

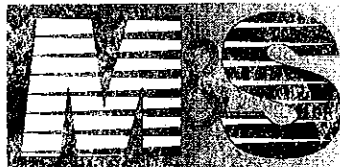
WOODMEN HEIGHTS BUSINESS PARK MASTER DEVELOPMENT DRAINAGE PLAN

March 2008

Prepared for:

SWAT X, LLC
20 Boulder Crescent, 2nd Floor
Colorado Springs, CO 80903

Prepared by:



AEC
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15 North Nevada Avenue
Colorado Springs, CO 80903
(719) 955-5485

Project #08-011


17527-21

**WOODMEN HEIGHTS BUSINESS PARK
MASTER DEVELOPMENT DRAINAGE PLAN**


DRAINAGE PLAN STATEMENTS

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 acceptable to the City of Colorado Springs. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

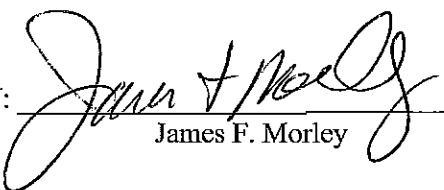


Virgil A. Sanchez, P.E. 39766
For and on Behalf of M & S Civil Consultants, Inc.




DEVELOPER'S STATEMENT

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

BY:  DATE: 4/9/08
James F. Morley
TITLE: Manager
ADDRESS: 20 Boulder Crescent, 2nd Floor
Colorado Springs, CO 80903

CITY OF COLORADO SPRINGS

Filed in accordance with Section 7-7-906 of the Code of the City of Colorado Springs, 2001, as amended.

BY:  DATE: 4/23/08

For The City Engineer

CONDITIONS:

**WOODMEN HEIGHTS BUSINESS PARK
MASTER DEVELOPMENT DRAINAGE PLAN**

TABLE OF CONTENTS

PURPOSE	4
GENERAL LOCATION AND DESCRIPTION	4
SOILS	4
CLIMATE	4
FLOODPLAIN STATEMENT	4
DRAINAGE CRITERIA	5
EROSION CONTROL PLAN	5
PROPOSED DRAINAGE CHARACTERISTICS	5
WATER QUALITY PROVISIONS	9
CONSTRUCTION PHASING	9
MAINTENANCE	9
SUMMARY	10
REFERENCES	11

APPENDIX
Vicinity Map
Soils Map
Floodplain Map
Hydrologic Calculations
Drainage Map

WOODMEN HEIGHTS BUSINESS PARK MASTER DEVELOPMENT DRAINAGE PLAN

PURPOSE

This document is the Master Development Drainage Plan for the Woodmen Heights Business Park (hereinafter referred to as WHBP) The purpose of this report is to identify the existing and proposed runoff patterns and peak rates of runoff to identify any drainage improvements needed to safely route stormwater to adequate outfall facilities per the current City of Colorado Springs Drainage Criteria.

This report is preliminary in nature. The parking areas and internal road network may change, however the basin boundary should remain similar to what is being shown. Development of any portion of the WHBP will require a Final Drainage Report with the approval of the Final Plat.

GENERAL LOCATION AND DESCRIPTION

The site is located in Section 5, Township 13 South, Range 65 West of the 6th P.M. in the City of Colorado Springs, El Paso County, Colorado. The business park site is bounded on the west by proposed Regional Detention Facility No. 6, on the south by East Woodmen Road, on the east by proposed Regional Detention Facility No. 3, and on the north by Forest Meadows Filing No. 1 and future single family development.

The existing site terrain generally slopes generally from north to south at grades of approximately 2% to 12%. Vegetation consists of native grasses, shrubs and a few trees.

The proposed site consists of approximately 44 acres. The entire development is currently zoned "PUD", Planned Unit Development, for the construction of multi-use buildings and adjacent parking facilities. Construction of the entire site, in this report, is anticipated to be completed in several phases.

SOILS

According to the Soil Survey of El Paso County, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the Blakeland soil series (Soil No.'s 8 & 9) is present on-site. The Blakeland is designated as a Hydrologic Group "A" soil.

CLIMATE

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation ranges from 12 to 14 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No's. 08041C0535 F (effective date March 17, 1997, as modified by LOMR 04-08-0779P effective

date December 7, 2005) and 08041C0529 F, effective date March 17, 1997, no portion of the of the WHBP site currently lies within a designated 100-year floodplain.

DRAINAGE CRITERIA

The drainage analysis has been prepared in accordance with the current City of Colorado Springs/El Paso County Drainage Criteria Manual. Calculations were performed to determine runoff quantities during the 5-year and 100-year frequency storms for developed conditions using the Rational Method as required for basins having areas less than 100 acres.

EROSION CONTROL PLAN

The City of Colorado Springs Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate be submitted with the Final Drainage Report. M & S Civil Consultants, Inc. respectfully requests that the Erosion Control Plan and estimate be submitted separately and that erosion control assurances be posted prior to obtaining a grading permit.

PROPOSED DRAINAGE CHARACTERISTICS

General

A brief description of each developed drainage basin runoff rates & drainage patterns for each basin is provided in this section of the report. A summary of peak developed runoff for the basins and designated design points are depicted on the Drainage Map in the appendix. The internal private streets will be constructed with a 28' fl-fl width, with type 1 - 8" vertical curb and gutter. The industrial/collector street (Rock Ring Drive - Public) will be constructed with a 44' fl-fl width, with type 1 - 8" vertical curb and gutter.

