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MASTER DEVELOPMENT DRAINAGE PLAN
AND
PRELIMINARY/FINAL DRAINAGE REPORT
FOR
SAGEWOOD FILING NOS. 1 THROUGH 4

November 1997
Revised April 1998
Revised June 1998

Prepared For:

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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.

Kyle R. Campbell, Colorado P.E. #29794 — 6-19-98
For and On Behalf of JR Engineering, Ltd. — 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: LP47, LLC
dba La Plata Investments

By: Bob Ingels

Title:

Address: 7150 Campus Drive, Suite 365
Colorado Springs, CO 80920

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 — July 2, 1998
Date

Conditions

MASTER DEVELOPMENT AND DRAINAGE PLAN AND PRELIMINARY/FINAL DRAINAGE REPORT FOR SAGEWOOD FILING NOS. 1 THROUGH 4

TABLE OF CONTENTS

MASTER DEVELOPMENT AND DRAINAGE PLAN AND PRELIMINARY/FINAL DRAINAGE REPORT FOR SAGEWOOD FILING NOS. 1 THROUGH 4

PURPOSE

This document is the Master Development Drainage Plan and Preliminary/Final Drainage Report for Sagewood Filing Nos. 1 through 4, to include Austin Bluffs Parkway from Brainard Drive to Rangewood Drive. The purpose of this report is to identify major drainage features and facilities and to estimate peak rates of stormwater runoff, from on-site and off-site sources, and outline the necessary improvements to safely convey the stormwater runoff to adequate outfall facilities.

GENERAL

Sagewood Filing Nos. 1 through 4 is a portion of Section 32, Township 12 South, Range 66 West of the Sixth Principal Meridian, City of Colorado Springs, El Paso County, Colorado. The 60.04-acre Parcel is bounded on the east by unplatted land and "Gatehouse Village at Briargate Filing No. 10"; on the south by Austin Bluffs Parkway and unplatted land; on the west by Austin Bluffs Parkway; and on the north by future Briargate Parkway. The Parcel is presently vegetated with grass. The parcel saddles the Pine Creek/Cottonwood Creek drainage boundary. Approximately 20.38 acres (portions of Filing Nos. 2 and 4) lie in the Pine Creek Basin and 39.66 acres (Filing Nos. 1 and 3 and portions of 2 and 4) are in the Cottonwood Creek Basin.

A review of the "Soil Survey of El Paso County Area," prepared by S.C.S. (see appendix) indicates that the on-site and the off-site watershed is mapped:

Bresser Sandy Loam, Hydrologic Group "B"
Blakeland Loamy Sand, Hydrologic Group "A"
Stapleton Sandy Loam, Hydrologic Group "B".
Stapleton - Bernal part, Hydrologic Group "B/D"

EXISTING DRAINAGE CONDITIONS

As stated above, Sagewood Filing Nos. 1 through 4 lie in both the Pine Creek and Cottonwood Creek Drainage Basins.

Portion Of On-Site Area In Pine Creek Basin

The portions of Sagewood Filing Nos. 2 and 4 that are in the Pine Creek Basin and presently undeveloped have no up-gradient watershed runoff which will impact the site. This portion of the site drains from the basin boundary to the north and northwest to the Pine Creek drainageway, which lies just off the north boundary of the parcel. Ground surface slopes vary from 2 to 15 percent.

Portion Of Study Area In Cottonwood Creek Basin

The portions of Sagewood Filing Nos. 2, 4, and all of filings 1 and 3 in Cottonwood Creek drain to the south. The majority of this portion of the site is tributary to an existing 66" diameter storm drain in Brainard Drive that outfalls to Austin Bluffs Channel. As shown on the Drainage Plan in the appendix of this report, the other areas potentially impacting this portion of the site are portions of Timberview Middle School site, Basins "E-8C" and "E-8D", also Basins "E-7", "E-7A", "E-8A", "E8-B", "E-8E" and "E-9", presently undeveloped. This area was previously studied in the Drainage Report and Plan, Gatehouse at Briargate Filing No. 10, prepared by Obering, Worth & Associates, January 10, 1987.

PROPOSED DRAINAGE CONDITIONS

As Sagewood Filing Nos. 2 and 4 lie in both the Pine Creek and Cottonwood Creek basins, the proposed drainage condition for the portion lying in each basin is described separately. It should be noted that even though the proposed drainage basin boundaries deviate from the historical major drainage basin boundary, the net change in the area between the major basins is estimated to be Pine Creek historic 19.45 acres, proposed area of 20.38 acres, and net 0.93 acres from Cottonwood Creek Basin to Pine Creek Basin.

Portion of On-Site Area in Pine Creek Basin

The ultimate planned outfall from this portion of Sagewood Filing Nos. 2 and 4 will be a large storm drain trunk line to be constructed in Briargate Parkway in the future. The future Briargate Parkway storm drain will replace the natural Pine Creek Channel as the major drainage conveyance adjacent to the Sagewood subdivision. Briargate Parkway and the associated storm drain are not expected to be constructed with the Sagewood Subdivision, thus the current plan requires that private temporary detention ponds be constructed at the discharge points from the subdivision to limit the peak 100-year flow rates from the subdivision to the historic peak 100-year flow rates. The private temporary detention ponds will allow the subdivision to be developed without creating a negative impact on the peak 100-year flow rates down stream. In the near future, three additional regional detention facilities are expected to be constructed in the Pine Creek Watershed downstream. These ponds will be designed to accept free discharge from the area of Sagewood that drains to Pine Creek and will eliminate the need for the private temporary detention ponds. The future Briargate Parkway storm drain and downstream regional detention ponds are shown and discussed in "Amendment No. 2 to Pine Creek Drainage Basin Planning Study and Master Development Drainage Plan for Pine Creek Subdivision," submitted for review in May 1998.

For the purposes of this study, the portion of Sagewood Filing Nos. 2 and 4 in Pine Creek Basin is divided into nine (9) drainage basins, P-1 through P-9, plus off-site Basins OP-10 and OP-11, delineated on the Drainage Map in the appendix of this report. With the exception of the flow from Basin P-6, (Q_5 = 3.0 cfs, Q_{100} = 6 cfs) from Austin Bluffs Parkway, which will flow onto Terravale Drive, it is proposed that runoff from the development will flow to the future Briargate Parkway storm drain system. Until such time the system is built, it is proposed that the majority of runoff be directed to two (2) temporary detention ponds "A" and "B". These ponds are intended to detain 100-year storm frequency discharge rates to historic levels. The proposed drainage conditions can be more specifically described as follows.

Runoff from the majority of Basin P-1 (Q_5 = 11 cfs, Q_{100} = 22 cfs) is proposed to be collected at the sump inlet AP-P1, on Prairie Clover Drive, as shown on the Drainage Plan and piped by the proposed 18" R.C.P. to AP-P2 sump inlet. Flow from Basin P-2 (Q_5 = 5 cfs, Q_{100} = 9 cfs) combines with the flow from basin P-1 at the proposed sump inlet at AP-P2 on the north side of Prairie Clover Drive. The combined flow is proposed to be piped to the future Briargate Parkway storm drainage system by a 30" R.C.P. Until such time as the Briargate Parkway system is constructed, the flow from AP-P2 is proposed to be piped to temporary Private Detention Pond "A" located in off-site Basin OP-11 future Briargate Parkway. Basin P-8 (Q_5 = 1 cfs, Q_{100} = 1 cfs) will temporarily flow, sheet flow to Private Detention Pond "A", and in the future, sheet flow to Briargate Parkway. Basins P-7 (Q_5 = 1 cfs, Q_{100} = 2 cfs) and P-9 (Q_5 = 3 cfs, Q_{100} = 6 cfs) are proposed to discharge, sheet flow to the future Briargate Parkway. It is proposed that Basins P-7 and P-9 temporarily discharge overland sheet flow to Pine Creek Channel.

Private Detention Pond "A" is proposed to maintain 100-year discharge from Basins P-1, P-2, P-7, P-8, P-9 and OP-10 to historic levels. Historic and developed condition runoff for these basins is estimated as follows:

Analysis Point	**Basin(s)**	**Historic Condition**		**Developed Condition**	
		Q_5	**Q_{100}**	**Q_5**	**Q_{100}**
AP-AP3	P-1, P-2, P-8, SP-10	4 cfs	9 cfs	17 cfs	34 cfs
AP-P10	P7	1 cfs	1 cfs	1 cfs*	2 cfs*
AP-P9	P9	2 cfs	3 cfs	3 cfs*	6 cfs*
	TOTAL	**7 cfs**	**13 cfs**	**21 cfs**	**42 cfs**

* Direct Discharge, Overland

Allowable Q_{100} Out = Q_{100} Historic – Q_{100} Direct Discharges

= 13 cfs – 2 cfs – 6 cfs = 5 cfs

The storage volume required in Pond "A" is estimated at 35,300 cu. Ft. (Q_{100} in 34 cfs, Q_{100} out 5 cfs).

The runoff from Basins P-3 and P-4 travels overland and by street gutter to Analysis Points AP-PB5 (Q_5 = 8 cfs, Q_{100} = 17 cfs), AP-PB4 (Q_5 = 11 cfs, Q_{100} = 22 cfs) on the north and south sides of Terravale Drive. 10' inlets are proposed for each location. Inlet AP-PB4 will intercept 11 cfs with the 11 cfs flowby in the 100-year storm and 6 cfs with 5 cfs flowby in 5-year storm. Inlet AP-PB5 will intercept 9 cfs with 8 cfs flowby in the 100-year storm and 5 cfs with 3 cfs flowby in the 5-year storm.

An 18" R.C.P. is proposed carry Q_{100} = 11 cfs from AP-PB4 to AP-PB5. A 24" R.C.P. from AP-PB5 will carry Q_{100} = 20 cfs temporarily to Private Detention Pond "B". In the future, the 24" R.C.P. will connect to the future storm drainage system in Austin Bluffs Parkway and be conveyed north to the future storm drainage system in Briargate Parkway.

The flowby from AP-PB4 and AP-AB5 will combine with runoff from Basin P5 (Q_5 = 5 cfs, Q_{100} = 9 cfs) at AP-PB6 (Q_5 = 8 cfs, Q_{100} = 17 cfs). The combined flows are proposed to be temporarily directed to temporary Private Detention Pond "B". It is proposed that these flows be conveyed by the Austin Bluffs Parkway storm drain system to the Briargate Parkway storm drain system in the future.

Temporary Private Detention Pond "B", AP-PB-7, (Q_5 = 21 cfs, Q_{100} = 43 cfs) is proposed to detain Q_{100} flows to historic levels (Q_5 = 8 cfs, Q_{100} = 17 cfs). An estimated pond storage volume of 42,700 cu. ft. is proposed to reduce Q_{100} in 43 cfs to Q_{100} out 17 cfs.

Basin P-6 (Q_5 = 3 cfs, Q_{100} = 6 cfs) runoff from Austin Bluffs Parkway right-of-way is proposed to discharge to the Terravale Drive gutter at AP-P8.

Portion of On-Site Area In Cottonwood Creek Basin

Portions of Sagewood Filing Nos. 2 and 4 and all of filing 1 and 3 lie in Cottonwood Creek Drainage Basin. On-site drainage within this portion of the subdivision, to include Basins C-1 through C-14, that will be tributary to Cottonwood Creek is proposed to be treated as described below. Supporting calculations are contained in the appendix of this report.

Runoff from Basins C-1, C-3, C-4 and C-5 will be concentrated in Squirrel Tail Drive, west of Brainard Drive at AP-C1 and AP-C2. The street will convey approximately 14 cfs per side above these points before the flow depth exceeds the crown elevation. Runoff from all of Basins C-1, C-3 and C-4 will flow to AP-C1 (Q_5 = 15 cfs, Q_{100} = 30 cfs). Runoff from of Basin C-5 will flow to AP-C2 (Q_5 = 3 cfs, Q_{100} = 6 cfs). During the 5-year storm, peak flow of 1 cfs (15-14) is expected to cross the crown of Squirrel Tail Drive. Runoff will flow higher than the crown elevation during the 100 year storm, thus it is assumed that a portion of the runoff will cross the crown of Squirrel Tail Drive above the analysis points and the combined runoff from Basins C-1, C-3, C-4 and C-5 will be distributed evenly between AP-C1 and AP-C2. A 24-foot long on-grade curb opening inlet is proposed to be constructed at both AP-C1 and AP-C2 (north and south sides of Squirrel Tail Drive). These combined inlets will intercept an estimated 28 cfs (14 cfs each x 2) in the 100-year storm and 16 cfs (12 cfs at AP-C1 + 4 cfs at AP-C2) in the 5-year storm. The intercepted flow will be conveyed to the existing 60" diameter storm drain in Brainard Drive through two existing 24" diameter storm drain stubs, one stub per each inlet. The combined flowby from the inlets (Q_5 = 3 cfs, Q_{100} = 8 cfs) will be conveyed on the surface to AP-22 at Bayswater Drive via the west side of Brainard Drive.

Runoff from Basin C-2 and C-14 will be collected and conveyed in the west side of Brainard Drive to AP-22, at the northwest corner of the intersection of Brainard Drive and Bays Water Drive, along with the flowby from AP-C1 and AP-C2, as noted above. Flow to AP-22 is estimated at Q_5 = 10 cfs and Q_{100} = 21 cfs. An existing 10-foot long on-grade curb opening inlet at AP-22 will intercept an estimated Q_5 = 6 cfs and Q_{100} = 11 cfs. The intercepted flow will be added to the existing 60" diameter storm drain in Brainard Drive. Flowby from the inlet estimated at Q_5 = 4 cfs and Q_{100} = 10 cfs will continue to travel down the west side of Brainard Drive to AP-23 located at the northwest corner of the intersection of Brainard Drive and Austin Bluffs Parkway.

Runoff from Basins C-6, C-7 and C-8 will be collected and conveyed to the adjacent streets to AP-C3 (Q_5 = 19 cfs, Q_{100} = 36 cfs) on the north side of Bays Water Drive. The flow from Basin C-9 will flow to AP-C4 (Q_5 = 5 cfs, Q_{100} = 10 cfs) on the south side of Bays Water Drive located west of Brainard Drive. The street will convey approximately 20 cfs per side above these points before the flow depth exceeds the crown elevation. Without flow crossing the crown, the 5-year peak flow rates at AP-C3 would be Q_5 = 19 cfs and Q_{100} = 36 cfs. Peak flow rates to AP-C4 would be Q_5 = 5 cfs and Q_{100} = 10 cfs. During the 5-year storm it is anticipated that flow will not cross over the crown of Bays Water Drive from the north to the south side. During the 100-year storm it is anticipated that significant flow will cross the crown of Bays Water Drive from the north side of the street and the composite flow to AP-C3 and AP-C4 (36 cfs + 10 cfs = 46 cfs) will be divided evenly between the north and south sides of the street (Q_{100} each side = 46 / 2 =

23 cfs). One 12-foot long and one 10-foot long on-grade curb opening inlets are proposed to be constructed at both AP-C3 and AP-C4 (north and south sides of Bays Water Drive). These inlets combined will intercept an estimated 38 cfs (19 cfs each side x 2) in the 100-year storm and 20 cfs (16 cfs at AP-C3 + 4 cfs at AP-C4) in the 5-year storm. The intercepted flow will be conveyed to the existing 60" diameter storm drain in Brainard Drive through an existing 36" diameter storm drain stub. The combined flowby from the inlets (Q_5 = 3 cfs, Q_{100} = 8 cfs) will be conveyed on the surface to AP-23 at the northwest corner of the intersection of Brainard Drive and Austin Bluffs Parkway via the west side of Brainard Drive.

Most of the runoff from Basin C-13 (open space and backyards) will be collected in Brainard Drive and will contribute to the total runoff at AP-23 (Q_5 = 9 cfs, Q_{100} = 24 cfs). A very small portion of the basin may drain to Austin Bluffs Parkway, but for simplicity of analysis it was assumed that all of C-13 would contribute to AP-23. An existing 8' long on-grade curb opening inlet at AP-23 will intercept an estimated Q_5 = 6 cfs and Q_{100} = 12 cfs. The intercepted flow will be added to the existing 60" diameter storm drain in Brainard Drive. Flowby from the inlet estimated at Q_5 = 3 cfs and Q_{100} = 12 cfs will continue to travel down the west side of Brainard Drive, then across Austin Bluffs Parkway to the existing sump inlet at AP-24 located along the south curb line of Austin Bluffs Parkway.

Runoff from Basin C-12 will be collected and conveyed to AP-C6 via the north side of Austin Bluffs Parkway. At AP-C6, the combined runoff from Basin C-12 is estimated to be Q_5 = 8 cfs and Q_{100} = 15 cfs. A 16' long on-grade curb opening inlet is proposed to be constructed at AP-C6. This inlet will intercept an estimated 10 cfs in the 100-year storm and 6 cfs in the 5-year storm. The intercepted flow will be conveyed to AP-C7 in a proposed 18" diameter storm drain. The flowby from the proposed inlet at AP-C6 (Q_5 = 2 cfs, Q_{100} = 5 cfs) will be conveyed in the Austin Bluffs Parkway street section to an existing 26' long curb inlet (AP-24) located in a sump along the south curb of Austin Bluffs Parkway at the intersection with Brainard Drive.

Runoff from Basins C-10 and C-11, AP-C5 (Q_5 = 12 cfs, Q_{100} = 23 cfs) will be collected and conveyed to a proposed 16' long curb opening inlet located in a sump, via the proposed streets in the basin. From the proposed inlet, located at the end of a proposed cul-de-sac, the flow will be conveyed to the proposed 24" diameter storm drain in Austin Bluffs Parkway via a proposed 24" R.C.P. storm drain. At AP-C7, the runoff from Basin C-10 and C-11 will be added to the runoff intercepted at AP-C6 for a total of Q_5 = 17 cfs and Q_{100} = 32 cfs in the proposed storm drain. The proposed 24" diameter storm drain will convey the combined flow to a new connection to the existing 60" diameter storm drain in Brainard Drive.

Off-Site Area in Cottonwood Creek Basin

A review of the "Cottonwood Creek Drainage Basin Planning Study," prepared by URS Consultants, dated June 9, 1994, Sheet 8 of 11, indicates no proposed drainage improvements north of Austin Bluffs Parkway. The indicated improvements south of Austin Bluffs Parkway have been implemented.

In order to assess the adequacy of the down stream storm drain and streets to convey the runoff from the on-site area, a Rational Method analysis of the off-site basins contributing to the Brainard Drive storm drain was performed. The off-site areas include portions of the developed Gate House Village Filing No. 10 subdivision, portions of the developed Timberview Middle School site, portions of Austin Bluffs Parkway and Brainard Drive, and a large unplatted tract of land located north of Squirrel Tail Drive and east of Brainard Drive. The off-site areas are shown on the Drainage Plan included in the appendix and are labeled with either an "E" or a "G" prefix. A prefix of "G" was given to basins within the Gatehouse Village Filing No. 10 Subdivision

A runoff analysis and a general drainage plan for the off-site area was included in the approved "Drainage Report and Plan for Gatehouse Village at Briargate Filing No. 10," by Obering, Wurth and Associates, dated January 1987. The Gatehouse Village Filing No. 10 analysis was performed using the S.C.S. method.

The current plan is consistent with the overall drainage concept proposed in the Gatehouse Village Filing No. 10 Report. The largest deviation to this is the current plan to limit discharge from the upstream off-site Basins E-7, E-9, and E-8A in order to achieve: conveyance of the 100-year storm runoff without severe surcharging of the storm drain system; creating deep flow conditions in Austin Bluffs Parkway and Brainard Drive; or allowing significant flow to overtop the Austin Bluffs Parkway street section south of Brainard Drive. Consistent with the above goals, the current plan also proposes that the allowable runoff from Basins E-7, E-8A, E-8B, and E-9 be discharged directly to the storm drain system rather than into Brainard Drive or Squirrel Tail Drive. The proposed allowable discharges were set to be similar to the discharge allowed from commercial, office, and light industrial sites within the Pine Creek Drainage Basin. Detention required to meet the allowable rates can generally be achieved within landscaping areas and parking lots on the site without substantial complication. Detention has not been proposed for Basins E-8B or E-8E as their proposed use is multi-family residential development.

While the current plan proposes conditions be placed on the development of the undeveloped portion of the off-site area, it is beyond the scope of the current plan to do specific drainage planning for these areas. Specific planning will be required for those areas prior to their development. The total discharge from the off-site basins shall be limited to the rates indicated and "not" based on a percentage, as the total discharge is limited by existing downstream facilities. This plan proposes the following criteria be followed in the planning of those sites.

Runoff from Basin E-9 should be limited to a maximum discharge of 125 cfs in the 100-year storm and should be discharged to the proposed storm drain or lined channel adjacent to Squirrel Tail Drive. The improved conveyance will likely be required to be completed to Brainard Drive before the basin can be developed. When planning is done in the basin, it should be assumed that a portion of Powers Boulevard will likely free discharge into the system and consume a portion of the allowable discharge. It should also be noted that while the area of Basin E-9 is shown as 37.2 acres, as carried forward from the Gatehouse Village Mini Master Plan, the actual area of the basin is approximately 39 acres. This was determined to be unimportant at this time given the following: the actual area of Powers Boulevard that will be included in E-9 has not been determined; the natural basin as delineated is irregular in shape and is unlikely to be followed in the developed condition; and with use of detention, the contributing area can be increased or decreased as long as the proposed total discharge constraint is met. Systems shall be sized to meet proposed discharge limits.

Runoff from Basin E-8B should be discharged directly to the proposed channel or storm drain to be constructed adjacent to Squirrel Tail Drive. The improved conveyance will likely be required to be completed to Brainard Drive before the basin can be developed. No discharge restriction is proposed for this site due to its' planned use for multi-family development. Likewise, no discharge restriction is proposed for Basin E-8E. Basin E-8E is assumed to discharge directly to Squirrel Tail Drive. If the basins are developed with a more impervious land use, exceeding discharge rates indicated, detention should be required.

Runoff from Basin E-8A should be restricted to a maximum discharge rate of 21 cfs in the 100-year storm and should be discharged directly to the existing Brainard storm drain or the proposed storm drain or channel to be constructed adjacent to Squirrel Tail Drive. The improved conveyance adjacent to Squirrel Tail Drive will likely be required to be completed through the basin to handle off-site flows before the basin can be developed.

Runoff from Basin E-7 should be restricted to a maximum discharge rate of 52 cfs in the 100-year storm and should be discharged directly into the Brainard Drive storm drain system at or near the existing temporary 60" diameter inlet located at the southern corner of the basin.

It is assumed that the proposed improved conveyance to be constructed adjacent to Squirrel Tail Drive be connected directly to the existing 60" diameter storm drain stub located at the northeast corner of Squirrel Tail Drive and Brainard Drive (AP-12 and AP-13). Based on the above criteria, the peak flow rates at AP-12 include runoff from Basins E-8A, E-8B, and E-9 and are estimated to be Q_5 = 130 cfs and Q_{100} = 186 cfs. At AP-13, the runoff from Basin E-7A is assumed to be added and peak rates are estimated to be Q_5 = 165 cfs and Q_{100} = 231 cfs. Based on this flow rate and the estimated flow rate into the system downstream, the estimated Hydraulic Grade associated with the 100-year peak flow rate at AP-13 will be at elevation 6953.2 as demonstrated by the Hydraulic Grade Line (HGL) calculation included in the appendix of this report.

The appendix of this report contains calculations of peak flow rates from the Gatehouse Village Filing No. 10 area and inlet interception calculations associated with the existing inlets constructed within Gatehouse Village Filing No. 10 and along the east side of Brainard Drive between Squirrel Tail Drive and Austin Bluffs Parkway. These calculations were primarily done to generate peak flow rates to be used to calculate the HGL in the Brainard Drive storm drain and to verify that significant flow from the east side of Brainard Drive would not cross the crown and impact the street capacity on the west side of Brainard Drive. The on-site drainage description for Gatehouse Village Filing No. 10 has been provided with the report for the subdivision, so only a summary table is provided here.

Analysis Point	Inlet Size	Flow In (cfs)		Flow Intercepted (cfs)		Flow By (cfs)	
		Q_5	Q_{100}	Q_5	Q_{100}	Q_5	Q_{100}
AP-14	NONE	10	19	NONE	NONE	10	19
AP-15	20'	12	23	10	16	2	7
AP-16	15'	12	25	9	17	3	8
AP-17	15'	12	23	9	14	3	9
AP-18	15'	13*	21*	9	13	4	7
AP-19	10'	8**	21**	6	11	3	9
AP-20	20'	14	36	11	13	3	13
AP-21	10'	8	27	6	15	2	12

* Calculated flow at AP-18 (Q_5 = 14 cfs, Q_{100} = 27 cfs) is reduced by flow assumed to cross the crown of street.

** Calculated flow at AP-19 (Q_5 = 7 cfs, Q_{100} = 14 cfs) is increased by flow assumed to cross the crown of street from the north side (AP-18).

The analysis coupled with a verification of the one half street capacity in Brainard Drive indicates that flow will not cross the crown of Brainard in the 5-year storm and flow crossing the crown in the 100-year storm will be very limited and will not significantly impact the capacity on the west side of Brainard.

The above analysis coupled with the analysis of the on-site area and the west half of Brainard indicates that flow to the sump along the south curb line of Austin Bluffs Parkway at Brainard Drive (AP-24) will be Q_5 = 18 cfs and Q_{100} = 49 cfs. This flow will be intercepted by the existing 26-foot long curb opening inlet in a sump at that location and conveyed to the existing

Brainard Drive storm drain. The computed capacity of the 26' sump inlet is 64 cfs with a 1.25 clogging factor.

Brainard Storm Drain

The analysis done for this report included routing the flows to be intercepted by existing and proposed inlets through the existing Brainard Drive storm drain. A summary table representing this analysis is provided below.

Analysis Point	Pipe Size	In Flow From	Flow Rate (cfs)		Rate Used for HGL Calc. (cfs) (pipe capacity)	Estimated Addit. Street Surface Flow
			Q_5	Q_{100}		
SD-1	66	AP-13, C1, C2, and 15	189	281	276	5
SD-2	66	SD-1, AP-C3, C4, 16, 17, and 20	236	369	313	56
SD-3	66	SD-2, AP-18, and 19	249	390	334	56
SD-4	66	SD-3, AP-C7, 21, and 23	277	447	395	52
SD-5	66	SD-4, AP-24	293	493	475	18

The Rate Used for HGL Calculation Column represents the estimated system capacity based on HGL calculations. The Estimated Additional Street Surface Flow Column is the estimate additional surface flow in Brainard Drive based on the HGL calculations.

The following tables summarize the total Q_{100} flow in Brainard Drive for Analysis Point SD-1 through SD-5 indicated on the Drainage Plan.

