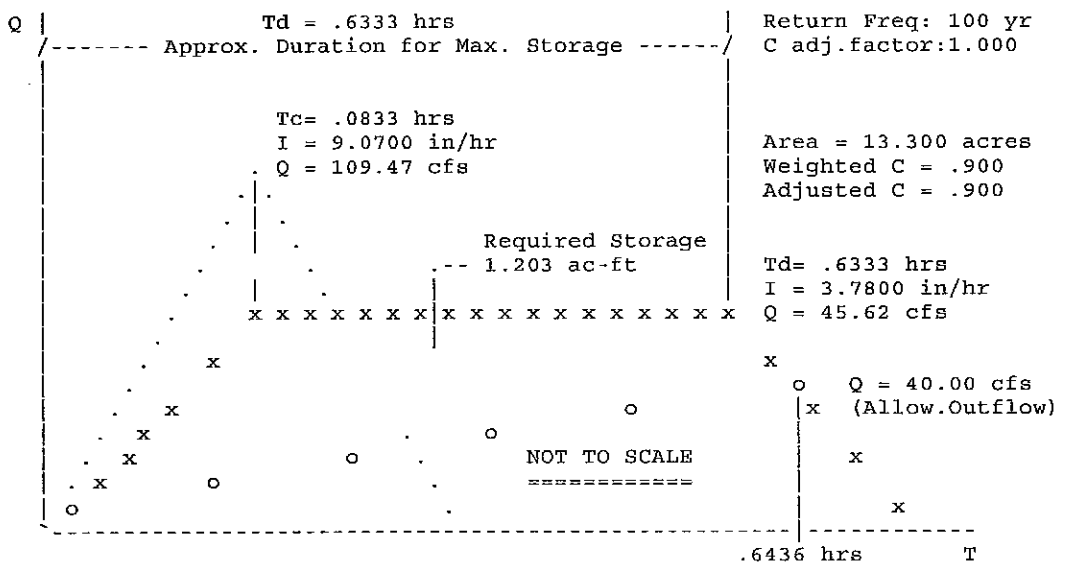
RETURN FREQUENCY: 5 yr	Allowable Outflow: 20.00 cfs
'C' Adjustment: 1.000	Required Storage: .750 ac-ft
Peak Inflow: 26.07 cfs	
.HYG File: 5yr	



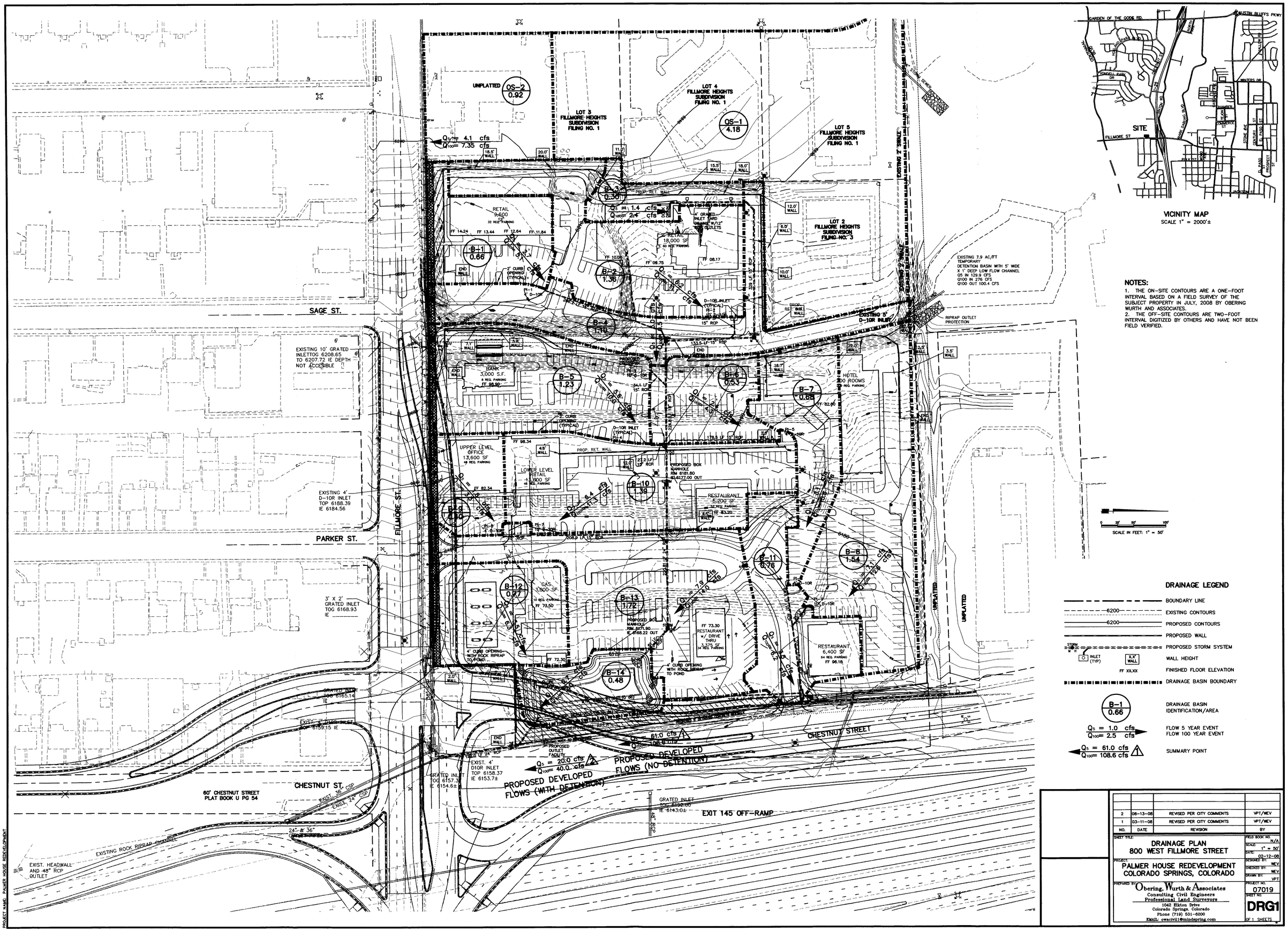
MODIFIED RATIONAL METHOD
---- Graphical Summary for Maximum Required Storage ----
Method I