Woodmen Heights MDDP Differences

As shown in the MDDP prepared by Classic Consulting, Inc., basins B & C drain into the future Sand Creek Detention Facility No. 6. At the time of preparation, this was thought to be the pattern proposed flows would be routed. Since that time, several items have necessitated a change in routing of the aforementioned basins. The wetlands, once assumed to be filled in and mitigated have since been chosen for preservation. A culvert to be constructed by the Woodmen Road Improvements Project (DP4 outfall, 60" RCP) has been planned to serve as the outfall for the wetlands. Proposed grading for the site has been refined per the Forest Meadows Avenue and Woodmen Road Improvements Project roadway designs. Also, CSU is now restricting sediment basin locations in the electric easement areas.

Wetlands

The wetland area in basin D is being preserved within this development per Army Corp of Engineer (ACOE) Nationwide Permit No. 2005 00413. The other wetland areas, in basins F & G, are being mitigated per the same referenced document. Per permit stipulations, the wetlands must be mitigated prior to the commencement of any disturbance. Per the aforementioned MDDP prepared by Classic Consulting, Inc. stormwater quality provisions will be required in the regional detention facilities. This item is being addressed in the Sand Creek Detention Facility No. 6 report currently being prepared by M&S Civil Consultants, Inc. To summarize, the majority of the wetlands within the pond no. 6 site will be retained and will serve as secondary water quality treatment. The primary form of treatment is now being accomplished through two water quality ponds at the entrances to the facility itself. These features will minimize sediment laden runoff from entering the preserved wetland areas.

Design Point 1 (DP1) flows, 6.59 ac., (Q5=28.2cfs, Q100=50.3cfs) are generated by basin A.

Basin Runoff Description

Basin A will consist of a mini storage facility development, rooftops and minimal landscaping areas. In the interim condition, there will be a temporary school site located within the basin. No permanent facilities will be constructed on the site.

Surface Routing

Basin A flows will be conveyed to DP1 via a combination of sheet flow, curb and gutter and possibly underground piping.

Clogging Statement

In the event of clogging or inlet failure, the runoff will overtop the parking lot curb and gutter and proceed to a proposed ditch along the north side of Woodmen Road and be conveyed to the west. This runoff will be collected in a pipe to the west that outfalls on the south side of Woodmen Road.

Pipe Routing/Pipe Capacity

A pipe will convey flows to the adjacent detention pond. During the FDR stage, the specifics regarding this pipe and outfall will be determined. Water quality for Basin A will be provided by the Sand Creek Detention Pond No. 6.

Design Point 2 (DP2) flows, 7.85 ac., (Q5=33.1cfs, Q100=59.0cfs) are generated by basin B.

Basin Runoff Description

Basin B will consist of multi-use development, streets, rooftops and minimal landscaping areas.

Surface Routing

Basin B flows will be conveyed to DP2 via a combination of sheet flow and curb and gutter. Flows will be spread as much as possible along the curb adjacent to basin D. Curb cuts will be made to disperse the flow as even as possible along the edge into a sand filter bed running parallel with the curb as an option to treat runoff prior to discharging into the wetlands. Other options can also be considered with the Final Drainage Report for the adjacent properties.

Clogging Statement

In the event of clogging, the runoff will overtop the parking lot curb and gutter and proceed to DP4.

Design Point 3 (DP3) flows, 8.37 ac., (Q5=35.6cfs, Q100=63.4cfs) are generated by basin C.

Basin Runoff Description

Basin C will consist of multi-use development, streets, rooftops and landscaping areas.

Surface Routing

Basin C flows will be conveyed to DP3 via a combination of sheet flow, curb and gutter and possibly underground piping. The water quality facility will be determined in the Final Drainage Report preparation phase based upon the final site characteristics.

Clogging Statement

In the event of clogging or inlet failure, the runoff will overtop the parking lot curb and gutter and proceed to a proposed ditch along the north side of Woodmen Road and conveyed to the west. This runoff will be

collected in a pipe and outfalls on the south side of Woodmen Road.

Pipe Routing/Pipe Capacity

A pipe will convey flows to the adjacent wetland area. Flow will be routed through the wetland area to a proposed pipe under Woodmen Road. During the FDR stage, the specifics regarding this pipe and outfall will be determined.

Design Point 4 (DP4) flows, 19.11 ac., (Q5=47.8cfs, Q100=86.0cfs) are generated by basins B, C & D.

Basin Runoff Description

Basin D consists of an existing wetland area.

Surface Routing

Basins B, C and D flows will be conveyed to DP4 via unconcentrated sheet flow to a 60" RCP.

Clogging Statement

In the event of clogging, the runoff will proceed to a proposed ditch along the north side of Woodmen Road which is collected in a pipe to the west that outfalls on the south side of Woodmen Road.

Pipe Routing/Pipe Capacity

A 60" RCP (as installed as part of the Woodmen Road Improvement Project) will convey flows to the south side of the road. The 100 yr design storm capacity of the pipe is ~300 cfs based on the approved Woodmen Road plan design data which is 3 times more than required for basins B, C and D. This pipe was designed to convey the historic contributing watershed which is assumed to yield ~300cfs discharge.

Design Point 5 (DP5) flows, 3.65 ac., (Q5=15.7cfs, Q100=29.6cfs) are generated by basins E (Q5=14.3cfs, Q100=27.0cfs) and OS-1 (Q5=1.5cfs, Q100=2.8cfs)

Basin Runoff Description

Basin E will consist of "public drainage" from Rock Ring Drive. Basin OS-1 will consist of pavement from the proposed Woodmen Road section.