BRAINARD DRIVE:

Computed Surface Flows:

Point	West Gutter	East Gutter
SD-1		
Flowby AP-C1	4	-
Flowby AP-C2	4	-
Basin C-2	6	-
Flowby AP-15	-	7
	14 cfs	7 cfs
Pipe Surcharge	5 cfs	
Total Q_{100} Street Flow	14 + 7 + 5= 26 cfs	

Point	West Gutter	East Gutter
SD-2		
Flowby AP-C3B	4	-
Flowby AP-C4B	4	-
Flowby AP-22	10	-
Flowby AP-20	-	13
	18 cfs	13 cfs
Pipe Surcharge	56 cfs	
Total Q_{100} Street Flow	18 + 13 + 56 = 83 cfs	
Average Street Slope	$\frac{2}{225} = 0.009$	

Point	West Gutter	East Gutter
SD-3		
Flowby AP-C3B	4	-
Flowby AP-C4B	4	-
Flowby AP-22	10	-
½ Basin C-13 [1/2(9)]	4.5	-
Flowby AP-20	-	13
Flowby AP-19	-	9
Flowby AP-18	-	7
	22.5 cfs	29 cfs
Pipe Surcharge	56 cfs	
Total Q_{100} Street flow	22.5 + 29 + 56 = 108 cfs	
Average Street Slope	$\frac{2}{235} = 0.008$	

Point	West Gutter	East Gutter
SD-4		
Basin C-13	9	-
Flowby AP-C6	5	-
Flowby AP-23	12	-
Flowby AP-21	-	12
Basin G-10	-	7
	26 cfs	19 cfs
Pipe Surcharge	52 cfs	
Total Q_{100} Street Flow	26 + 19 + 52 = 97 cfs	
Average Street Slope	$\frac{2}{240} = 0.008$	
SD-5		
Pipe Surcharge	18 cfs Estimated	
(Flow over Curb at AP-24, 18 cfs)		

As indicated in the preceding table, the estimated maximum street flow of 108 cfs (Q_{100}) occurs at Analysis Point SD-3 on Brainard Drive flowing south to Austin Bluffs Parkway. The average street slope is 0.008. A 40' wide street at this slope would have a depth of flow of 0.8' above the flowline at the Q_{100} flow and capacity of 184 cfs with 1' (maximum for collector streets) of water depth at the flow line. HGL spreadsheet and street capacity calculations are included in the appendix of this report. The analysis concluded that approximately 18 cfs (Q_{100}) would overtop the Austin Bluffs Parkway curb at AP-24 and flowing into the swale over the existing 66" storm drain to the existing open channel at the 66" storm drain outfall.

As shown in the table, the 5-year frequency generated flow rates are well below the pipe capacity for Analysis Points SD-1 through SD-5.

At AP-13, the connection point for extension of the storm drain to the north and east, is recommended that the hydraulic grade line elevation of 6953.2 be utilized for design. It is further recommended that the existing manhole cover at the intersection of Brainard Drive and Bays Water Drive be bolted down to prevent it from being pushed off if the high HGL condition described above occurs.

HYDROLOGIC CALCULATIONS

Hydraulic calculations were performed in accordance with the City of Colorado Springs/El Paso Drainage Criteria Manual, as revised in November 1991 and October 1994. The Rational Method was used to estimate stormwater runoff rates anticipated from design storms with 5-year and 100-year recurrence intervals. Stormwater routings were done by the Rational Method using weighted "CA" coefficients for the basins identified above and on the enclosed drainage maps. Analysis spreadsheets are included in the appendix of this report. A summary of the stormwater routing flows is tabulated and included in the appendix of this report.

The required capacity of the proposed detention ponds was estimated using Quick TR-55 Version 5.46, Modified Rational Method. Detention Pond calculations are included in the appendix of this report.

HYDRAULIC CALCULATIONS

Pipe sizes and channel sections were estimated with Heastad Methods, Inc. FlowMaster v5.10 software using the Manning's Formula. Data sheets for all hydraulic calculations are included in the appendix of this report.

FLOODPLAIN STATEMENT

No portion of this site is within a designated F.E.M.A. floodplain, as determined from Flood Insurance Rate Maps Community Panel Numbers 08041C0509 F and 08041C0528 F, effective date March 17, 1997.

CONSTRUCTION COST OPINION

Filing No.	Facilities In Pine Creek Basin	Cottonwood Creek Basin
1	NONE	Public Storm Sewer
2	Public Storm Sewer Temporary Pond A	NONE
3	NONE	Public Storm Sewer
4	Public Storm Sewer Temporary Pond B	NONE

CONSTRUCTION COST OPINION

Portion of Sagewood Filing No. 2 in Pine Creek Basin

Public Non-Reimbursable

Item	Description	Quantity	Unit Cost	Cost
1.	10' Long Inlets	2 EACH	$4600/EA	$ 9,200.00
2.	24" R.C.P.	35 L.F.	$35/L.F.	$ 1,225.00
3.	30" R.C.P.	136 L.F.	$40/L.F.	$ 5,440.00
		SUB-TOTAL		**$ 15,865.00**

Private Temporary Detention Pond "A"

Item	Description	Quantity	Unit Cost	Cost
1.	Earthwork	LS	-	$ 4,000.00
2.	12" CMP	200 L.F.	$10/L.F.	$ 2,000.00
3.	36" CMP	150 L.F.	$43/L.F.	$ 6,450.00
4.	36" CMP/Conc./Bend	LS	-	$ 500.00
5.	Rip-Rap	200 C.Y.	$14/C.Y.	$ 2,800.00
6.	Outlet Structure	LS	-	$ 1,500.00
7.	Turf Establishment	1 ACRES	$1200/AC	$ 1,200.00
		SUB-TOTAL		**$ 18,450.00**

CONSTRUCTION COST OPINION

Portion of Sagewood Filing No. 4 in Pine Creek Basin

Public Non-Reimbursable

Item	Description	Quantity	Unit Cost	Cost
1.	10' Long Inlets	2 EACH	$4600/EA	$ 9,200.00
2.	18" R.C.P.	35 L.F.	$25/L.F.	$ 875.00
3.	24" R.C.P.	40 L.F.	$35/L.F.	$ 1,400.00
4.	R.C. 45° Bends	2 EACH	$1200/EA	$ 2,400.00
		SUB-TOTAL		**$ 13,875.00**

Private Temporary Detention Pond "B"

Item	Description	Quantity	Unit Cost	Cost
1.	Earthwork	LS	-	$ 7,000.00
2.	24" CMP	310 L.F.	$20/L.F.	$ 6,200.00
3.	Rip-Rap	472 C.Y.	$14/C.Y.	$ 6,600.00
4.	Outlet Structure	LS	-	$ 1,500.00
5.	Turf Establishment	2 ACRES	$1200/AC	$ 2,400.00
		SUB-TOTAL		**$ 23,700.00**

Portion of Sagewood Filing No. 1 in Cottonwood Creek Basin

Public Non-Reimbursable

Item	Description	Quantity	Unit Cost	Cost
1.	10' Long Inlets	2 EACH	$4600/EA	$ 9,200.00
2.	12' Long Inlets	2 EACH	$5200/EA	$ 10,400.00
3.	24' Long Inlets	2 EACH	$10000/EA	$ 20,000.00
4.	18" R.C.P.	44 L.F.	$25/L.F.	$ 1,100.00
5.	24" R.C.P.	175 L.F.	$35/L.F.	$ 6,125.00
6.	36" R.C.P.	20 L.F.	$50/L.F.	$ 1,000.00
7.	R.C. 45° Bend	1 EACH	$1200/EA	$ 1,200.00
8.	R.C. Wye	1 EACH	$1500/EA	$ 1,500.00
		SUB-TOTAL		**$ 50,525.00**

Portion of Sagewood Filing No. 3 in Cottonwood Creek Basin
Public Non-Reimbursable

Item	Description	Quantity	Unit Cost	Cost
1.	16' Long Inlets	2 EACH	$6400/EA	$ 12,800.00
2.	18" R.C.P.	230 L.F.	$25/L.F.	$ 5,750.00
3.	24" R.C.P.	230 L.F.	$35/L.F.	$ 8,050.00
4.	R.C. Wye	1 EACH	$1500/EA	$ 1,500.00
		SUB-TOTAL		**$ 28,100.00**

TOTAL CONSTRUCTION COST ESTIMATE **$150,515.00**

JR Engineering, Ltd. cannot and does not guarantee that the construction cost will not vary form these opinions of probable construction costs. These opinions represent our best judgement as design professionals familiar with the construction industry and this development in particular.

EROSION CONTROL PLAN

The City of Colorado Springs Drainage Criteria Manual specifies that an Erosion Control Plan and associated cost estimate be submitted in conjunction with the Final Drainage Report. We respectfully request the Erosion Control Plan and cost opinion be submitted in conjunction with the Overlot Grading Plan and construction assurances posted prior to obtaining a grading permit.

DRAINAGE, BRIDGE AND POND FEES

Pine Creek Basin

For the portion of Sagewood in the Pine Creek Basin, 20.38 acres, the Pine Creek Drainage Basin is a non-fee basin. The developer is responsible for the installation of all drainage facilities.

Cottonwood Creek Basin

The portions of Sagewood Filing Nos. 1 through 4 in Cottonwood Creek Basin (39.66 acres) are subject to the following drainage, bridge, and pond fees.

Item	Filing No. 1	Filing No. 2	Filing No. 3	Filing No. 4
(1) Total Area (Ac)	16.44	22.57	11.24	9.79
(2) Area in Cottonwood Creek Basin (Ac)	16.44	11.20	11.24	0.78
(3) Drainage Fees: 5455 x (2)	$89,680.20	$61,096.00	$61,314.20	$4,254.90
(4) Drainage Fees (Interim): (6137 – 5455) x (2)	$11,212.08	$7,638.40	$7,665.68	$531.96
(5) Bridge Fees: (274) x (2)	$4,504.56	$3,068.80	$3,079.76	$213.72
(6) Bridge Fees (Interim): (543 – 274) x (2)	$4,422.36	$3,012.80	$3,023.56	$209.82
(7) Detention Pond Fees: (105 + 331) x (2)	$7,167.84	$4,883.20	$4,900.64	$340.08

Fees shall be posted prior to plat recordation. We recommend that the developer pay bridge fees in the amount of: $4,504.56 (Filing No. 1), $3,068.80 (Filing No. 2), $3,079.76 (Filing No. 3), $213.72 (Filing No. 4). Post a Letter of Credit for the interim bridge fees in the amount of: $4,442.36 (Filing No. 1), $3,012.80 (Filing No. 2), $3,023.56 (Filing No. 3), $209.82 (Filing No. 4). Post a Letter of Credit for the interim drainage fees in the amount of: $11,212.08 (Filing No. 1), $7,638.40 (Filing No. 2), $7,665.68 (Filing No. 3), $531.96 (Filing No. 4).

The developer, LP47, LLC dba La Plata Investments, has drainage credits with the City of Colorado Springs which will offset the tabulated drainage fees, as well as the tabulated detention pond fees stated above.

SUMMARY AND RECOMMENDATIONS

Drainage improvements outlined in this report demonstrate that Sagewood Filing Nos. 1 through 4 can be developed without adversely affecting the surrounding developments and infrastructure providing 100 storm frequency runoff discharge flow rates in offsite basins E-7, E-8A, and E-9 are limited to the rates stated in this report.

Prepared By:

John R. Bessette, P.E. Project Engineer Land Development For and On Behalf of JR Engineering, Ltd.	Vance S. Fossinger, P.E. Project Engineer Land Development For and On Behalf of JR Engineering, Ltd.

/cw/887822/MDDP.doc

REFERENCES

1. Current City/County Drainage Criteria Manual.

2. "Drainage Report and Plan, Gatehouse Village at Briargate Filing No. 10," prepared by Obering, Wurth & Associates, January 1987

3. "Pine Creek Drainage Basin Planning Study," prepared by Obering, Wurth & Associates, January 1987.

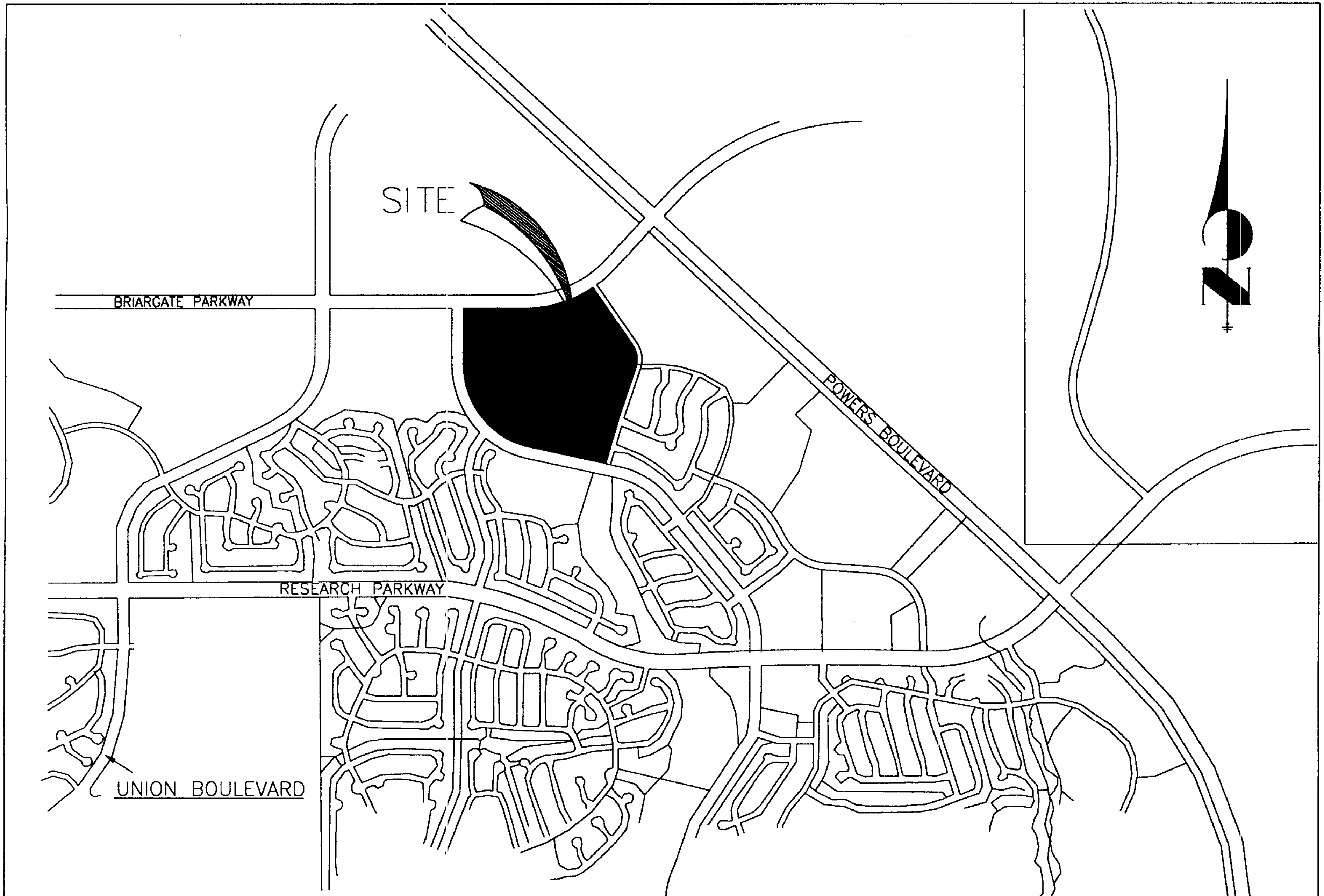
4. "Amendment No. 1 to Pine Creek Drainage Basin Planning Study," prepared by Obering, Wurth & Associates, July 1992.

5. "Cottonwood Creek Drainage Basin Planning Study," prepared by URS Consultants, June 1994.

GENERAL

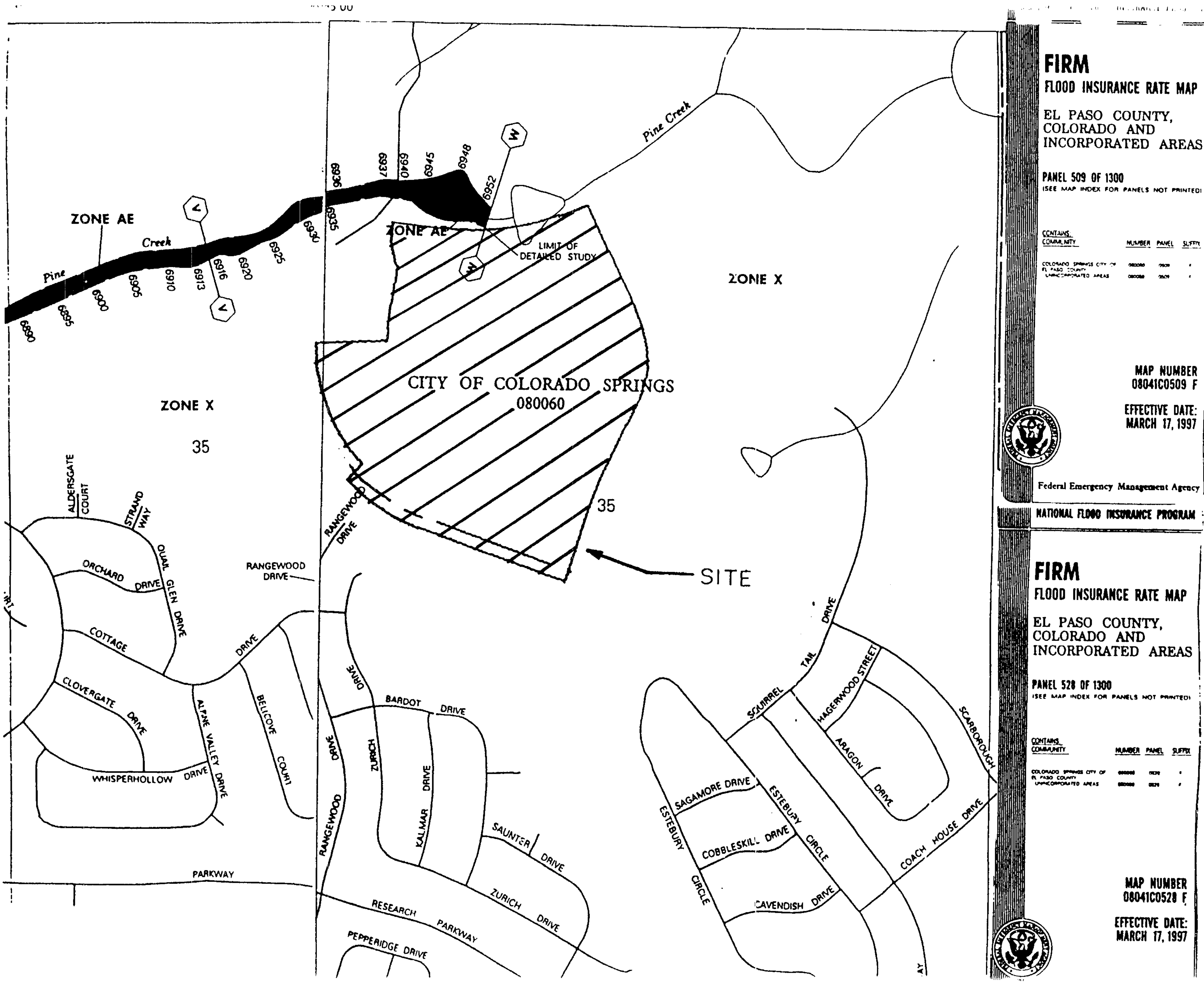
APPENDIX

VICINITY MAP


SITE
BRIARGATE PARKWAY
POWERS BOULEVARD
RESEARCH PARKWAY
UNION BOULEVARD
N

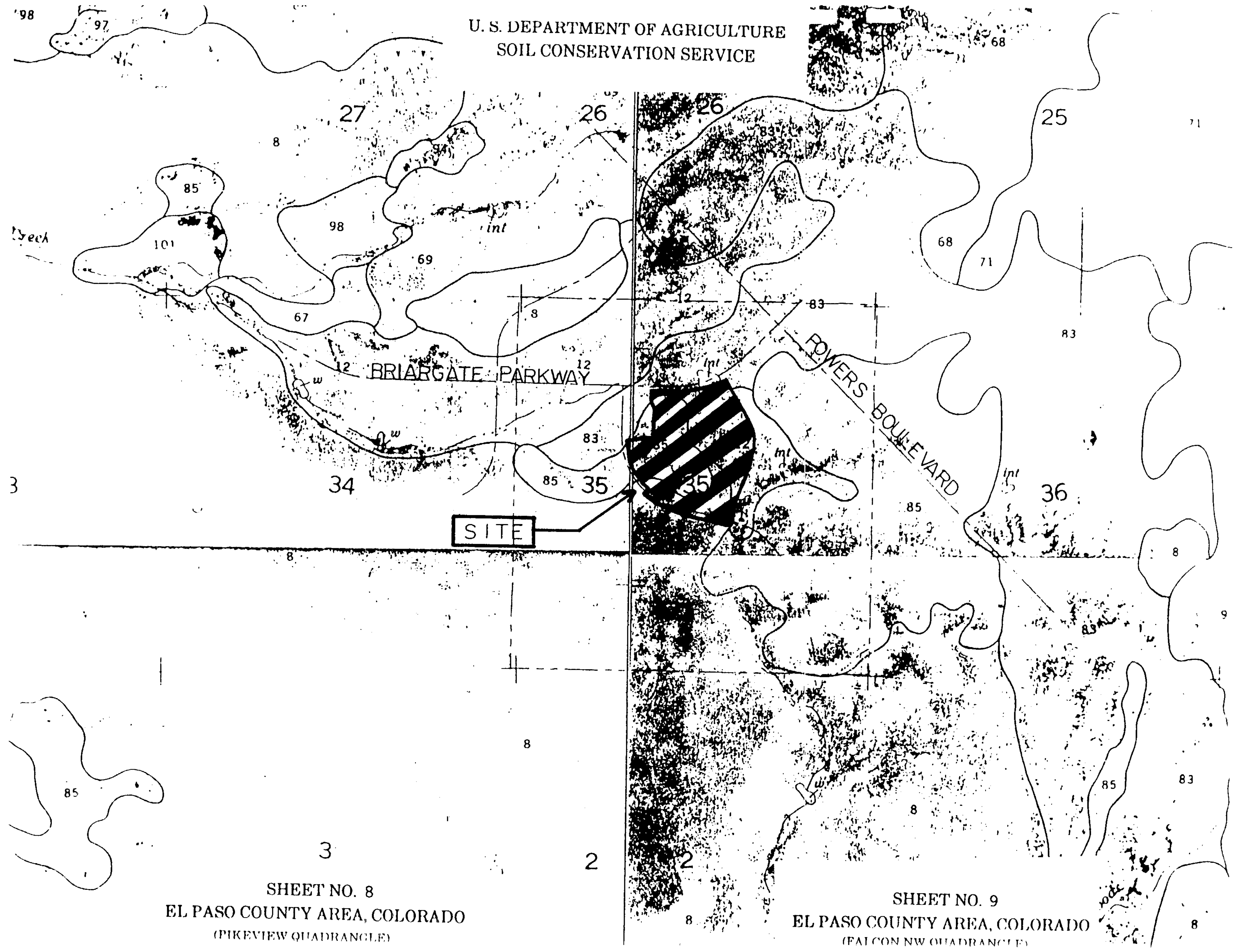
F.E.M.A.

FLOODPLAIN MAP


FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 509 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
MAP NUMBER 08041C0509 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 528 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
MAP NUMBER 08041C0528 F
EFFECTIVE DATE: MARCH 17, 1997
ZONE AE
Pine Creek
ZONE AE
LIMIT OF DETAILED STUDY
ZONE X
ZONE X
CITY OF COLORADO SPRINGS
080060
35
35
SITE
6890
6895
6900
6905
6910
6913
6916
6920
6925
6930
6935
6936
6937
6940
6945
6948
6952
ALDERSGATE COURT
STRAND WAY
QUAIL GLEN DRIVE
ORCHARD DRIVE
COTTAGE DRIVE
CLOVERGATE DRIVE
WHISPERHOLLOW DRIVE
ALPINE VALLEY DRIVE
BELLCOVE COURT
RANGEWOOD DRIVE
PARKWAY
ZURICH DRIVE
BARDOT DRIVE
KALMAR DRIVE
SAUNTER DRIVE
RESEARCH PARKWAY
PEPPERIDGE DRIVE
SQUIRREL TAIL DRIVE
HAGERWOOD STREET
ARAGON DRIVE
SCARBOROUGH
SAGAMORE DRIVE
ESTEBURY CIRCLE
COBBLESKILL DRIVE
CAVENDISH DRIVE
COACH HOUSE DRIVE

S.C.S.