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 100 yr	Allowable Outflow: 40.00 cfs
'C' Adjustment: 1.000	Required Storage: 1.203 ac-ft
Peak Inflow: 45.62 cfs	
.HYG File: 100yr	



Drainage Plan



VICINITY MAP
SCALE 1" = 2000'±

NOTES:

1. THE ON-SITE CONTOURS ARE A ONE-FOOT INTERVAL BASED ON A FIELD SURVEY OF THE SUBJECT PROPERTY IN JULY, 2008 BY OBERING WURTH AND ASSOCIATES.
2. THE OFF-SITE CONTOURS ARE TWO-FOOT INTERVAL DIGITIZED BY OTHERS AND HAVE NOT BEEN FIELD VERIFIED.

DRAINAGE LEGEND

- BOUNDARY LINE
- 6200 EXISTING CONTOURS
- 6200 PROPOSED CONTOURS
- PROPOSED WALL
- PROPOSED STORM SYSTEM
- INLET (TYP)
- X.X' WALL — WALL HEIGHT
- FF XX.XX — FINISHED FLOOR ELEVATION
- DRAINAGE BASIN BOUNDARY
- B-1 / 0.66 — DRAINAGE BASIN IDENTIFICATION/AREA
- Q5 = 1.0 cfs / Q100= 2.5 cfs — FLOW 5 YEAR EVENT FLOW 100 YEAR EVENT
- Q5 = 61.0 cfs / Q100= 108.6 cfs — SUMMARY POINT

NO.	DATE	REVISION	BY
2	08-13-08	REVISED PER CITY COMMENTS	VPT/WEV
1	03-11-08	REVISED PER CITY COMMENTS	VPT/WEV

SHEET TITLE: DRAINAGE PLAN
800 WEST FILLMORE STREET

PROJECT: PALMER HOUSE REDEVELOPMENT
COLORADO SPRINGS, COLORADO

FIELD BOOK NO.: N/A
SCALE: 1" = 50'
DATE: 02-12-08
DESIGNED BY: WEV
CHECKED BY: WEV
DRAWN BY: VPT
PROJECT NO.: 07019
SHEET NO.: DRG1

PREPARED BY:
Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors
1042 Elkton Drive
Colorado Springs, Colorado
Phone (719) 531-5800
EMAIL: owacivil1@mindspring.com

OF 1 SHEETS

PROJECT NAME: PALMER HOUSE REDEVELOPMENT
D:\07\07019\Y19-Drg-plan.dwg Wed Aug 13 10:12:01 2008 VPT