Surface Routing

Basin E & OS-1 flows will be conveyed to DP5 via a combination of sheet flow and curb and gutter flow. The road will be designed to convey flows to a low point in Rock Ring Drive on the east side. Flows will then be routed via a proposed (Woodmen Road Project) roadside ditch easterly to the proposed outfall pipe (by others) beneath Woodmen Road. The water quality facility will be determined in the Final Drainage Report preparation phase based upon the final site characteristics.

Clogging Statement

In the event of clogging, the runoff will overtop the roadway low point and proceed to the proposed ditch along the north side of Woodmen Road and be routed to design point 6.

Design Point 6 (DP6) flows, 17.75 ac., (Q5=68.6cfs, Q100=124.1cfs) are generated by basins E (Q5=14.3cfs, Q100=27.0cfs), F (Q5=36.8cfs, Q100=65.6cfs), OS-1 (Q5=1.5cfs, Q100=2.8cfs) and OS-2 (Q5=6.1cfs, Q100=11.5cfs)

Basin Runoff Description

Basin E will primarily consist of the Rock Ring Drive roadway segment as well as a small portion of the adjacent development. Basin F will consist of multi-use development, streets, rooftops and landscaping areas. Basins OS-1 and OS-2 will consist of pavement from the proposed Woodmen Road section as well as a small roadside ditch adjacent to the edge of the road.

Surface Routing

Basin flows will be conveyed to DP6 via the adjacent Woodmen Road ditch. The water quality facility will be determined in the Final Drainage Report preparation phase based upon the final site characteristics. Flows will then outfall directly into a depression area in which a 54" RCP (as installed as part of the Woodmen Road Improvement Project) will be stubbed.

Clogging Statement

In the event of clogging or inlet failure, the runoff will overtop the depression area and proceed easterly in the roadside ditch towards a low point in the roadway approximately 400' to the east.

Pipe Routing/Pipe Capacity

A 54" RCP (as installed as part of the Woodmen Road Improvement Project) will convey flows to the south side of the road. The 100 yr design storm capacity of the pipe is ~180 cfs based on the approved Woodmen Road plan design data. Therefore, the proposed 54" RCP will have ~45% more capacity than is required for this development (180cfs max verses 124.1cfs actual). Flows then travel southerly in a natural tributary ditch to Sand Creek.

Design Point 7 (DP7) flows, 2.98 ac., (Q5=11.8cfs, Q100=21.1cfs) are generated by basin G.

General

These flows were not accounted for in the Sand Creek Detention Pond No. 3 calcs per the aforementioned MDDP for Woodmen Heights prepared by Classic Consulting. However, this additional flow is approximately 0.8% of the anticipated inflow which can easily be accounted for in the final design of Sand Creek Detention Pond No. 3.

Basin Runoff Description

Basin G will consist of streets, rooftops and landscaping areas.

Surface Routing

Basin G flows will be conveyed to DP7 via a combination of sheet flow and curb and gutter. Flows will be intercepted by a sump inlet or similar collection device. This watershed cannot be routed to the south due to the topography and existing utility lines present on-site along the east side which dictates the grading in that area. These flows will then be directly discharged into Sand Creek Detention Pond No. 3. However in the interim, until Pond No. 3 is fully constructed, flows will be routed to a temporary water quality facility constructed along with or prior to the Forest Meadows filing No. 5 development to the north which is scheduled for the summer of 2008.

Clogging Statement

In the event of clogging or inlet failure, the runoff will overtop the curb and gutter and proceed to the low point in Forest Meadows Avenue.

WATER QUALITY PROVISIONS

The water quality capture volume (WQCV) required for the site will be determined during the Final Drainage Report preparation phase based on the guidelines as set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual – Volume II. The final outlet facilities will be designed as part of the final construction drawings for the site. *Refer to the Drainage Map for locations of contributing watershed basins for water quality defined areas.* The contributing watershed as noted in the prior design point narratives was determined based upon the latest available site plan impervious areas as shown on the Drainage Map. These values are conceptual in nature and will be refined when subsequent FDR's are submitted for the individual filings when developed within the business park site. Stormwater quality facilities will be privately maintained by the Woodmen Heights Business Park Owners Association.

CONSTRUCTION PHASING

The Woodmen Heights Business Park will be constructed over the next several years. Within that time period, the Woodmen Road Improvements will be completed (next 18 to 24 months) in an earlier timeframe with regards to drainage improvements. During the time of final construction document preparation, the engineer will be required to ensure flow is routed to such existing facilities and that they do in fact accommodate such development. If not, a modified system will be required in the interim to over detain released flows at the site outfall locations until the Woodmen Road facilities are completed.

MAINTENANCE

Private drainage facilities will be privately maintained by the Woodmen Heights Business Park Owners Association.

SUMMARY

The Woodmen Heights Business Park site contains 44+/- acres within the Sand Creek Drainage Basin. The development of the site will require drainage and facilities to accommodate developed flows and meet City of Colorado Springs Drainage Criteria. Water quality ponds and/or a combination of "Stormceptor" devices will be constructed based on the tributary developed flows within the site. All drainage facilities described herein and shown on the included drainage map are subject to change due to final analysis and design considerations. The proposed drainage facilities will adequately convey, and route runoff from the site ultimately to Sand Creek.