SOIL MAP


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
BRIARGATE PARKWAY
POWERS BOULEVARD
SITE
27
26
26
25
34
35
35
36
3
2
2
SHEET NO. 8
EL PASO COUNTY AREA, COLORADO
(PIKEVIEW QUADRANGLE)
SHEET NO. 9
EL PASO COUNTY AREA, COLORADO
(FALCON NW QUADRANGLE)

APPENDIX

AREA OF PARCEL IN PINE CREEK BASIN

HYDROLOGIC CALCULATIONS
AREA OF PARCEL IN PINE CREEK BASIN

DEVELOPED CONDITION

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN
(Pine Creek Basin Drainage Summary, Developed Condition)

BASIN	AREA TOTAL (Ac)	WEIGHTED C(5) For Calcs See Runoff Summary	WEIGHTED C(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	STREET / CHANNEL Tc (min)	STREET / CHANNEL Length (ft)	STREET / CHANNEL Slope (%)	STREET / CHANNEL Velocity (fps)	STREET / CHANNEL Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	TOTAL FLOWS Q(100) (c.f.s.)
P-1 POND "A"	4.47	0.58	0.68	0.25	50	2.00	7.11	300 530	1.00% 4.00%	3.50 7.00	1.43 1.26	9.80	4.09	7.13 CA(equiv.)	11 2.59	22 3.04
P-2 POND "A"	1.73	0.64	0.71	0.25	50	2.00	7.11	300 530	1.00% 4.00%	3.50 7.00	1.43 1.26	9.80	4.09	7.13 CA(equiv.)	5 1.11	9 1.23
P-3 POND "B"	4.90	0.58	0.68	0.25	180	3.00	18.02	300 200 400	2.00% 1.00% 4.50%	4.95 3.50 7.42	1.01 0.95 0.90	20.88	2.99	4.97 CA(equiv.)	8 2.84	17 3.33
P-4 POND "B"	4.44	0.59	0.69	0.25	50	2.00	7.11	300 200 400	2.00% 1.00% 4.50%	4.95 3.50 7.42	1.01 0.95 0.90	9.97	4.07	7.08 CA(equiv.)	11 2.62	22 3.06
P-5 POND "B"	2.23	0.61	0.68	0.25	80	2.00	10.51	700	1.50%	4.29	2.72	13.23	3.65	6.25 CA(equiv.)	5 1.36	9 1.52
P-6 TERRAVALE	1.03	0.69	0.76	0.25	10	0.20	4.00	700	1.50%	4.29	2.72	6.72	4.62	8.23 CA(equiv.)	3 0.71	6 0.78
P-7 BRIARGATE BOUL.	0.73	0.36	0.43	0.25	200	8.00	14.23					14.23	3.55	6.04 CA(equiv.)	1 0.26	2 0.31
P-8 POND "A"	0.71	0.39	0.46	0.25	120	12.00	8.14					8.14	4.36	7.68 CA(equiv.)	1 0.28	3 0.33
P-9 BRIARGATE BOUL.	2.05	0.34	0.41	0.25	170	22.00	8.90					8.90	4.23	7.42 CA(equiv.)	3 0.70	6 0.84
OP-10 POND "A"	0.70	0.27	0.38	0.25	170	14.00	10.34					10.34	4.02	6.98 CA(equiv.)	1 0.19	2 0.27
OP-11 POND "B"	1.53	0.27	0.38	0.25 0.25	200 100	16.00 26.00	11.32 5.42					16.74	3.31	5.58 CA(equiv.)	1 0.41	3 0.58
TOTAL	24.52															

SGPCD 4/8/98

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN

COMPOSITE "CA" CALCULATION

PINE CREEK BASIN, DEVELOPED CONDITION

ANALYSIS POINT	SUB-BASIN I.D.	SUB-BASIN AREA (ac)	SUB-BASIN CA(5)	SUB-BASIN CA(100)	COMPOSITE CA(5)	COMPOSITE CA(100)
AP-PA1	P-1	4.47	2.59	3.04		
	TOTAL	4.47			2.59	3.04
AP-PA2	P-2	1.73	0.64	0.71		
	TOTAL	1.73			0.64	0.71
AP-PA3	P-1	4.47	2.59	3.04		
(POND "A")	P-2	1.73	1.11	1.23		
	OP-10	0.7	0.19	0.27		
	P-8	0.71	0.28	0.33		
	TOTAL	7.61			4.17	4.87
AP-PB4	P-4	4.44	2.62	3.06		
	TOTAL	4.44			2.62	3.06
AP-PB5	P-3	4.9	2.84	3.33		
	TOTAL	4.9			2.84	3.33
AP-PB6	P-5	2.23	1.36	1.52		
	F.B. AP-PB4		1.11	1.58		
	F.B. AP-PB5		0.96	1.62		
	TOTAL	2.23			3.43	4.72
AP-PB7	OP-11	1.53	0.41	0.58		
POND "B"	AP-PB6		3.43	4.72		
	INLT AP-PB4		1.59	1.53		
	INLT AP-PB5		1.72	1.80		
	TOTAL	1.53			7.15	8.63
AP-P8	P-6	1.03	0.71	0.78		
	TOTAL	1.03			0.71	0.78
AP-P9	P-9	2.05	0.70	0.84		
	TOTAL	2.05			0.70	0.84
AP-P10	P-7	0.73	0.26	0.31		
	TOTAL	0.73			0.26	0.31

Comcd 4/9/98

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN
(PINE CREEK BASIN DEVELOPED CONDITION ROUTING)

ANALYSIS POINT	AREA TOTAL (Ac)	WEIGHTED		OVERLAND/POND OUTFLOW				STREET / CHANNEL/PIPE				Tc TOTAL (min)	INTENSITY		TOTAL FLOWS	
		CA(5) * For Calcs See Runoff Summary	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)		I(5) (in/hr)	I(100) (in/hr)	Q(5) (c.f.s.)	Q(100) (c.f.s.)
AP-PA1 P-1	4.47	2.59	3.04	0.25	50	2.00	7.11	300 530	1.00% 4.00%	3.50 7.00	1.43 1.26	9.80	4.09	7.13	**11**	**22**
AP-PA2 P-2	1.73	1.11	1.23	0.25	50	2.00	7.11	300 530	1.00% 4.00%	3.50 7.00	1.43 1.26	9.80	4.09	7.13	**5**	**9**
AP-PA3 P-1+P-2+ P-8+OP-10 (POND "A")	7.61	4.17	4.87	0.25	50	2.00	7.11	300 530 120 200	1.00% 4.00% 2.00% 4.00%	3.50 7.00 4.95 7.00	1.43 1.26 0.40 0.48	10.68	3.97	6.88	**17**	**34**
AP-PB4 P-4	4.44	2.62	3.06	0.25	50	2.00	7.11	300 200 400	2.00% 1.00% 4.50%	4.95 3.50 7.42	1.01 0.95 0.90	9.97	4.07	7.08	**11**	**22**
AP-PB5 P-3	4.90	2.84	3.33	0.25	180	3.00	18.02	300 200 400	2.00% 1.00% 4.50%	4.95 3.50 7.42	1.01 0.95 0.90	20.88	2.99	4.97	**8**	**17**
AP-PB6 P-5 + F.B.AP-PB4 + F.B. AP-PB5		3.43	4.72	0.25	180	3.00	18.02	300 200 400	2.00% 1.00% 4.50%	4.95 3.50 7.42	1.01 0.95 0.90	20.88	2.99	4.97	**10**	**23**
AP-PB7 OP-11 + AP-PB6 + INLT AP-PB4+ INLT AP-PB5		7.15	8.63	0.25	180	3.00	18.02	300 200 400 100	2.00% 1.00% 4.50% 4.00%	4.95 3.50 7.42 7.00	1.01 0.95 0.90 0.24	21.12	2.97	4.94	**21**	**43**
AP-P8 P-6 Terravale	1.03	0.71	0.78	0.25	10	0.20	4.00	700	1.50%	4.29	2.72	6.72	4.62	8.23	**3**	**6**
AP-P9 P9 overland	2.05	0.70	0.84	0.25	170	22.00	8.90					8.90	4.23	7.42	**3**	**6**
AP-P10 P7 overland	0.73	0.26	0.31	0.25	150	2.00	17.70					17.70	3.23	5.42	**1**	**2**

RTGPCD 4/8/98

HYDROLOGIC CALCULATIONS

AREA OF PARCEL IN PINE CREEK BASIN

HISTORIC CONDITION

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN
(Pine Creek Basin Drainage Summary, Historic Condition)

BASIN	AREA TOTAL	WEIGHTED		OVERLAND				STREET / CHANNEL				Tc TOTAL	INTENSITY		TOTAL FLOWS	
		C(5)	C(100)	C(5)	Length	Height	Tc	Length	Slope	Velocity	Tc		I(5)	I(100)	Q(5)	Q(100)
	(Ac)	For Calcs See Runoff Summary			(ft)	(ft)	(min)	(ft)	(%)	(fps)	(min)	(min)	(in/hr)	(in/hr)	(c.f.s.)	(c.f.s.)
P-1	4.47	0.16	0.21	0.16	320	22.00	16.64					16.64	3.32	5.60	**2**	**5**
														CA(equiv.)	**0.72**	**0.94**
P-2	1.73	0.16	0.21	0.16	200	18.00	12.04					12.04	3.79	6.53	**1**	**2**
														CA(equiv.)	**0.28**	**0.36**
P-3	4.90	0.18	0.23	0.18	320	24.00	15.83	420	5.70%	8.36	0.84	16.67	3.31	5.59	**3**	**6**
														CA(equiv.)	**0.88**	**1.13**
P-4	4.44	0.18	0.23	0.18	300	14.00	17.92	360	5.00%	7.83	0.77	18.69	3.15	5.27	**3**	**5**
														CA(equiv.)	**0.80**	**1.02**
P-5	2.23	0.18	0.23	0.18	300	16.00	17.15	400	2.00%	4.95	1.35	18.50	3.16	5.30	**1**	**3**
														CA(equiv.)	**0.40**	**0.51**
P-6	1.03	0.18	0.23	0.18	300	14.00	17.92	400	3.30%	6.36	1.05	18.97	3.12	5.23	**1**	**1**
														CA(equiv.)	**0.19**	**0.24**
P-7	0.73	0.15	0.20	0.15	200	8.00	15.90					15.90	3.38	5.73	**0**	**1**
														CA(equiv.)	**0.11**	**0.15**
P-8	0.71	0.17	0.22	0.17	120	12.00	8.91					8.91	4.23	7.41	**1**	**1**
														CA(equiv.)	**0.12**	**0.16**
P-9	2.05	0.18	0.23	0.18	170	22.00	9.64					9.64	4.12	7.18	**2**	**3**
														CA(equiv.)	**0.37**	**0.47**
OP-10	0.70	0.15	0.20	0.15	170	14.00	11.55					11.55	3.85	6.65	**0**	**1**
														CA(equiv.)	**0.11**	**0.14**
OP-11	1.53	0.17	0.22	0.17	300	24.00	15.17					15.17	3.45	5.86	**1**	**2**
														CA(equiv.)	**0.26**	**0.34**
TOTAL	24.52															

SGPCH 4/9/98

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN

COMPOSITE "CA" CALCULATION

PINE CREEK BASIN, HISTORIC CONDITION

ANALYSIS POINT	SUB-BASIN I.D.	SUB-BASIN AREA (ac)	SUB-BASIN CA(5)	SUB-BASIN CA(100)	COMPOSITE CA(5)	COMPOSITE CA(100)
AP-PA1	P-1	4.47	0.72	0.94		
	TOTAL	4.47			0.72	0.94
AP-PA2	P-2	1.73	0.28	0.36		
	TOTAL	1.73			0.28	0.36
AP-PA3	P-1	4.47	0.72	0.94		
	P-2	1.73	0.28	0.36		
	OP-10	0.7	0.11	0.14		
	P-8	0.71	0.12	0.16		
	TOTAL	7.61			1.23	1.60
AP-PB4	P-4	4.44	0.80	1.02		
	TOTAL	4.44			0.80	1.02
AP-PB5	P-3	4.9	0.88	1.13		
	TOTAL	4.9			0.88	1.13
AP-PB6	P-5	2.23	0.40	0.51		
	P-4	4.44	0.80	1.02		
	P-3	4.9	0.88	1.13		
	TOTAL	11.57			2.08	2.66
AP-PB7	OP-11	1.53	0.26	0.34		
	AP-PB6	11.57	2.08	2.66		
	TOTAL	13.1			2.34	3.00
AP-P8	P-6	1.03	0.19	0.24		
	TOTAL	1.03			0.19	0.24
AP-P9	P-9	2.05	0.37	0.47		
	TOTAL	2.05			0.37	0.47
AP-P10	P-7	0.73	0.11	0.15		
	TOTAL	0.73			0.11	0.15

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN
(PINE CREEK BASIN HISTORIC CONDITION ROUTING)

ANALYSIS POINT	AREA TOTAL (Ac)	WEIGHTED CA(5) * For Calcs See Runoff Summary	CA(100)	OVERLAND/POND OUTFLOW C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL/PIPE Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	Q(100) (c.f.s.)
AP-PA1 P-1	4.47	0.72	0.94	0.16	320	22.00	16.64					16.64	3.32	5.60	**2**	**5**
AP-PA2 P-2	1.73	0.28	0.36	0.16	200	18.00	12.04					12.04	3.79	6.53	**1**	**2**
AP-PA3	7.61	1.23	1.60	0.16	320	22.00	16.64	340	7.00%	9.26	0.61	17.26	3.26	5.50	**4**	**9**
AP-PB4 P-4	4.44	0.80	1.02	0.18	300	14.00	17.92	360	5.00%	7.83	0.77	18.69	3.15	5.27	**3**	**5**
AP-PB5 P-3	4.90	0.88	1.13	0.18	320	24.00	15.83	420	5.70%	8.36	0.84	16.67	3.31	5.59	**3**	**6**
AP-PB6 P-5 + P-4 + P-3	11.57	2.08	2.66	0.18	320	24.00	15.83	420	5.70%	8.36	0.84	16.67	3.31	5.59	**7**	**15**
AP-PB7 OP-11 + AP-PB6 +	13.10	2.34	3.00	0.18	320	24.00	15.83	420	5.70%	8.36	0.84	16.67	3.31	5.59	**8**	**17**
AP-P8 P-6	1.03	0.19	0.24	0.18	300	14.00	17.92	400	3.30%	6.36	1.05	18.97	3.12	5.23	**1**	**1**
AP-P9 P9	2.05	0.37	0.47	0.18	170	22.00	9.64					9.64	4.12	7.18	**2**	**3**
AP-P10 P7	0.73	0.15	0.20	0.15	200	8.00	15.90					15.90	3.38	5.73	**1**	**1**

INLET CALCULATIONS

AREA OF PARCEL IN PINE CREEK BASIN

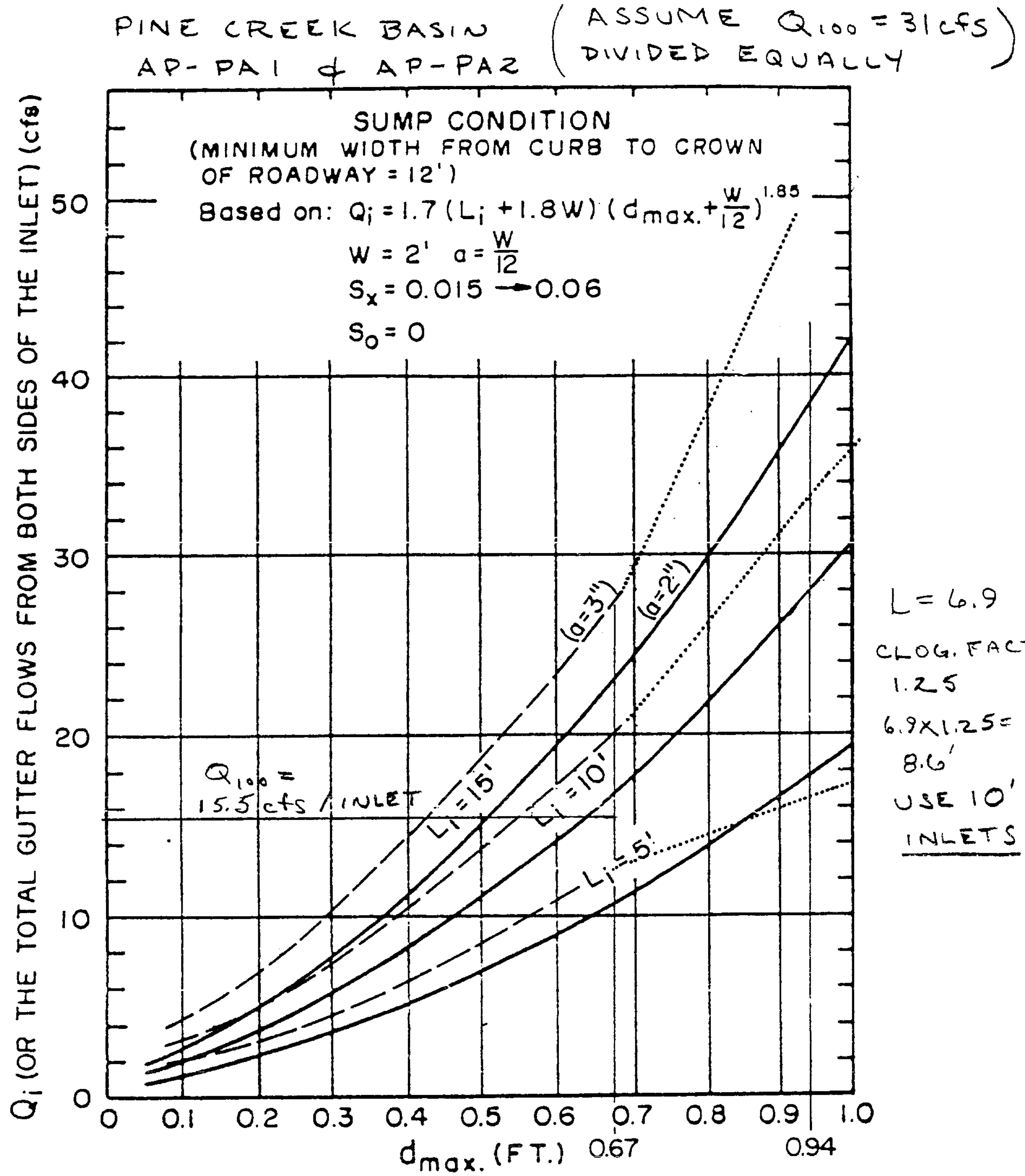
SELECTION OF SUMP INLETS
PINE CREEK BASIN
AP-PA1 AND AP-PA2

Assume: Q_{100} at AP-PA1 will over top crown, flowing to AP-PA2

Analysis Point		Q_5		Q_{100}
AP-PA1		11 cfs		22 cfs
AP-PA2		5 cfs		9 cfs
		16 cfs		31 cfs
Average:	$\frac{16}{2}$	= 8 cfs	$\frac{31}{2}$	= 15.5 cfs

Design Inlets for average Q_{100} of 15.5 cfs / each inlet

From Figure 7-11 attached
Use 1 – 10' Inlet at AP-PA1
1 – 10' Inlet at AP-PA2



REFERENCE : Izzard, Carl. f., Report presented at the Annual Meeting of the National Transportation Board, January 1977; Simplified Method For Design of Curb-opening Inlets

——— (As Modified by El Paso County, per Type R Inlet)

Note: Depth of ponding measured at curb above depressed area ; a = 3", For $d \leq .67$

$Q_i = (1.7 L_i + 6.12)(d_{max} + .25)^{1.85}$; $Q_i = 3.60 L_i (d - .08)^{.5}$ For $d \geq .94$; Note : No Clogging Factor

9/30/90

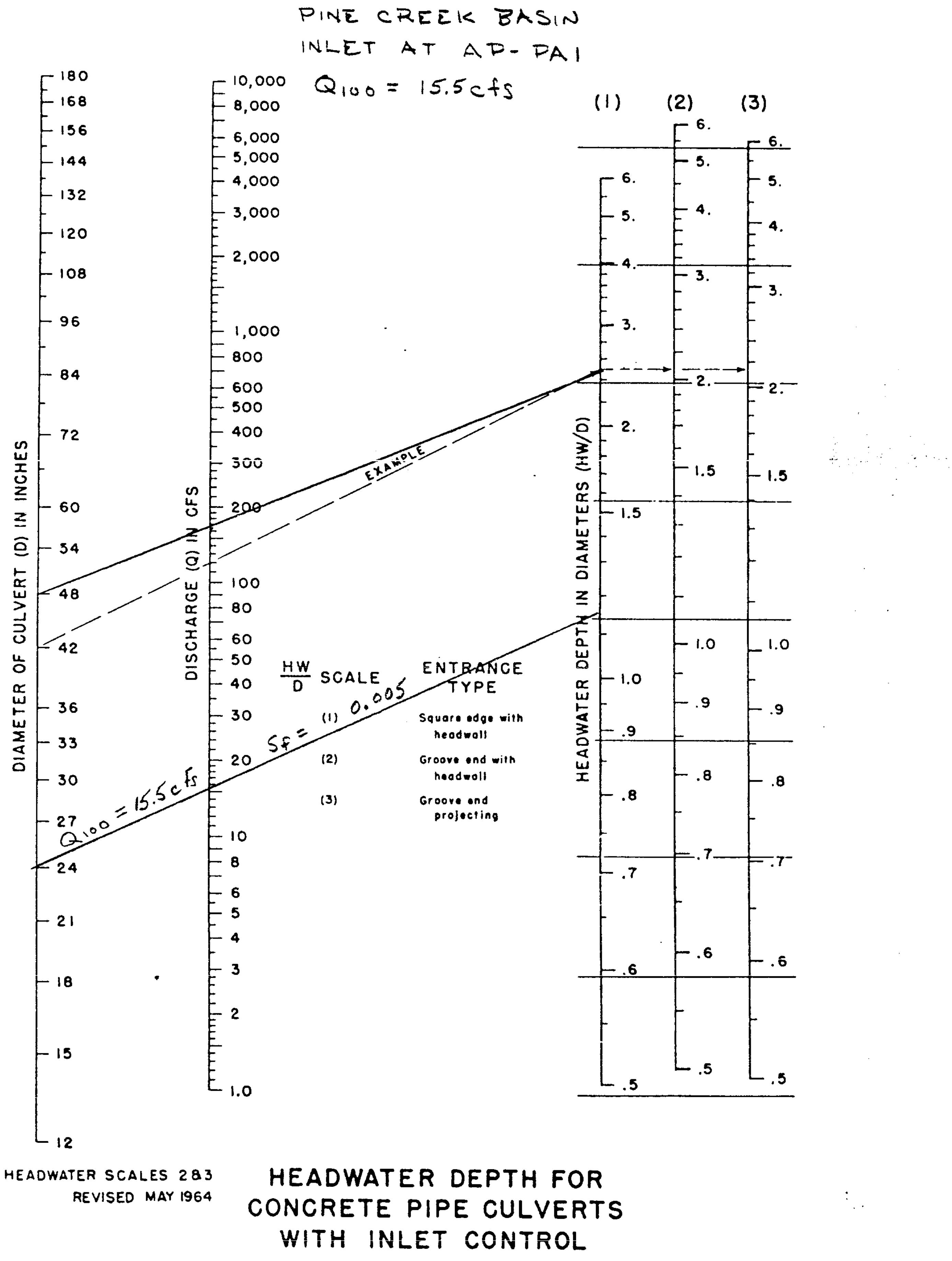
HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Sump Capacity for Curb-opening Inlets

Date: OCT. 1987

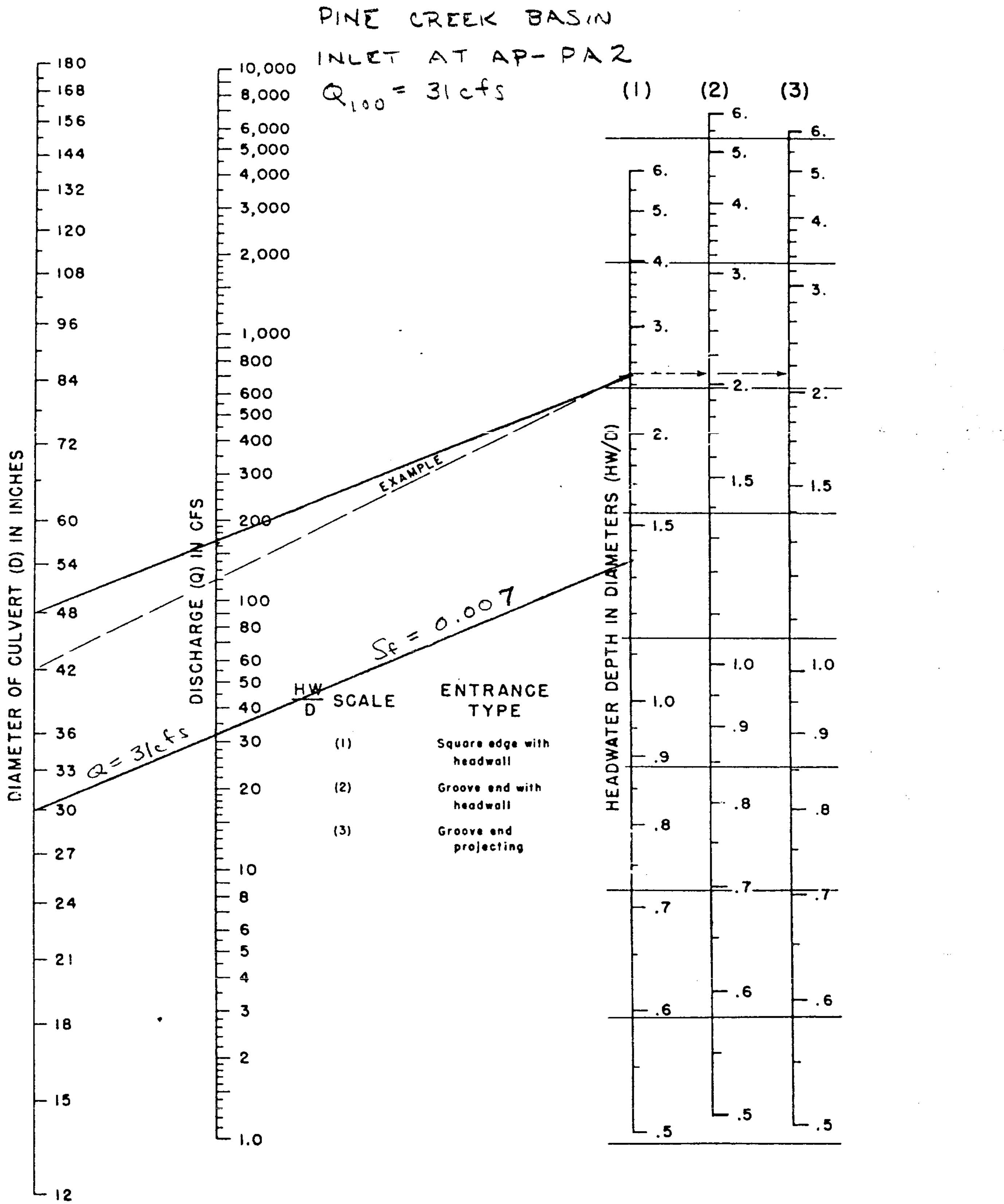
Figure: 7-11



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Fig. 4. **Inlet-control nomograph.**

BUREAU OF PUBLIC ROADS JAN. 1963



HEADWATER DEPTH FOR
CONCRETE PIPE CULVERTS
WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Fig. 4. **Inlet-control nomograph.**