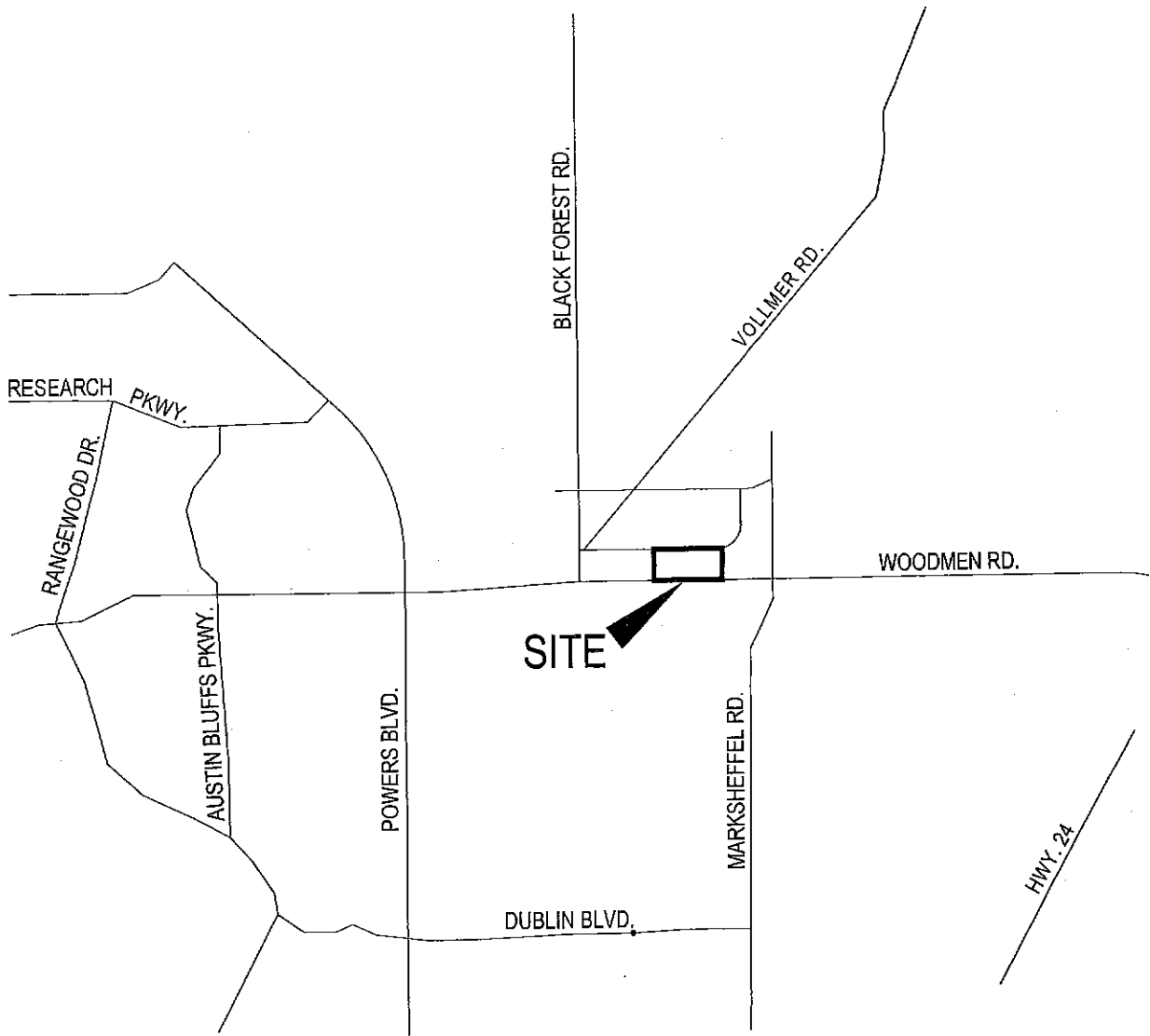
REFERENCES

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs and El Paso County "Drainage Criteria Manual", October 1987, revised November 1991, volumes 1 & 2.
2. Soil Survey for El Paso County, Colorado, U.S. Department of Agriculture, Soil Conservation Service, June 1980.
3. Master Development Drainage Plan for Woodmen Heights Master Plan, Classic Consulting Engineers and Surveyors, LLC, June 2004.
4. Master Development Drainage Plan update for Woodmen Heights and Final Drainage Report for Forest Meadows Filing No. 1 and No. 4, ESI, Inc., February 2006
5. Sand Creek Drainage Basin Planning Study Preliminary Design Report, Kiowa Engineering Corporation, revised March 1996

APPENDIX

VICINITY MAP



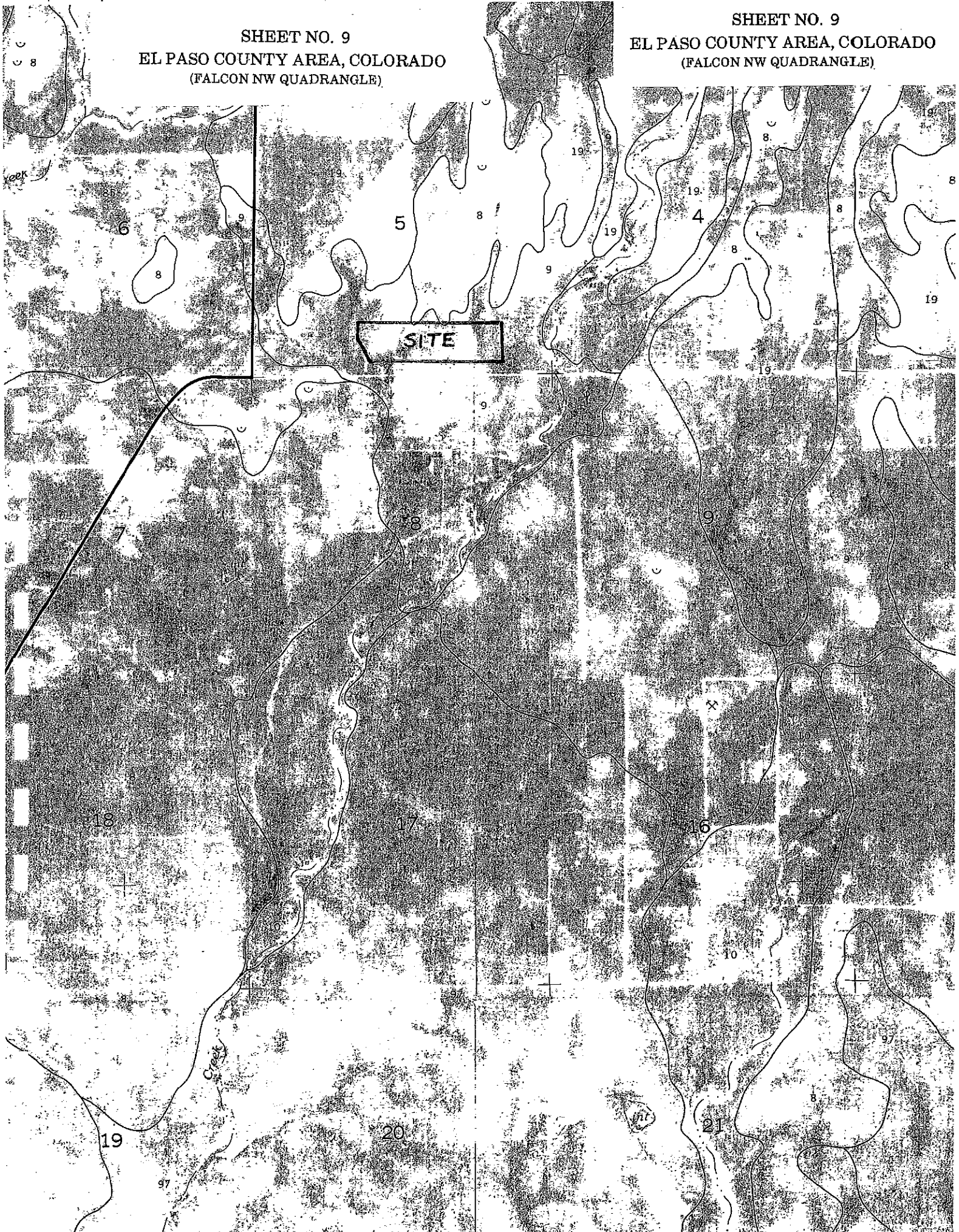
VICINITY MAP

N.T.S.

SOILS MAP

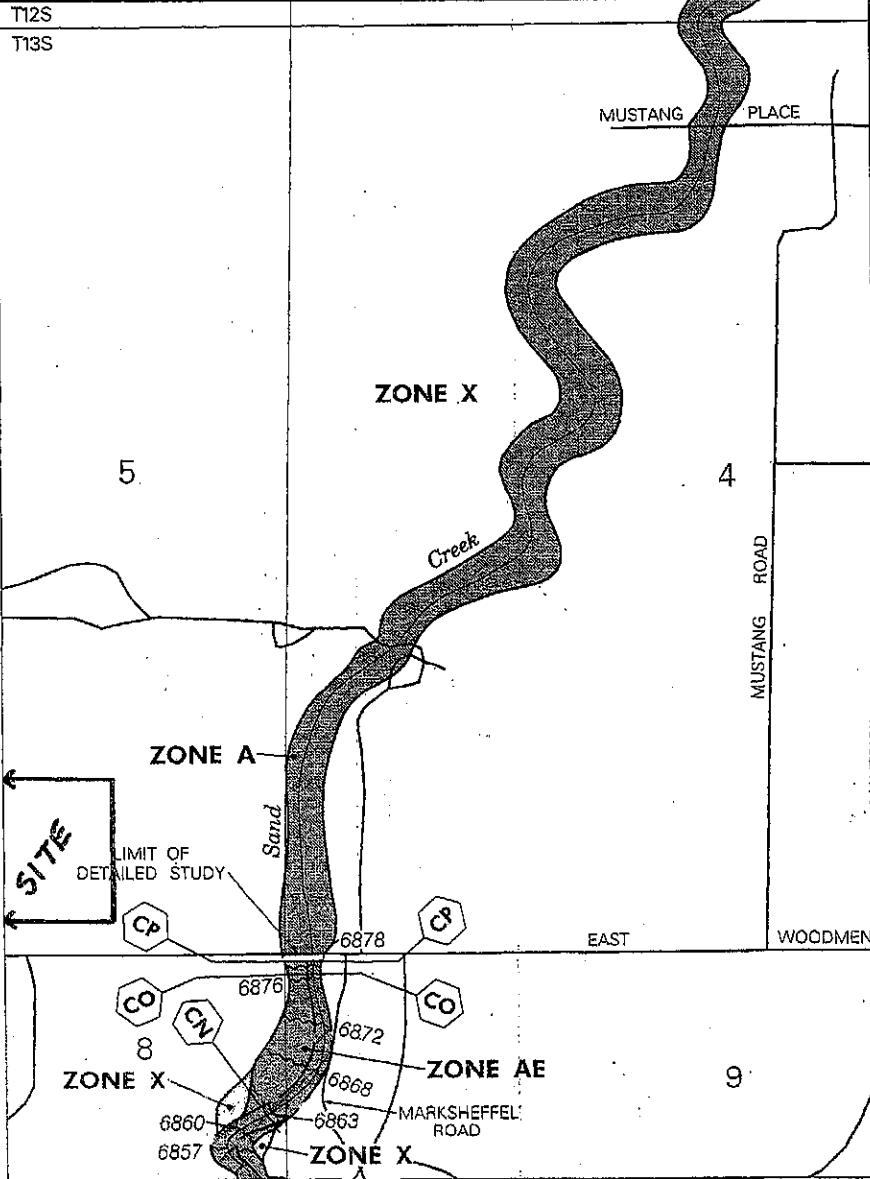
SHEET NO. 9
EL PASO COUNTY AREA, COLORADO
(FALCON NW QUADRANGLE)