SAGEWOOD
INLET CALCULATIONS PINE CREEK BASIN

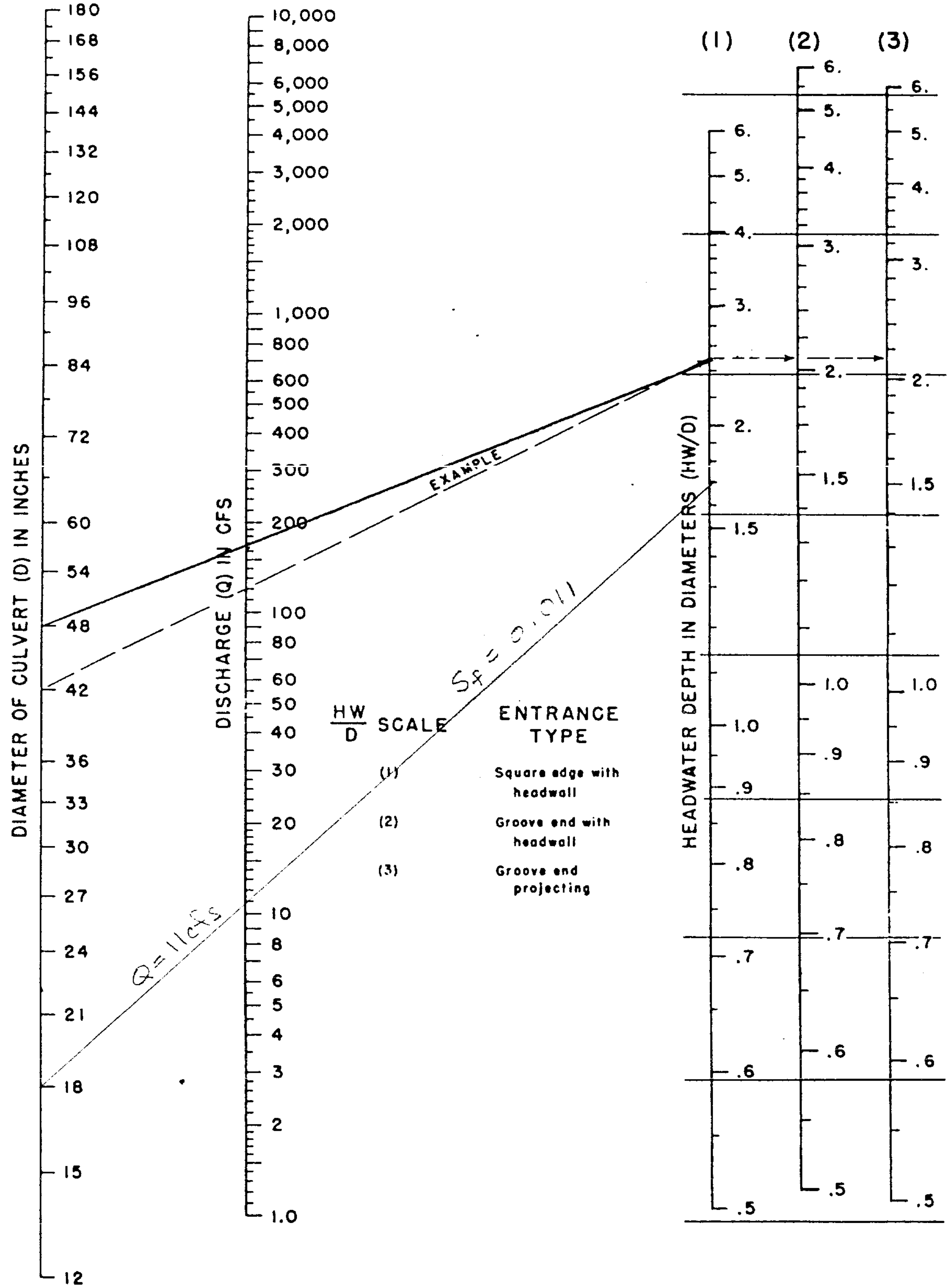
AP-PB4
100-YR. FLOW

Q(100)	22	I(100)	7.1	Inlet size ? L(i) =	10
DEPTH	0.35	Fr	2.71	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	13.2	L(1)	27.6		
				If Li > L(2) then Qi =	11
CROSS SLOPE	2.0%	L(2)	16.6	CA(eqv.)=	1.53
STREET SLOPE	4.5%	L(3)	59.2	FB =	11
				CA(eqv.)=	1.58

5-YR. FLOW

Q(5)	11	I(10)	4.1	Inlet size ? L(i) =	10
DEPTH	0.27	Fr	2.51	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	9.1	L(1)	17.6		
				If Li > L(2) then Qi =	6
CROSS SLOPE	2.0%	L(2)	10.5	CA(eqv.)=	1.59
STREET SLOPE	4.5%	L(3)	37.8	FB =	5
				CA(eqv.)=	1.11

PINE CREEK BASIN
INLET AT AP-PB4
Q_{100} = 11 cfs



HEADWATER SCALES 2&3
REVISED MAY 1964

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Fig. 4. **Inlet-control nomograph.**

SAGEWOOD
INLET CALCULATIONS PINE CREEK BASIN
AP-PB5
100-YR. FLOW

Q(100)	17	I(100)	5.0	Inlet size ? L(i) =	10
DEPTH	0.31	Fr	2.63	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	11.5	L(1)	23.2		
				If Li > L(2) then Qi =	9
CROSS SLOPE	2.0%	L(2)	13.9	CA(eqv.)=	1.8
STREET SLOPE	4.5%	L(3)	50.0	FB =	8
				CA(eqv.)=	1.62

5-YR. FLOW

Q(5)	8	17	3.0	Inlet size ? L(i) =	10
DEPTH	0.24	Fr	2.41	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	7.6	L(1)	14.1		
				If Li > L(2) then Qi =	5
CROSS SLOPE	2.0%	L(2)	8.4	CA(eqv.)=	1.72
STREET SLOPE	4.5%	L(3)	30.3	FB =	3
				CA(eqv.)=	0.96

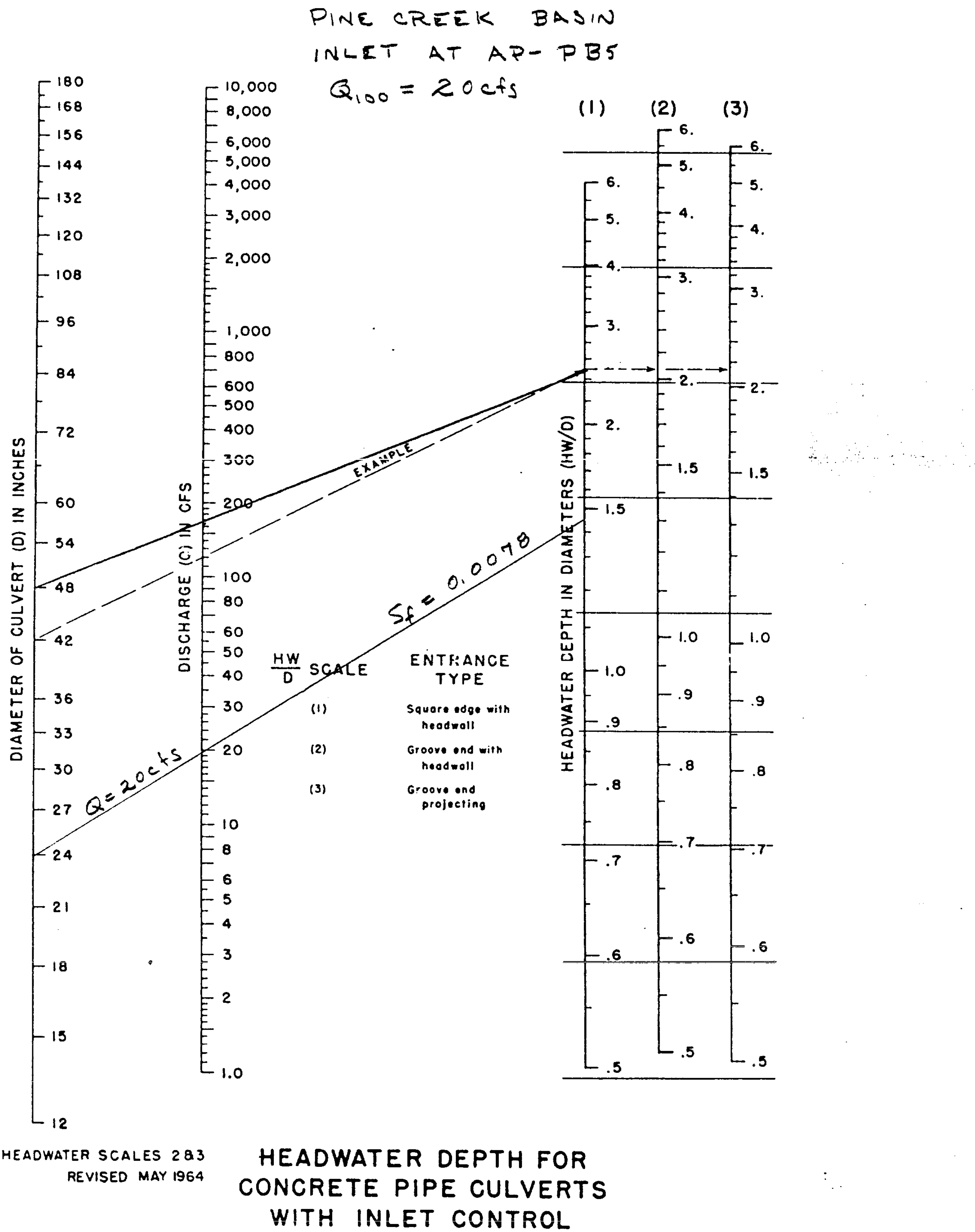


Fig. 4. **Inlet-control nomograph.**

BUREAU OF PUBLIC ROADS JAN. 1963

HYDRAULIC CALCULATIONS
AREA OF PARCEL IN PINE CREEK BASIN

24" RCP, AP-PA1 TO AP-PA2
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, PINE CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	24.00	in
Discharge	15.50	cfs

Results		
Channel Slope	0.004695	ft/ft
Depth	24.0	in
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.42	ft
Percent Full	100.00	
Critical Slope	0.006463	ft/ft
Velocity	4.93	ft/s
Velocity Head	0.38	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	16.67	cfs
Full Flow Capacity	15.50	cfs
Full Flow Slope	0.004695	ft/ft

30" RCP, OUTLET FROM AP-PB2
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, PINE CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	30.00	in
Discharge	31.00	cfs

Results		
Channel Slope	0.005713	ft/ft
Depth	30.0	in
Flow Area	4.91	ft^2
Wetted Perimeter	7.85	ft
Top Width	0.00	ft
Critical Depth	1.90	ft
Percent Full	100.00	
Critical Slope	0.006685	ft/ft
Velocity	6.32	ft/s
Velocity Head	0.62	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	33.35	cfs
Full Flow Capacity	31.00	cfs
Full Flow Slope	0.005713	ft/ft

36" CMP, TEMP TO POND A
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, PINE CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.024	
Diameter	36.00	in
Discharge	31.00	cfs

Results		
Channel Slope	0.007363	ft/ft
Depth	36.0	in
Flow Area	7.07	ft^2
Wetted Perimeter	9.42	ft
Top Width	0.00	ft
Critical Depth	1.81	ft
Percent Full	100.00	
Critical Slope	0.016171	ft/ft
Velocity	4.39	ft/s
Velocity Head	0.30	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	33.35	cfs
Full Flow Capacity	31.00	cfs
Full Flow Slope	0.007363	ft/ft

12" CMP, POND A OUTLET
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, PINE CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.024	
Diameter	12.00	in
Discharge	5.00	cfs

Results		
Channel Slope	0.067133	ft/ft
Depth	12.0	in
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Top Width	0.00	ft
Critical Depth	0.92	ft
Percent Full	100.00	
Critical Slope	0.058374	ft/ft
Velocity	6.37	ft/s
Velocity Head	0.63	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	5.38	cfs
Full Flow Capacity	5.00	cfs
Full Flow Slope	0.067133	ft/ft

18" RCP, AP-PB4 TO AP-PB5
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, PINE CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	18.00	in
Discharge	11.00	cfs

Results		
Channel Slope	0.010967	ft/ft
Depth	18.0	in
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.27	ft
Percent Full	100.00	
Critical Slope	0.010388	ft/ft
Velocity	6.22	ft/s
Velocity Head	0.60	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	11.83	cfs
Full Flow Capacity	11.00	cfs
Full Flow Slope	0.010967	ft/ft

24" RCP, OUTLET AP-PB5
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, PINE CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	24.00	in
Discharge	20.00	cfs

Results		
Channel Slope	0.007817	ft/ft
Depth	24.0	in
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.61	ft
Percent Full	100.00	
Critical Slope	0.008120	ft/ft
Velocity	6.37	ft/s
Velocity Head	0.63	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	21.51	cfs
Full Flow Capacity	20.00	cfs
Full Flow Slope	0.007817	ft/ft

24" CMP, OUTLET AP-PB5, TEMP TO POND B
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, PINE CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.024	
Diameter	24.00	in
Discharge	20.00	cfs

Results		
Channel Slope	0.026642	ft/ft
Depth	24.0	in
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.61	ft
Percent Full	100.00	
Critical Slope	0.027675	ft/ft
Velocity	6.37	ft/s
Velocity Head	0.63	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	21.51	cfs
Full Flow Capacity	20.00	cfs
Full Flow Slope	0.026642	ft/ft

24" CMP, OUTLET POND B
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, PINE CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.024	
Diameter	24.00	in
Discharge	17.00	cfs

Results		
Channel Slope	0.019249	ft/ft
Depth	24.0	in
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.49	ft
Percent Full	100.00	
Critical Slope	0.023648	ft/ft
Velocity	5.41	ft/s
Velocity Head	0.46	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	18.29	cfs
Full Flow Capacity	17.00	cfs
Full Flow Slope	0.019249	ft/ft

DETENTION POND CALCULATIONS
AREA OF PARCEL IN PINE CREEK BASIN

SAGEWOOD

PINE CREEK

TEMPORARY DETENTION POND "A"

Size pond to maintain Q_{100} total discharge from the following basins at historic levels

Analysis Point	Basin(s)	Historic Condition Q_5	Historic Condition Q_{100}	Developed Condition Q_5	Developed Condition Q_{100}	Discharge
AP-AP3	P-1, P-2, P-8, SP-10	4 cfs	9cfs	17 cfs	34 cfs	To Pond A
AP-P10	P7	1 cfs	1 cfs	1cfs	2 cfs	Direct Overland
AP-P9	P9	2 cfs	3 cfs	3 cfs	6 cfs	Direct Overland
	TOTAL	**7 cfs**	**13 cfs**	**21 cfs**	**42 cfs**	

Allowable Q_{100} Out = Q_{100} Historic – Q_{100} Direct Discharges

= 13 cfs – 2 cfs – 6 cfs = 5 cfs

Q_{100} in = 34 cfs

Quick TR-55 Ver.5.46 S/N:
Executed: 10:17:12 04-13-1998

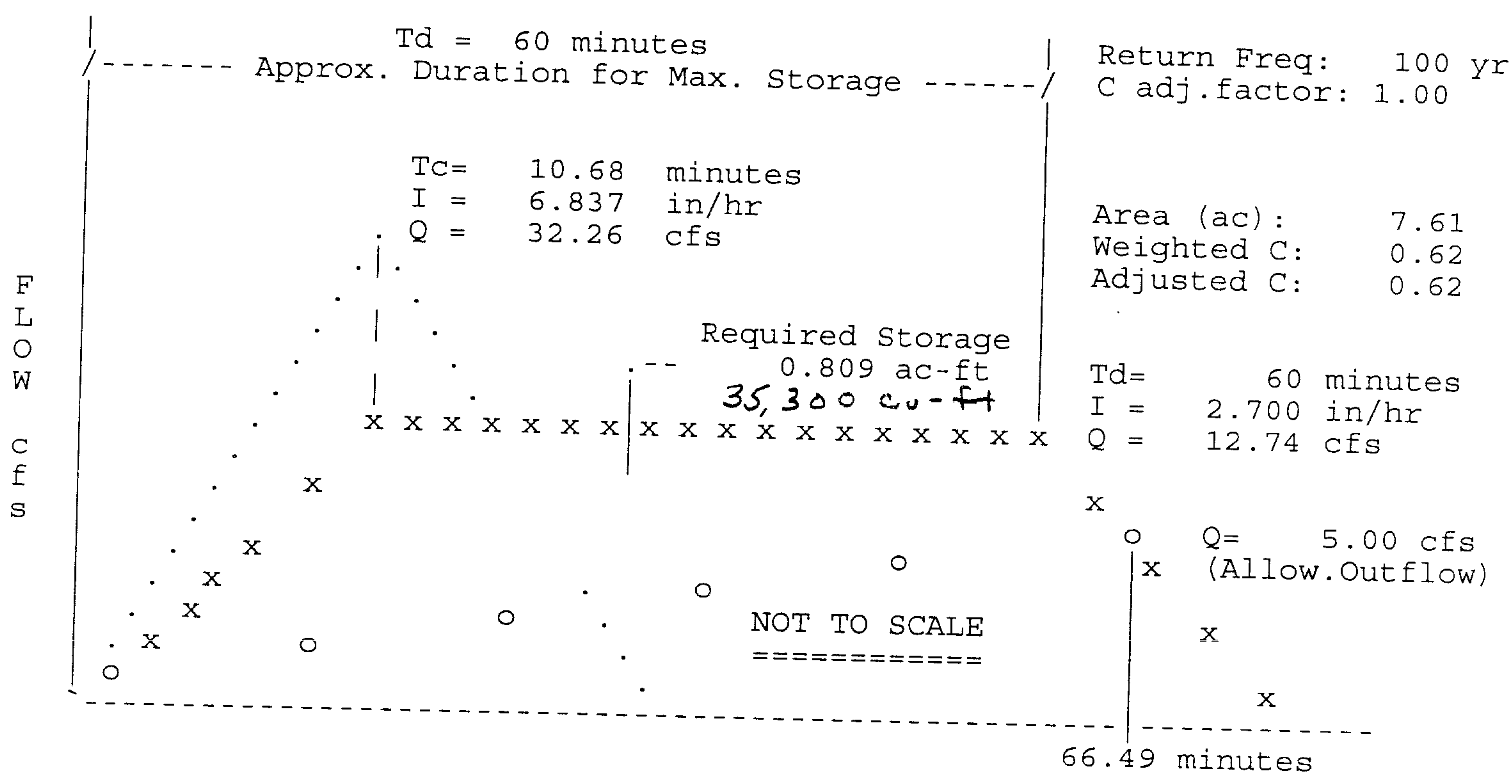
MODIFIED RATIONAL METHOD

---- Graphical Summary for Maximum Required Storage ----

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

Sagewood, Pine Creek Basin Pond A

```
*********************************************************************
*  RETURN FREQUENCY: 100 yr    | Allowable Outflow:    5.00 cfs    *
*  'C' Adjustment: 1.000       | Required Storage:     0.809 ac-ft *
*-------------------------------------------------------------------*
*  Peak Inflow:   12.74 cfs      Inflow .HYD stored: NONE STORED   *
*********************************************************************
```



PINE CREEK BASIN
TEMPORARY POND "A"
OUTLET, Q_{100} OUT = 5 cfs
HW = 6'

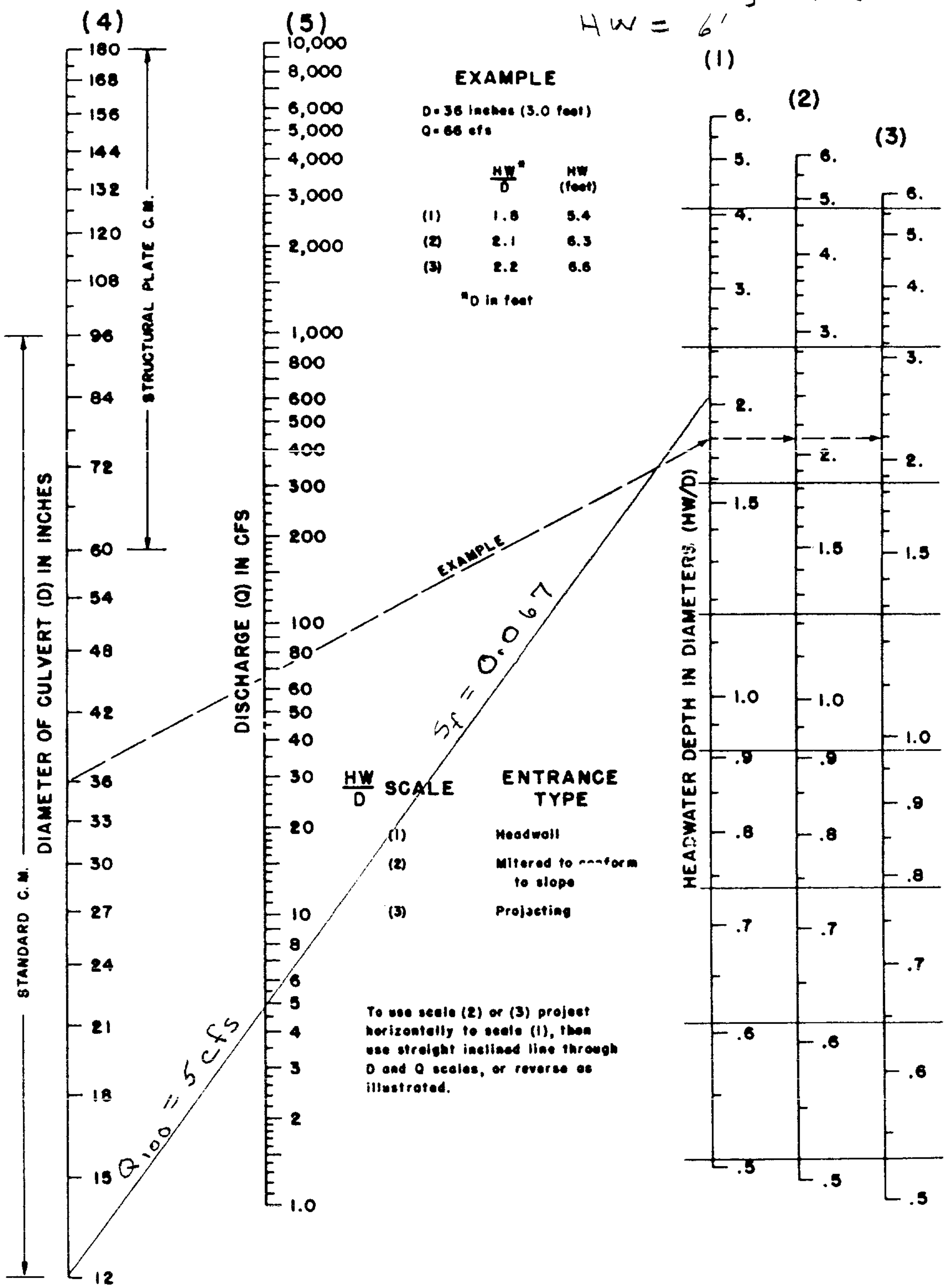


Exhibit 3-10 Headwater depth for CM pipe culverts with inlet control (Ref. Hyd. Eng. Cir. No. 5, USBPR, 1965)

SAGEWOOD

PINE CREEK

TEMPORARY DETENTION POND "B"

Size pond to maintain Q_{100} total discharge from the following basins at historic levels

Analysis Point	**Basin(s)**	**Historic Condition**		**Developed Condition**		**Discharge**
		Q_5	Q_{100}	Q_5	Q_{100}	
AP-PB7	P-3, P-4, P-5, OP-11	8 cfs	17 cfs	21 cfs	43 cfs	Pond "B"

Allowable Q_{100} Out = 17 cfs

Developed Q_{100} in = 43 cfs

Quick TR-55 Ver.5.46   S/N:
Executed: 15:16:25   04-02-1998

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

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

PINE CREEK BASIN POND B

```
**********************************************************************
*  RETURN FREQUENCY: 100 yr     |  Allowable Outflow:    17.00 cfs   *
*  'C' Adjustment: 1.000        |  Required Storage:     0.980 ac-ft *
*--------------------------------------------------------------------*
*  Peak Inflow:   23.34 cfs        Inflow .HYD stored: NONE STORED   *
**********************************************************************

     |              Td =  60 minutes                     |  Return Freq:   100 yr
     /------- Approx. Duration for Max. Storage ------/   C adj.factor: 1.00
     |                                                    |
     |                                                    |
     |               Tc=    21.12  minutes                |
     |               I =    5.010  in/hr                  |  Area (ac):     13.10
     |             . Q =    43.32  cfs                    |  Weighted C:     0.66
     |            .|.                                     |  Adjusted C:     0.66
F    |           .   .                                    |
L    |          .  |  .            Required Storage       |
O    |         .       .        .--      0.980 ac-ft      |  Td=       60 minutes
W    |        .    |    .      |    (42,700 cuft)         |  I =    2.700 in/hr
     |       .     x x x x x x x|x x x x x x x x x x x      Q =    23.34 cfs
c    |      .                   |
f    |     .    x                                            x
s    |    .                                                    o    Q=   17.00 cfs
     |   .   x                                 o               |x  (Allow.Outflow)
     |  .  x                    .       o                      |
     | .  x               o      .        NOT TO SCALE         |   x
     |. x       o                 .       ============         |
     |o                            .                           |      x
     `---------------------------------------------------------|------------
                                                          65.74 minutes
```

PINE CREEK BASIN
TEMPORARY POND "B"
OUTLET Q100 OUT = 17cfs
HW = 3' MAX

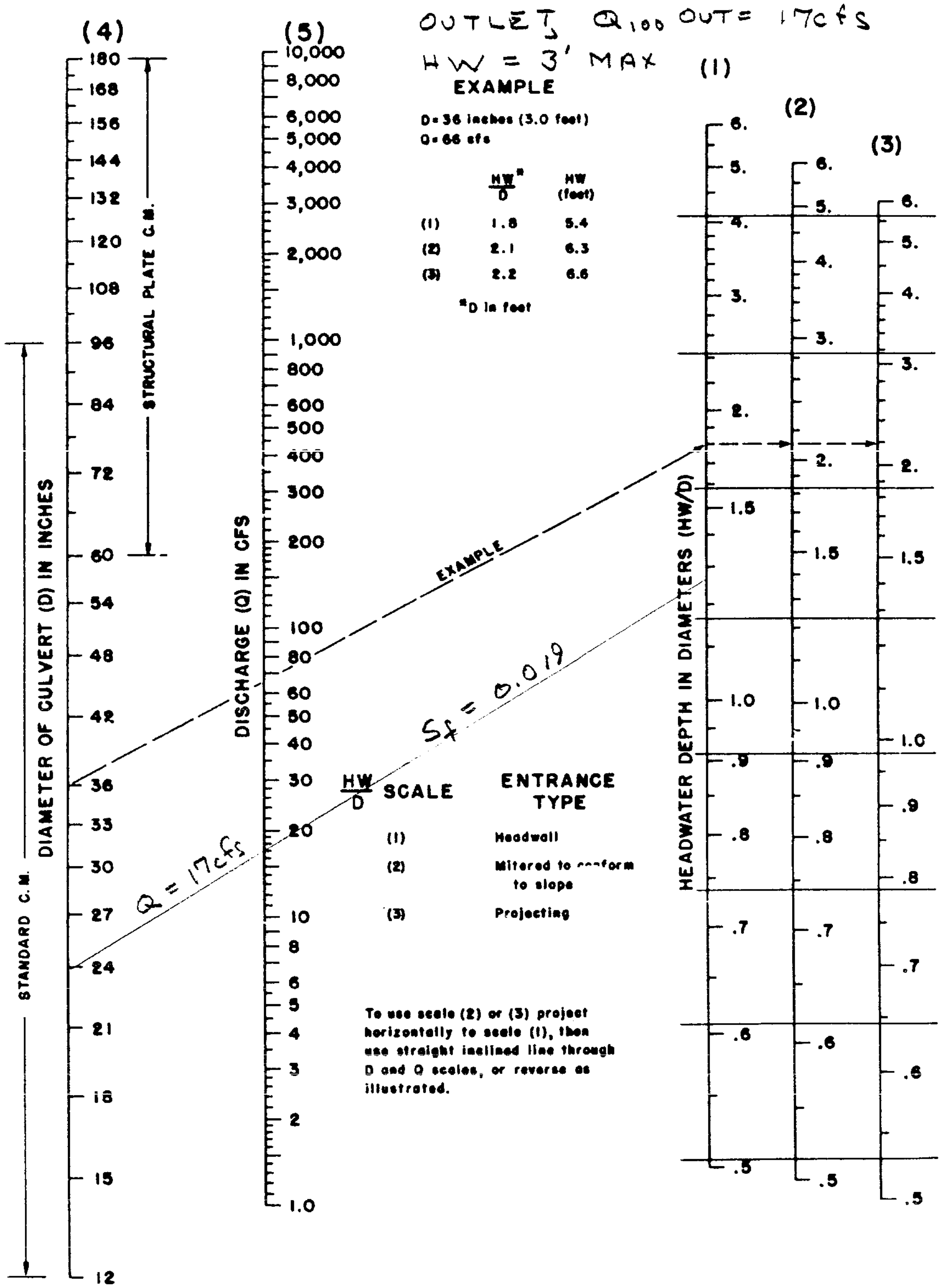


Exhibit 3-10 Headwater depth for CM pipe culverts with inlet control (Ref. Hyd. Eng. Cir. No. 5, USBPR, 1965)

APPENDIX
AREA OF PARCEL IN
COTTONWOOD CREEK BASIN

HYDROLOGIC CALCULATIONS
AREA OF PARCEL IN COTTONWOOD CREEK BASIN
DEVELOPED CONDITIONS

SAGEWOOD

MASTER DEVELOPMENT DRAINAGE PLAN

(Cottonwood Creek Basin Drainage Summary, Developed Condition)

BASIN	AREA TOTAL (Ac)	WEIGHTED C(5)	WEIGHTED C(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL Length (ft)	STREET / CHANNEL Slope (%)	STREET / CHANNEL Velocity (fps)	STREET / CHANNEL Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	TOTAL FLOWS Q(100)
		For C's See Runoff Summary														
C-1 AP-C1	1.69	0.60	0.70	0.25	50	1.00	8.94	200 250	4.00% 1.20%	7.00 3.83	0.48 1.09	10.50	3.99	6.93	4	8
														CA(equiv.)	1.01	1.18
C-2	2.39	0.53	0.60	0.25	50	1.00	8.94	900	1.80%	4.70	3.19	12.14	3.78	6.51	5	9
														CA(equiv.)	1.27	1.43
C-3 AP-C1	2.65	0.60	0.70	0.25	50	1.00	8.94	600	2.00%	4.95	2.02	10.96	3.93	6.80	6	13
														CA(equiv.)	1.59	1.86
C-4 AP-C1	2.47	0.58	0.68	0.25	150	2.00	17.70	300 400	3.30% 1.50%	6.36 4.29	0.79 1.56	20.05	3.04	5.08	4	9
														CA(equiv.)	1.43	1.68
C-5 AP-C2	1.17	0.64	0.71	0.25	50	1.00	8.94	300 400	3.30% 1.50%	6.36 4.29	0.79 1.56	11.28	3.89	6.72	3	6
														CA(equiv.)	0.75	0.83
C-6 AP-C3	3.31	0.58	0.68	0.25	150	1.50	19.47	500	1.20%	3.83	2.17	21.64	2.93	4.88	6	11
														CA(equiv.)	1.92	2.25
C-7 AP-C3	5.92	0.57	0.67	0.25	140	2.00	16.72	300 280 100	4.60% 2.10% 1.40%	7.51 5.07 4.14	0.67 0.92 0.40	18.71	3.14	5.27	11	21
														CA(equiv.)	3.37	3.97
C-8 AP-C3	2.65	0.58	0.68	0.25	70 90	4.00 1.00	7.48 18.85	230 620	1.67% 4.20%	4.52 7.17	0.85 1.44	28.62	2.54	4.16	4	8
														CA(equiv.)	1.54	1.80
C-9 AP-C4	2.05	0.62	0.69	0.25	50	1.00	8.94	210 620	1.67% 4.20%	4.52 7.17	0.77 1.44	11.16	3.91	6.75	5	10
														CA(equiv.)	1.27	1.41
C-10 AP-C5	1.35	0.64	0.71	0.25	50	1.00	8.94	380 300	4.20% 1.50%	7.17 4.29	0.88 1.17	10.99	3.93	6.80	3	7
														CA(equiv.)	0.86	0.96
C-11 AP-C5	6.10	0.58	0.66	0.25	170	2.00	19.64	300 400 350	1.30% 2.00% 3.40%	3.99 4.95 6.45	1.25 1.35 0.90	23.15	2.84	4.70	10	19
														CA(equiv.)	3.54	4.03
C-12 AP-C6	3.44	0.61	0.68	0.25	70	2.00	9.40	780 270	1.30% 3.20%	3.99 6.26	3.26 0.72	13.38	3.64	6.22	8	15
														CA(equiv.)	2.10	2.34
C-13	2.21	0.54	0.61	0.25	50	1.00	8.94	400	1.00%	3.50	1.90	10.85	3.95	6.84	5	9
														CA(equiv.)	1.19	1.35
C-14	1.67	0.57	0.64	0.25	70	2.00	9.40	550	1.80%	4.70	1.95	11.36	3.88	6.70	4	7
														CA(equiv.)	0.95	1.07
TOTAL	39.07															

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN
(Area Drainage Summary)

(COTTONWOOD CREEK BASIN, OFF-SITE DEVELOPED)

BASIN	AREA TOTAL (Ac)	VEIGHTED C(5)	C(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	NTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	Q(100) (c.f.s.)
		alcs See Runoff Summary														
E-7	15.30	0.77	0.83	0.25	100	1.00	15.90	800 800	7.00% 1.25%	9.26 3.91	1.44	17.33	3.26	5.48	**38**	**70**
														CA(equiv.)	**11.78**	**12.70**
E-7A	1.15	0.77	0.83	0.25	100	1.00	15.90	800 800	7.00% 1.25%	9.26 3.91	1.44	17.33	3.26	5.48	**3**	**5**
														CA(equiv.)	**0.89**	**0.95**
E-8A	6.10	0.77	0.83	0.25	100	1.00	15.90	1100	7.00%	9.26	1.98	17.87	3.21	5.40	**15**	**27**
														CA(equiv.)	**4.70**	**5.06**
E-8B	12.70	0.71	0.77	0.25	100	1.00	15.90	1000	2.00%	4.95	3.37	19.26	3.10	5.19	**28**	**51**
														CA(equiv.)	**9.02**	**9.78**
E-8C	2.80	0.41	0.50	0.25	180	1.00	25.89	300	4.00%	7.00	0.71	26.60	2.64	4.34	**3**	**6**
														CA(equiv.)	**1.15**	**1.40**
E-8D	6.30	0.41	0.50	0.25	180	1.00	25.89	400	4.00%	7.00	0.95	26.84	2.63	4.32	**7**	**14**
														CA(equiv.)	**2.58**	**3.15**
E-8E	2.30	0.70	0.76	0.25	100	2.00	12.65	350 550 450	3.00% 1.00% 2.70%	6.06 3.50 5.75	0.96 2.62 1.30	17.53	3.24	5.45	**5**	**10**
														CA(equiv.)	**1.61**	**1.75**
E-9	37.23	0.77	0.83	0.25	100	2.00	12.65	2250	2.50%	5.53	6.78	19.42	3.09	5.17	**89**	**160**
														CA(equiv.)	**28.67**	**30.90**
E-10	1.97	0.69	0.76	0.25	15	0.30	4.90	750 650	1.30% 2.30%	3.99 5.31	3.13 2.04	10.07	4.05	7.05	**6**	**11**
														CA(equiv.)	**1.36**	**1.50**

GATEHOUSE 10
(RATIONAL METHOD Q=CIA)

BASIN	AREA TOTAL (Ac)	WEIGHTED C(5)	WEIGHTED C(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height	OVERLAND Tc (min)	STREET Length (ft)	STREET Slope (%)	STREET Velocity (fps)	STREET Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	TOTAL FLOWS Q(100) (c.f.s.)
G-1	3.28	0.50	0.60	0.25	125	2.50	14.1	745	1.5%	4.3	2.9	17.0	3.3	5.5 CA(equiv.)	5 1.64	11 1.97
G-2	2.11	0.50	0.60	0.25	125	2.50	14.1	905	1.6%	4.5	3.4	17.5	3.2	5.5 CA(equiv.)	3 1.06	7 1.27
G-3	4.31	0.50	0.60	0.25	125	2.50	14.1	915	2.8%	5.9	2.6	16.7	3.3	5.6 CA(equiv.)	7 2.16	14 2.59
G-4	1.36	0.50	0.60	0.25	50	1.00	8.9	845	2.3%	5.3	2.7	11.6	3.8	6.6 CA(equiv.)	3 0.68	5 0.82
G-5	3.57	0.50	0.60	0.25	125	2.50	14.1	1000 600	1.9% 0.7%	4.9 2.9	3.4 3.4	17.6 21.0	3.2	5.4 CA(equiv.)	6 1.79	12 2.14
G-6	3.83	0.50	0.60	0.25	125	2.50	14.1	600	2.3%	5.3	1.9	16.0	3.4	5.7 CA(equiv.)	6 1.92	13 2.30
G-7	5.87	0.50	0.60	0.25	125	2.50	14.1	1475 1070	1.2% 2.6%	3.8 5.6	6.4 3.2	20.5 23.7	3.0	5.0 CA(equiv.)	9 2.94	18 3.52
G-8	1.78	0.50	0.60	0.25	125	2.50	14.1	555	2.8%	5.8	1.6	15.7	3.4	5.8 CA(equiv.)	3 0.89	6 1.07
G-9	6.59	0.50	0.60	0.25	125	2.50	14.1	1070	2.6%	5.7	3.1	17.3	3.3	5.5 CA(equiv.)	11 3.30	22 3.95
G-10	2.73	0.50	0.60	0.25	125	2.50	14.1	700	2.9%	6.0	1.9	16.1	3.4	5.7 CA(equiv.)	5 1.37	9 1.64
G-11	0.88	0.90	0.95	0.25	10	0.20	4.0	550	2.5%	5.5	1.7	5.7	4.8	8.7 CA(equiv.)	4 0.79	7 0.84

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN

COMPOSITE "CA" CALCULATION

COTTONWOOD CREEK BASIN, DEVELOPED CONDITION

ANALYSIS POINT	SUB-BASIN I.D.	SUB-BASIN AREA (ac)	SUB-BASIN CA(5)	SUB-BASIN CA(100)	COMPOSITE CA(5)	COMPOSITE CA(100)
AP-C1	C-1	1.69	1.01	1.18		
	C-3	2.65	1.59	1.86		
	C-4	2.47	1.43	1.68		
	TOTAL	6.81			4.03	4.72
AP-C2	C-5	1.17	0.75	0.83		
	TOTAL	1.17			0.75	0.83
AP-C3	C-6	3.31	1.92	2.25		
	C-7	5.97	3.37	3.97		
	C-8	2.65	1.54	1.80		
	TOTAL	11.93			6.83	8.02
AP-C4	C-9	2.05	1.27	1.41		
	TOTAL	2.05			1.27	1.41
AP-C5	C-10	1.35	0.86	0.96		
	C-11	6.1	3.54	4.03		
	TOTAL	7.45			4.40	4.99
AP-C6	C-12	3.97	2.42	2.70		
	TOTAL	3.97			2.42	2.70
AP-C7	AP-C5	7.45	4.4	4.99		
	INLT AP-C6		1.75	1.85		
	TOTAL	7.45			6.15	6.84

Comcwd 4/7/98

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN

COMPOSITE "CA" CALCULATION

COTTONWOOD CREEK BASIN, DEVELOPED CONDITION

ANALYSIS POINT	SUB-BASIN I.D.	SUB-BASIN AREA (ac)	SUB-BASIN CA(5)	SUB-BASIN CA(100)	COMPOSITE CA(5)	COMPOSITE CA(100)
AP-11	E-9	37.23	28.67	23.58		
	E-8C	2.8	1.15	1.40		
	TOTAL	40.03			29.82	24.98
AP-12	AP-11	40.03	29.82	24.98		
	E-8A	6.1	4.7	3.74		
	E-8B	12.7	9.02	9.78		
	TOTAL	58.83			43.54	38.50
AP-13	AP-12	58.83	43.54	38.50		
	E-7	15.3	11.78	9.25		
	TOTAL	74.13			55.32	47.75
AP-14	E-8D	6.3	2.58	3.15		
	E-8E	2.3	1.61	1.75		
	TOTAL	8.60			4.19	4.90
AP-15	AP-14	8.6	4.19	4.90		
	E-7A	1.15	0.89	0.95		
	TOTAL	9.75			5.08	5.85

COMCD2 4/7/98

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN

COMPOSITE "CA" CALCULATION
COTTONWOOD CREEK BASIN, DEVELOPED CONDITION

ANALYSIS POINT	SUB-BASIN I.D.	SUB-BASIN AREA (ac)	SUB-BASIN CA(5)	SUB-BASIN CA(100)	COMPOSITE CA(5)	COMPOSITE CA(100)
AP-16	G-2	2.11	1.06	1.27		
	G-3	4.31	2.16	2.59		
	G-4	1.36	0.68	0.82		
	TOTAL	7.78			3.90	4.68
AP-17	G-5	3.57	1.79	2.14		
	G-6	3.83	1.92	2.30		
	TOTAL	7.4			3.71	4.44
AP-18	G-7	5.87	2.94	3.52		
	G-9(60%)	3.95	1.98	2.37		
	TOTAL	9.82			4.92	5.89
AP-19	G-8	1.78	0.89	1.07		
	G-9(40%)	2.64	1.32	1.58		
	TOTAL	4.42			2.21	2.65
AP-20	F.B. AP-15		0.90	1.69		
	F.B. AP-16		0.82	1.59		
	F.B. AP-17		1.04	1.64		
	G-1	3.28	1.64	1.97		
	TOTAL	3.28			4.40	6.89
AP-21	F.B. AP-18		1.26	1.59		
	F.B. AP-19		0.85	1.75		
	F.B. AP-20		0.98	2.65		
	TOTAL	0			3.09	5.99
AP-22	F.B. AP-C1		0.87	0.74		
	F.B. AP-C2		0.00	0.74		
	C-2	2.39	1.27	1.43		
	C-14	1.67	0.95	1.07		
	TOTAL	4.06			3.09	3.98
AP-23	F.B. AP-C3		0.82	0.78		
	F.B. AP-C4		0.00	0.78		
	F.B. AP-22		1.09	1.80		
	C-13	2.21	1.19	1.35		
	TOTAL	2.21			3.10	4.71
AP-24	F.B. AP-23		1.09	2.36		
	F.B. AP-C6		0.50	0.88		
	F.B. AP-21		0.84	2.75		
	E-10	1.97	1.36	1.50		
	G-10	2.73	1.37	1.64		
	G-11	0.88	0.79	0.84		
	TOTAL	5.58			5.95	9.97
COMCD3	4/8/98					

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN

(COMPOSIT "CA" CALCULATION)

(COTTONWOOD CREEK, BASIN DEVELOPED CONDITION)

ANALYSIS POINT	SUB-BASIN I.D.	SUB-BASIN AREA (ac)	SUB-BASIN CA(5)	SUB-BASIN CA(100)	COMPOSITE CA(5)	COMPOSITE CA(100)
SD-1	INLT AP-C1		3.54	2.41		
	INLT AP-C2		1.36	2.41		
	INLT AP-13		55.32	47.75		
	INLT AP-15		5.08	5.85		
					65.30	58.42
SD-2	INLT AP-C3		4.66	3.30		
	INLT AP-C5		1.18	3.30		
	INLT AP-16		2.93	3.13		
	INLT AP-17		2.83	2.78		
	INLT AP-20		3.69	4.70		
	INLT AP-22		2.03	2.16		
	SD-1		65.30	58.42		
					82.62	77.79
SD-3	SD-2		82.62	77.79		
	INLT AP-18		3.24	2.87		
	INLT AP-19		1.78	2.12		
					87.64	82.78
SD-4	SD-3		87.64	82.78		
	INLT AP-C7		6.15	6.84		
	INLT AP-21		2.12	3.25		
	INLT AP-23		1.75	2.20	97.66	95.07
SD-5	SD-4		97.66	95.07		
	INLT AP-24		5.95	9.97		
					103.61	105.04

COMCD 4/8/98

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN
(COTTONWOOD CREEK BASIN DEVELOPED CONDITION ROUTING)

ANALYSIS POINT	AREA TOTAL (Ac)	WEIGHTED CA(5)	CA(100)	OVERLAND/POND OUTFLOW C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL/PIPE Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	Q(100) (c.f.s.)
		* For Calcs See Runoff Summary														
AP-C1 C-1+C-3+ C-4	6.81	4.03	4.72	0.25	50	1.00	8.94	200 250 600	4.00% 1.20% 2.00%	7.00 3.83 4.95	0.48 1.09 2.02	12.52	3.74	6.41	**15**	**30**
AP-C2 C-5	1.17	0.75	0.83	0.25	50	1.00	8.94	300 400	3.30% 1.50%	6.36 4.29	0.79 1.56	11.28	3.89	6.72	**3**	**6**
AP-C3 C-6 to C-8	11.93	6.83	8.02	0.25	150	1.50	19.47	500 330 280 300 110	1.20% 4.60% 1.40% 1.33% 3.60%	3.83 7.51 4.14 4.04 6.64	2.17 0.73 1.13 1.24 0.28	25.02	2.73	4.50	**19**	**36**
AP-C4 C-9	2.05	1.27	1.41	0.25	50	1.00	8.94	200 620	1.67% 4.20%	4.52 7.17	0.74 1.44	11.12	3.91	6.76	**5**	**10**
AP-C5 C-10 +C-11	7.45	4.40	4.99	0.25	170	2.00	19.64	300 400 350	1.30% 2.00% 3.40%	3.99 4.95 6.45	1.25 1.35 0.90	23.15	2.84	4.70	**12**	**23**
AP-C6 C-12	3.44	2.10	2.34	0.25	70	2.00	9.40	780 270	1.30% 3.20%	3.99 6.26	3.26 0.72	13.38	3.64	6.22	**8**	**15**
AP-C7 AP-C5+ INLT AP-6	7.45	6.15	6.84	0.25	170	2.00	19.64	300 400 350 110	1.30% 2.00% 3.40% 3.00%	3.99 4.95 6.45 6.06	1.25 1.35 0.90 0.30	23.45	2.82	4.67	**17**	**32**

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN
(COTTONWOOD CREEK BASIN DEVELOPED CONDITION ROUTING)

ANALYSIS POINT	AREA TOTAL (Ac)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND/POND OUTFLOW C(5)	OVERLAND/POND OUTFLOW Length (ft)	OVERLAND/POND OUTFLOW Height (ft)	OVERLAND/POND OUTFLOW Tc (min)	STREET / CHANNEL / PIPE Length (ft)	STREET / CHANNEL / PIPE Slope (%)	STREET / CHANNEL / PIPE Velocity (fps)	STREET / CHANNEL / PIPE Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	TOTAL FLOWS Q(100) (c.f.s.)
		* For Calcs See Runoff Summary														
AP-11 E-9 +E-8C	40.03	29.82	24.98	ASSUMED TIME OF PEAK OUTFLOW FROM BASIN E-9 DETENTION PONDS			20.00	100 250	18.00% 3.50%	20.00 19.00	0.08 0.22	20.30	3.03	5.05	**90**	**126**
AP-12 E9 + E-8C + E-8A + E-8B	58.83	43.54	38.50	ASSUMED TIME OF PEAK OUTFLOW FROM BASIN E-9 DETENTION PONDS			20.00	100 500 800 350	18.00% 3.50% 0.50% 5.00%	20.00 19.00 12.00 20.00	0.08 0.44 1.11 0.29	21.92	2.92	4.84	**127**	**186**
AP-13 E-7 + AP-12 HEAD WALL	74.13	55.32	47.75	ASSUMED TIME OF PEAK OUTFLOW FROM BASIN E-9 DETENTION PONDS			20.00	100 500 800	18.00% 3.50% 0.50%	20.00 19.00 12.00	0.08 0.44 1.11	21.92	2.92	4.84	**161**	**231**
AP-14 E-8D + E-8E	8.60	4.19	4.90	0.25	180	1.00	25.89	400 600 650	4.00% 1.33% 2.50%	7.00 4.04 5.53	0.95 2.48 1.96	31.28	2.42	3.95	**10**	**19**
AP-15 E-7A + AP-14	9.75	5.08	5.85	0.25	180	1.00	25.89	400 600 650	4.00% 1.33% 2.50%	7.00 4.04 5.53	0.95 2.48 1.96	31.28	2.42	3.95	**12**	**23**
AP-16 G-2 + G-3 +G-4	7.78	3.90	4.68	0.25	125	2.50	14.14	915 350	2.80% 1.00%	5.86 3.50	2.60 1.67	18.41	3.17	5.32	**12**	**25**
AP-17 G-5 + G-6	7.40	3.70	4.44	0.25	125	2.50	14.14	950 400	2.40% 1.00%	5.42 3.50	2.92 1.90	18.96	3.13	5.23	**12**	**23**
AP-18 G -7 + + 60%G-9	9.82	4.92	5.89	0.25	125	2.50	14.14	600 1000 950	1.50% 0.90% 2.80%	4.29 3.32 5.86	2.33 5.02 2.70	24.19	2.78	4.59	**14**	**27**
AP-19 G-8+ 40%G-9	4.42	2.21	2.65	0.25	125	2.50	14.14	1600	2.90%	5.96	4.47	18.61	3.15	5.29	**7**	**14**

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN

(COTTONWOOD CREEK BASIN DEVELOPED CONDITION ROUTING)

ANALYSIS POINT	AREA TOTAL (Ac)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND/POND OUTFLOW C(5)	OVERLAND/POND OUTFLOW Length (ft)	OVERLAND/POND OUTFLOW Height (ft)	OVERLAND/POND OUTFLOW Tc (min)	STREET / CHANNEL/PIPE Length (ft)	STREET / CHANNEL/PIPE Slope (%)	STREET / CHANNEL/PIPE Velocity (fps)	STREET / CHANNEL/PIPE Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	TOTAL FLOWS Q(100) (c.f.s.)
		* For Calcs See Runoff Summary														
AP-20 FLOW-BY AP-15,16 &17 + G-1		4.40	6.89	0.25	125	2.50	14.14	950 400	2.40% 1.00%	5.42 3.50	2.92 1.90	18.96	3.13	5.23	**14**	**36**
AP-21 FLOW-BY AP-18,19 & 20		3.09	5.99	0.25	125	2.50	14.14	600 1000 950 140	1.50% 0.90% 2.80% 0.90%	4.29 3.32 5.86 3.32	2.33 5.02 2.70 0.70	24.90	2.74	4.51	**8**	**27**
AP-22 FLOW-BY AP-C1, C2 +C-2 + C-14		3.09	3.98	0.25	100	2.00	12.65	1000 600	1.90% 1.54%	4.82 4.34	3.45 2.30	18.40	3.17	5.32	**10**	**21**
AP-23 FLOW-BY AP-22, C3, C4 & C-13		3.10	4.71	0.25	100	2.00	12.65	1000 600 450	1.90% 1.54% 0.90%	4.82 4.34 3.32	3.45 2.30 2.26	20.66	3.00	5.00	**9**	**24**
AP-24 FLOW-BY AP-23, C6, & 21 +E10, + G10 + G11		5.95	9.97	0.25	100	2.00	12.65	1000 600 450 100	1.90% 1.54% 0.90% 2.00%	4.82 4.34 3.32 4.95	3.45 2.30 2.26 0.34	21.00	2.98	4.96	**18**	**49**
SD - 1 INFLOW FROM AP-13, C-1, C-2, &15		65.30	58.42	ASSUMED TIME OF PEAK OUTFLOW FROM BASIN E-9 DETENTION PONDS			20.00	100 500 800 350 100	18.00% 3.50% 0.50% 5.00% 1.50%	20.00 19.00 12.00 12.00 17.00	0.08 0.44 1.11 0.49 0.10	22.22	2.90	4.81	**189**	**281**
SD - 2 SD-1 + INFLOW FROM AP-C-3, C-4, 16, 17, & 20		82.62	77.79	ASSUMED TIME OF PEAK OUTFLOW FROM BASIN E-9 DETENTION PONDS			20.00	100 500 800 350 700	18.00% 3.50% 0.50% 5.00% 1.50%	20.00 19.00 12.00 12.00 17.00	0.08 0.44 1.11 0.49 0.69	22.81	2.86	4.74	**236**	**369**

SAGEWOOD

MASTER DEVELOPMENT DRAINAGE PLAN

(COTTONWOOD CREEK BASIN DEVELOPED CONDITION ROUTING)

ANALYSIS POINT	AREA TOTAL (Ac)	WEIGHTED CA(5)	CA(100)	OVERLAND/POND OUTFLOW C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL/PIPE Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	Q(100) (c.f.s.)
		* For Calcs See Runoff Summary														
SD-3		87.64	82.78	ASSUMED TIME OF PEAK OUTFLOW FROM BASIN E-9 DETENTION PONDS			20.00					23.04	2.85	4.71	**249**	**390**
SD-2 + INFLOW FROM AP-18 & 19								100	18.00%	20.00	0.08					
								500	3.50%	19.00	0.44					
								800	0.50%	12.00	1.11					
								350	5.00%	12.00	0.49					
								700	1.50%	17.00	0.69					
								300	2.00%	21.00	0.24					
SD-4		97.66	95.07	ASSUMED TIME OF PEAK OUTFLOW FROM BASIN E-9 DETENTION PONDS			20.00					23.17	2.84	4.70	**277**	**447**
SD - 3 + INFLOW FROM AP-C7, 21 & 23								100	18.00%	20.00	0.08					
								500	3.50%	19.00	0.44					
								800	0.50%	12.00	1.11					
								350	5.00%	12.00	0.49					
								700	1.50%	17.00	0.69					
								460	2.00%	21.00	0.37					
SD-5		103.61	105.04	ASSUMED TIME OF PEAK OUTFLOW FROM BASIN E-9 DETENTION PONDS			20.00					23.25	2.83	4.69	**293**	**493**
SD - 4 + INFLOW FROM AP-24								100	18.00%	20.00	0.08					
								500	3.50%	19.00	0.44					
								800	0.50%	12.00	1.11					
								350	5.00%	12.00	0.49					
								700	1.50%	17.00	0.69					
								560	2.00%	21.00	0.44					

HYDROLOGIC CALCULATIONS
AREA OF PARCEL IN COTTONWOOD CREEK BASIN
HISTORIC CONDITION
(OFF-SITE BASINS)

SAGEWOOD
MASTER DEVELOPMENT DRAINAGE PLAN
(Area Drainage Summary)