SHEET NO. 9
EL PASO COUNTY AREA, COLORADO
(FALCON NW QUADRANGLE)



FLOODPLAIN MAP

JOINS PANEL 0528



38°56'15"
104°41'15"



APPROXIMATE SCALE IN FEET
1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,
COLORADO AND
INCORPORATED AREAS

PANEL 535 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:	NUMBER	PANEL	SUFFIX
COMMUNITY			
EL PASO COUNTY, UNINCORPORATED AREAS	080029	0535	F

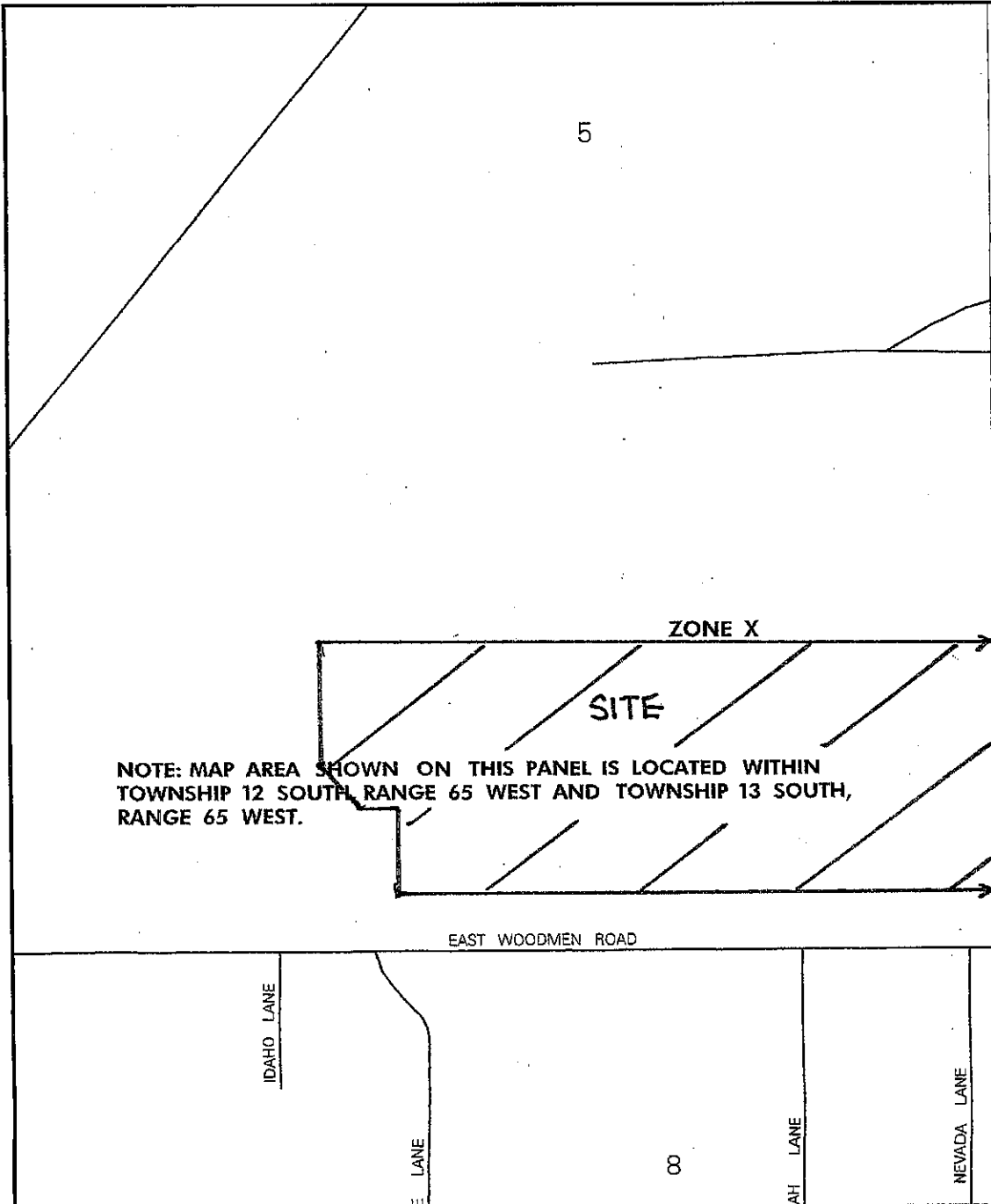
MAP NUMBER
08041C0535 F

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



APPROXIMATE SCALE IN FEET
 500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM
 FLOOD INSURANCE RATE MAP**

EL PASO COUNTY,
 COLORADO AND
 INCORPORATED AREAS

PANEL 529 OF 1300
 (SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:
 COMMUNITY

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080050	0529	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0529	F

**MAP NUMBER
 08041C0529 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

WOODMEN HEIGHTS BUSINESS PARK
MDDP
(Area Drainage Summary)