COTTONWOOD CREEK BASIN, HISTORIC CONDITION

BASIN	AREA TOTAL (Ac)	WEIGHTED C(5)	WEIGHTED C(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL Length (ft)	STREET / CHANNEL Slope (%)	STREET / CHANNEL Velocity (fps)	STREET / CHANNEL Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	TOTAL FLOWS Q(100) (c.f.s.)
		* For Calcs See Runoff Summary														
E-7	15.30	0.25	0.30	0.25	300	3.00	27.53	800	6.00%	6.00	2.22	29.75	2.49	4.07	**10**	**19**
														CA(equiv.)	**3.83**	**4.59**
E-8A	6.10	0.25	0.30	0.25	100	2.00	12.65	1000	7.00%	5.00	3.33	15.98	3.38	5.71	**5**	**10**
														CA(equiv.)	**1.53**	**1.83**
E-9	37.23	0.25	0.30	0.25	100	2.00	12.65	1700	7.00%	5.00	5.67	18.31	3.18	5.33	**30**	**60**

Runoffgh 4/8/98

INLET CALCULATIONS

AREA OF PARCEL IN

COTTONWOOD CREEK BASIN

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

TOTAL Q100 IN STREET = 36 cfs
ASSUME 18 cfs ON EACH SIDE OF STREET

AP-C1
100-YR. FLOW

Q(100)	18	I(100)	5.7	Inlet size ? L(i) =	24
DEPTH	0.36	Fr	2.07	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	13.7	L(1)	21.9		
				If Li > L(2) then Qi =	14
CROSS SLOPE	2.0%	L(2)	13.2	CA(eqv.)=	2.41
STREET SLOPE	2.6%	L(3)	47.0	FB =	4
				CA(eqv.)=	0.74

5-YR. FLOW

Q(5)	15	I(10)	3.4	Inlet size ? L(i) =	24
DEPTH	0.33	Fr	2.03	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	12.4	L(1)	19.4		
				If Li > L(2) then Qi =	12
CROSS SLOPE	2.0%	L(2)	11.6	CA(eqv.)=	3.54
STREET SLOPE	2.6%	L(3)	41.7	FB =	3
				CA(eqv.)=	0.87

SAGEWOOD

INLET CALCULATIONS COTTONWOOD CREEK BASIN

TOTAL Q100 IN STREET = 36 cfs
ASSUME 18 cfs ON EACH SIDE
OF STREET

AP-C2

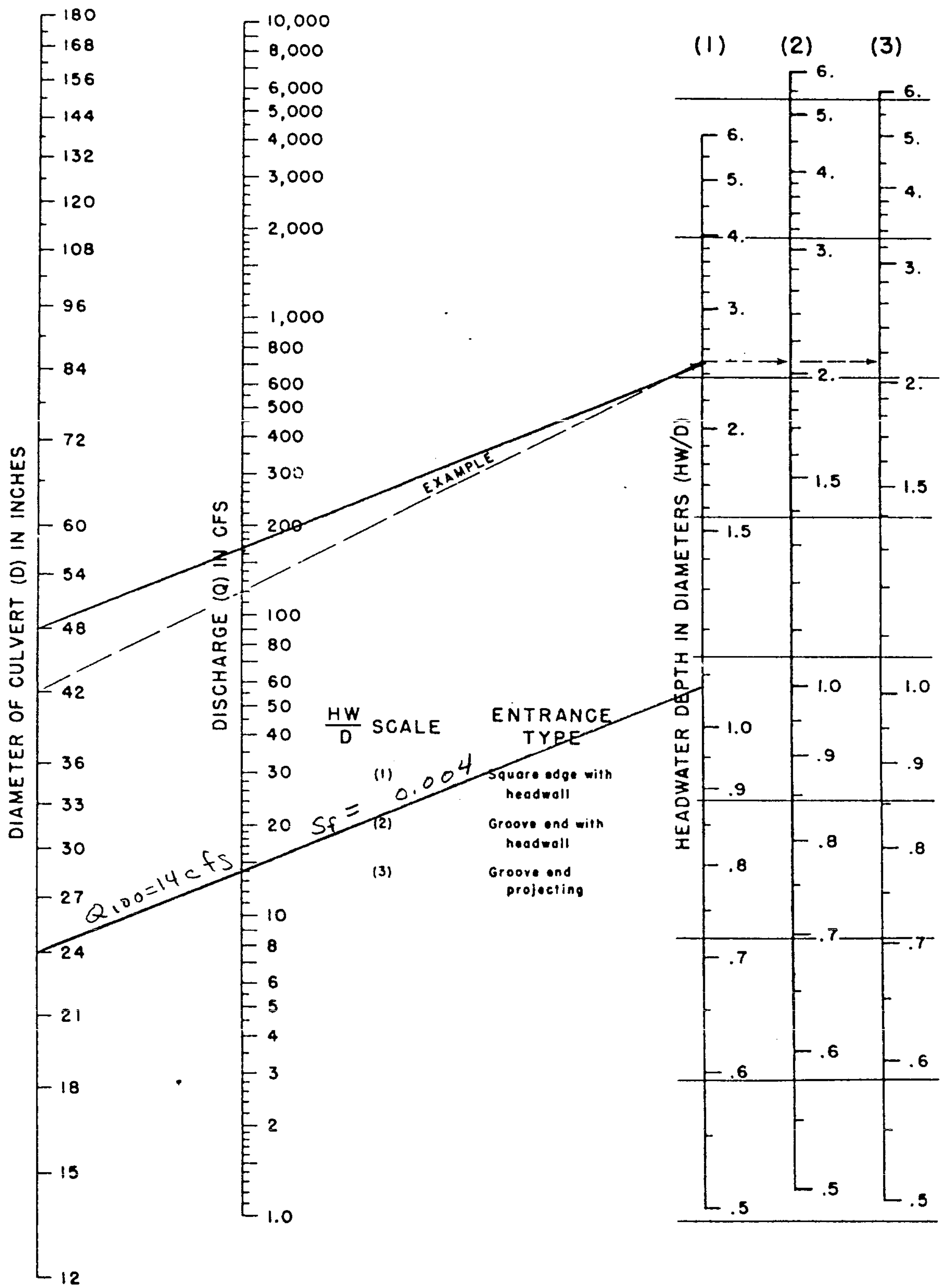
100-YR. FLOW

Q(100)	18	I(100)	5.7	Inlet size ? L(i) =	24
DEPTH	0.36	Fr	2.07	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	13.7	L(1)	21.9		
				If Li > L(2) then Qi =	14
CROSS SLOPE	2.0%	L(2)	13.2	CA(eqv.)=	2.41
STREET SLOPE	2.6%	L(3)	47.0	FB =	4
				CA(eqv.)=	0.74

5-YR. FLOW (3 cfs + 1 cfs overtops crown)

Q(5)	4	I(10)	3.4	Inlet size ? L(i) =	24
DEPTH	0.20	Fr	1.72	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	5.9	L(1)	7.8		
				If Li > L(2) then Qi =	4 ~~5~~
CROSS SLOPE	2.0%	L(2)	4.6	CA(eqv.)=	1.36
STREET SLOPE	2.6%	L(3)	16.7	FB =	0
				CA(eqv.)=	0.00

COTTONWOOD CREEK BASIN
INLETS AT AP-C1 & AP-C2



HEADWATER SCALES 2&3
REVISED MAY 1964

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Fig. 4. **Inlet-control nomograph.**

BUREAU OF PUBLIC ROADS JAN. 1963

SAGEWOOD

INLET CALCULATIONS COTTONWOOD CREEK BASIN

TOTAL Q100 IN STREET = 46cfs
ASSUME 23 cfs ON EACH SIDE
OF STREET

AP-C3.A

100-YR. FLOW

Q(100)	23	I(100)	5.7	Inlet size ? L(i) =	12
DEPTH	0.37	Fr	2.46	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	14.3	L(1)	27.1		
				If Li > L(2) then Qi =	12
CROSS SLOPE	2.0%	L(2)	16.3	CA(eqv.)=	2.15
STREET SLOPE	3.6%	L(3)	58.1	FB =	11
				CA(eqv.)=	1.89

5-YR. FLOW

Q(5)	19	I(10)	3.4	Inlet size ? L(i) =	12
DEPTH	0.34	Fr	2.40	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	12.9	L(1)	23.8		
				If Li > L(2) then Qi =	11
CROSS SLOPE	2.0%	L(2)	14.3	CA(eqv.)=	3.13
STREET SLOPE	3.6%	L(3)	51.3	FB =	8
				CA(eqv.)=	2.46

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

FLOWBY FROM AP-C3.A

AP-C3.B
100-YR. FLOW

Q(100)	11	I(100)	5.7	Inlet size ? L(i) =	10
DEPTH	0.28	Fr	2.28	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	9.8	L(1)	17.2		
				If Li > L(2) then Qi =	7
CROSS SLOPE	2.0%	L(2)	10.3	CA(eqv.)=	1.15
STREET SLOPE	3.6%	L(3)	36.9	FB =	4
				CA(eqv.)=	0.78

5-YR. FLOW

Q(5)	8	I(10)	3.4	Inlet size ? L(i) =	10
DEPTH	0.25	Fr	2.18	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	8.1	L(1)	13.6		
				If Li > L(2) then Qi =	5
CROSS SLOPE	2.0%	L(2)	8.2	CA(eqv.)=	1.53
STREET SLOPE	3.6%	L(3)	29.3	FB =	3
				CA(eqv.)=	0.82

SAGEWOOD

INLET CALCULATIONS COTTONWOOD CREEK BASIN

TOTAL Q100 IN STREET = 46cfs
ASSUME 23 cfs ON EACH SIDE
OF STREET

AP-C4.A
100-YR. FLOW

Q(100)	23	I(100)	5.7	Inlet size ? L(i) =	12
DEPTH	0.37	Fr	2.46	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	14.3	L(1)	27.1		
				If Li > L(2) then Qi =	12
CROSS SLOPE	2.0%	L(2)	16.3	CA(eqv.)=	2.15
STREET SLOPE	3.6%	L(3)	58.1	FB =	11
				CA(eqv.)=	1.89

5-YR. FLOW

Q(5)	5	I(10)	3.4	Inlet size ? L(i) =	12
DEPTH	0.21	Fr	2.04	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	6.1	L(1)	9.6		
				If Li > L(2) then Qi =	4
CROSS SLOPE	2.0%	L(2)	5.7	CA(eqv.)=	1.18
STREET SLOPE	3.6%	L(3)	20.6	FB =	1
				CA(eqv.)=	0.29

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

FLOWBY FROM AP-C4.A

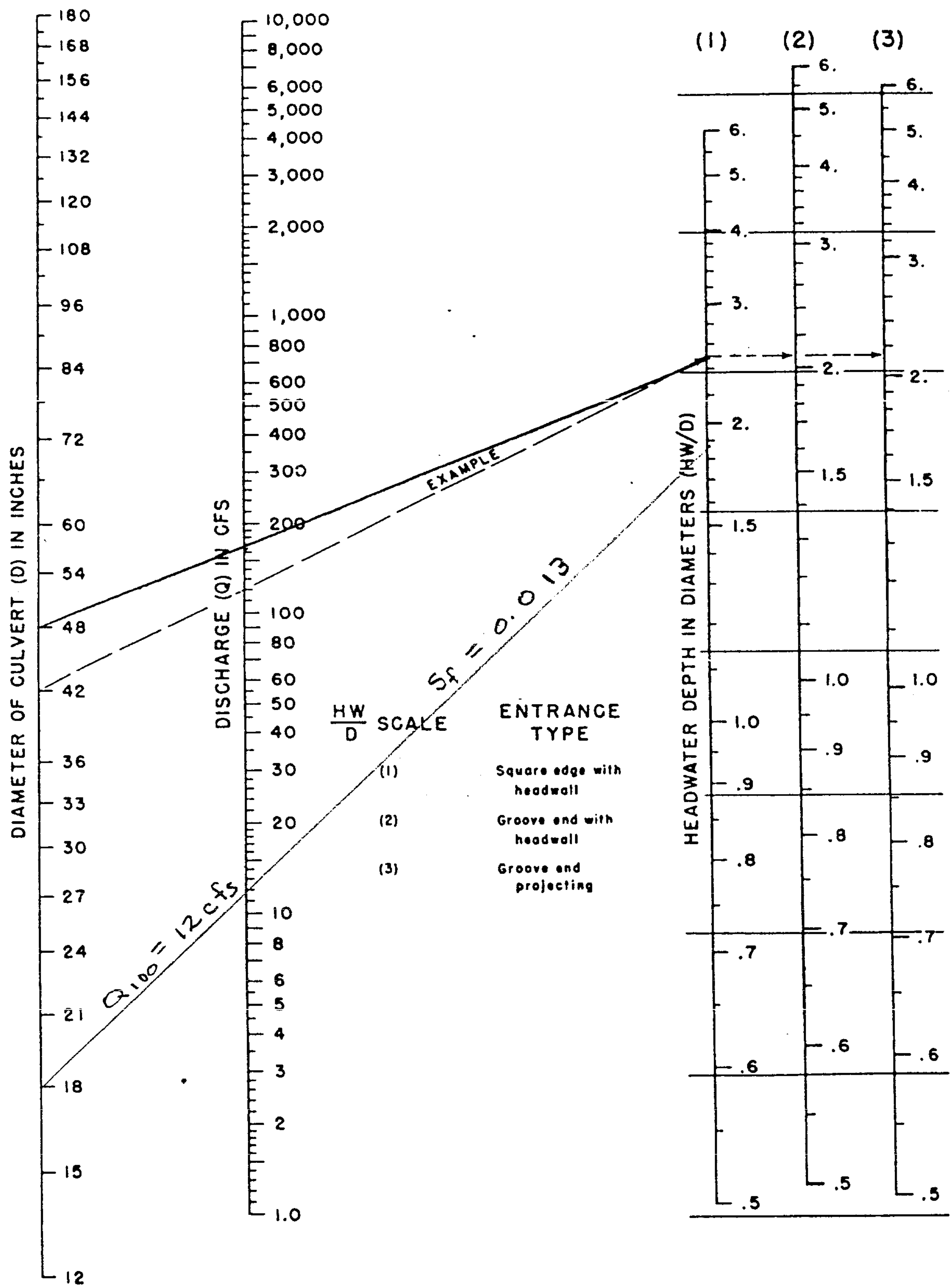
AP-C4.B
100-YR. FLOW

Q(100)	11	I(100)	5.7	Inlet size ? L(i) =	10
DEPTH	0.28	Fr	2.28	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	9.8	L(1)	17.2		
				If Li > L(2) then Qi =	7
CROSS SLOPE	2.0%	L(2)	10.3	CA(eqv.)=	1.15
STREET SLOPE	3.6%	L(3)	36.9	FB =	4
				CA(eqv.)=	0.78

5-YR. FLOW

Q(5)	1	I(10)	3.4	Inlet size ? L(i) =	10
DEPTH	0.11	Fr	#NUM!	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	1.4	L(1)	#NUM!		
				If Li > L(2) then Qi =	#####
CROSS SLOPE	2.0%	L(2)	#NUM!	CA(eqv.)=	#####
STREET SLOPE	3.6%	L(3)	#NUM!	FB =	0
				CA(eqv.)=	0.00

COTTONWOOD CREEK BASIN
INLETS AT AP-C3A & AP-C4A

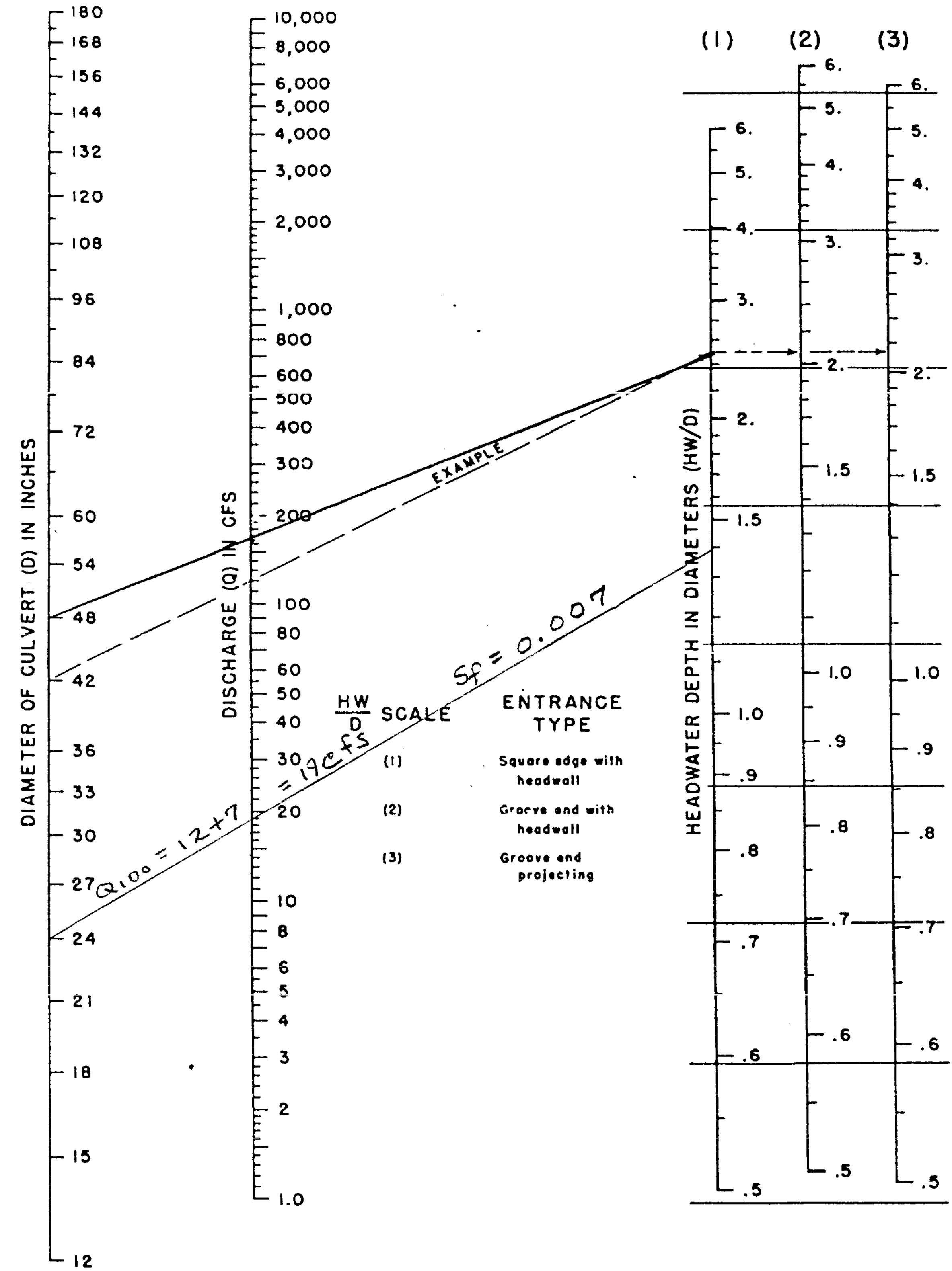


HEADWATER DEPTH FOR
CONCRETE PIPE CULVERTS
WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Fig. 4. Inlet-control nomograph.

COTTONWOOD CREEK BASIN
INLETS AT AP-C3B + AP-C4B



HEADWATER SCALES 2&3
REVISED MAY 1964

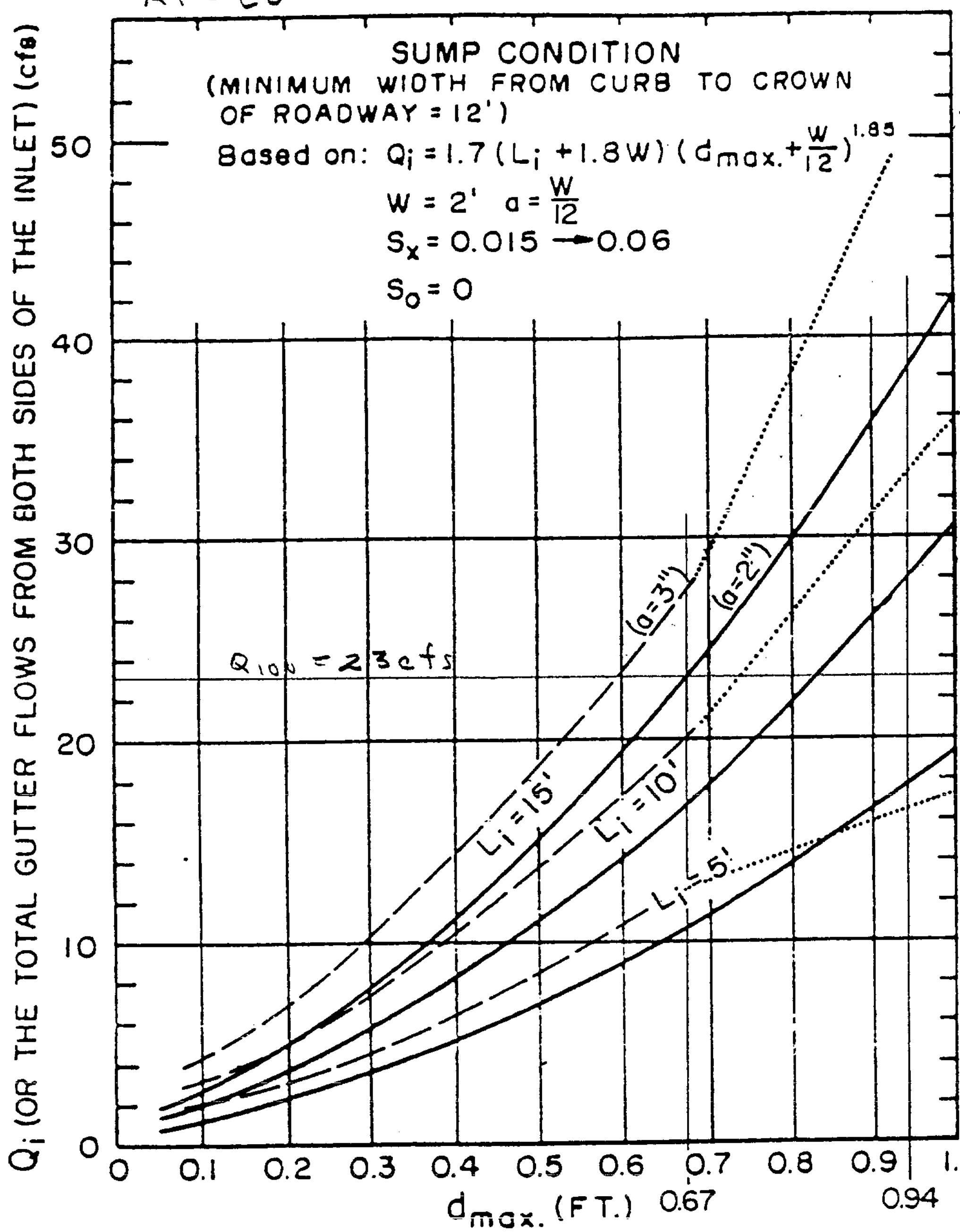
HEADWATER DEPTH FOR
CONCRETE PIPE CULVERTS
WITH INLET CONTROL

Fig. 4. Inlet-control nomograph.

BUREAU OF PUBLIC ROADS JAN. 1963

COTTONWOOD CREEK BASIN

AP-C5



L = 12'
CLOG. FACT. 1.25
12 × 1.25 = 15'.
USE 16' INLET

REFERENCE : Izzard, Carl. f., Report presented at the Annual Meeting of the National Transportation Board, January 1977; Simplified Method For Design of Curb-opening Inlets

— — — (As Modified by El Paso County, per Type R Inlet)

Note: Depth of ponding measured at curb above depressed area ; a = 3", For d ≤ .67

$Q_i = (1.7 L_i + 6.12)(d_{max} + .25)^{1.85}$; $Q_i = 3.60\ L_i (d - .08)^{.5}$ For d ≥ .94; Note : No Clogging Factor

9/30/90

HDR Infrastructure, Inc.
A Centerra Company

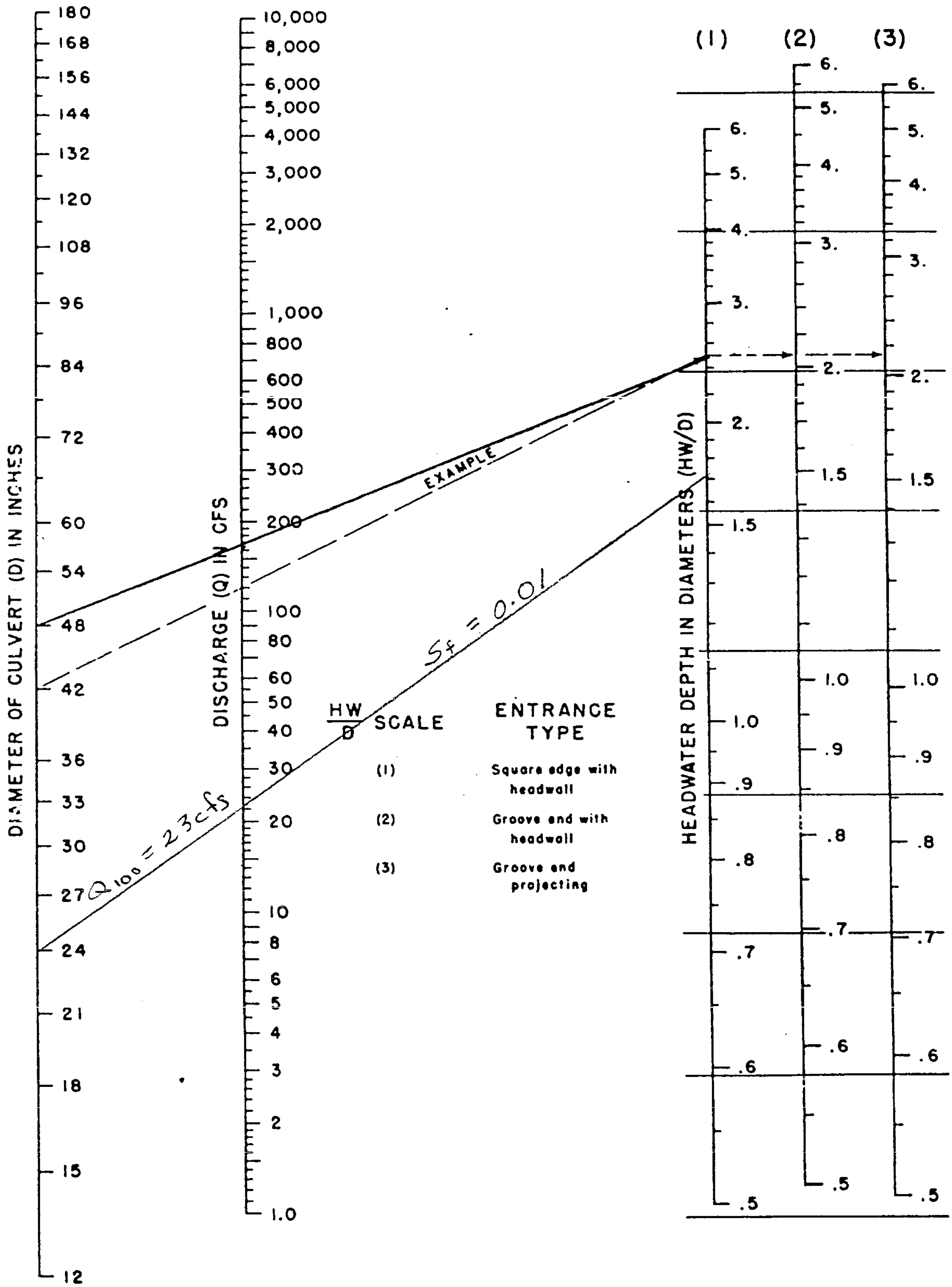
The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Sump Capacity for Curb-opening Inlets

Date	OCT. 1987
Figure	7-11

COTTONWOOD CREEK BASIN

AP-C5 Q_{100} = 23 CFS



HEADWATER SCALES 2&3
REVISED MAY 1964

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Fig. 4. Inlet-control nomograph.