BASIN	AREA TOTAL (Acres)	OVERLAND		STREET / CHANNEL FLOW				Time of Travel (T _c)		INTENSITY *		TOTAL FLOWS				
		C ₅	C ₁₀₀	C ₅	Length (ft)	Height (ft)	T _c (min)	Length (ft)	Slope (%)	Velocity (fps)	T _c (min)	TOTAL (min)	I ₅ (in/hr)	I ₁₀₀ (in/hr)	Q ₅ (c.f.s.)	Q ₁₀₀ (c.f.s.)
A	6.59	0.90	0.90	0.90	300	9.6	4.4	600	2.0%	4.9	2.0	6.4	4.8	8.5	28.2	50.3
B	7.85	0.90	0.90	0.90	300	9.6	4.4	800	2.6%	5.6	2.4	6.8	4.7	8.3	33.1	59.0
C	8.37	0.90	0.90	0.90	300	9.9	4.4	800	2.9%	6.0	2.2	6.6	4.7	8.4	35.6	63.4
D	2.89	0.15	0.20	0.25	300	11	17.9	0	0.0%	0.1	0.0	17.9	3.2	5.7	1.4	3.3
E	3.32	0.90	0.95	0.25	10	0.2	4.0	780	2.7%	5.8	2.3	6.3	4.8	8.5	14.3	27.0
F	12.73	0.90	0.90	0.25	200	6	15.6	400	1.0%	3.5	1.9	17.5	3.2	5.7	36.8	65.6
G	2.98	0.90	0.90	0.25	20	0.4	5.7	500	0.9%	3.3	2.5	8.2	4.4	7.9	11.8	21.1
OS-1	0.33	0.88	0.93	0.90	80	1.6	2.7	130	0.5%	2.5	0.9	5.0	5.1	9.1	1.5	2.8
OS-2	1.37	0.88	0.93	0.90	80	1.6	2.7	650	1.5%	4.3	2.5	5.2	5.1	9.0	6.1	11.5

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: BES

Date: 2/27/2008

Checked by: VAS

WOODMEN HEIGHTS BUSINESS PARK
MDDP
(Surface Routing Summary)

Design Point(s)	Contributing Basins/Design Points	Equivalent CA ₅	Equivalent CA ₁₀₀	Maximum T _C	Intensity		Flow		Comments
					I ₅	I ₁₀₀	Q ₅	Q ₁₀₀	
1	A	5.93	5.93	6.4	4.8	8.5	28.2	50.3	Sump Inlet(s) Required/FDR to Finalize
2	B	7.07	7.07	6.8	4.7	8.3	33.1	59.0	Curb Cuts along Parking Lot Edge
3	C	7.53	7.53	6.6	4.7	8.4	35.6	63.4	Sump Inlet(s) Required/FDR to Finalize
4	B,C & D	15.03	15.18	17.9	3.2	5.7	47.8	86.0	Routed To Proposed 60" Outfall Pipe
5	E, OS-1	3.28	3.46	6.3	4.8	8.5	15.7	29.6	Curb Cut to Open Channel to Woodmen Ditch
6	E, F, OS-1, OS-2	15.94	16.19	8.8	4.3	7.7	68.6	124.1	Routed To Proposed 54" Outfall Pipe
7	G	2.68	2.68	8.2	4.4	7.9	11.8	21.1	Routed to Future Detention Pond No. 3

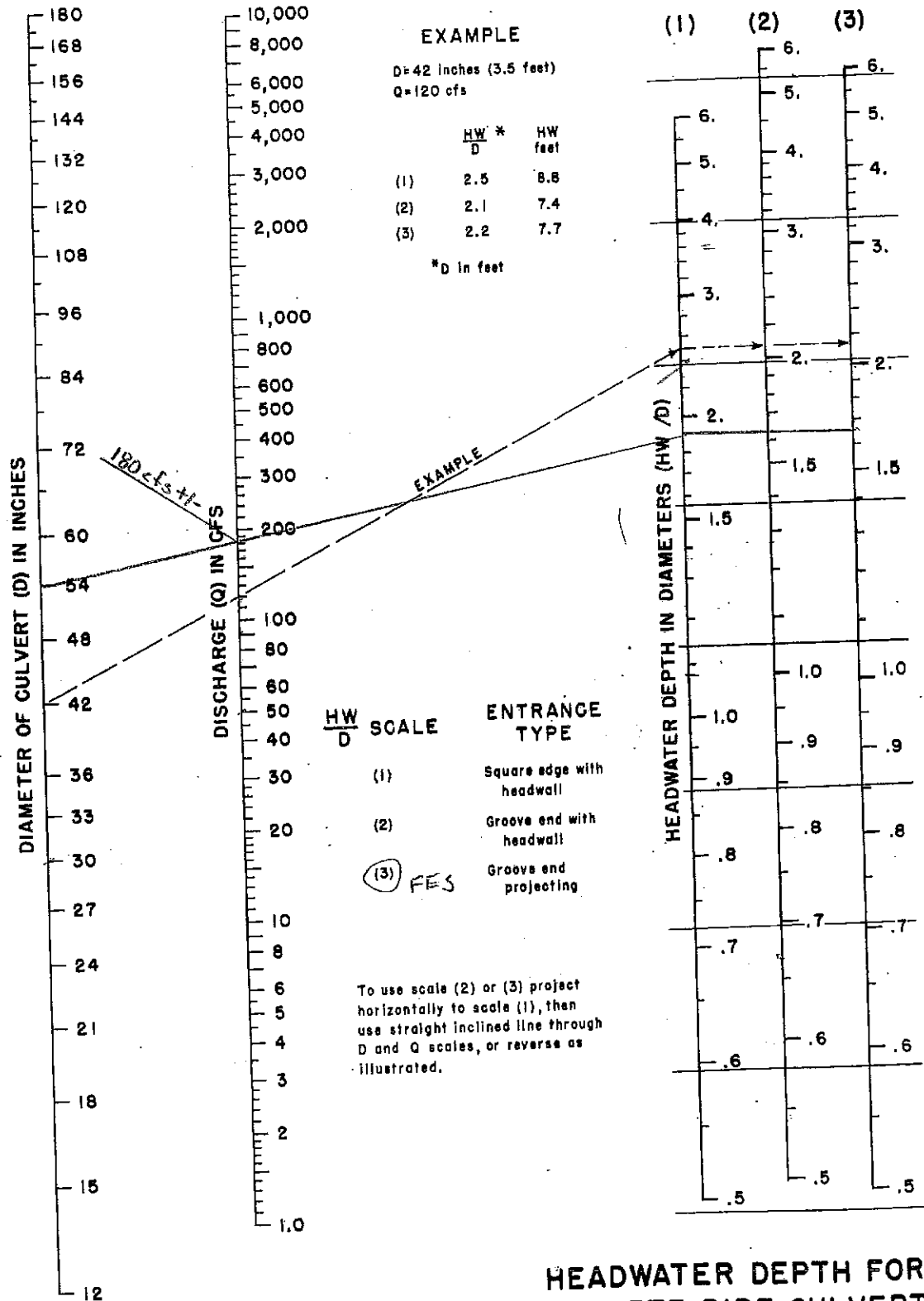
Calculated by: BES
Date: 2/27/2008
Checked by: VAS