BUREAU OF PUBLIC ROADS JAN. 1963

SAGEWOOD

INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-C6

100-YR. FLOW

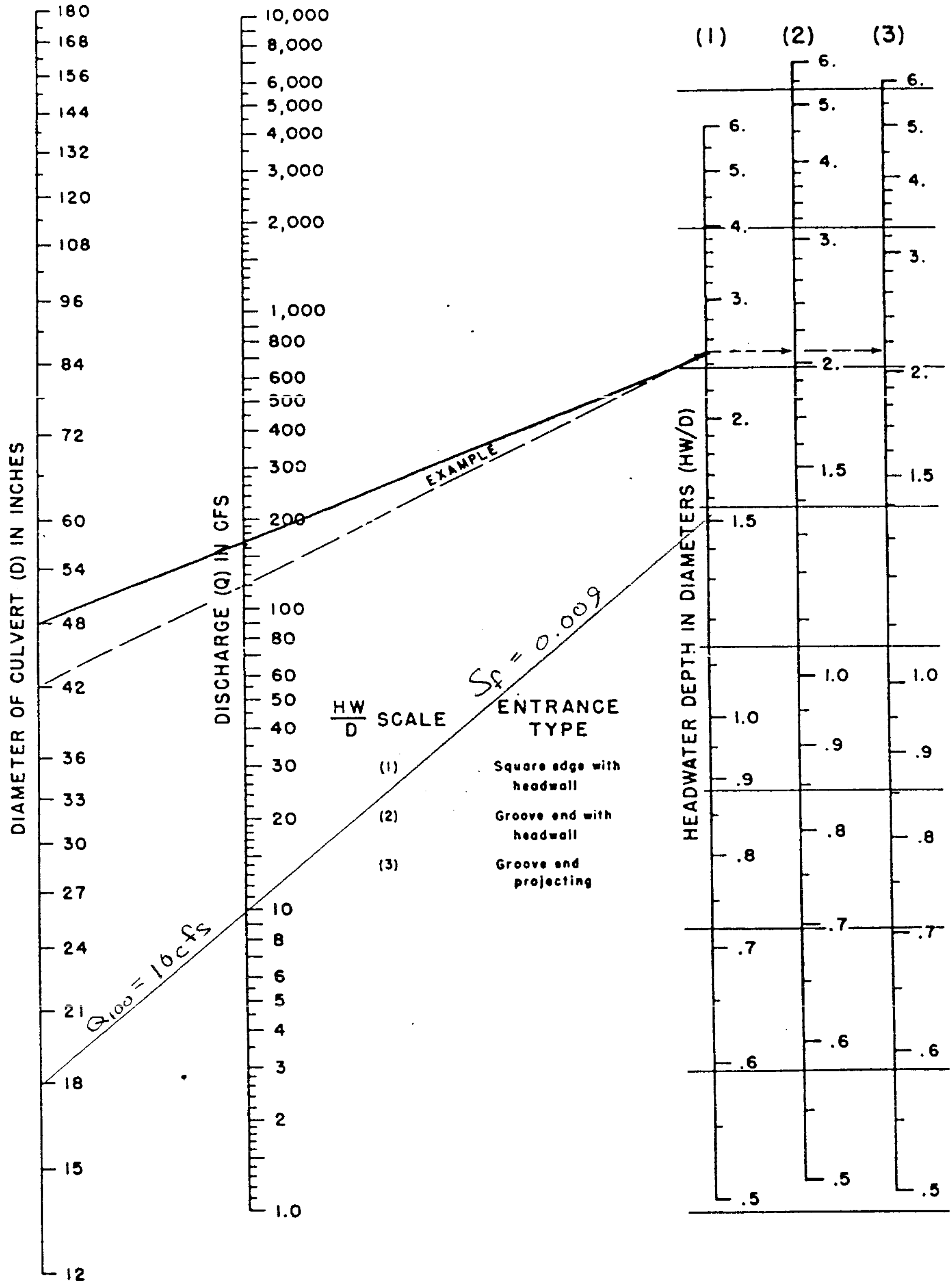
Q(100)	15	I(100)	5.7	Inlet size ? L(i) =	16
DEPTH	0.32	Fr	2.30	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	11.7	L(1)	20.7		
				If Li > L(2) then Qi =	10
CROSS SLOPE	2.0%	L(2)	12.5	CA(eqv.)=	1.75
STREET SLOPE	3.4%	L(3)	44.4	FB =	5
				CA(eqv.)=	0.88

5-YR. FLOW

Q(5)	8	I(10)	3.4	Inlet size ? L(i) =	16
DEPTH	0.25	Fr	2.13	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	8.3	L(1)	13.5		
				If Li > L(2) then Qi =	6
CROSS SLOPE	2.0%	L(2)	8.1	CA(eqv.)=	1.85
STREET SLOPE	3.4%	L(3)	29.1	FB =	2
				CA(eqv.)=	0.50

COTTONWOOD CREEK BASIN

AP-C6



HEADWATER SCALES 2&3
REVISED MAY 1964

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Fig. 4. Inlet-control nomograph.

BUREAU OF PUBLIC ROADS JAN. 1963

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-15
100-YR. FLOW

Q(100)	23	I(100)	4.0	Inlet size ? L(i) =	20
DEPTH	0.43	Fr	1.67	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	17.4	L(1)	22.2		
				If Li > L(2) then Qi =	16
CROSS SLOPE	2.0%	L(2)	13.3	CA(eqv.)=	4.06
STREET SLOPE	1.5%	L(3)	47.9	FB =	7
				CA(eqv.)=	1.69

5-YR. FLOW

Q(5)	12	I(10)	2.4	Inlet size ? L(i) =	20
DEPTH	0.34	Fr	1.57	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	12.7	L(1)	15.3		
				If Li > L(2) then Qi =	10
CROSS SLOPE	2.0%	L(2)	9.1	CA(eqv.)=	4.1
STREET SLOPE	1.5%	L(3)	32.9	FB =	2
				CA(eqv.)=	0.90

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-16
100-YR. FLOW

Q(100)	25	I(100)	5.3	Inlet size ? L(i) =	15
DEPTH	0.51	Fr	1.17	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	21.7	L(1)	19.4		
				If Li > L(2) then Qi =	17
CROSS SLOPE	2.0%	L(2)	11.6	CA(eqv.)=	3.13
STREET SLOPE	0.7%	L(3)	41.8	FB =	8
				CA(eqv.)=	1.59

5-YR. FLOW

Q(5)	12	I(10)	3.2	Inlet size ? L(i) =	15
DEPTH	0.39	Fr	1.10	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	15.4	L(1)	13.0		
				If Li > L(2) then Qi =	9
CROSS SLOPE	2.0%	L(2)	7.8	CA(eqv.)=	2.93
STREET SLOPE	0.7%	L(3)	27.9	FB =	3
				CA(eqv.)=	0.82

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-17
100-YR. FLOW

Q(100)	23	I(100)	5.2	Inlet size ? L(i) =	15
DEPTH	0.43	Fr	1.67	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	17.4	L(1)	22.2		
				If Li > L(2) then Qi =	14
CROSS SLOPE	2.0%	L(2)	13.3	CA(eqv.)=	2.78
STREET SLOPE	1.5%	L(3)	47.9	FB =	9
				CA(eqv.)=	1.64

5-YR. FLOW

Q(5)	12	I(10)	3.1	Inlet size ? L(i) =	15
DEPTH	0.34	Fr	1.57	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	12.7	L(1)	15.3		
				If Li > L(2) then Qi =	9
CROSS SLOPE	2.0%	L(2)	9.1	CA(eqv.)=	2.83
STREET SLOPE	1.5%	L(3)	32.9	FB =	3
				CA(eqv.)=	1.04

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-18
100-YR. FLOW

Q(100)	21	I(100)	4.6	Inlet size ? L(i) =	15
DEPTH	0.41	Fr	1.68	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	16.3	L(1)	21.0		
				If Li > L(2) then Qi =	13
CROSS SLOPE	2.0%	L(2)	12.6	CA(eqv.)=	2.87
STREET SLOPE	1.6%	L(3)	45.2	FB =	7
				CA(eqv.)=	1.59

5-YR. FLOW

Q(5)	13	I(10)	2.8	Inlet size ? L(i) =	15
DEPTH	0.34	Fr	1.60	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	12.9	L(1)	15.8		
				If Li > L(2) then Qi =	9
CROSS SLOPE	2.0%	L(2)	9.5	CA(eqv.)=	3.24
STREET SLOPE	1.6%	L(3)	34.1	FB =	4
				CA(eqv.)=	1.26

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-19
100-YR. FLOW

Q(100)	21	I(100)	5.3	Inlet size ? L(i) =	10
DEPTH	0.41	Fr	1.68	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	16.3	L(1)	21.0		
				If Li > L(2) then Qi =	11
CROSS SLOPE	2.0%	L(2)	12.6	CA(eqv.)=	2.12
STREET SLOPE	1.6%	L(3)	45.2	FB =	9
				CA(eqv.)=	1.75

5-YR. FLOW

Q(5)	8	I(10)	3.2	Inlet size ? L(i) =	10
DEPTH	0.29	Fr	1.54	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	10.5	L(1)	12.3		
				If Li > L(2) then Qi =	6
CROSS SLOPE	2.0%	L(2)	7.4	CA(eqv.)=	1.78
STREET SLOPE	1.6%	L(3)	26.5	FB =	3
				CA(eqv.)=	0.85

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-20
100-YR. FLOW

Q(100)	36	I(100)	4.9	Inlet size ? L(i) =	20
DEPTH	0.51	Fr	1.73	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	21.4	L(1)	28.4		
				If Li > L(2) then Qi =	23
CROSS SLOPE	2.0%	L(2)	17.0	CA(eqv.)=	4.70
STREET SLOPE	1.5%	L(3)	61.1	FB =	13
				CA(eqv.)=	2.65

5-YR. FLOW

Q(5)	14	I(10)	3.0	Inlet size ? L(i) =	20
DEPTH	0.36	Fr	1.59	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	13.7	L(1)	16.7		
				If Li > L(2) then Qi =	11
CROSS SLOPE	2.0%	L(2)	10.0	CA(eqv.)=	3.69
STREET SLOPE	1.5%	L(3)	36.0	FB =	3
				CA(eqv.)=	0.98

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-21
100-YR. FLOW

Q(100)	27	I(100)	4.5	Inlet size ? L(i) =	10
DEPTH	0.50	Fr	1.32	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	21.2	L(1)	21.5		
				If Li > L(2) then Qi =	15
CROSS SLOPE	2.0%	L(2)	12.9	CA(eqv.)=	3.25
STREET SLOPE	0.9%	L(3)	46.2	FB =	12
				CA(eqv.)=	2.75

5-YR. FLOW

Q(5)	8	I(10)	2.7	Inlet size ? L(i) =	10
DEPTH	0.32	Fr	1.18	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	11.8	L(1)	10.7		
				If Li > L(2) then Qi =	6
CROSS SLOPE	2.0%	L(2)	6.4	CA(eqv.)=	2.12
STREET SLOPE	0.9%	L(3)	23.1	FB =	2
				CA(eqv.)=	0.84

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-22
100-YR. FLOW

Q(100)	21	I(100)	5.3	Inlet size ? L(i) =	10
DEPTH	0.41	Fr	1.65	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	16.7	L(1)	21.1		
				If Li > L(2) then Qi =	11
CROSS SLOPE	2.0%	L(2)	12.6	CA(eqv.)=	2.16
STREET SLOPE	1.5%	L(3)	45.5	FB =	10
				CA(eqv.)=	1.80

5-YR. FLOW

Q(5)	10	I(10)	3.2	Inlet size ? L(i) =	10
DEPTH	0.31	Fr	1.54	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	11.6	L(1)	13.6		
				If Li > L(2) then Qi =	6
CROSS SLOPE	2.0%	L(2)	8.2	CA(eqv.)=	2.03
STREET SLOPE	1.5%	L(3)	29.4	FB =	4
				CA(eqv.)=	1.09

SAGEWOOD
INLET CALCULATIONS COTTONWOOD CREEK BASIN

AP-23
100-YR. FLOW

Q(100)	24	I(100)	5.0	Inlet size ? L(i) =	8
DEPTH	0.48	Fr	1.31	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	20.1	L(1)	20.1		
				If Li > L(2) then Qi =	12
CROSS SLOPE	2.0%	L(2)	12.1	CA(eqv.)=	2.44
STREET SLOPE	0.9%	L(3)	43.4	FB =	12
				CA(eqv.)=	2.36

5-YR. FLOW

Q(5)	9	I(10)	3.0	Inlet size ? L(i) =	8
DEPTH	0.33	Fr	1.20	If Li < L(2) then Qi =	
				CA(eqv.)=	
SPREAD	12.6	L(1)	11.5		
				If Li > L(2) then Qi =	6
CROSS SLOPE	2.0%	L(2)	6.9	CA(eqv.)=	1.91
STREET SLOPE	0.9%	L(3)	24.8	FB =	3
				CA(eqv.)=	1.09

COTTONWOOD CREEK BASIN

EXISTING INLET CAPACITY

AP-24

$Q_i = 1.7\,(L_i + 1.8\,w)(d_{max} + a)^{1.85}$

$w = 3'$; $a = 4'' = 0.33'$ $\quad a = \frac{w}{12} = \frac{3}{12} = 0.25$

Use: $a = 0.25$

$Q_i = (1.7)(26 + (1.8)(3))(1' + .25)^{1.85}$

$= (1.7)(31.34)(1.51) = 80$ cfs

with 1.25 clogging factor

$Qi = \frac{80}{1.25} = 64$ cfs

HYDRAULIC DATA
AREA OF PARCEL IN
COTTONWOOD CREEK BASIN

OUTLETS AP-C1 & AP-C2
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD COTTONWOOD CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	24.00	in
Discharge	14.00	cfs

Results		
Channel Slope	0.003830	ft/ft
Depth	24.0	in
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.35	ft
Percent Full	100.00	
Critical Slope	0.006050	ft/ft
Velocity	4.46	ft/s
Velocity Head	0.31	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	15.06	cfs
Full Flow Capacity	14.00	cfs
Full Flow Slope	0.003830	ft/ft

OUTLETS AP-C3.A & AP-C4.A
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD COTTONWOOD CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	18.00	in
Discharge	12.00	cfs

Results		
Channel Slope	0.013052	ft/ft
Depth	18.0	in
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.31	ft
Percent Full	100.00	
Critical Slope	0.011803	ft/ft
Velocity	6.79	ft/s
Velocity Head	0.72	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	12.91	cfs
Full Flow Capacity	12.00	cfs
Full Flow Slope	0.013052	ft/ft

OUTLETS AP-C3.B & AP-C4.B
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD COTTONWOOD CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	24.00	in
Discharge	19.00	cfs

Results		
Channel Slope	0.007055	ft/ft
Depth	24.0	in
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.57	ft
Percent Full	100.00	
Critical Slope	0.007688	ft/ft
Velocity	6.05	ft/s
Velocity Head	0.57	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	20.44	cfs
Full Flow Capacity	19.00	cfs
Full Flow Slope	0.007055	ft/ft

OUTLET AP-C5
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD COTTONWOOD CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	24.00	in
Discharge	23.00	cfs

Results		
Channel Slope	0.010338	ft/ft
Depth	24.0	in
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.71	ft
Percent Full	100.00	
Critical Slope	0.009682	ft/ft
Velocity	7.32	ft/s
Velocity Head	0.83	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	24.74	cfs
Full Flow Capacity	23.00	cfs
Full Flow Slope	0.010338	ft/ft

OUTLET AP-C6
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD COTTONWOOD CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	18.00	in
Discharge	10.00	cfs

Results		
Channel Slope	0.009064	ft/ft
Depth	18.0	in
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.22	ft
Percent Full	100.00	
Critical Slope	0.009207	ft/ft
Velocity	5.66	ft/s
Velocity Head	0.50	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	10.76	cfs
Full Flow Capacity	10.00	cfs
Full Flow Slope	0.009064	ft/ft

AP-C7 TO EX. 60" MAIN
Worksheet for Circular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD COTTONWOOD CREEK BASIN
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Slope

Input Data		
Mannings Coefficient	0.013	
Diameter	24.00	in
Discharge	32.00	cfs

Results		
Channel Slope	0.020011	ft/ft
Depth	24.0	in
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.89	ft
Percent Full	100.00	
Critical Slope	0.017306	ft/ft
Velocity	10.19	ft/s
Velocity Head	1.61	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	34.42	cfs
Full Flow Capacity	32.00	cfs
Full Flow Slope	0.020011	ft/ft

HYDRAULIC GRADE LINE CALCULATIONS
AND STREET CAPACITY CALCULATIONS
AREA IN PARCEL IN
COTTONWOOD CREEK BASIN

PROJECT: PARKWAY VILLAGE MASTER DEVELOPMENT DRAINAGE PLAN
JOB#: 8878.20
DATE: 4/9/98
TIME: 8:12 AM
ANALYSIS BY: VANCE FOSSINGER, JR ENGINEERING LTD.

ASSUMES ADDITIONAL FLOW-BY FROM INLETS AT THE BRAINARD/BAYSWATER INTERSECTION DUE TO HIGH HGL. ASSUMES ADDITIONAL BYPASS FLOW PICKED UP AT AUSTIN BLUFFS PKWY. SUMP

STARTING CONDITIONS:
TAILWATER ELEVATION = 6894.91
MANNING'S ROUGHNESS = 0.012
ASSUMED STARTING HGL ELEV.= 6895.00

STATION	STRUCTURE	MAINLINE FLOW RATE (cfs)	PIPE DIA. (inches)	LAY LENGTH (feet)	PIPE SLOPE (fpf)	PIPE INVERT (elev.)	FLOW VELOCITY (fps)	VELOCITY HEAD (feet)	FRICTION SLOPE (fpf)	FRICTION LOSS Hf	MANHOLE LOSS Hm	ANGLE PT. LOSS Hb	JUNCTION LOSS Hj	EXPANSION LOSS Hx	SUM OF LOSSES	ENERGY GRADE LINE ELEVATION	HYDRAULIC GRADE LINE ELEVATION	FINISHED GRADE ELEVATION
				----> @	OUTLET =	6892.61										6895.00	6895.00	6901.00
8+50	M.H.	475.00	66	650.00	0.0200	6905.61	19.99	6.21	0.0170	11.081	0.000	0.000	0.000	6.207	17.288	6917.32	6911.11	6915.00
15+82	M.H.	475.00	66	732.00	0.0190	6919.52	19.99	6.21	0.0170	12.479	0.000	0.348	0.000	0.000	12.827	6931.22	6925.02	6929.00
16+32 + - = 1+15+ -	JCT. SD-5	475.00	60	50.00	0.0350	6921.27	24.19	9.09	0.0283	1.417	0.000	0.000	2.778	0.268	4.463	6935.69	6926.60	6936.40
2+11	BEND	395.00	60	96.00	0.0370	6924.82	20.12	6.28	0.0196	1.882	0.000	0.353	0.000	0.000	2.234	6937.92	6931.64	6939.00
2+20	WYE SD-4	395.00	60	9.00	0.0350	6925.11	20.12	6.28	0.0196	0.176	0.000	0.000	0.855	0.000	1.031	6938.95	6932.67	6939.10
2+48	WYE	367.00	60	28.00	0.0350	6925.96	18.69	5.42	0.0169	0.474	0.000	0.000	0.623	0.000	1.097	6940.05	6934.63	6939.20
2+50	WYE	345.00	60	2.00	0.0200	6926.00	17.57	4.79	0.0150	0.030	0.000	0.000	0.255	0.000	0.285	6940.34	6935.54	6939.20
3+65	WYE SD-3	334.00	60	115.00	0.0200	6928.26	17.01	4.49	0.0140	1.612	0.000	0.000	0.202	0.000	1.813	6942.15	6937.66	6939.80
4+04	WYE	324.00	60	39.00	0.0200	6929.04	16.50	4.23	0.0132	0.514	0.000	0.000	0.206	0.000	0.720	6942.87	6938.64	6940.00
6+37	WYE SD-2	313.00	60	233.00	0.0200	6933.70	15.94	3.95	0.0123	2.867	0.000	0.000	0.261	0.000	3.128	6946.00	6942.05	6942.80
7+01	WYE	300.00	60	64.00	0.0200	6934.98	15.28	3.62	0.0113	0.724	0.181	0.000	0.202	0.000	1.107	6947.10	6943.48	6943.80
7+03	WYE	290.00	60	2.00	0.0150	6935.01	14.77	3.39	0.0106	0.021	0.000	0.000	0.184	0.000	0.205	6947.31	6943.92	6943.80
7+11	WYE	282.00	60	8.00	0.0150	6935.13	14.36	3.20	0.0100	0.080	0.000	0.000	0.112	0.000	0.192	6947.50	6944.30	6944.00
12+86	WYE	276.00	60	575.00	0.0150	6943.76	14.06	3.07	0.0096	5.502	0.000	0.000	0.182	0.000	5.684	6953.18	6950.12	6952.60
13+15	WYE	261.00	60	29.00	0.0150	6944.19	13.29	2.74	0.0086	0.248	0.000	0.000	0.226	0.000	0.474	6953.66	6950.92	6953.00
13+49	WYE	246.00	60	34.00	0.0150	6944.70	12.53	2.44	0.0076	0.258	0.000	0.000	0.208	0.000	0.467	6954.13	6951.69	6954.00
13+87	BEND	231.00	60	38.00	0.0150	6945.27	11.76	2.15	0.0067	0.255	0.000	0.000	0.000	0.000	0.255	6954.38	6952.23	6955.00
14+40	INLET	231.00	60	53.00	0.0150	6946.07	11.76	2.15	0.0067	0.355	0.000	0.638	0.000	0.000	0.994	6955.37	6953.22	6955.00
14+41	DUMMY	231.00	60	1.00	0.0150	6946.08	11.76	2.15	0.0067	0.007	0.000	0.000	0.000	0.000	0.007	6955.38	6953.23	
INLET	DUMMY	231.00	60	1.00	0.0150	6946.10	11.76	2.15	0.0067	0.007	0.000	0.000	0.000	0.000	0.007	6955.39	6953.24	

Flow depth for Q100
Worksheet for Irregular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, BRAINARD STREET CAPICITY
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.008000 ft/ft

Elevation range: 0.00 ft to 1.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.00	0.00	40.00	0.016
0.01	0.00			
2.00	0.13			
20.00	0.49			
38.00	0.13			
39.99	0.00			
40.00	1.00			

Discharge 108.00 cfs

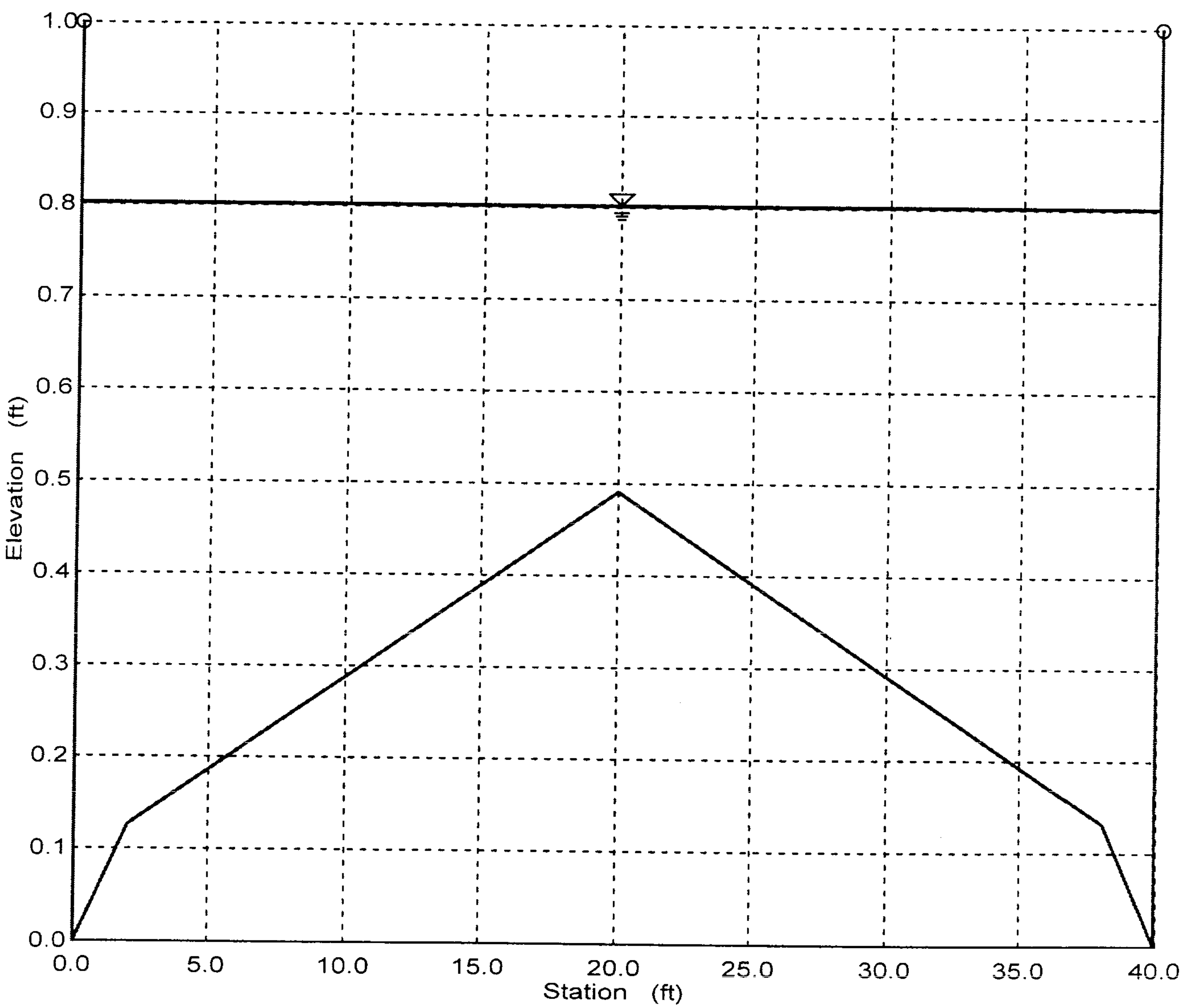
Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.80	ft
Flow Area	20.70	ft^2
Wetted Perimeter	41.60	ft
Top Width	40.00	ft
Height	0.80	ft
Critical Depth	0.89	ft
Critical Slope	0.004663	ft/ft
Velocity	5.22	ft/s
Velocity Head	0.42	ft
Specific Energy	1.22	ft
Froude Number	1.28	

Flow is supercritical.

40' Wide Street, Q100=108 cfs
Cross Section for Irregular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, BRAINARD STREET CAPICITY
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.008000	ft/ft
Water Surface Elevation	0.80	ft
Discharge	108.00	cfs



Q at 1 foot flow depth
Worksheet for Irregular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, BRAINARD STREET CAPICITY
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data

Channel Slope	0.008000	ft/ft
Water Surface Elevation	1.00	ft

Elevation range: 0.00 ft to 1.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.00	0.00	40.00	0.016
0.01	0.00			
2.00	0.13			
20.00	0.49			
38.00	0.13			
39.99	0.00			
40.00	1.00			

Results

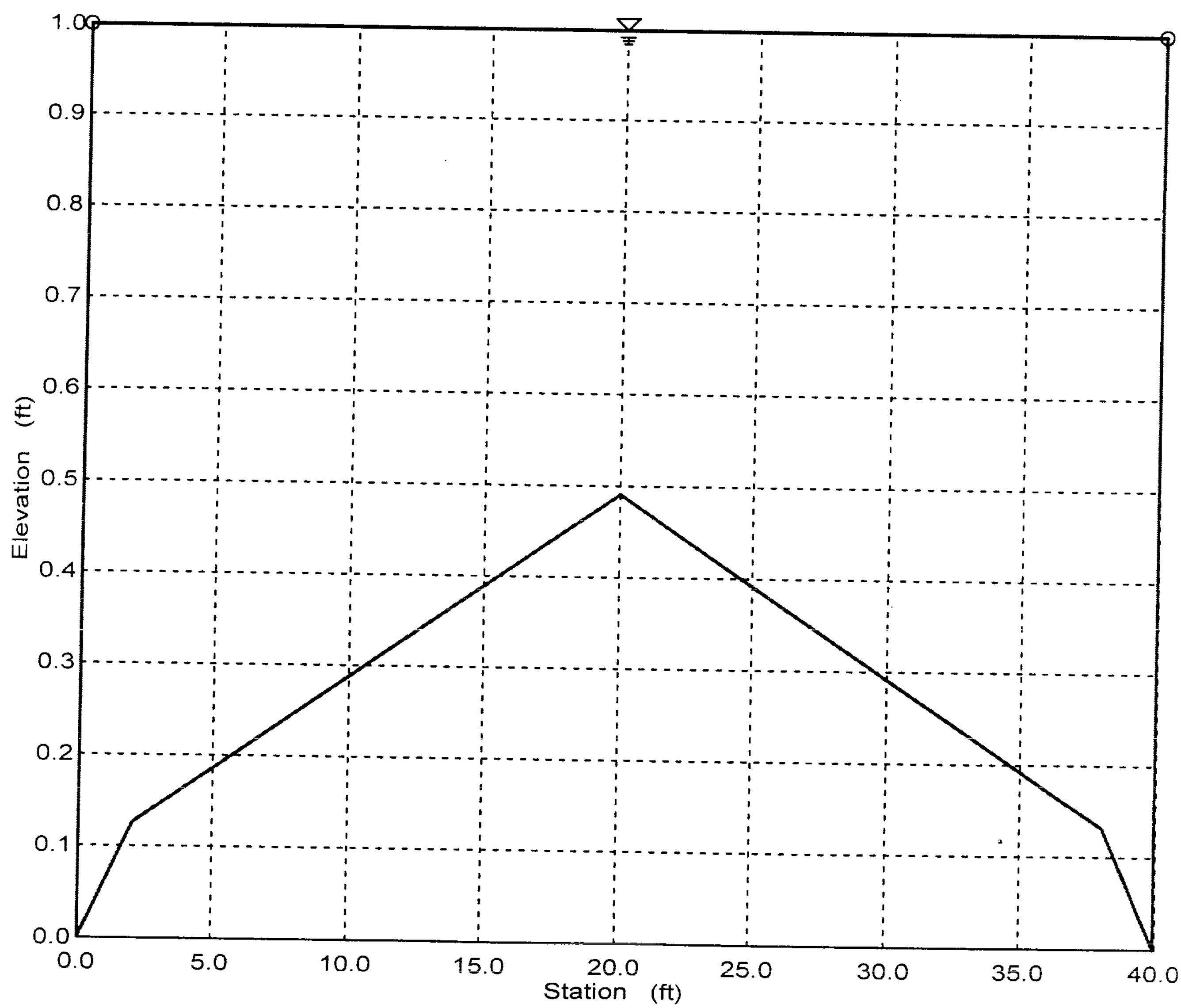
Wtd. Mannings Coefficient	0.016	
Discharge	184.12	cfs
Flow Area	28.62	ft^2
Wetted Perimeter	42.00	ft
Top Width	40.00	ft
Height	1.00	ft
Critical Depth	1.15	ft
Critical Slope	0.004211	ft/ft
Velocity	6.43	ft/s
Velocity Head	0.64	ft
Specific Energy	1.64	ft
Froude Number	1.34	

Flow is supercritical.

Cross Section 40' wide street
Cross Section for Irregular Channel

Project Description	
Project File	untitled.fm2
Worksheet	SAGEWOOD, BRAINARD STREET CAPICITY
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.008000	ft/ft
Water Surface Elevation	1.00	ft
Discharge	184.12	cfs



DETENTION POND CALCULATIONS
AREA OF PARCEL IN
COTTONWOOD CREEK BASIN

Quick TR-55 Ver.5.46   S/N:
Executed: 16:49:08   05-22-1997

MODIFIED RATIONAL METHOD

---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

SAGEWOOD FILING NO.1,
PRELIMINARY POND SIZING FOR POND BASIN "E-7"

```
*********************************************************************
*  RETURN FREQUENCY: 100 yr     |  Allowable Outflow:    52.00 cfs   *
*  'C' Adjustment: 1.000        |  Required Storage:     0.489 ac-ft *
*-------------------------------------------------------------------*
*  Peak Inflow:   71.37 cfs        Inflow .HYD stored: E-7     .HYD  *
*********************************************************************
```

```
    |               Td =  18 minutes                |  Return Freq:   100 yr
    /------- Approx. Duration for Max. Storage ------/  C adj.factor: 1.00
    |                                               |
    |                                               |
    |                 Tc=   17.30  minutes          |
    |                 I =   5.732  in/hr            |  Area (ac):     15.30
    |                . Q =   72.79  cfs             |  Weighted C:     0.83
    |               .|.                             |  Adjusted C:     0.83
F   |              .  .                             |
L   |             .  |  .           Required Storage|
O   |            .      .       .--     0.489 ac-ft |  Td=       18 minutes
W   |           .    |    .     |                   |  I =    5.620 in/hr
    |          .     x x x x x x x|x x x x x x x x x x x  Q =    71.37 cfs
c   |         .                 |
f   |        .    x                                    x
s   |       .                 o o o o o o o o o o o o o o o o    Q=   52.00 cfs
    |      .    x         o   |.                          |x  (Allow.Outflow)
    |     .             o     | .                         |
    |    .  x      o          |  .       NOT TO SCALE     |   x
    |   .   o                 |   .      ============     |
    | o                       |    .                      |      x
    `-------------------------|---------------------------|-----------
                         22.24 minutes               22.69 minutes
```

CA (EQUIV) = 52 ÷ 5.62 = 9.25

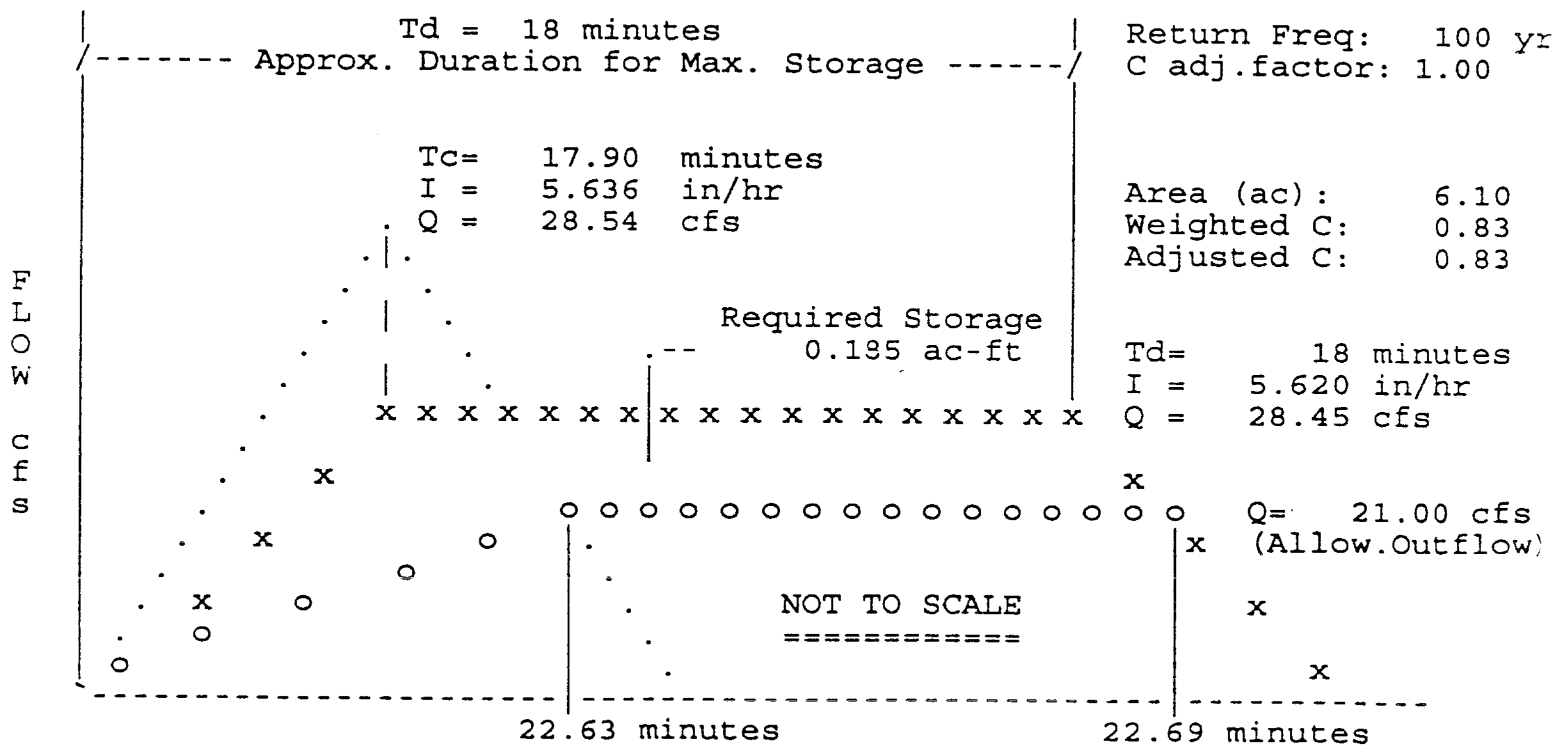
Quick TR-55 Ver.5.46 S/N:
Executed: 16:46:01 05-22-1997

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

First peak outflow point assumed to occur at Tc hydrograph recession leg.

SAGEWOOD FILING NO.1,
PRELIMINARY POND SIZING FOR POND BASIN "E-8A"

```
**********************************************************************
*  RETURN FREQUENCY: 100 yr      |  Allowable Outflow:    21.00 cfs  *
*  'C' Adjustment: 1.000         |  Required Storage:     0.185 ac-ft *
*--------------------------------------------------------------------*
*  Peak Inflow:   28.45 cfs        Inflow .HYD stored: E-8A   .HYD   *
**********************************************************************
```



CA (EQUIV.) = 21 ÷ 5.62 = 3.74

Quick TR-55 Ver.5.46   S/N:
Executed: 16:37:35   05-22-1997

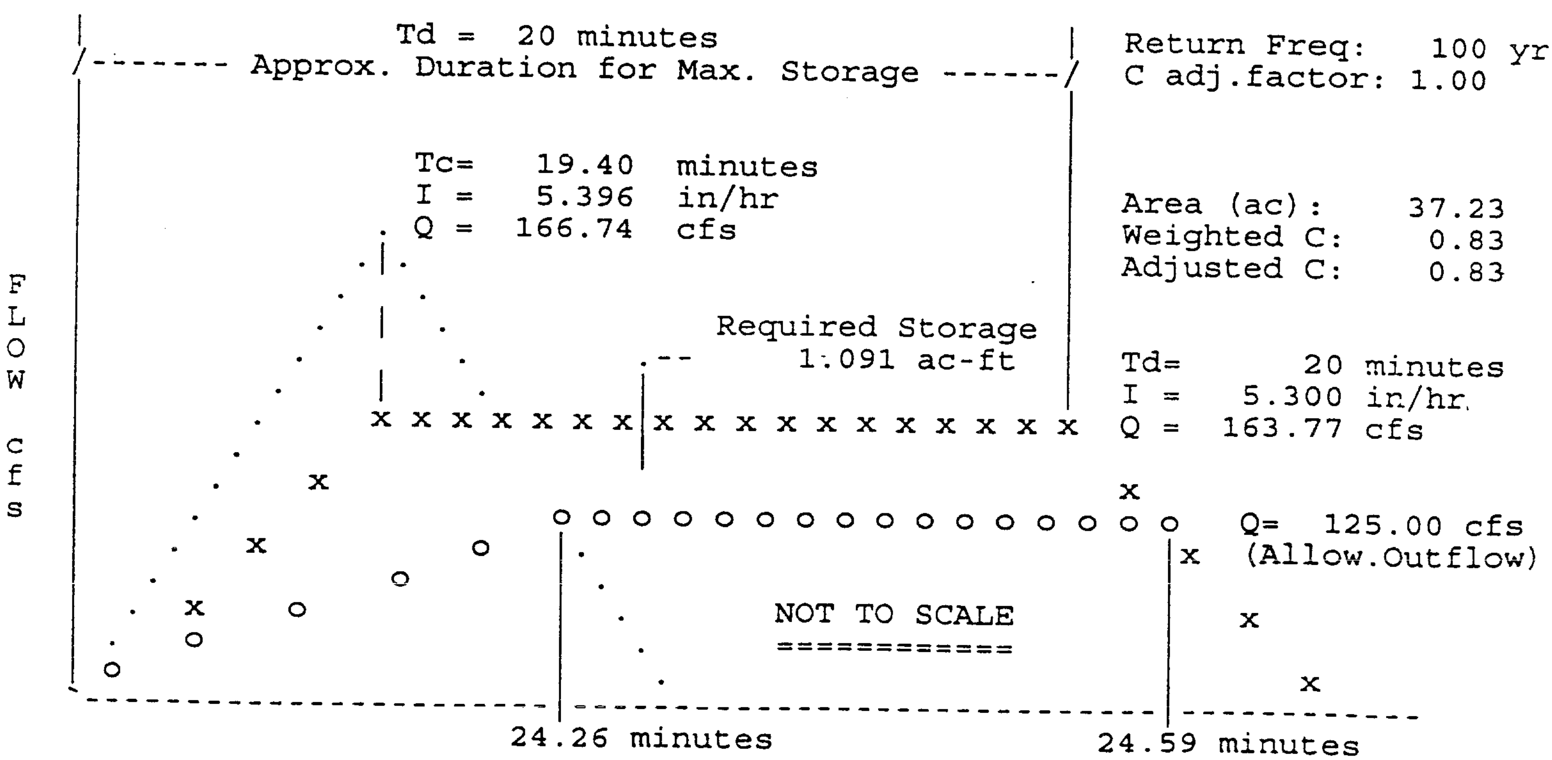
MODIFIED RATIONAL METHOD

---- Graphical Summary for Maximum Required Storage ----

First peak outflow point assumed to occur at Tc hydrograph recession leg.

SAGEWOOD FILING NO.1,
PRELIMINARY POND SIZING FOR POND BASIN "E-9"

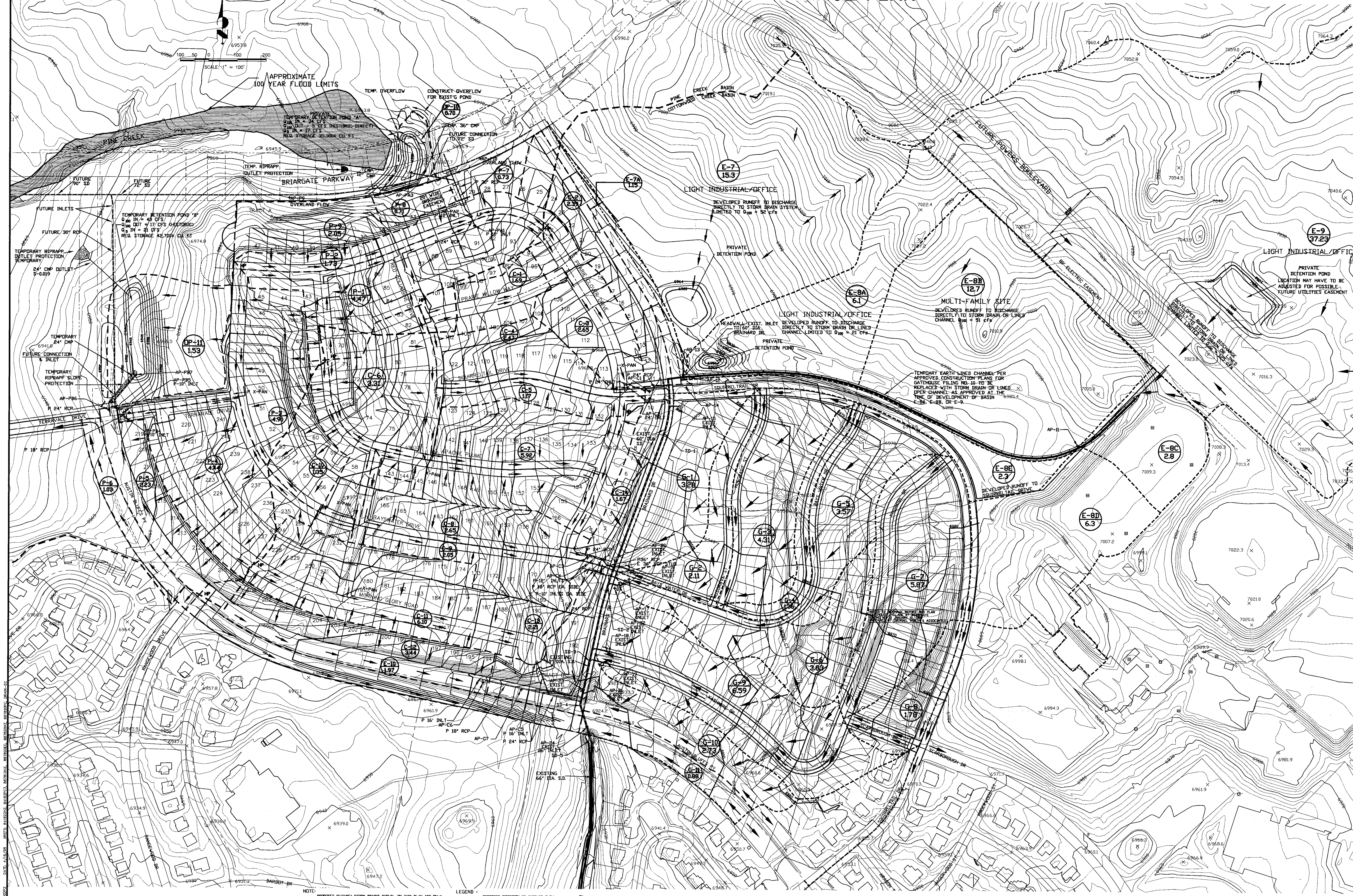
```
***********************************************************************
*  RETURN FREQUENCY: 100 yr     | Allowable Outflow:   125.00 cfs    *
*  'C' Adjustment: 1.000        | Required Storage:    1.091 ac-ft   *
*-------------------------------------------------------  ----------*
*  Peak Inflow:  163.77 cfs       Inflow .HYD stored:          .HYD  *
***********************************************************************
```



CA (EQUIV.) = 125 ÷ 5.3 = 23.58

DRAINAGE PLAN

SAGEWOOD MDDP AND DRAINAGE PLAN



NOTE: PROPOSED (FUTURE) STORM DRAINS SHOWN ON THIS PLAN ARE ONLY INTENDED TO INDICATE GENERAL LOCATION AND "APPROXIMATE" SIZES FACILITIES. ACTUAL SIZES SHALL BE DETERMINED IN MORE DETAILED ANALYSIS AT THE TIME OF DETAILED DESIGN OF THE FACILITIES.

LEGEND:

PROPOSED DIRECTION OF SURFACE FLOW
HISTORIC MAJOR DRAINAGE BASIN BOUNDARY
PROPOSED DRAINAGE BASIN BOUNDARY
DRAINAGE BASIN — BASIN IDENTIFIER (A-1) / AREA, (ACRES) (2.34)
PROPOSED CONTOURS 10'
PROPOSED CONTOURS 2'
EXISTING CONTOURS 10'
EXISTING CONTOURS 2'
PROPOSED X' LONG STORM DRAIN INLET — P X' INLT
PROPOSED X' DIA. RCP STORM DRAIN — P X' RCP
PROPOSED CROSS PAN LOCATION — P X-PAN
PROPOSED STORM DRAIN
PROPOSED INLET
EXISTING STORM DRAIN
CHANNEL
FUTURE STORM DRAIN

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, JR ENGINEERING, LTD. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

JR Engineering, Ltd.
4935 North 30th Street
Colorado Springs, Colorado 80919
(719) 593-2593 • FAX (719) 528-6613

NO.	REVISION	BY	DATE

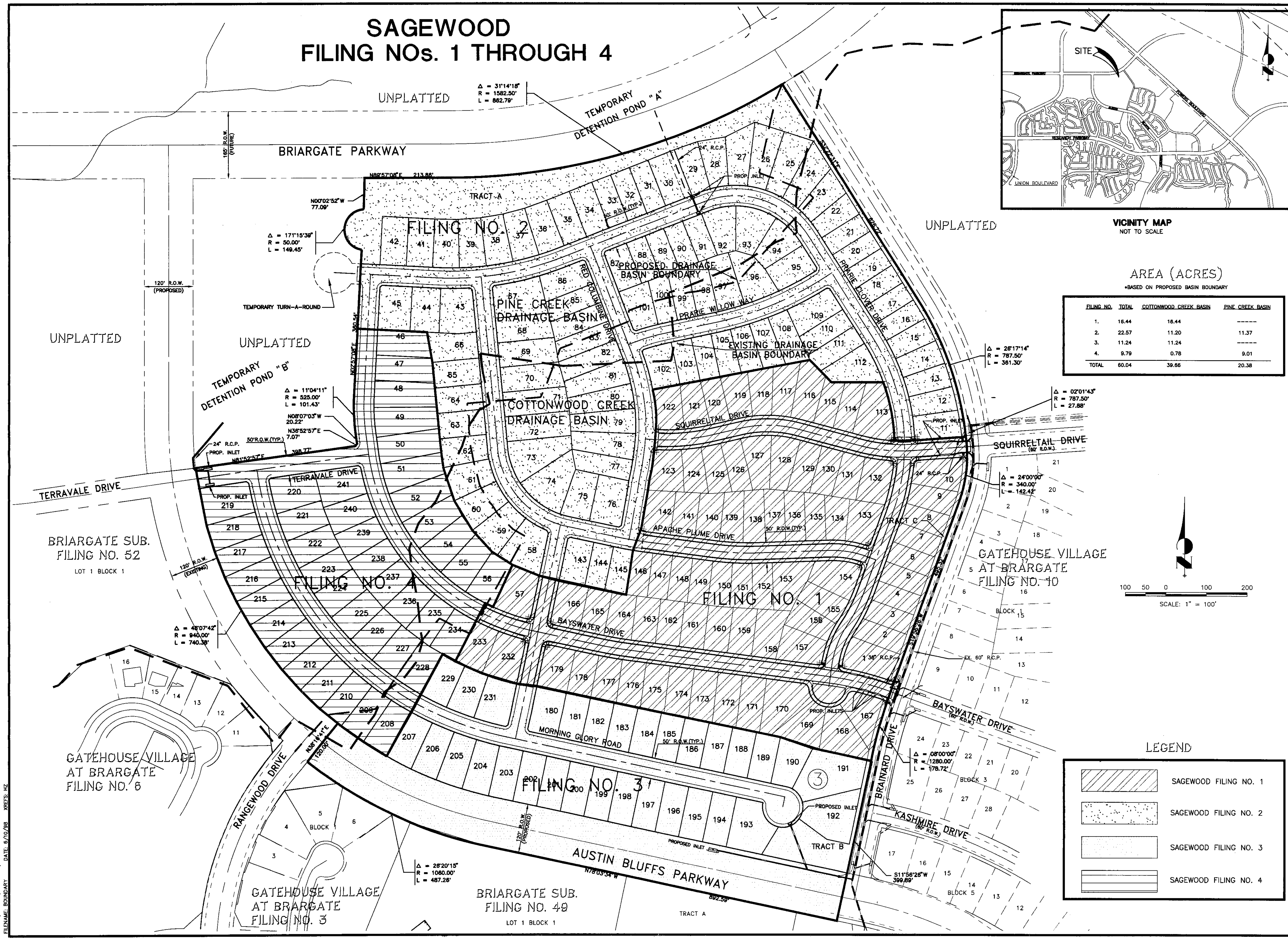
SAGEWOOD
MDDP AND FINAL DRAINAGE PLAN

SCALE	1"=100'
DATE	10/27/97
DES. BY	JRB
CHK. BY	
DWN. BY	BAP

SHEET 1 OF 2
JOB NO. 8878.20

1-4

SAGEWOOD
FILING NOs. 1 THROUGH 4



AREA (ACRES)

*BASED ON PROPOSED BASIN BOUNDARY

FILING NO.	TOTAL	COTTONWOOD CREEK BASIN	PINE CREEK BASIN
1.	16.44	16.44	-----
2.	22.57	11.20	11.37
3.	11.24	11.24	-----
4.	9.79	0.78	9.01
TOTAL	60.04	39.66	20.38

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NO.	REVISION	BY	DATE

SCALE	1"=100'
DATE	6/11/98
DES. BY	JRB
CHK. BY	
DWN. BY	WWS

SAGEWOOD
FILING NOs. 1 THROUGH 4

SHEET 2 OF 2

JOB NO. 8878.20