HYDRAULIC CALCULATIONS

• Design Point 14 pipe Capacity
 per Woodmen Road pipe design
 Sta 103+65.2/

HW/D = 1.66
 Capacity yielded = 180 cfs

CHART 1



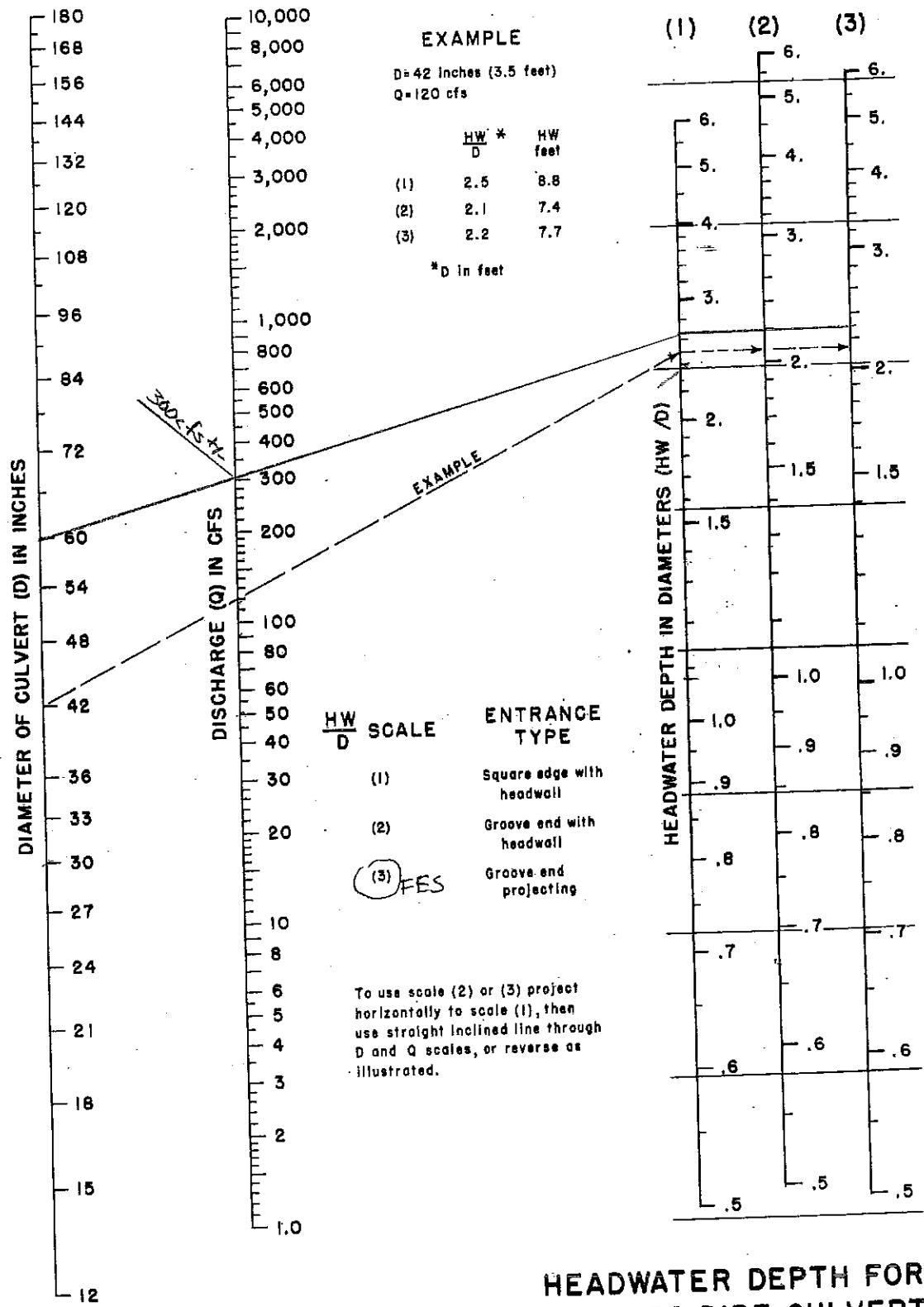
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
 REVISED MAY 1964

• Design Point 4 pipe capacity per Woodmen Road pipe design Sta 86+66.70

HW/D = 2.3
Capacity yielded = 300 cfs

CHART 1



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2 & 3
 REVISED MAY 1964

DRAINAGE MAP